

Small-Sided Games: Analysis of the Internal Load and Technical Skills in Young Soccer Players

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Abstract: *The Small-Sided Games are very widespread football training exercises because are very functional to improve both the physical condition and the technical abilities. The aim of the study is to evaluate and compare the internal load of the young football player using the heart rate (HR) and the perceived exertion (RPE) and to describe the number and frequency of some technical skills in 3vs3, 4vs4 and 5vs5. The study shows that the size with small number of players allows to have a grater internal load while the format with large number of participants makes it possible to achieve a higher number and frequency of technical skills. The 3vs3 is more effective for a high-intensity aerobic training while the 5vs5 is more effective to train technical skills.*

Keywords: Small-Sided Games - Heart Rate - Young soccer players – Football technical skills – RPE

1. Introduction

The coaches and conditioning coaches use the *Small-Sided Games* (SSG) in the sport-specific session training varying rules, number of players, size and time in relation to the training objective (Clemente et al., 2012). These variations are done to simplify and preserve the specific characteristics of team sports practiced (Tan et al., 2012).

Many studies in the literature amply describe the functional adaptations resulting from the SSG practice (Sampaio et al., 2007; Aguiar et al., 2012): SSG are very widespread football training exercises to improve both the physical condition and the technical abilities, both in adults than in young soccer players (Casamichana et al., 2013; Castellano et al., 2013; Halouani et al., 2014; Sannicandro & Cofano, 2015) optimizing the training time (Little, 2009).

The literature suggests that compared to traditional matches 11vs 11, the SSG allow to get similar or even higher values in relation of heart rate (Gabbett & Mulvey, 2008; Hill-Haas et al., 2009), to the concentration of blood lactate, as well as to the distance covered (Capranica et al., 2001); resulting, thus, very functional for the physical and technical training (Hill-Haas et al., 2011; Aguiar et al., 2012; Halouani et al., 2014).

In the youth training, it is sought training proposals that are appropriate in the physiological characteristics of young soccer player and that may increase the functional values and technical skills (D'Ottavio & Russo, 1993).

Even the cognitive aspects relating to understanding of the game for young soccer players, also seem to depend on the field sizes, the number of players and the type of the exercises (Luhtanen et al., 2001). In addition to motivational aspects and learning, the SSG, already from the prepubertal age, represent significant exercises for the development of technical skills, such as passing, stop, shot on goal, etc (Platt

et al., 2001; Jones & Drust, 2007; Katis & Kellis, 2009; Kelly & Drust, 2009; Da Silva et al., 2011; Bekris et al., 2012; Silva et al., 2014; Sannicandro & Cofano, 2015) and physical aspects (Casamichana & Castellano, 2010; Da Silva et al., 2011; Ngo et al., 2012; Köklü et al., 2015; Sannicandro & Cofano, 2015).

2. Methodology

The aim of the study is to evaluate and compare the internal load and the number and frequency of some technical skills in different types of SSG (3vs3, 4vs4, 5vs5) in young soccer players.

The study included 10 young soccer players U17 (mean age 15.6 ± 0.5 years, weight: 66 ± 7.3 kg; height: 172 ± 5 cm). Written informed consent was obtained from all subject.

HR was assessed using wireless heart rate monitors equipped with a telemetry system (*Polar Electro Oy, Kempele, Finland*). The 3vs3, 4vs4 and 5vs5 SSG was played on a 18 x 30 metre, 24 x 36 metre and 30 x 42 metre, respectively (Rampinini et al., 2007a). The playing surface was composed of the latest generation of artificial turf. For the RPE the 6-20 Borg scale was used (Borg, 1962; Borg, 1970). The exercises were filmed with a camera for the next counting of technical skills. All SSG formats used a size 5 football.

Descriptive statistics ($M \pm SD$) were calculated for all assessed variables; Student's paired t-test was used to verify the existence of statistically significant differences between the average values obtained. The significance was set at $p < 0.05$.

