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Manipulating the number of players and targets in team sports. Small-Sided Games during Physical Education classes

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SMALL-SIDED GAMES IN PHYSICAL EDUCATION

KEYWORDS: Team sports, Small-sided games, Physical education, Technical, Tactical and physiological indicators.

ABSTRACT: This study aimed to examine the effects of players and targets number variation on technical, tactical and physiological indicators in basketball, handball and indoor football. Nine 8th grade students (age 13.3 ± 0.7 years, stature 166.8 ± 3.8 cm, body mass 55.3 ± 4.2 kg) participated in four small-sided games (SSG) for each sport. Despite the differences between the sports, similar average values for technical and tactical indicators were found in both basketball and indoor football SSG. An increase in the number of players affected the duration of unsuccessful offensive phases, the number of passes per offensive phase, successful passes per offensive phase and decreased ball possession per player. Whilst all SSG in this study imposed high physiological demands, 3-a-side games played with one target elicited the greatest responses. In conclusion, the 3-a-side SSG promoted similar technical-tactical indicators and higher physiological demands than 4-a-side SSG.

The use of small-sided games (SSG) in team sports training tasks have been widely investigated and reported (Abrantes, Nunes, Macas, Leite, y Sampaio, 2012; Koklu, Ersoz, Alemdaroglu, Asci and Ozkan, 2012; Owen, Wong, McKenna and Dellal, 2011). In the basis of this research is the SSG capacity to reproduce the competition factors that influence athlete's performance, such as technical, tactical and physiological indicators (Dellal et al., 2008; Katis and Kellis, 2009; Tessitore, Meeusen, Piacentini, Demarie and Capranica, 2006).

The SSG can be defined as constrained games that are practiced in small spaces, often with adapted rules and a lower number of player's (Hill Haas, Dawson, Impellizzeri and Coutts, 2011). These constraints allow adapting the game to the characteristics and needs of players, which makes SSG a privileged framework in team sports teaching (Ortega, Alarcón and Piñar, 2012; Owen, Twist and Ford, 2004). The decrease of number of players enables each player to contact more often with the ball, resulting in more dribbles, passes, shots and tackles (Koklu, Asci, Kocak, Alemdaroglu and Dundar, 2011; Reilly, 2005), which may contribute to a better technical development. The players' tactical knowledge can be developed by constantly expose players to offensive and defensive situations (Dellal, Jannault, Lopez-Segovia and Pialoux, 2011). These SSG tactical problems require creativity to be solved. Creativity can be defined as the ability to make varied, rare and flexible decisions that will allow players to solve tactical problems that arise in the course

of the game and that are essential for success in the team sports (Memmert, 2010; Memmert and Roth, 2007). This decision-making ability will enhance if performers learn how to attune the relevant environmental informations that support immediate actions and exploratory behaviors (Davids, Araújo, Correia and Vilar, 2013; Travassos et al., 2012). Therefore, players must practice in situations that contains similar environmental information from the competitive match situations. The SSG seem to help players in increasing experience in coupling actions and decisions according to the ongoing environmental informational dynamics (Davids et al., 2013; Travassos et al., 2012). Likewise, SSG are used as a specific method for aerobic training, significantly contributing to players physical condition improvement (Casamichana and Castellano, 2010; Hill Haas, Coutts, Rowsell and Dawson, 2009; Rampinini et al., 2007). Additionally, recent researchers have verified that SSG can produce similar heart rate (HR) responses than those tests specifically developed to improve player's physical condition (Dellal et al., 2008; Impellizzeri et al., 2006; Katis and Kellis, 2009).

The technical, tactical and physiological indicators can be affected by the manipulation of some variables, such as playing area, number of players, number and type of targets, the aim of the game, ball possession or finalization, type of exercise, intermittent or continuous, duration of exercise and coach's incentives (Hill Haas et al., 2011; Katis and Kellis, 2009;

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Rampinini et al., 2007). Indeed, understand the effect of varying these variables is crucial for careful selection of exercise, to apply the appropriate stimulus and to obtain the desired adaptations (Hill Haas et al., 2011). For example, Vilar, Duarte, Silva, Chow and Davids (2014) examined how the ball possession, the passing and shooting skills are influenced by the pitch dimensions in soccer SSG performed by amateurs players. The authors found that increasing the pitch size could provide more time to decide and perform and, therefore, it is a constraint to be adopted in early stages of learning. As consequence, SSG constraints should be carefully designed and allow performers to explore between stable and variable movement patterns (Davids et al., 2013). Moreover, SSG should be manipulated to help performers to explore different performance solutions and emphasize exploratory learning (Davids et al., 2013; Travassos et al., 2012).

However, the vast majority of studies carried under SSG scope, are produced in soccer and studies related to the application of SSG in Physical Education are scarce. Jeffreys (2004) suggest that the systematic use of SSG improves students' motivation in an effective and time-efficient way. Additionally, a previous study advocates that SSG enhance high levels of enjoyment, involvement and energy expenditure (Toh, Guelfi, Wong and Fournier, 2011).

Based on the previous considerations, it can be point out that the SSG allow to develop the students technical and tactical abilities, while increase their motivation and fitness levels in a time-efficient way. These evidences highlight the importance of expanding research, therefore, this study aimed to analyse and compare the effect of varying the number of targets and players in game actions and exercise intensity in basketball, handball and futsal SSG. Specifically, this study seeks to identify which of the previous constraints can better foster the technical, tactical and physical development, and concomitantly, are more suitable to be applied in physical education classes. We hypothesized that decreasing the number of players and targets in the SSG will enhance the players involvement with the ball and also physiological stimulus.

Method

Participants

A total of nine participants (age 13.3 ± 0.7 years; stature 166.8 ± 3.8 cm; body mass 55.3 ± 4.2 kg), from a High School in Vila Real (Portugal) belonging to the 8th grade volunteered to participate in this study. They were deliberately selected to participate in this study due to their inexperience in practicing formal training in invasion games or in officially governed competitions (Clemente and Rocha, 2012; Gutiérrez, Fissette, García-López and Contreras, 2014). The goalkeepers participated in the game, but were excluded from the analysis. The repeated-measures design from this study implied that each subjects' responses were measured in 12 different situations, therefore, obtaining a total of 108 situations. After a detailed explanation of the study aims, protocol, benefits and potential risks involved with this investigation, this study obtained formal consent from the school's director and the participants' parents.

