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Determining the Endurance Property in Female Soccer Players During Pre-season and In-season

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ABSTRACT The purpose of this study was to determine the endurance characteristic of woman football players during pre-season and in season. The study group consisted of 20 voluntary participants who were soccer players at Marmara University. Bioelectric impedance to determine the body compositions of the players, Yo-yo Intermittent Recovery Test to determine the aerobic capacities, lactate test from fingertip to specify lactate concentration, and total blood parameters to establish hemoglobin concentration were utilized. As a result of the study, a significant difference has been found between the findings obtained from the tests performed during pre-season and the findings obtained from the tests performed during in-season. Significant differences can be observed between pre and posttests values of hemoglobin concentrations, yo-yo and VO_2Max ($p<0.01$). Although the lactate levels taken before the yo-yo test vary considerably from pre-season to in-season ($p<0.05$), same significant difference does not exist for the lactate levels taken after the yo-yo test.

INTRODUCTION

Soccer, that is the most important sport in the world, is played by males and females with different levels of expertise. Performance of football depends on various factors like technique, tactic, and mental and physiological variables. Therefore, soccer is very popular worldwide, and players may not need to have an extraordinary capacity within any of these performance areas, but possess a reasonable level within all areas (Stolen et al. 2005). Because of the length of a soccer match, at least ninety percent the energy released must be aerobic (Bangsbo 1994). During a 90-minute match, players run for about 10 km (Bangsbo et al. 1991; Helgerud et al. 2001) at intensity close to anaerobic threshold or eighty to ninety percent of maximal heart rate (Bangsbo 1994; Helgerud et al. 2001). In addition to endurance activities, footballers must also do so explosive movements (Turner et al. 2013) and jump, shoot, accelerate and direction changing, with most of these preceding target opportunities in-season (Faude et al. 2012). Repeating these abilities throughout a 90 minutes match may be related with intramuscular capacity (Trexler et al. 2015; Rosas et al. 2017). Endurance is related to three factors: maximal oxygen uptake (Max-VO_2), anaerobic threshold, and work economy (Pate 1984). The meaning of MaxVO_2 is highest oxygen uptake that could be achieved during training by muscles (Wagner 1996). Anaerobic threshold is highest exercise intensity, heart rate, or oxygen uptake, with large muscle groups, in which the production and clearance of lactate is about the same (Helgerud et al. 1990). Despite its dependency on MaxVO_2 (ml/kg/min), anaerobic threshold does not seem to change the percentage of VO_2Max (Hoff et al. 2002). Therefore, the footballers' capacity of aerobic exactly plays a big role in elite football and it has an important effect on their technic performance and correct tactic. Thus, the assessment of footballers' aerobic performance can be substantial interest for trainers in order to evaluate and arrange better

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endurance exercise periods (Chamari et al. 2005). Performance tests include technical, tactical, psychological and physical condition sections of game. The best test for players is to play a soccer match, but it is quite difficult to measure player performance in the game. The use of physical condition tests will be beneficial for better training, motivation or return to sport after injury of players. Soccer-specific tests are required to achieve these purposes (Bangsbo 1996). Although comparative studies have not been performed, physiological match demands have been reported to be familiar across genders and competitive levels in football (Stolen et al. 2005). Differences may be associated mainly to match intensity, that is, reflection of footballers' condition level (Krustrup et al. 2005; Stolen et al. 2005). In other words, only difference between male and female soccer players is physical. Male soccer players have higher physical capacity than female players. Because game profiles of male and female are same, both male and female soccer players' response to training is at the same level. Therefore, male and female players can implement same training programs (Bangsbo 1996; Ozbar 2009).

To conclude, the purpose of this study was to determine endurance characteristics in female soccer players during the period of preparation and competition.

METHODOLOGY

Participants

Twenty female soccer players (body mass, 54.02±7.48kg; height, 161.03±4.97cm; and age, 18.53±3.16 years) were involved in the study. All players were members of the Women's Football Team of Marmara University Sports. Before each testing session, subjects were instructed not to eat for at least 4 hours before testing and not to drink alcohol for at least 48 hours and not to do high intensity training for at least 12 hours before physical testing. All of the testing procedures were completed in pre-season and in-season (four months apart).