3. Training Procedures

The young soccer players before making the different SSG formats have followed a warm up of 15 minutes, including

an aerobic activation, dynamic stretching exercises, joint mobility exercises, and running technique exercises.

The 4vs4 and 5vs5 formats were performed for 3 to 6 min while the 3vs3 for 3 to 4 min. The recovery between series was passive for 90 sec for all types of SSG examined. During the duration of the playing sessions, heart rate was constantly monitored using wireless Polar heart rate monitors and at the end of each exercise, individually, it was requested the value of RPE.

The three types of SSG was evaluated in three different days with a recovery of 24 hours between the different training sessions.

4. Results

The internal load analysis show that the 3vs3 has produced significant mean values of% HRmax (3vs3: $87,2 \pm 3,3\%$; 4vs4: $83,8 \pm 3,8\%$ p <0.05; 5vs5: $83,7 \pm 3,6\%$ p <0.05 – **figure 1**) and significant higher RPE values (3vs3: $17,5 \pm 0,7$ AU; 4vs4: $16,4 \pm 1,3$ AU p < 0.05; 5vs5: $15,8 \pm 1,1$ AU p < 0.001 – **figure 2**) than other SSG.

In the analysis of the technical variables the 5vs5 format allows to perform the highest number of passes (323 – **figure 3**) and tackles (59 – **figure 4**), and the lowest frequency of passes (1 pass every 3,3 seconds) and tackles (1 tackle every 18,3 seconds).

The results are summarized in **table 1**.

Table 1: Analysis of the different SSG in relation to the different parameters analyzed

	3 vs 3	4 vs 4	5 vs 5
% HRmax	$87,2 \pm 3,3\%$	$83,8 \pm 3,8\%$ *	$83,7 \pm 3,6\%$ *
RPE (6-20 AU)	$17,5 \pm 0,7$	$16,4 \pm 1,3$ #	$15,8 \pm 1,1$ ##
Total number of passes	196	312	323
Frequency of passes	1 pass every 3,6 sec	1 pass every 3,4 sec	1 pass every 3,3 sec
Total number of tackles	33	39	59
Frequency of tackles	1 tackle every 21,8 sec	1 tackle every 27,6 sec	1 tackle every 18,3 sec