Procedures

The study was conducted over a 4-week period between October and November of 2010. The first week was used to familiarize players with the protocol and to assess the individual

HR_{max} values by completing the yo-yo IR2 (Bangsbo, Iaia and Krusturup, 2008). Afterwards, the participants performed three practical sessions, one session for each invasion team sport (second week for basketball, third week for handball and the fourth week for futsal). Therefore, the SSG were played on different days (Halouani, Chtourou, Dellal, Chaouachi and Chamari, 2014; Silva, Garganta, Santos and Teoldo, 2014), ensuring a one-week interval between each sport. Task constraints of the SSG were manipulated by altering the numbers of players involved per side and the number of targets (3x3ONE - 3x3 with one target; 3x3TWO - 3x3 with two targets; 4x4ONE - 4x4 with one target; 4x4TWO - 4x4 with two targets). Field dimensions used during different SSG formats were manipulated in order to keep the relative area per player constant (Hill-Haas, Coutts, Rowsell and Dawson, 2008), by reducing the length and the maintenance of width of field (see figure 1). The criterion used led to the decrease in pitch length, but not width, to maintain the game integrity, including the 3-point in basketball, the restricted area in handball and the goalkeeper area in futsal (Leite, Gonçalves, Jiménez and Sampaio, 2013). Each SSG was performed in four periods of four minutes interspersed with a two-minute period of active rest (Kelly and Drust, 2009). The team constitution was random, but maintained across the three team sports performed.

Rules common in physical education classes were established, in order to ensure the organization, dynamic and logic of SSG. In basketball, when the defensive team won the ball had to leave the restricted area to attack in 3x3ONE and 4x4ONE. For handball and futsal, in 3x3ONE and 4x4ONE it was used an goalkeeper, and only one team made offensive actions and the other only defensive, and each attack was initiated in the final line of the side of offensive team. For the SSG realized to two targets in handball, two cones were placed on each goal line as target, and was goal when at least one of the cones was dropped, while in futsal was used two cones spaced one meter, and goal was scored when the ball transposed the goal line. During the application of the SSG a large number of balls were placed around the playing area so that when the ball leave the boundary lines of the field was quickly respond, avoiding time loss (Impellizzeri et al., 2006; Jones and Drust, 2007; Kelly and Drust, 2009).

Assessment of the Technical and Tactical Variables

A list of potential performance indicators were provided to technical experts who selected the most relevant indicators for subsequent analysis (Castellano, Casamichana and Lago, 2012; Igor Gruic, Vuleta and Milanovic, 2006; Sampaio, Janeira, Ibanez and Lorenzo, 2006). The following technical and tactical indicators were collected and analysed through hand notation: successful shots; unsuccessful shots; offensive rebound; defensive rebound; unsuccessful pass; ball loss; ball recovery; interception; tackle; offensive efficiency; unsuccessfully offensive phase duration; number of passes per phase; successful passes per offensive phase; time of ball possession per player. All technical and tactical indicators were gathered by an experience researcher in performance analysis; nevertheless, data reliability was inspected by retesting 15% of the sample. The intra-class correlation coefficients were high (ICC > 0.92) (O'Donoghue, 2010).

Assessment of the physiological variables

Exercise during each SSG was assessed using percentage of HR_{max} and classified into time spent in following zones: zone 1

(<75% HR_{max}), zone 2 (75-84.9% HR_{max}), zone 3 (85-89.9% HR_{max}), and zone 4 (≥90% HR_{max}) (Casamichana and Castellano, 2010). To assess the individual HR_{max} values the

players performed the yo-yo Intermittent Recovery Test Level 2 (yo-yo IR2) according to standardized procedures (Bangsbo et al., 2008).