Measurements of Height, Weight and Body Mass Index

The height measurement was taken with a Martin type anthropometer sensitive to 1 mm and weight measurement with a digital weight machine sensitive to 100 g. Participants only wear shorts during measurements. Weight and height anthropometric measurements were taken from the participants in this study and Body Mass Index (BMI) values were calculated with these measurements (weight / height m^2) (Shahvirdi and Gultekin 2017).

Determination of $MaxVO_2$

With Cooper Test, $MaxVO_2$ is determined indirectly. In this study, a 12-minute Cooper Test was conducted on a 400-meter athletics track with tartan type ground. At the end of the test, the $MaxVO_2$ values of the athletes were determined by the nomogram (Sagiroglu et al. 2016).

Yo-Yo Intermittent Recovery Test

The Yo-Yo Intermittent Recovery Test consists of repeated runs starting with a speed of 10 km/hour and progressively accelerating according to audio bleeps from a tape recorder between the starting, turning and finishing lines in an area of 2m x 20m. Between each running bout, the subjects have a 10-second active rest period that consists of 2x5m of jogging. When the participants failed to complete the test in a given period, the distance completed is recorded and refers as the test result (Castagna et al. 2006; Krustrup et al. 2006).

Blood Analysis

Measurement of lactate acid is made by lactate analyzer using enzymatic-amperometric method with samples drawn from 0.5uL capillary blood of the fingertip. The mean concentration of the two blood lactate values is calculated. These two blood tests are carried out three minutes before and three minutes after the yo-yo test by a nurse under doctor supervision (Photometer LP 400, Dr. Lange). The reproducibility value for the Dr. Lange lactate analysis kit was 99.5 percent. Hemoglobin concentration test were performed with an E-4000 auto analyzer.

Statistics

The findings are written as mean and standard deviations (±SD). Paired samples t-test is applied to determine the difference between two

measurements. For analysis the data that reached, SPSS 17.0 (Statistical Package for the Social Sciences, Chicago, IL) was used. In all cases the level of significant value was set at $p<0.05$.

RESULTS

At the end of the study, the average age of the players had been determined as 18.53±3.16 years, the average height as 161.03±4.97cm and the average weight as 54.02±7.48kg.

As a result of the study, a significant difference has been determined between the findings obtained from the tests implemented during preseason and the findings obtained from the tests implemented during in-season. Significant differences ($p<0.01$) have been found between pre- and post-test values of hemoglobin concentrations, yo-yo and $MaxVO_2$.

As indicated before, the lactate levels taken after the yo-yo test did not vary considerably from the period of preparation to period of competition, whereas a significant difference rises to surface in terms of the lactate levels taken before the yo-yo test during the period of preparation and competition ($p<0.05$) (Table 1).

DISCUSSION

In literature, there are only few studies that studied the endurance in female soccer players. The aerobic capacities of the current soccer players that were determined by field test (Yo-Yo endurance test) and lactate test are in agreement with the values that are obtained with similar methods in other studies on soccer players. Similar values of $MaxVO_2$ were also observed for other footballers that performed the same yo-yo running distance and lactate values.

According to previous study results, elite Turkish women soccer players have 676 m (Sezgin et al. 2011), elite Serbian women soccer players 872.5 m (Trajkovic et al. 2010), elite Danish women soccer players 1,379 m (Krustup et al. 2005), and elite Hong Kong women soccer players 673 m (Can and Cihan 2013 transmitting) as yo-yo running distances. Julian et al. (2017) determined the yo-yo test results in women's football players at menstrual cycle period as 2,822 m. Spain elite female soccer players have 1,224 m, while Spanish division 2 players have 826 m running distance. Therefore, there is a significant difference between Spain elite soccer player and division 2 players. Consequently, elite players have higher running distance (48%) than division 2 players (Mujika et al. 2009). In addition, Serbian national team soccer players who play at different game positions (area) have ran between 880m and 930 m (Milanovic et al. 2011). This is a significantly lower distance in comparison with those reported as moderately active adult male subjects having 1,793 m (600-2.320m) and elite-level male having between 2,040 and 2,260 m and female soccer players having 1,379 m (600-1960 m) (Krustup et al. 2003, 2005; Mohr et al. 2003). These values are similar to the current results.

