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# Physical Activity Pattern Differences Between Youth Soccer Players in Small Sided Games

Dissertation submitted to the Faculty of  
Sport Sciences and Physical Education of the University of Coimbra

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# **Physical Activity Pattern Differences Between Youth Soccer Players in Small Sided Games**

Dissertation submitted to the Faculty of Sport Sciences and Physical Education of the University of Coimbra, for the degree of Master in Youth Sports Training

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## **ABSTRACT**

Soccer is one of the most popular sports in the world, and there are a lots of training method introduced to improve players' performance, and small-side game (SSG) was one of the reliable method as it is highly modifiable and a good method to simulate real match situation. The aim of present study was to investigate the differences of activity pattern between different age groups during small-sided game (SSG) by investigating the change of heart rate (HR), speed and distance covered and see if there was any difference to between ages to provide feedback for the coaches which assist their SSG training plan. In present study, there were no significant difference ( $p>0.05$ ) between U-12 and U-13, U-12 and U-14, U-13 and U-14 in HR, no significant difference ( $p>0.05$ ) between U13 and U-14 in distance covered, and no significant difference ( $p>0.05$ ) between U-12 and U-13, U-12 and U-14, U-13 and U-14 in speed. To conclude the finding of present study, present study discovers that during a seven-a-side SSG match, there were no significant differences between U-12, U-13, and U-14 players in HR, distance covered and speed which suggest that U-12, U-13 and U-14 have similar activity pattern during a seven-a-side SSG.

Keywords: time-motion analysis, speed, acceleration, heart rate, GPS, tracking system, match analysis, performance analysis

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## **INTRODUCTION**

Soccer is one of the most played sports around the world, from the report of FIFA, the 2014 FIFA World Cup have 32 teams, and there are over 265 million soccer players around the world which shows soccer is a very popular team sport in the world. As a team sport, soccer players could develop a complex, open system during the match which constituted of many degrees of freedom that result from the variety of possible interactions among system components (Duarte et al., 2012; Mendez-Villanueva et al., 2013). In these systems, they consist lots of high speed, intensive activities. During a match, soccer players must cover distance by walking, jogging, running, and sprinting. The speed intensity is dependent upon a variety of factors, including training level, team playing style and ability to maintain possession, player positions, tactical situations, period of competition, and the intensity can reach to the anaerobic threshold, but 90% of the energy used was produced by the aerobic system (Di Salvo, 2012; Radzimisnski et al., 2013). The overall activity pattern of soccer consists intermittent high-intensity type and, in average, high-speed activity accounts for approximately 8 % of the total distance covered during match-play (Gregson, 2010; Mukherjee & Chia, 2013; Nicholas et al., 1999). To develop an elite soccer team, players must go through the training from a young age and learn all types of soccer motor skills and master them when they are growing up. Since soccer development has gone through a long period of time, modern soccer training evolved towards integrated types of physical training and many types of training method to suit the need of competitive demands and technical skills development. Among these types of training methods, small-sided game (SSG) is one of the most popular training method and proved to be a reliable, effective training.

SSG also known as skill-based conditioning games or game-based training, it has been assumed a great soccer training because it mimics the specific characteristic of formal soccer game, and multiple development of soccer players including technical, tactical, physical and physiological elements (Clemente et al., 2015; Hill-Haas et al., 2011; Travassos et al., 2014). Moreover, SSG also proof to be an effective training method because coaches can adjust the size of field, duration and breaks, number of players to control the intensity of training (Michailidis, 2013). It is guess that SSG can provide advantage to the youth soccer players as it is closely related to the sports specific skills

required because players experience similar situation to their competitive matches (Casamichana & Castellano, 2010).

When comparing the difference between SSG and generic training, both training method can achieve similar training effect. However, SSG can achieve better psychological effect than generic training and interval training. Hill-Haas et al., (2009) found that SSG and generic training are effective at improving pre-season YY1RTL1 performance, but not VO2max, sprint and RSA performance which suggest that elite youth players can improve YY1RTL1 performance with SSG training. Los Arcos et al., (2015) compared the differences between SSG to different types of training and found that SSG and interval training were equally effective in maintaining aerobic fitness, and SSG promoted higher physical enjoyment than interval training as SSG resembles real football, which may motivate players to experience greater feeling of competence.