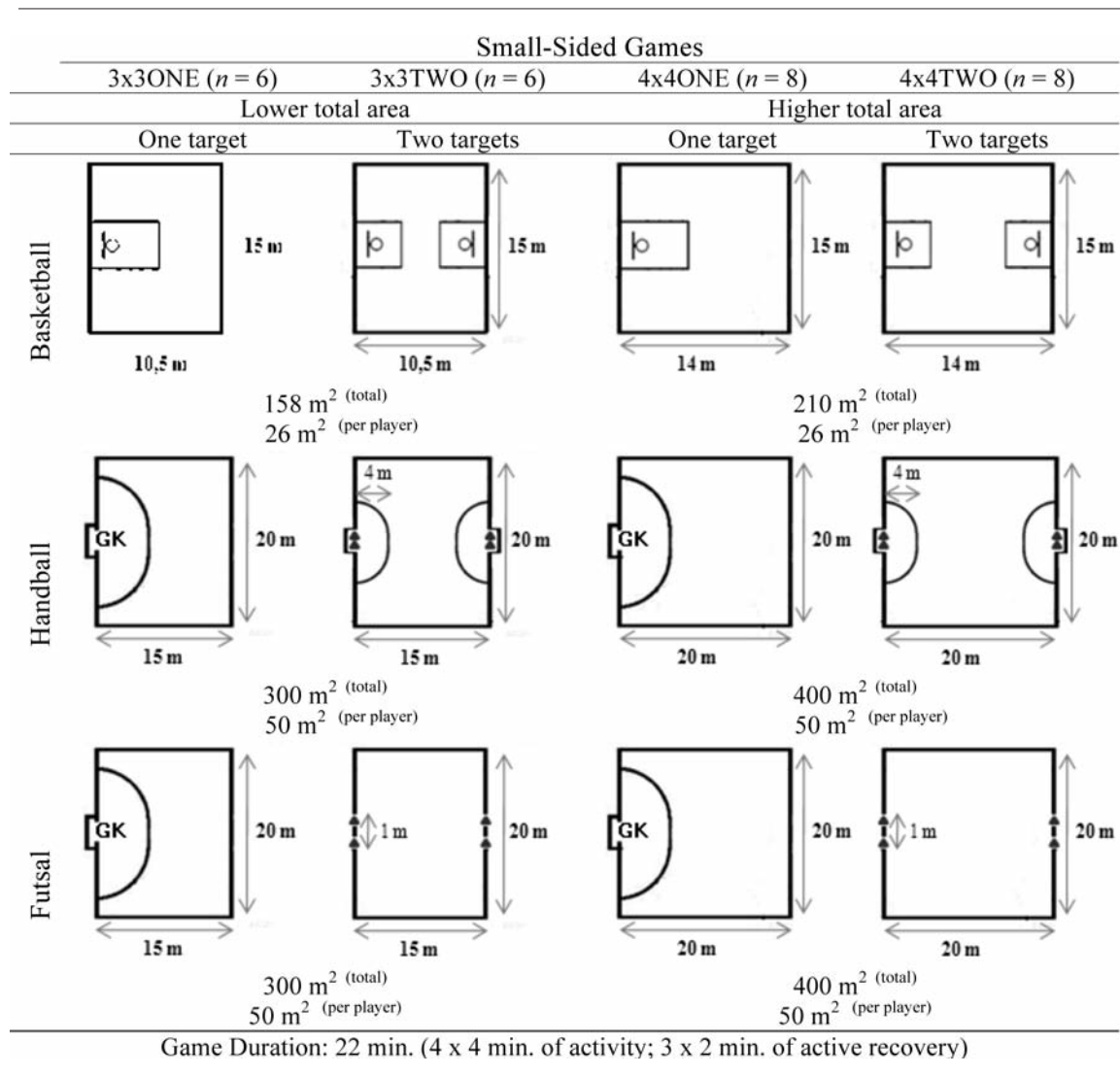


Figure 1. Experimental Protocol Design.

Instruments

The games were filmed using a digital video camera (Samsung ST550), positioned on a tripod up to 3 meters to the half-way line. The HR values were registered by short range radio-telemetry heart-rate monitors (Polar Team System, Polar Electro, Finland). The rate of perceived exertion (RPE) was registered immediately after each game period using the Borg scale 6-20 (Hill Haas et al., 2009).

Data Processing and Analysis

The technical, tactical and physiological indicators are present as mean and standard deviation. To verify the existence

of significant differences in the analyses of multiple comparisons between the variables of the study, the variance analysis ANOVA and *Post-Hoc Tukey HSD* tests were applied between the follow group comparison (3x3ONE vs 3x3TWO; 4x4ONE vs 4x4TWO; 3x3ONE vs 4x4ONE; and 3x3TWO vs 4x4TWO). The independent samples t-test was used to evaluate the differences in %HR_{max} and in RPE between the different SSG for each of the three team sports studied. When necessary, non-parametric techniques were used, specifically the Mann-Whitney test. Effect sizes (ES) were also calculated and interpreted based on the following criteria: < 0.20 = trivial; 0.20 to 0.59 = small; 0.60-1.19 = moderate, 1.20 - 2.0 = large; > 2.0 = very large (Hopkins, 2002).

All data sets were tested for each statistical technique corresponding assumptions. These calculations were done in SPSS software for Windows, version 17.0 (SPSS Inc., Chicago, IL). The level of statistical significance was set at $p \leq 0.05$.

Results

The descriptive results for the technical indicators for each SSG are presented in Table 1. In handball, higher successful shots were found in 3x3ONE than in 3x3TWO ($F = 4.2; p < .05, ES = 2.9$). With regard to futsal, there were more interceptions made in 4x4TWO than in 3x3TWO and 4x4ONE ($F = 9.1; p < .01, ES = -2.4$ and -1.7 , respectively), while higher tackles were found in 4x4ONE than in 4x4TWO ($F = 4.1; p < .05; ES = 1.4$). No significant differences for technical mean values were found among the different SSG in basketball.

The descriptive results of tactical indicators for each SSG are presented in Table 1. The basketball 4x4ONE presented higher duration of unsuccessful offensive phase than 4x4TWO and 3x3ONE ($F = 10.5; p < .05; ES = 2.7$ and -1.7 respectively). In respect to handball, differences were found in all tactical variables ($p < .05$). The increased of number of players incited higher duration of unsuccessful offensive phase, number of passes per phase, successful passes per offensive phase and decreased ball possession per player. Also stronger interaction were found between 3x3ONE and 3x3TWO ($F = 14.8; p < .01; ES = 2.7$) for the duration of unsuccessful offensive phase. Additionally, higher offensive efficiency was registered in 3x3ONE than in 3x3TWO ($F = 4.2; p < .05; ES = 2.9$).

