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THE EFFECT OF THE DEPTH AND WIDTH OF PITCH SIZES IN SMALL-SIDED GAMES ON PHYSIOLOGICAL PARAMETERS AND TECHNICAL ACTIONS IN FOOTBALL*

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Abstract: This study aimed to find out whether SSGs using wide and length field sizes have an effect on the physiological parameters and technical actions in football. Sixteen amateur male football players were recruited on a voluntary basis. The players were divided into teams of 4 according to the opinions of their coaches and the results of the Yo-Yo test. The study was applied in the form of 2 different SSGs: SSG_{Width} (26 m length and 34 m wide) and SSG_{Length} (34 m length and 26 m wide). The SSGs were performed in 3 sets for 6 minutes. A passive rest of 3 min was given between the sets. The heart rate (HR), blood lactate, and Rating of Perceived Exertion (RPE) were measured before and after the SSGs. The technical actions were determined by the notation analysis. No significant difference was found in the HR, the blood lactate, and the RPE between the groups in the post-test. After the SSGs, the HR, blood lactate and RPE increased significantly in both the SSG_{Length} and SSG_{Width}. Although the number of interceptions in SSG_{Width} was statistically lower than in the SSG_{Length}, there was no statistically significant difference between the SSG_{Length} and SSG_{Width} in the goal kicks, accurate passing, inaccurate pass, dribbling, tackling, and ball possession time. Finally, for fast attacking after catching the ball (interception), coaches may prefer the SSG_{Length} rather than the SSG_{Width}. It seems that more studies are needed on the effect of SSG_{Length} and SSG_{Width} in terms of other variables.

Key Words: Blood lactate, football, small-side games, heart rate, technical actions.

FUTBOLDA SINIRLI OYUN ALANININ DERİNLİK VE GENİŞLİĞİNİN FİZYOLOJİK PARAMETRELERE VE TEKNİK AKSİYONLARA ETKİSİ

Öz: Bu çalışmanın amacı, geniş ve uzun saha boyutları kullanılarak oynanan sınırlı alan oyunlarının (SAO) futboldaki fizyolojik parametreler ve teknik eylemler üzerinde bir etkisi olup olmadığını bulmaktır. On altı amatör erkek futbolcu gönüllülük esasına göre çalışmaya alınmıştır. Oyuncular antrenörlerinin görüşleri ve Yo-Yo testi sonuçlarına göre 4 kişilik takımlara ayrılmıştır. Çalışma 2 farklı SAO şeklinde uygulanmıştır: $SAO_{Geniş}$ (26 m uzunluk ve 34 m genişlik) ve SAO_{Uzun} (34 m uzunluk ve 26 m genişlik). Oyuncular, her biri 3 set x 6 dakikalık SAO'ları, aralarında 3 dakikalık pasif toparlanma ile uyguladılar. Kalp atış hızı (KAH), kan laktatı ve Algılanan Efor Derecesi (AED) SAO'lardan önce ve sonra ölçülmüştür. Teknik aksiyonlar notasyon analizi ile belirlenmiştir. Son testte gruplar arasında KAH, kan laktatı ve AED açısından anlamlı bir fark bulunmamıştır. SAO'lardan sonra, KAH, kan laktatı ve AED hem SAO_{Uzun} hem de $SAO_{Geniş}$'de istatistiksel olarak anlamlı şekilde artmıştır. $SAO_{Geniş}$'de top kapma sayısı SAOUzun'a göre istatistiksel olarak daha düşük olmasına rağmen, SAO_{Uzun} ve $SAO_{Geniş}$ arasında gol vuruşu, isabetli pas, hatalı pas, top sürme, ikili mücadele ve topa sahip olma sürelerinde istatistiksel olarak anlamlı bir fark bulunmamıştır. Sonuç olarak, antrenörler rakipten topu kaptıktan sonra hızlı hücum için (interception) çalışmalarında $SAO_{Geniş}$'in yerine SAO_{Uzun}'u tercih edebilirler. SAO_{Uzun} ve $SAO_{Geniş}$'in diğer değişkenler açısından etkisi konusunda daha fazla çalışmaya ihtiyaç olduğu görülmektedir.

Anahtar Kelime: Kan laktatı, futbol, sınırlı alan oyunları, kalp atım hızı, teknik aksiyonlar.