Comparing SSG with eleven-a-side training, SSG is a better training method. Capranica et al., (2001) found that both seven-a-side SSG and eleven-a-side matches achieve similar blood lactate concentration and HR but there were more passes and fewer tackles during SSG which suggest that smaller number of players will increase the number of time individual players are in possession of the ball. Joo et al., (2016) found that eight-a-side SSG allow greater chances for the players to be exposed to the technical aspect including goal shots, and passes, greater physical demands on the players because of the increased work rates by altering the number of players and pitch size.

Comparing the difference between types of SSG, the training effect of SSG are related to the pitch size and number of players. Hill-Haas et al., (2009) found that as the size of SSG formats decrease in size and relative pitch size area remain constant, overall physiological and perceptual workload would increase because in their study, the team found that two-a-side SSG achieve the highest HR, blood lactate, and RPE than four-a-side SSG and six-a-side SSG. Katis & Kellis, (2009) found that three-a-side SSG achieve higher exercise intensity than six-a-side SSG, six-a-side SSG result in more long passes than three-a-side SSG, more shots in three-a-side SSG than six-a-side SSG, higher number of dribbles and tackles in three-a-side SSG than six-a-side SSG, declined jumping

scores, throw-in test scores in both SSG conditions. Silva et al., (2015) found that in SSG, even the manipulations of player numbers and field dimensions may be used to set the same relative spaces per player, emergent interpersonal coordination tendencies of players during each constraining SSG differed and suggests that players co-adapted to the specific constraints being manipulated in the experimental treatments. Silva et al., (2016) found that during the SSG, as the relative space per player decreased, players tended to spread on field and increasing player number in the SSG would impacted on their dispersion in the field. However, different relative space per player values did not impact on the teams' movements in coupling strength in the goal-to-goal and side-to-side directions, which were highly synchronous for most of the match time in all SSG, independent of playing direction (Silva et al., 2016).

To understand the physical activity pattern during the SSG match, the common method of match analysis is using the global positioning system (GPS) because GPS devices provided task-dependent and time-dependent reliability that must be considered when reporting differences between or within individual team sport athletes (Aughey, 2011). The practical value of GPS to match analyses is that well-chosen performance indicators can help coaches to identify good and bad performances of individuals or teams because match-analysis has been helpful in identifying the physiological demands of the sport, and in examining how a player compares to the needs of his event (Di Salvo, 2007).

The aim of this study was to investigate if different ages affect the change of HR, distance covered, and speed in SSG between youth soccer players in different maturity level and provide some insight to coach's training plan.



## **METHOD**

### **Participants**

The sample comprised 42 soccer players from Associação Académica de Coimbra Coimbra – Organismo Autónomo de Futebol (AAC-OAF), Portugal, who participated in the U-12, U-13, and U-14 ages competitions. All players were under professional training with the club before and during the research. All data was collected during the 2015/2016 season.

### **Procedures**

In present study, there were a total of 18 matches, 3 of each ages group recorded in the same week. Before the SSG data was collected, all players performed a 15 minutes general warm-up which leaded by the AAC-OAF coaches and followed by a Yo-yo Intermittent Recovery Test Level 2 (YYIRTL2). After the YYIRTL2 was done, a 3 matches SSG began consisting with 8 minutes each match. The field of the SSG was 70m length and 40.3m wide. For the SSG, there were 3 types including normal match which including a 7 vs 7 (6 players and 1 goalkeeper); 7 vs 7 with one team having an extra offensive joker; 7 vs 7 with one team having an extra defensive joker.

### **Data Collection**

***HR measurement.*** In the HR measurement, it recorded from the entire training and the data required were separated from the time zone during the SSG. The purpose of the measurement was to investigate the intensity of training and compare the difference between these three age groups. HR is one of the reliable measurements to monitor training intensity and investigate player's status because the mean HR and oxygen consumption (VO<sub>2</sub>) relationship are similar which makes HR to be a valid measure of exercise intensity (Hill-Haas et al., 2011; Mendez-Villanueva et al., 2013).