	Basketball				Handball				Futsal				
	3x3ONE (n = 6)	3x3TWO (n = 6)	4x4ONE (n = 8)	4x4TWO (n = 8)	3x3ONE (n = 6)	3x3TWO (n = 6)	4x4ONE (n = 8)	4x4TWO (n = 8)	3x3ONE (n = 6)	3x3TWO (n = 6)	4x4ONE (n = 8)	4x4TWO (n = 8)	
Technical Indicators	Successful Shots	2.9 ± 2.6	4.9 ± 2.5	3.2 ± 3.8	3.5 ± 2.4	7.2 ± 1.8 ^a	3.1 ± 1.1	5.1 ± 3.2	3.2 ± 2.4	0.7 ± 0.8	2.5 ± 2.3	0.5 ± 1.1	1.8 ± 1.1
	Unsuccessful Shots	14.4 ± 4.3	16.4 ± 4.2	18.4 ± 4.7	16.1 ± 4.4	12.7 ± 3.6	13.1 ± 2.9	13.6 ± 3.1	11.7 ± 3.5	5.2 ± 2.8	7.2 ± 3.2	4.2 ± 0.9	5.8 ± 3.1
	Offensive Rebounds	2.6 ± 2.4	3.4 ± 2.5	3.7 ± 2.8	3.9 ± 2.6	-	-	-	-	-	-	-	-
	Defensive Rebounds	5.0 ± 3.1	4.8 ± 2.4	3.3 ± 3.9	5.9 ± 2.8	-	-	-	-	-	-	-	-
	Unsuccessful Passes	5.7 ± 4.1	5.3 ± 2.6	5.1 ± 3.9	3.4 ± 1.9	2.5 ± 2.1	3.1 ± 2.3	3.7 ± 0.8	5.9 ± 4.8	14.2 ± 1.3	9.2 ± 2.5	14.3 ± 4.1	11.4 ± 4.6
	Ball Loss	4.1 ± 2.9	4.1 ± 2.9	4.5 ± 4.4	5.3 ± 2.1	2.2 ± 0.8	5.8 ± 4.5	2.4 ± 1.8	2.8 ± 1.9	0.8 ± 0.9	3.3 ± 2.6	1.3 ± 1.4	2.2 ± 2.5
	Ball Recovery	1.4 ± 1.7	2.1 ± 2.1	3.6 ± 2.5	4.3 ± 1.7	1.4 ± 1.1	3.2 ± 2.6	2.6 ± 2.3	2.8 ± 3.1	4.1 ± 1.5	4.1 ± 1.9	5.2 ± 0.9	4.1 ± 1.4
	Interception	-	-	-	-	-	-	-	-	3.1 ± 2.3	5.4 ± 2.1 ^f	3.9 ± 1.9 ^g	9.9 ± 3.3
	Tackle	-	-	-	-	-	-	-	-	4.5 ± 0.9	3.1 ± 2.9	9.3 ± 7.2 ^h	2.2 ± 1.8
Tactical Indicators	Offensive efficacy	0.1 ± 0.1	0.1 ± 0.1	0.1 ± 0.1	0.1 ± 0.1	7.2 ± 1.8 ^a	3.1 ± 1.1	5.1 ± 3.2	3.2 ± 2.4	0.7 ± 0.8	2.5 ± 2.3	0.5 ± 1.1	1.8 ± 0.9
	Unsuccessfully offensive phase duration (s)	1.8 ± 0.5 ^b	1.5 ± 0.2	2.5 ± 0.4 ^d	1.6 ± 0.3	1.5 ± 0.2 ^b	1.4 ± 0.1 ^c	2.0 ± 0.2 ^d	1.7 ± 0.2	1.0 ± 0.2	1.1 ± 0.2	1.4 ± 0.3	1.1 ± 0.2
	Number of passes per phase	25.5 ± 8.1	20.8 ± 6.4	32.1 ± 5.2	25.8 ± 7.7	19.3 ± 3.8 ^b	15.7 ± 5.6 ^c	39.4 ± 7.1	30.6 ± 5.8	21.0 ± 7.5	15.8 ± 4.7	18.3 ± 5.8	20.6 ± 11.2
	Successful passes per offensive phase	0.3 ± 0.1	0.2 ± 0.1	0.3 ± 0.1	0.3 ± 0.1	0.2 ± 0.1 ^b	0.2 ± 0.1 ^c	0.4 ± 0.1	0.3 ± 0.1	0.2 ± 0.1	0.2 ± 0.1	0.2 ± 0.1	0.2 ± 0.1
	Time of ball possession per player	0.6 ± 0.1	0.6 ± 0.1	0.7 ± 0.1	0.6 ± 0.2	0.6 ± 0.1 ^b	0.7 ± 0.1 ^c	0.5 ± 0.1	0.5 ± 0.1	0.5 ± 0.2	0.4 ± 0.1	0.5 ± 0.1	0.4 ± 0.1

Significant differences are identified as: (a) 3x3ONE vs. 3x3TWO; (b) 3x3ONE vs. 4x4ONE; (c) 3x3TWO vs. 4x4TWO; (d) 4x4ONE vs 4x4TWO.

Table 1. Results of technical and tactical indicators for each SSG of the three team sports.

SSG	Basketball	Handball	Futsal
3x3ONE (n = 6)	15.3 ± 1.1 ^{a,b}	15.2 ± 1.1 ^a	15.2 ± 0.9 ^a
3x3TWO (n = 6)	13.8 ± 0.7	13.9 ± 0.8 ^c	14.6 ± 0.8 ^c
4x4ONE (n = 8)	13.9 ± 0.8 ^d	13.6 ± 0.7 ^d	14.2 ± 0.8 ^d
4x4TWO (n = 8)	13.6 ± 0.6	13.4 ± 0.6	14.1 ± 0.7

Significant differences are identified as: (a) 3x3ONE vs. 3x3TWO; (b) 3x3ONE vs. 4x4ONE; (c) 3x3TWO vs. 4x4TWO; (d) 4x4ONE vs 4x4TWO.

Table 2. Mean ± SD of RPE for each SSG of the three sports.

The time spent in each HR zone is presented in Figure 2. In general, all SSG provided patterns of activity at highest intensity zone (zone 4, $\geq 90\%$ HR_{max}). In basketball (see Figure 2a) significant effects were found between zone 3 and zone 4 ($F = 3.2$; $p < .05$), in handball between zone 2 and zone 3 ($F = 2.7$; $p < .05$), while in futsal differences were found between zone 1 and zone 4 ($F = 3.5$; $p < .05$) and also between zone 3 and zone 4 ($F = 3.5$; $p < .05$).

Table 2 presents the perceptual responses. The values obtained in RPE are in agreement with the findings obtained by %HR zones. In basketball, significant effects were found between 3x3ONE and 3x3TWO ($p < .0001$; $ES = 1.7$), 4x4ONE and 4x4TWO ($p < .05$; $ES = 0.5$) and between 3x3ONE and 4x4ONE ($p < .0001$; $ES = 1.6$). Handball and futsal have registered significant differences between 3x3ONE and 3x3TWO ($p < .0001$; $ES = 1.5$, and 0.8 , respectively), 3x3TWO and 4x4TWO ($p < .0001$; $ES = 1.9$, and 1.3 , respectively) and 3x3ONE and 4x4ONE ($p < .05$; $ES = 0.4$, and 0.7 , respectively).