* p < 0.05; 3vs3 versus 4vs4 and 5vs5

p < 0.05; 3vs3 versus 4vs4

p < 0.001; 3vs3 versus 5vs5

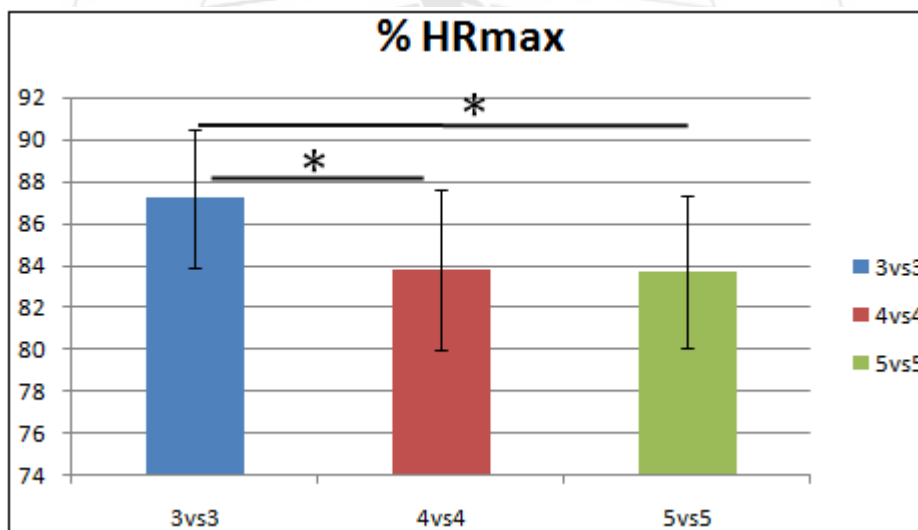


Figure 1: HRmax percentage in different SSG

* p < 0.05; 3vs3 versus 4vs4 and 5vs5

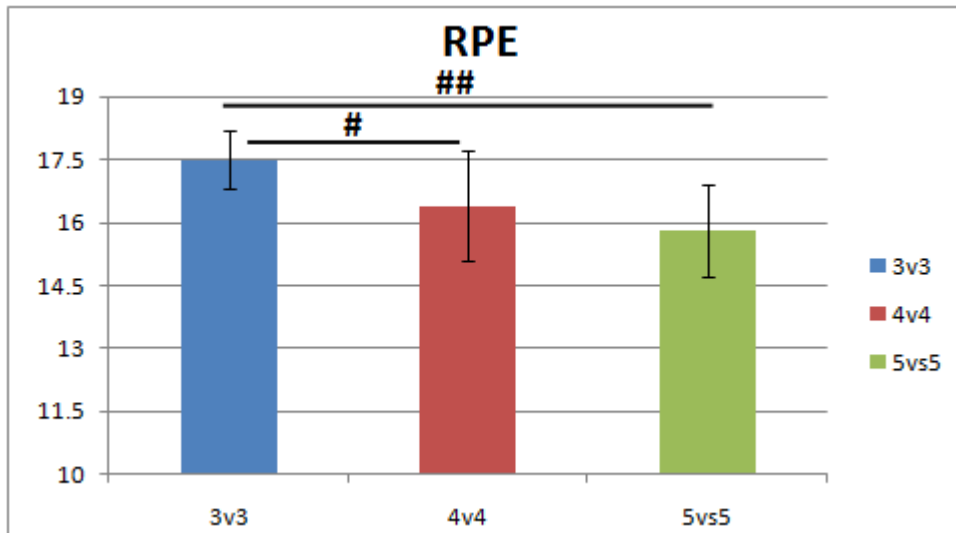


Figure 2: RPE in different SSG

$p < 0.05$; 3vs3 versus 4vs4

$p < 0.001$; 3vs3 versus 5vs5

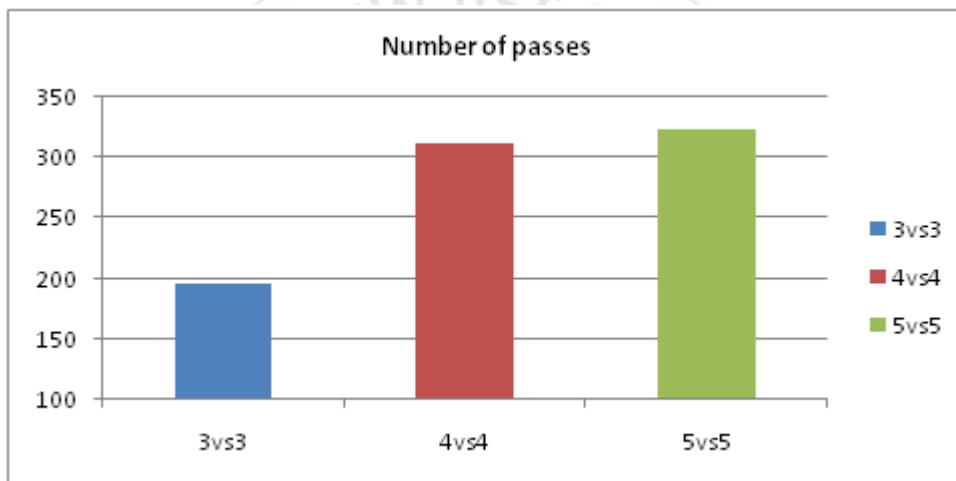


Figure 3: Number of passes in different SSG

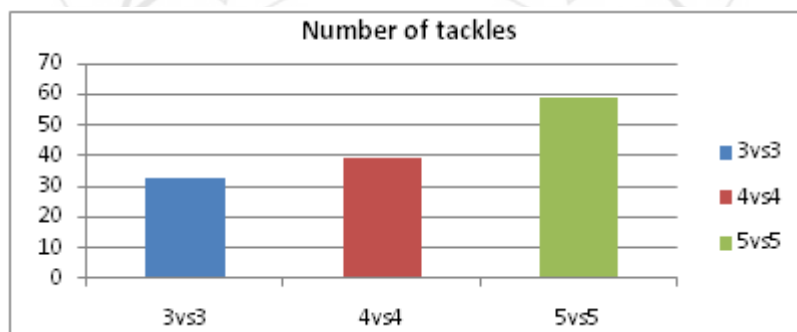


Figure 4: Number of tackles in different SSG

5. Discussion

The first hypothesis of the study was to evaluate and compare the internal load by HR and RPE. In the comparison between the different exercises, observing the values of HR, shows that in 3vs3 are detected significantly higher values ($p < 0.05$) compared to 4vs4 and 5vs5, confirming literature results, or rather that the 2vs2 and 3vs3 formats are able to reach higher intensities compared to 4vs4 and 5vs5 formats (Owen et al., 2004; Little & Williams, 2007; Rampinini et al., 2007b; Aguiar et al., 2012; Clemente

et al., 2014). In the comparison between these last two SSG type there are no significant differences.

The HR% values recorded in the following study, during the exercise of 3vs3, stands at $87,2 \pm 3,3\%$ of HR max, are in agreement with other studies assessing the 3vs3, (performed with or without the presence of goalkeepers) that have reported percentages of maxHR ranging between 87% and 89% (Platt et al., 2001; Aroso et al., 2004; Katis & Kellis, 2009; Aguiar et al., 2013; Koklü et al., 2015).

This values are in agreement with another study that showed during an exercise conducted in 3vs3 "cage" modality, although with smaller subjects compared to those of this study, FC values equal to $88 \pm 2,7\%$ of HRmax (Sannicandro et al., 2016). The highest and significant values of RPE, indicated in the study during the 3vs3, confirm that this exercise is more intense and wasteful compared to the other SSG, that are performed with a greater number of players and larger size. The RPE values of 3vs3 ($17,5 \pm 0,7$) are in agreement with