***Distance covered measurement.*** In the distance covered measurement, it recorded from the GPS and the data will transfer to the GPS analysis software (Team AMS, GPSspts, Australia).

***Speed measurement.*** In the speed measurement, it recorded from the GPS and the data will transfer to the GPS analysis software (Team AMS, GPSspts, Australia).

### **Data Analysis**

There were six age group (U-12 to U-14) in present study and raw data of HR, and speed was calculated the mean value. Distance covered was recorded by the GPS and calculated the total value.

### **Statistical Analysis**

In present study, it was compared the differences between HR, acceleration, and distance covered during the SSG matches between two formats of SSGs: 1) 7 vs 7, and; 2) 7 vs 7 plus offensive joker. All statistical procedures will be analysed by using statistical software IBM SPSS Statistics version 24.0 (IBM, Somers, NY, USA). based on the results of data normality analysis of data, Wilcoxon test has been performed and the statistical significance was set at  $p < 0.05$ .

## RESULTS

In present study, there were 42 players participant in the study. After the data collection was completed and analysed, data of distance covered in the U-12 was removed due to some error with the data set.

According to Table 1, the result of HR shows no significant difference between U-12 and U-13 ( $p>0.05$ ), U-12 & U-14 ( $p>0.05$ ), U-13&U-14 ( $p>0.05$ ).

**Table 1: HR result of U-12, U-13, and U-14**

	U12 (n = 14)	U13 (n = 14)	U14 (n = 14)	U12 x U13	U12 x U14	U13 x U14
<b>HR</b>	M (SD)	M (SD)	M (SD)	<i>p</i>	<i>p</i>	<i>p</i>
	167,38 (21,65)	177,84 (18,59)	170,23 (18,36)	0.372	0.927	0.587

According to table 2, the result of distance covered shows no significant difference between U-13 and U-14 ( $p>0.05$ ).

**Table 2: Distance covered result of U-13, and U-14**

	U13 (n = 14)	U14 (n = 14)	U13 x U14
<b>Distance</b>	M (SD)	M (SD)	<i>p</i>
<b>Covered</b>	829,46 (288,91)	933,13 (213,76)	0.996

According to Table 3, the result of speed shows no significant difference between U-12 and U-13 ( $p>0.05$ ), U-12 and U-14 ( $p>0.05$ ), U-13 and U-14 ( $p>0.05$ ).

**Table 3: Speed result of U-12, U-13, U-14**

	U12 (n = 14)	U13 (n = 14)	U14 (n = 14)	U12 x U13	U12 x U14	U13 x U14
<b>Speed</b>	M (SD)	M (SD)	M (SD)	<i>p</i>	<i>p</i>	<i>p</i>
	5,90 (1,86)	6,68 (1,99)	6,65 (1,40)	0.487	0.518	0.998

According to Table 4, there was significant difference of height between U-12 and U-14 ( $p<0.01$ ), no significant difference between U-12 and U-13 ( $p>0.05$ ), U-13 and U-14 ( $p>0.05$ ).

**Table 4: Height result of U-12, U-13, U-14**

	U12 (n = 14)	U13 (n = 14)	U14 (n = 14)	U12 x U13	U12 x U14	U13 x U14
<b>Height</b>	M (SD)	M (SD)	M (SD)	<i>p</i>	<i>p</i>	<i>p</i>
	152,53 (5,15)	157,00 (4,76)	162,34 (8,98)	0.210	0.001	0.120

According to Table 5, there was significant difference of weight between U-12 and U-14 ( $p < 0.05$ ), no significant difference between U-12 and U-13 ( $p > 0.05$ ), U-13 and U-14 ( $p > 0.05$ ).

**Table 5: weight result of U-12, U-13, U-14**

	U12 (n = 14)	U13 (n = 14)	U14 (n = 14)	U12 x U13	U12 x U14	U13 x U14
<b>Weight</b>	M (SD)	M (SD)	M (SD)	<i>p</i>	<i>p</i>	<i>p</i>
	39,70 (4,52)	43,19 (4,85)	47,98 (8,45)	0.335	0.004	0.144

## **DISCUSSIONS**

The aim of present study was to investigate if different ages affect the change of HR, distance covered, and speed in SSG between youth soccer players in different maturity level and provide some insight to coach's training plan.