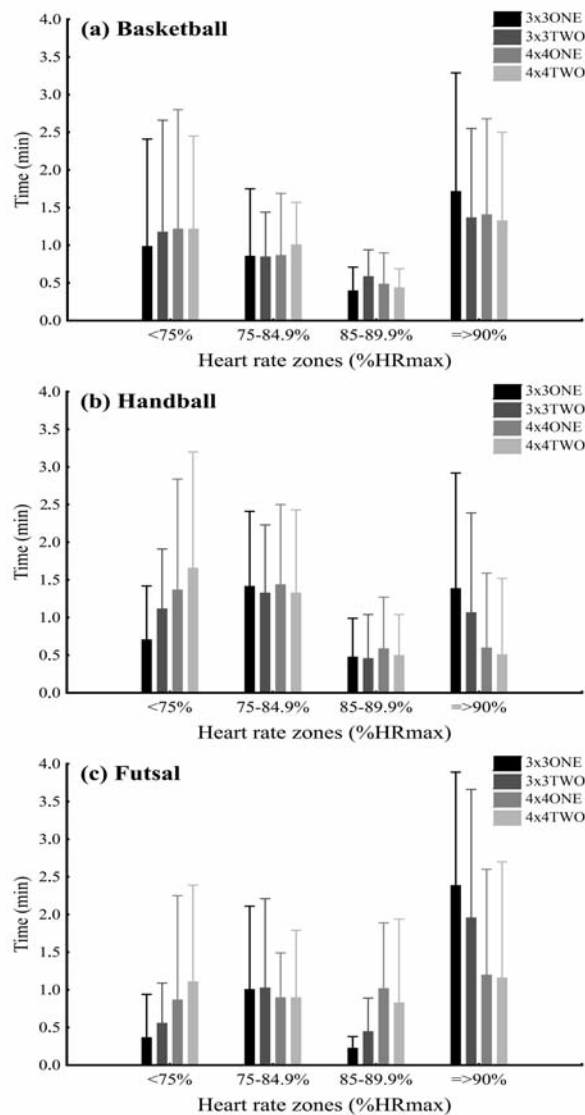


Figure 2. Variation of time spent at the considered heart rate speed zones.

Discussion

This study aimed to examine the effects of number of players and targets on the technical, tactical and physiological indicators of basketball, handball and futsal SSG. Children's participation in team sports elicits and promotes feeling of self-competency, affiliation with the peers and competitive excitement (McCarthy, Jones and Clark-Carter, 2008; Méndez-Giménez, Fernández-Río, Cecchini and González, 2013; Ortega et al., 2012). In this sense, the use of SSG has been strongly recommended for teaching team sports in children (Castagna, D'Ottavio and Abt, 2003). Moreover, the time available for physical education classes is extremely short, so the use of SSG enables the program to focus on the game, increasing the time spent with activities that are meaningful and in which children and young build their own learning process (Panter et al., 2008). Basketball and futsal SSG seems to be unaffected by the pitch size and the number of players' manipulation once technical and tactical performance indicators presented small variations across conditions in each sport. However, the results of this study suggest that the tactical demands of handball are strongly affected by the number of players and targets. The increase of the number of players incites higher duration of unsuccessful offensive phase, number of passes per phase, successful passes per offensive phase and to decrease ball possession per player. Additionally, higher physiological demands were registered in SSG with small number of players and targets.

Basketball

The technical and tactical indicators mean values were similar in all basketball SSG. The lower level of the participants expertise in this study may also be linked with the lack of differences between the used conditions. Although, the literature has reported no effects of manipulating the number of players according to the players' level of experience for physiological variables (Halouani, Chtourou, Gabbett, Chaouachi and Chamari, 2014), however, differences were expected in tactical performance indicators. The variation of number of players and targets have only affected the duration of unsuccessful offensive phase and higher mean values were found in 4x4ONE. The agglomeration of players in the end zones could explain these results. However, the manipulation of the same variables showed a higher impact on physiological indicators. Generally, the decreased of targets and players number has contributed to higher mean values of RPE and time spent in higher intensities zones. Similarly, previous research has shown that decreasing the number of players elicited higher HR and RPE (Abrantes et al., 2012). Also, reducing the number of targets tends to focus the game in specific pitch spaces (e.g. near the targets, central zone of the pitch) (Travassos, Gonçalves, Marcelino, Monteiro and Sampaio, 2014). This situation allow the players to constantly interact in the game due to their proximity between the ball, teammates, opponents and the targets, which may increase the game intensity (McCormick et al., 2012). Moreover, this interaction could also enhance the motivation, due to the inherent possibility to participate in the game at each second.

Handball

In handball, technical performance indicators showed that decreasing the number of targets resulted in a higher frequency of successful shots when comparing the 3x3ONE with 3x3TWO. In fact, the available research has showed that the way of score

can affect players' decision-making process (Llorca-Miralles, Sánchez-Delgado, Piñar, Cárdenas and Perales, 2013; Mallo and Navarro, 2008). Additionally, the presence of a goalkeeper may motivate some players (Dellal et al., 2008), and contribute to a greater commitment and organization to protect their goal (Aguiar, Botelho, Lago, Macas and Sampaio, 2012). Major variations were recorded in tactical indicators. The increase of number of players contributed to higher duration of unsuccessful offensive phase, number of passes per phase, successful passes per offensive phase and to decrease ball possession per player. As previously argued, the greater duration of unsuccessful offensive phase may be caused by the players' agglomeration. This fact may imply that team expand in order to open space between defense lines and use pass to provoke defenders displacement. Dellal, Chamari, et al. (2011) add that a great number of players consequently require a higher tactical contribution, such as higher number of passes. Moreover the highest number of players provides more tactical options (Kelly and Drust, 2009; Owen et al., 2004). These results suggest that's important to carefully select the number of players in this sport.

The findings of the time spent at the considered HR zones are in agreement with previous researches. For instance, manipulating the number of players (Hill-Haas, Dawson, Coutts and Rowsell, 2009; Rampinini et al., 2007) and the ways of score (Bangsbo, 1994) may affect the game intensity. In this study, the decrease of number of players and targets has contributed to higher game intensity. The RPE values reflected the patterns observed in time spent at the considered zones, confirming that the decrease number of players increases the exercise intensity. This is consistent with previous findings (Rampinini et al., 2007; Sampaio, Abrantes and Leite, 2009).