* *This study is derived from the corresponding author's master's thesis.*

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INTRODUCTION

The performance of players during a football game (soccer) is related to the structure of the game (Paul et al., 2015) Because of the complexity of the game, performance of players is related to the simultaneous movement of players' physical condition, technical skill and tactical knowledge, rather than just a ability (Aquino et al., 2017; Costa et al., 2010; Mendez-Villanueva & Buchheit, 2011). Therefore, instead of reaching a high level in just quality, athletes need to have sufficient capacity in many qualities that determine performance in football (Aslan., 2012). For this reason, in today's football, coaches have sought training types and regulated games to maximize the technical-tactical and physical capacity of athletes simultaneously (Dellal et al., 2011). Hence, football coaches commonly prefer the small-sided games (SSG) training mode to ensure a simultaneous development in players by determining the field size, number of players and different rules in training (Balsom et al., 1999; Reilly & Gilbourne, 2003). SSG are a type of training that is applied with modified or normal football rules, in a measure of less than 11x11 players within a certain target and smaller than the normal football field (Bizati, 2016). Previously, football coaches used straight runs to improve the endurance of athletes, but today they prefer SSG to improve both endurance and technical-tactical performance (Little & Williams, 2006). In a study on field dimensions in SSG, it was stated that the change in field size and number of players causes a change maximum running distance, sprints, acceleration numbers, heart rate and metabolic demands (Mara et al., 2016). In another study on the field dimension, Guven et al. (2014) stated that SSGs using two different field sizes (26 x 34 m versus 30 x 40 m) had no effect on the technical parameters, but that there was a decrease in the number of inaccurate passing and dribbling in the last set of the SSG with 30 x 40 m field size when compared the SSG with 26 x 34 m field size. Bulut (2019) stated that the SSGs performed on three different field sizes did not affect the technical parameters, that playing the wider field size (35 x 50 m) had a higher heart rate and that playing the longer field size (25x75m) caused an increase in the covered distance at maximum speed and high speed. Luchesi et al. (2023) reported that the SSG performed with wide field size had similar findings to the official football games when compared to the SSGs applied with wide field size (26 x 40 m) and length field size (40 x 26 m). As a result, using a SSGs with wide or long field sizes in training can be considered as a factor that might affect the conditional, technical and tactical performance of football players. Therefore, the recent study aimed to find out whether SSGs using wide and length field sizes have an effect on the physiological parameters and technical actions of football players.

METHOD

Model of the Research

In the study, a screening model and a pre-test post-test experimental design was employed.

The Universe and Sample

Sixteen male football players (age: 22.13 ± 2.42 years; body mass: 68.38 ± 6.76 kg; height: 175.38 ± 5.71 cm; and VO_{2max} 47.03 ± 3.20 ml/kg/min) from the Turkish Regional Amateur League were recruited on a voluntary basis. Players trained regularly at least 3 days a week and participated in 1 official competition every week. They joined the study during the competition period. Before the study, the participants were informed about the nature and possible consequences of the study and signed an informed consent form. Karamanoğlu Mehmetbey University Ethics Committee dated 29.07.2020 and numbered E-95728670-044- gave its institutional approval for the study. Football players were divided into teams of 4

according to the opinions of their coaches and the results of the Yo-Yo Intermittent Recovery Test Level 1. The teams performed both SSGs in different days at least 3 days apart.

One-week prior to SSGs, the VO_{2max} level of each participant was determined by using the Yo-Yo Intermittent Recovery Test Level 1. The test included a 20 m shuttle run at a gradually increasing running speed15. This test was conducted on an open-air turf pitch where the football players were wearing football boots.

Data Collection Tools

Small-Sided Games

The study was applied in the form of 2 different SSGs: SSG_{Width} and SSG_{Length}. SSG_{Width} on a 26 m length and 34 m wide field size and SSG_{Length} on a 34 m length and 26 m wide field size were conducted. SSGs were performed using miniature goals and without goalkeepers. The playing field lines were clearly drawn, and enough balls were placed inside the goal and around the playing field so that the game would not be interrupted. In each session, the players competed in the SSGs of 3 sets x 6 min each with 3 min of passive recovery between them (Aguiar et al., 2012; Brandes et al., 2012).

Heart Rate (HR)

The athletes' HRs were measured in the beginning of the SSGs, between sets and at the end of the SSGs by using heart rate monitors (RS 800, Polar Vantage NV, Polar Electro Oy, Finland). The HRs measured just before the SSGs were recorded as the pre-test and the mean of the HRs measured at the end of each set as the post-test.

Blood Lactate (BL)

BL concentration of the participants were determined by using a portable blood lactate analyzer (Lactate Scout, SENS LAN, Leipzig, Germany) before and after the SSGs. The blood lactate samples were appropriately obtained from the fingertip by using the test strip of the lactate analyzer, which results in 10 seconds and recorded in mmol/L (Tanner et al., 2010).