Furthermore, a study by Gabbett and Mulvey (2008) on the $MaxVO_2$ of Australian Matildas women soccer team players showed that these players had 51.4 ml/kg/min $MaxVO_2$ values. Similarly, Castagna et al. (2006) found 56.28±4.41 $MaxVO_2$ values for female soccer players. Moreover, Thomas et al. (2005) demonstrated similar results (Lactate max 9.93 ±1.74, Vo_2 max 56.33 ±2.73) for soccer players. In addition, according to a review by Stolen et al. (2005), average $MaxVO_2$ values are reported as 38.6-57.6 mL/kg/min. Also, the mean Max Vo_2 of elite soccer

Table 1: The comparison of pre-season and in season measurements of players

Paired samples test	*Pre-test Mean±StD*	*Post-test Mean±StD*	*Differences Mean±StD*	*t*	*p*
Body mass index (kg/m)	20.93± 3.41	20.84± 3.21	0.08± 0.62	0.578	0.571
Hemoglobin	10.19± 0.89	12.74± 1.40	2.55± 0.81	-12.968	**0.000****
Yo-yo (Level)	14.08± 0.65	14.62± 0.64	0.53± 0.48	-4.590	**0.000****
Yo-yo (m)	541.18±155.63	694.12± 180.52	152.94±109.75	-5.745	**0.000****
VO_2max (ml/kg/min)	52.66± 2.11	54.74± 2.45	2.08± 1.49	-5.745	**0.000****
Resting Lactic acid level	1.40± 0.47	3.40± 0.82	0,45± 0.73	-2.562	**0.021***
Lactic acid level after test	10.86± 0.49	9.30± 2.58	1.24± 4.08	-1.251	0.229

**$p<0.01$, *$p<0.05$

players is normally reported to be between 55-67 ml/kg/min with individual values greater than 70 mL/kg /min (Hoff and Helgerud 2004). These findings support the current study.

Another study on female soccer players demonstrated the values of pre-season average yo-yo test level as 14.21±0.80, $MaxVO_2$ as 53.25±2.77ml/kg/min and hemoglobin as 10.21±0.91g/dl. Moreover, after season yo-yo test level is given as 14.34±0.69, $MaxVO_2$ as 53.834±2.47ml/kg/min and hemoglobin value as 12.66±1.40g/dl (Ozbar et al. 2010). According to result of this study, there is a significant difference between hemoglobin concentration at pre-season and after season ($p<0.01$).

Ekblom (1986) found lactic acid values 7-8 mm/l during a soccer match, while Bangsbo's (1994) research showed lactic acid level has changed between 3-9 mm/l during soccer match. In another study, Julian et al. (2017) found lactate level at 8.7 mm/l after five minutes of the yo-yo test. Also, generally, soccer players who exceed 10mm/l lactic acid levels, reach seventy percent of their maximum heart rate in soccer game. The value of $MaxVO_2$ is probably the single most important factor determining success in an aerobic endurance sport (Astrand and Rodahl 1986).

Some previous studies showed that $MaxVO_2$ values vary between 48.1 and 67.8 in soccer players (Gunay et al. 1994), while Bangsbo (2003) has reported that there is a non-ignorable relationship between $MaxVO_2$ and running distance. Ozbar et al. (2010) found that endurance performance of female soccer players' depends not only on training but also on their nutrition. Furthermore, in the case of bringing nutrition under control, hemoglobin concentration increases and consequently $MaxVO_2$ value increases as well. So it can be said that this study shows parallelism with existing literature.

In addition, improved blood values can be seen if nutrition and sleep pattern of soccer player are under control in season. Thus, it prevents performance losses. There are many factors that play a role in improving one's endurance for soccer. Aerobic and anaerobic training have been previously found to increase endurance, as well as sport-specific training (Nelson 2017).

CONCLUSION

Consequently, the researchers have found that the big difference in aerobic capacity and hemoglobin concentration of soccer players during pre-season and in-season is the result of precautions taken by soccer players for normalization of anemic results in blood parameters during pre-season.

RECOMMENDATIONS

Moreover, while preparing training programs for the soccer players, it is important to determine the frequency and type of their motions during the game and correspondingly which of their qualities need to be improved by match analysis and performance tests. For instance, lactate threshold and $MaxVO_2$ could be determined by this matter using these match analysis and performance tests. In order it to be useful it may be recommended that their anaerobic threshold and the corresponding running speed should be determined to design individual training programs for each soccer player who should be followed periodically.

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