Futsal

The Futsal SSG has presented similar technical and tactical indicators. The manipulation of number of player has affected the interceptions, and the variation of number of targets has a stronger interaction in interceptions and tackles. Higher number of interceptions were obtained when the number of players are increased, comparing the 3x3TWO with 4x4TWO. Despite non-significant effects obtained, the study of Owen et al. (2004), found a higher frequency of interceptions in 4x4 SSG than in 3x3 SSG. The decrease of targets number increased number of tackles and decreased number of interceptions between 4x4ONE and 4x4TWO. This finding is similar to the results of Koklu et al. (2011), in which the authors stated that SSG realized with small number of players promoted higher number of tackles. In other study, Katis and Kellis (2009) reported that more tackles were performed in 3x3 SSG than in 6x6 SSG. In addition, the lack of differences in tactical performance indicators could be linked with the participants expertise. In fact, an previous study showed that non-experienced players use individual actions to solve the game contextual problems (Almeida, Ferreira and Volossovitch, 2013). Thus, most of the tactical variables used in this study are related with ball possession, however, this ability is not exclusively related with the technical ability (Almeida et al., 2013), but also with the ability to attune the environmental information and use it to constantly regulate the interpersonal interactions with the teammates (Davids et al., 2013; Travassos et al., 2012).

Several authors have shown that SSG provides a high physiological impact, which translates into optimal conditions for the development of anaerobic threshold and maximal oxygen

uptake (Casamichana and Castellano, 2010; Hoff, Wisloff, Engen, Kemi and Helgerud, 2002; Impellizzeri et al., 2006). It's important that activities in physical education induce a high amount of energy expenditure, while children develop technical and tactical actions in an enjoyable way (Toh et al., 2011). The findings from physiological indicators showed that SSG performed with small number of players caused a higher physiological impact, particularly the 3x3ONE, which induced higher mean values of RPE and contribute to patterns of activity in the higher intensity zone (Zone 4, $\geq 90\%$ HR_{max}). An previous study add that task intensity perception can be affected by the number of players (Casamichana, Castellano, Blanco-Villasenor and Usabiaga, 2012).

Practical Applications

In order to promote higher physiological stimulus, teachers should frequently use 3x3 SSG situations;

In basketball, teachers can change the players and targets constraints without affect significantly the players actions;

The use of 4x4 Handball SSG are more suitable for lessons with passing aims and 3x3ONE for shooting;

Teachers can change the Futsal SSG conditions according to defensive contents to be applied: increasing the players stimulate the interceptions made, and decreasing targets elicits more tackles.

Conclusions

The SSG allow students developing in an extremely positive environment their technical, tactical, social and mental skills, as

the decision-making (Owen et al., 2004). As a result, it is justified the use of SSG in the planning of physical education classes, since include physical requirements similar to those found in the game and focuses on learning through game play. Moreover, this type of teaching focused in the game delivers high levels of motivation and involvement of students in the tasks. The manipulation of the constraints used in this study did not affected the technical and tactical performance indicators in basketball and futsal. Thus, it's possible to use between 6 and 9 players without significantly altering the technical and tactical actions during the game. Handball tactical indicators have been significantly affected by the manipulation of the variables, specially the number of players. Adding players contributed to higher duration of unsuccessful offensive phase, number of passes per phase, successful passes per offensive phase and to decreases ball possession per player. The physiological indicators in all team sports showed that decreasing number of players and targets contributed to higher mean values of RPE and time spent in the specified HR zones. As hypoteshized, higher physiological stimulus was found in 3x3 SSG situations for all team sports, nevertheless, higher values were found in 3x3ONE. Using only one target, the game tends to be more focus in specific spaces, allowing players to act more in game, and therefore, increase the game intensity. Different findings were found regardless to the technical and tactical performance indicators: while basketball and futsal SSG seems to be unaffected by the manipulation in the number of players and targets, in contrast to what we hypoteshized, adding players in handball SSG increase the number and success of the passes.

MANIPULACIÓN DEL NÚMERO DE JUGADORES Y METAS EN JUEGOS REDUCIDOS DE DEPORTES COLECTIVOS DURANTE LAS CLASES DE EDUCACIÓN FÍSICA

PALABRAS CLAVE: Deportes de equipo, Juegos reducidos, Educación física, Indicadores fisiológicos, Técnicos y tácticos

RESUMEN: Este estudio tuvo como objetivo examinar los efectos del número de jugadores y metas en la variación de los indicadores técnicos, tácticos y fisiológicos en baloncesto, balonmano y fútbol sala. Nueve estudiantes del octavo grado (edad 13.3 ± 0.7 años, estatura 166.8 ± 3.8 cm, masa corporal 55.3 ± 4.2 kg) participaron en cuatro juegos reducidos (SSG) para cada deporte. A pesar de las diferencias entre los deportes, se encontraron valores medios similares en los indicadores técnicos y tácticos tanto en los juegos reducidos del baloncesto como en los de fútbol sala. El aumento de los jugadores ha provocado el aumento de la duración de la fase ofensiva sin éxito, número de pases por fase ofensiva, pases acertados por fase ofensiva y ha provocado una disminución de la posesión del balón por jugador. Mientras la totalidad de juegos reducidos utilizados en este estudio han impuesto un elevada demanda fisiológica, los juegos reducidos de 3x3 jugados con una meta provocaron las mayores respuestas. En conclusión, los juegos reducidos de 3x3 ha inducido valores similares en los indicadores técnico-tácticos, pero demandas fisiológicas más altas que los juegos reducidos de 4x4.

MANIPULAÇÃO DO NÚMERO DE JOGADORES E OBJECTIVOS EM JOGOS REDUZIDOS DE DESPORTOS COLECTIVOS DURANTE AS AULAS DE EDUCAÇÃO FÍSICA

PALAVRAS-CHAVE: Desportos de equipa, Jogos reduzidos, Educação física, Indicadores fisiológicos, técnicos e tácticos.

RESUMO: Este estudo teve como objectivo analisar os efeitos do número de jogadores e dos objectivos na variação dos indicadores técnicos, tácticos e fisiológicos no basquetebol, andebol e futsal. Nove estudantes do oitavo ano (idade 13.3 ± 0.7 anos, estatura 166.8 ± 3.8 cm, massa corporal 55.3 ± 4.2 kg) participaram em quatro jogos reduzidos (SSG) para cada modalidade. Apesar das diferenças entre os desportos, foram verificados valores médios similares nos indicadores técnicos e tácticos nos jogos reduzidos de basquetebol e futsal. O aumento dos jogadores provocou o aumento da duração da fase ofensiva sem êxito, número de passes por fase ofensiva, passes certos por fase ofensiva e provocou uma diminuição da posse de bola por jogador. Enquanto a totalidade de jogos reduzidos utilizados neste estudo implicou uma elevada exigência fisiológica, os jogos reduzidos de 3X3 jogados com um objectivo provocaram as maiores respostas. Em suma, os jogos reduzidos de 3x3 induziram valores similares nos indicadores técnico-tácticos, mas exigências fisiológicas mais elevadas que os jogos reduzidos de 4X4.