Rating of Perceived Exertion

The 15-point Borg scale (Borg, 1970) was used to determine the level of rating of perceived exertion (RPE) in the beginning of the SSGs and at the end of the SSGs. The participants looked at the 6-to-20-point scale, determined their own perceived exertion levels. The mean of the Borg scale scores between the sets and after the SSGs was taken.

Analysis of Technical Actions in the SSGs

It was carried out using a digital camera that was adjusted to see the entire field and fixed with a tripod for analysis of technical actions in the SSG. The video records during the SSGs were examined with a computer compatible Mathball Match Analysis Program (Algorithm Information Processing Co.Ltd.) to analyze the technical actions of the players. With the notation technique, the technical actions consisting of 8 categories in the game (goal kick, number of passes, accurate pass, inaccurate pass, possessions won, dribbling, tackling and ball possession time) were recorded by the notation analysis of the video recordings for each of the players (Fanchini et al., 2011).

Analysis of Data

Data were analyzed with descriptive and inferential statistics. The Shapiro Wilk test was used to determine the normal distribution of variables. According to the normality analyses, the paired t-test and Wilcoxon test were performed to find out differences between the pretest and the posttest. The unpaired t-test and Mann-Whitney U test were conducted to compare the groups. Statistical significance was set at $p<0.05$. Data were analyzed using SPSS 26.0 statistical package program.

RESULT

The demographic data of the participants during the SSGs in Table 1 are presented.

Table 1. The demographic data of the participants (n=16).

Variables	Mean ± SD
Age (year)	22.13 ± 2.42
Height (cm)	175.38 ± 5.71
Body Mass (kg)	68.38 ± 6.76
Sport Experience (years)	5.00 ± 2.76
VO_{2max} (ml-kg^{-1}/min^{-1})	47.03 ± 3.20

Table 2 shows the physiological parameters during the SSGs. Before the SSGs, the blood lactate (U = 105.500; p = 0.385) and the RPE (U = 103.500; p = 0.338) did not differ between the groups although the HR was statistically higher in the SSG_{Length} group than in the SSG_{Width} group (U = 76,000; p = 0.049). In the post-test, no significant difference was found in the HR (t = -0.110; p = 0.914), the blood lactate (t = -1.499; p = 0.144), and the RPE (t = -0.684; p = 0.499) between the groups. After the SSGs, the HR increased statistically significantly in both the SSG_{Length} (t = -45.073; p = 0.000) and the SSG_{Width} (Z = -3.517; p = 0.000). Football players' blood lactate levels increased significantly after the SSGs on the SSG_{Length} (Z = -3.517; p = 0.000) and the SSG_{Width} (Z = -3.517; p = 0.000). Similarly, RPE increased significantly after the SSGs on the SSG_{Length} (Z = -3.524; p = 0.000) and the SSG_{Width} (t = -8.274; p = 0.000).

Table 2. The SSGs before and after the heart rate, the blood lactate and the RPE (Mean ± SD).

Variables	Groups	Pre-test	Post-test
Heart rate (bpm)	SSG_{Length}	80.44 ± 7.77	176.67 ± 6.14**
	SSG_{Width}	73.75 ± 7.89*	176.90 ± 5.69**
Blood Lactate (mmol/l)	SSG_{Length}	1.73 ± 0.31	6.42 ± 2.37**
	SSG_{Width}	1.76 ± 0.21	8.02 ± 3.55**
RPE	SSG_{Length}	8.00 ± 1.79	13.13 ± 1.71**
	SSG_{Width}	8.94 ± 2.57	13.58 ± 2.06**

RPE: Rating of perceived exertion.
* Statistically lower than the SSG_{Length} group in the pre-test ($p < 0.05$).
** Statistically higher than the pre-test ($p < 0.05$).

The technical actions during the SSGs in Table 3 are presented. There was no statistically significant difference between the SSG_{Length} and the SSG_{Width} in the goal kicks (U = 94.000; p = 0.188), the accurate passing (t = -0.766; p = 0.451), the inaccurate pass (t = 1.716; p = 0.096), the dribbling (t = -0.462; p = 0.648), the tackling (U = 83.000; p = 0.086), and the ball possession time (t = 1.138; p = 0.264). It was found that the number of interceptions in SSG_{Width} was statistically lower than in the SSG_{Length} (U = 31,000; p = 0,000).

Table 3. Technical Actions during the SSGs (Mean ± SD).