other studies that, however, used a larger field, a greater playing time and different age subjects (Aguiar et al., 2013; Sampaio et al., 2007). The RPE values revealed during the 4vs4 ($16,3 \pm 1,3$) are in agreement with other studies carried out on young players (Aguiar et al., 2013; Brandes & Elvers, 2017; Aroso et al., 2004).

The second objective of the study aims to describe the total number and frequency of passes and tackles observed in different SSG types. This is the first study to examine the frequency of use of tackle and passages, so you can not compare these values with similar studies.

The higher *number* of passes has been observed when the size and the number of players is increased.

The total number of tackles has followed the same trend.

The different sizes and the relative different duration have not returned a frequency of different passes. Instead, they have shown a frequency of not homogenous tackles.

The higher frequency was observed in 5vs5. Most likely the 5vs5 requires the same technical skills of the other formats but exposes a major injury risk in view of the number of participating players. The 3vs3 fact is often performed with the football player who spends more time with the ball, thus reducing the opportunities to bring and / or get a tackle.

6. Conclusions

The study results showed that among the SSG formats observed, the 3vs3 is more effective for high-intensity aerobic training, because it generates an heart response of 90% of the HRmax. The increase of the number of players involved in the exercises has produced an increase in the number of specific technical skills.

The 3vs3 and 4vs4 allow to reduce the tackle frequency in youth soccer.

In conclusion, it suggests the need to monitor these types of exercises to understand, describe and modulate training load of young *athletes*.

7. Future Scope

Future studies may investigate whether the technical level of young players influence the studied variables; the same study may extend to women's football and describe gender differences.

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