References

- Abrantes, C. I., Nunes, M. I., Macas, V. M., Leite, N. M. y Sampaio, J. E. (2012). Effects of the number of players and game type constraints on heart rate, rating of perceived exertion, and technical actions of small-sided soccer games. *Journal of Strength and Conditioning Research*, 26(4), 976-981.
- Aguiar, M., Botelho, G., Lago, C., Macas, V. y Sampaio, J. (2012). A review on the effects of soccer small-sided games. *Journal of Human Kinetics*, 33, 103-113.
- Almeida, C. H., Ferreira, A. P. y Volossovitch, A. (2013). Offensive sequences in youth soccer: Effects of experience and small-sided games. *Journal of Human Kinetics*, 36, 97-106.
- Bangsbo, J. (1994). The physiology of soccer with special reference to intense intermittent exercise. *Acta Physiol Scand Suppl*, 619, 1-155.
- Bangsbo, J., Iaiá, F. M. y Krstrup, P. (2008). The yo-yo intermittent recovery test - a useful tool for evaluation of physical performance in intermittent sports. *Sports Medicine*, 38(1), 37-51.
- Casamichana, D. y Castellano, J. (2010). Time-motion, heart rate, perceptual and motor behaviour demands in small-sides soccer games: Effects of pitch size. *Journal of Sports Sciences*, 28(14), 1615-1623.
- Casamichana, D., Castellano, J., Blanco-Villasenor, A. y Usabiaga, O. (2012). Study of perceived exertion in soccer training tasks with the generalizability theory. *Revista de Psicología del Deporte*, 21(1), 35-40.
- Castagna, C., D'Ottavio, S. y Abt, G. (2003). Activity profile of young soccer players during actual match play. *Journal of Strength and Conditioning Research*, 17(4), 775-780.
- Castellano, J., Casamichana, D. y Lago, C. (2012). The use of match statistics that discriminate between successful and unsuccessful soccer teams. *Journal of Human Kinetics*, 31, 139-147.
- Clemente, F. y Rocha, R. (2012). The effects of task constraints on the heart rate responses of students during small-sided handball games. *Kinesiology Slovenica*, 18(2), 27-35.
- Davids, K., Araújo, D., Correia, V. y Vilar, L. (2013). How small-sided and conditioned games enhance acquisition of movement and decision-making skills. *Exercise and Sport Sciences Reviews*, 41(3).
- Dellal, A., Chamari, K., Owen, A. L., Wong, D. P., Lago-Penas, C. y Hill-Haas, S. (2011). Influence of technical instructions on the physiological and physical demands of small-sided soccer games. *European Journal of Sport Science*, 11(5), 341-346.
- Dellal, A., Chamari, K., Pintus, A., Girard, O., Cotte, T. y Keller, D. (2008). Heart rate responses during small-sided games and short intermittent running training in elite soccer players: A comparative study. *Journal of Strength and Conditioning Research*, 22(5), 1449-1457.
- Dellal, A., Jannault, R., Lopez-Segovia, M. y Pialoux, V. (2011). Influence of the numbers of players in the heart rate responses of youth soccer players within 2 vs. 2, 3 vs. 3 and 4 vs. 4 small-sided games. *Journal of Human Kinetics*, 28, 107-114.
- Gutiérrez, D., Fiset, J., García-López, L. y Contreras, O. (2014). Assessment of secondary school students' game performance related to tactical contexts. *Journal of Human Kinetics*, 42, 223-234.
- Halouani, J., Chtourou, H., Dellal, A., Chaouachi, A. y Chamari, K. (2014). Physiological responses according to rules changes during 3 vs. 3 small-sided games in youth soccer players: Stop-ball vs. Small-goals rules. *Journal of Sports Sciences*, 1-6.
- Halouani, J., Chtourou, H., Gabbett, T., Chaouachi, A. y Chamari, K. (2014). Small-sided games in team sports training: A brief review. *Journal of Strength and Conditioning Research*, 28(12), 3594-3618.
- Hill Haas, S., Coutts, A. J., Rowsell, G. J. y Dawson, B. T. (2009). Generic versus small-sided game training in soccer. *International Journal of Sports Medicine*, 30(9), 636-642.
- Hill Haas, S., Dawson, B., Impellizzeri, F. y Coutts, A. (2011). Physiology of small-sided games training in football a systematic review. *Sports Medicine*, 41(3), 199-220.
- Hill-Haas, Coutts, A., Rowsell, G. y Dawson, B. (2008). Variability of acute physiological responses and performance profiles of youth soccer players in small-sided games. *Journal of Science and Medicine in Sport*, 11(5), 487-490.
- Hill-Haas, S. V., Dawson, B. T., Coutts, A. J. y Rowsell, G. J. (2009). Physiological responses and time-motion characteristics of various small-sided soccer games in youth players. *Journal of Sports Sciences*, 27(1), 1-8. doi: 10.1080/02640410802206857
- Hopkins, W. (2002). A new view of statistics. from <http://www.sportsci.org/resource/stats/effectmag.html>
- Gruic, I., Vuleta, D. y Milanovic, D. (2006). Performance indicators of teams at the 2003 men's world handball championship in Portugal. *Kinesiology*, 38(2), 164-175.
- Impellizzeri, F. M., Marcora, S. M., Castagna, C., Reilly, T., Sassi, A., Iaiá, F. M. et al. (2006). Physiological and performance effects of generic versus specific aerobic training in soccer players. *International Journal of Sports Medicine*, 27(6), 483-492.
- Jeffreys, I. (2004). The use of small-sided games in the metabolic training of high school soccer players. *Strength and Conditioning Journal*, 26(5), 77-78.
- Jones, S. y Drust, B. (2007). Physiological and technical demands of 4 v 4 and 8 v 8 games in elite youth soccer players. *Kinesiology*, 39(2), 150-156.
- Katis, A. y Kellis, E. (2009). Effects of small-sided games on physical conditioning and performance in young soccer players. *Journal of Sports Science and Medicine*, 8(3), 374-380.
- Kelly, D. A. y Drust, B. (2009). The effect of pitch dimensions on heart rate responses and technical demands of small-sided soccer games in elite players. *Journal of Science and Medicine in Sport*, 12(4), 475-479.
- Koklu, Y., Asci, A., Kocak, F. U., Alemdaroglu, U. y Dundar, U. (2011). Comparison of the physiological responses to different small-sided games in elite young soccer players. *Journal of Strength and Conditioning Research*, 25(6), 1522-1528.
- Koklu, Y., Ersoz, G., Alemdaroglu, U., Asci, A. y Ozkan, A. (2012). Physiological responses and time-motion characteristics of 4-a-side small-sided game in young soccer players: The influence of different team formation methods. *Journal of Strength and Conditioning Research*, 26(11), 3118-3123.
- Leite, N., Gonçalves, B., Jiménez, S. y Sampaio, J. (2013). Effects of the playing formation and game format on heart rate, rate of perceived exertion, vertical jump, individual and collective performance indicators in youth basketball training. *International SportMed Journal*, 14(3), 127-138.
- Llorca-Miralles, J., Sánchez-Delgado, G., Piñar, M., Cárdenas, D. y Perales, J. C. (2013). Basketball training influences shot selection assessment: A multi-attribute decision-making approach. *Revista de Psicología del Deporte*, 22(1), 223-226.
- Mallo, J. y Navarro, E. (2008). Physical load imposed on soccer players during small-sided training games. *Journal of Sports Medicine and Physical Fitness*, 48(2), 166-171.