Variables	**SSG_{Length}**	**SSG_{Width}**
Goal Kick	5.44 ± 2.58	4.19 ± 1.05
Accurate Pass	49.44 ± 2.45	50.38 ± 4.24
Inaccurate Pass	11.69 ± 2.52	10.25 ± 2.21
Dribbling	4.94 ± 1.57	5.25 ± 2.21
Interception	6.50 ± 1.97	3.75 ± 1.53*
Tackle	6.56 ± 2.10	5.25 ± 1.48
Ball possession time (sec)	109.94 ± 10.47	105.56 ± 11.25

* Lower than SSG_{Length} ($p<0.05$)

DISCUSSION AND CONCLUSION

The study was conducted to determine whether there were differences between the SSGs using wide and length field sizes on some physiological parameters and technical actions of football players. The physiological parameters were HR, blood lactate, and RPE, and technical actions were goal kick, accurate pass, inaccurate pass, dribbling, interception, tackle, and ball possession time.

SSGs are an important part of football training programs due to factors such as including the movements during the football match, the technical-tactical development of the athlete, the motivation of the training with the ball, and the reduction of the total amount of load on the players by maximizing the training efficiency (Hill-Haas et al., 2011). In addition, the playing of SSG in different formats causes different effects on the players, and these reveal physiological responses. Knowing these effects provide an opportunity how to specifically design endurance training for the football game (Eniseler, 2018). Although HR is frequently used as a preferred method to determine exercise intensity, its use alone is not considered sufficient (Hill-Haas et al., 2011). Therefore, the intensity of exercise in the SSGs is determined by the RPE and blood lactate as well as the HR of players (Köklü & Alemdaroğlu, 2016). In this study, as expected, HR, blood lactate, and RPE increased after both SSGs. Nevertheless, the results of the study suggest that the HR, lactate, and RPE of the players did not difference between SSG_{Length} and SSG_{Width} after the SSGs. Changes in the field dimensions of the SSGs might affect the intensity of the exercise (Hill-Haas et al., 2011). In the two SSGs conducted in this study, the playing area per player was the same. Therefore, the similarity of exercise intensity in the SSG_{Length} and SSG_{Width} is consistent with the literature.

The change in the number of players can alter the technical actions. For this reason, by reducing the number of players in the SSG, they are exposed to more technical actions, however, there are no sufficient answers about the effects of the SSGs with the same area, but different pitch formats on the physical or technical parameters (Aguiar et al., 2012). The study showed that although the SSG_{Length} and the SSG_{Width} in the same area did not change the goal kick, accurate pass, inaccurate pass, dribbling, tackle, and ball possession time, the players performed more interceptions in the SSG_{Length} than in the SSG_{Width}. Before the study, it was expected that the number of inaccurate passes and tackles would be more in the SSG_{Length} than in the SSG_{Width} while the players would perform more goal kicks, accurate passes, dribbling, and ball possession time in the SSG_{Width} than in the SSG_{Length}, but these did not happen.

Folgado et al. (2019) determined that the numbers of accurate pass and dribbling were higher in the game played on the longer field in comparison of the technical parameters of the SSG they played in the same field but in two different fields (40x30 m versus 30x40 m) formats. In this study, there was no change in the number of accurate passes and dribbles between the

field formats. On the other hand, according to Say et al. (2020) it is seen that female football players performed similar goal kicks and inaccurate passes in the first 2 sets of both SSG, but more goal kicks and inaccurate passes were made in the 26 x 34 m pitch in the 3rd set. Dribbling and tackling were found to be more in 30 x 40 m pitch in set 1, while in both SSG in set 2 and 3. When the total actions of the 3 sets in SSGs are examined; it was found that female soccer players dribbled more on a 30 x 40 m pitch, but other technical actions were not different between SSGs, but were performed at a similar level (Say et al., 2020). In another study conducted with different field formats (30x20 m), (40x30 m) and (50x40 m), it is stated that the changes in the field size perform more technical action on the field played in a small area in terms of technical parameters (Hodgson et al., 2014). It is reported that the games played in the small field provide more opportunities for dribbling, tackling and goal kicking actions while the SSGs in wider field increases passing account and technical actions such as head ball and long pass are carried out in the medium and large field for an increase in the passing rate (Eniseler, 2018).

In conclusion, the study showed that in the comparison of the SSGs in the same area but in different format, the players performed more interceptions in the SSG_{Length} than in the SSG_{Width} in term of technical actions. Other technical actions were similar in SSGs. In both SSGs, players' HR, blood lactate level and RPE scores increased, but they were not different between the SSG_{Length} and SSG_{Width}. Finally, for fast attacking after catching the ball (interception), coaches may prefer the SSG_{Length} rather than the SSG_{Width}. It seems that more studies are needed on the effect of SSG_{Length} and SSG_{Width} in terms of other variables.

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