### **Finding of HR between U-12, U-13, and U-14**

One of the purpose in present study was to investigate if there were any difference of HR between 3 age group and the result of HR found that there was no significant difference of these ages and suggest that in term of HR, players in these 3-age group behave similar.

For the reason of having similar HR with no significant difference, it might explain with the pitch size per player. Some studies found that during SSG, when the pitch size is unchanged, but the number players increased, it would generally lead to an increase in physical and physiological workloads and RPE (Casamichana et al., 2010; Hill-Hass et al., 2009; Katis & Kellis, 2009; Owen et al., 2004). Rampinini et al., (2007) found that varying field dimensions would induce different physiological responses as the exercise intensity of a SSG on a small pitch with less players would be similar to a SSG on a bigger pitch with more players.

When comparing result from present study these studies, the HR was similar which players in all 3-age groups result in high intensity as they achieve over 80% of their maximum HR during the SSG which suggest that even there were no significant difference of HR between 3-age groups, all groups were experiencing high intensity training in the SSG.

### **Finding of distance covered between U-13, and U-14**

Besides HR, another purpose of present study was to investigate the difference of distance covered between these 2-age groups during SSG and the result show no significant difference which suggest that players in these 2-age group have travel similar distance.

For the reason of having similar distance covered within 2-age groups, technical action during the SSG might be able to explain in this situation. Capranica et al. (2001) found that young soccer

player tends to behave similar activity in both regular eleven-a-side and SSG competition which include more running activity, less walking activity. Moreover, there were more passes and fewer tackles was occurred during SSG than regular eleven-a-side match (Capranica et al., 2001). Joo et al. (2016) found that SSG showed greater ball exposures with reduced physical demands and technical plays than the regular eleven-a-side game as SSG allowed greater chances for the players to be exposed to the technical aspects such as ball touches, goal shots, and pass.

Based on the finding from these studies, the amount of technical action during the SSG in these 2-age groups were similar which lead to no significant difference in distance covered. However, since technical action was not record in present study was not recorded, it is unsure if it is the reason of having similar distance covered in both age group.

#### **Finding of speed between U-12, U-13, and U-14**

Similar to the result of HR and distance covered, result of speed showed there were no significant between 3-age groups which might suggest that the players in these 3-age group behave similar during the SSG.

One of the reason for having no significant difference might be the player number during SSG. Hill-Hass et al. (2010) found that when having extra player on one team during SSG, it provided a greater incentive for each team to work harder to gain possession and gain benefit of having an extra player or defend the team which had the extra player. However, changes in game formats and variations in player number would had greater influence on time-motion characteristics and perceptual responses than on the physiological responses as the pitch size might negate the effects of variations in player number (Hill-Hass et al., 2010).

Based on the research by Hill-Hass and colleagues in 2010, it might provide some insight to the no significant difference in speed to present study which cause by same player number of all 3-age groups, and as the player number in these 3-age groups were the same, they might have similar activity pattern.

## **Limitations**

The present study had two main limitations which needed to be aware when interpreting the current result. First, this investigation is limited to U-12, U-13 and U-14 players which cannot represent all age group in different maturity level. Second, due to lack of resource and time, this study only recorded HR, distance covered, and speed as variables which clearly was not enough as other variables such as technical actions was also important for the activity pattern.

## **Conclusion**

In respond to the finding in present study, the HR, and speed in U-12, U-13 and U-14 during a seven-a-side SSG was similar, and the distance covered for U-13 and U-14 was similar which suggest that players seven-a-side SSG might achieve similar effect to players at these 3-age groups. However, since the technical actions were not recorded, further investigation may research in this area to see if the effect is similar or not. To conclude, present study discovers that during a seven-a-side SSG match, there were no significant differences between U-12, U-13, and U-14 players in HR, distance covered and speed which suggest that U-12, U-13 and U-14 have similar activity pattern during a seven-a-side SSG and it potentially to be a good training method for youth soccer player.



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