- McCarthy, P. J., Jones, M. V. y Clark-Carter, D. (2008). Understanding enjoyment in youth sport: A developmental perspective. *Psychology of Sport and Exercise*, 9(2), 142-156.
- McCormick, B. T., Hannon, J. C., Newton, M., Shultz, B., Miller, N. y Young, W. (2012). Comparison of physical activity in small-sided basketball games versus full-sided games. *International Journal of Sports Science and Coaching*, 7(4), 689-687.
- Memmert, D. (2010). Game test situations: Assessment of game creativity in ecological valid situations. *International Journal of Sport Psychology*, 41, 94-95.
- Memmert, D. y Roth, K. (2007). The effects of non-specific and specific concepts on tactical creativity in team ball sports. *Journal of Sports Sciences*, 25(12), 1423-1432.
- Méndez-Giménez, A., Fernández-Río, J., Cecchini, J. and González, C. (2013). Perfiles motivacionales y sus consecuencias en educación física. Un estudio complementario de metas de logro 2x2 y autodeterminación. *Revista de Psicología del Deporte*, 22(1), 29-38.
- O'Donoghue, P. (2010). *Research methods for sports performance analysis*. London: Routledge.
- Ortega, E., Alarcón, F. y Piñar, M. (2012). Modificaciones reglamentares en baloncesto de formación: Un nuevo equipamiento, una nueva perspectiva. In A. Antúnez and S. J. Ibáñez (Eds.), *El camino hacia la excelencia en baloncesto* (pp. 135-159). Sevilla: Wanceulen Editorial Deportiva.
- Owen, A., Twist, C. y Ford, P. (2004). Small-sided games: The physiological and technical effect of altering pitch size and player numbers. *Insight*, 7(2), 50-53.
- Owen, A. L., Wong, D. P., McKenna, M. y Dellal, A. (2011). Heart rate responses and technical comparison between small-vs. Large-sided games in elite professional soccer. *Journal of Strength and Conditioning Research*, 25(8), 2104-2110.
- Rampinini, E., Impellizzeri, F. M., Castagna, C., Abt, G., Chamari, K., Sassi, A. et al. (2007). Factors influencing physiological responses to small-sided soccer games. *Journal of Sports Sciences*, 25(6), 659-666.
- Reilly, T. (2005). An ergonomics model of the soccer training process. *Journal of Sports Sciences*, 23(6), 561-572.
- Sampaio, J., Abrantes, C. y Leite, N. (2009). Power, heart rate and perceived exertion responses to 3x3 and 4x4 basketball small-sided games. *Revista de Psicología del Deporte*, 18, 463-467.
- Sampaio, J., Janeira, M., Ibanez, S. y Lorenzo, A. (2006). Discriminant analysis of game-related statistics between basketball guards, forwards and centres in three professional leagues. *European Journal of Sport Science*, 6(3), 173-178.
- Silva, B., Garganta, J., Santos, R. y Teoldo, I. (2014). Comparing tactical behaviour of soccer players in 3 vs. 3 and 6 vs. 6 small-sided games. *Journal of Human Kinetics*, 41, 191-202.
- Tessitore, A., Meeusen, R., Piacentini, M. F., Demarie, S. y Capranica, L. (2006). Physiological and technical aspects of "6-a-side" soccer drills. *Journal of Sports Medicine and Physical Fitness*, 46(1), 36-43.
- Toh, S. H., Guelfi, K. J., Wong, P. y Fournier, P. A. (2011). Energy expenditure and enjoyment of small-sided soccer games in overweight boys. *Human Movement Science*, 30(3), 636-647.
- Travassos, B., Araujo, D., Davids, K., Vilar, L., Esteves, P. y Vanda, C. (2012). Informational constraints shape emergent functional behaviours during performance of interceptive actions in team sports. *Psychology of Sport and Exercise*, 13(2), 216-223.
- Travassos, B., Gonçalves, B., Marcelino, R., Monteiro, R. y Sampaio, J. (2014). How perceiving additional targets modifies teams' tactical behavior during football small-sided games. *Hum Mov Sci*, 38, 241-250.
- Vilar, L., Duarte, R., Silva, P., Chow, J. Y. y Davids, K. (2014). The influence of pitch dimensions on performance during small-sided and conditioned soccer games. *Journal of Sports Sciences*, 32(19), 1751-1759.

