



Comparison of Physical Demands between Possession Games and Matches in Football

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Abstract

The main purpose of this study was to examine the extent to which possession games (POS) are efficient in stimulating the physical and physiological demands of competition and their relationship with the player's position in competitive matches. A descriptive study was conducted with 19 professional footballers in Argentina (24.7±4.8 years, 74.5±6.2 kg, 176.3±5.3 cm). Load was monitored by GPS and heart rate (HR) of each player in 16 competitive matches (eight observations for each tactical system: 1-3-4-3 and 1-4-2-1-3) and during three POS formats: 6 vs. 6, 7 vs. 7 and 8 vs. 8 (eight observations for each format). The average (AHR) and maximum (MHR) heart rate and the HSLR (distance travelled >14.9 kph, per minute) and HILR (distance travelled >19.9 kph, per minute) metabolic load rates were analysed. When the sample means were compared, both metabolic rates were significantly lower in POS, but with HSLR values representing 69-75% of the level reached in matches. The AHR value in POS was similar to competition (except 8 vs. 8), while the MHR was significantly lower in POS. When performance between playing positions was compared, no significant differences were observed in the HILR and the HSLR for central defenders and midfielders or in all playing positions for the AHR. In conclusion, possession games could be used to recreate the physical and physiological demands to which players are exposed during competition, significantly influencing their internal-external load.

Keyword: physical performance, playing positions, tactical training, metabolic load rate, heart rate.

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Introduction

Small-sided games (SSGs) are played on smaller pitches, often under modified rules and with fewer players than regulation football (Hill-Haas et al., 2011). The use of such games in professional player training is based on the premise that greater performance improvements are achieved when the specific demands of the sport are transferred (Dellal et al., 2011; Little, 2009). Accordingly, SSGs enable players to get as close as possible to real competitive situations, and the physical, physiological, technical and tactical demands of a match can largely be reproduced (Dellal et al., 2011; Dellal et al., 2012).

Global positioning system (GPS) technology has been used in professional football to quantify movement demands on players during training or in competition, providing movement parameters such as frequency and amount of impacts, distances, speeds, accelerations and decelerations (Casamichana et al., 2015). Several authors have analysed these parameters during different types of small-sided games: number of players per team (Brandes et al., 2012; Hill-Haas et al., 2009), modification of certain rules (Hill-Haas et al., 2009), relative area per player (Casamichana & Castellano, 2010; Dellal et al., 2011; Porres et al., 2010), comparison with competition (Casamichana et al., 2015; Dellal et al., 2012), floaters (Casamichana et al., 2018), etc. In terms of playing positions, a study conducted by Lacome et al. (2017) compared three SSG formats (6 vs. 6, 7 vs. 7 and 8 vs. 8) to competitive matches and then differentiated performance by the players' positions on the pitch, concluding that central defenders accumulated more distance at high intensity than the other positions in the 6 vs. 6 format.

Studies exploring rules inherent to tactical or strategic outcomes have also been published. For example, Fradua et al. (2013) extrapolated SSG sizes from the actual pitch (11 vs. 11) to investigate variables related to tactics in the game and concluded that pitch size is a variable which influences ball possession. Thus, a variation in pitch size can create favourable and also unfavourable conditions for attack and defence (Silva et al., 2016; Vilar et al., 2014). Equally, in the review by Hill-Haas et al. (2011), the authors suggested that "conventional" SSGs could facilitate the development of a core tactical concept with an appropriate game context, although this will depend on its design. This fresh line of analysis leads to a new concept in sports games: the "possession game". Possession games (POS) are similar to conventional SSGs but have some different implications. In an SSG, pla-

yer deployment is totally random and the occupation of space is not pre-established, whereas in a POS the ownership of space is pre-established on the basis of intelligent occupation whereby the players who keep possession of the ball are deployed in such a way that the interrelationship between them and the space is as effective and efficient as possible, thereby making it possible to retain possession of the ball during the session. The primary objective of this kind of training is to generate unoccupied spaces through individual and group movements in order to build up play and attack with greater fluidity, thus promoting factors inherent in strategy and tactics with greater transference to specific match situations. In high-performance football, many teams use this type of game as part of their training sessions to emulate real competitive situations. Gaudino, et al. (2014) compared conventional SSGs and POS with 5, 7 and 10 players on each side in which no more than two touches were allowed in both games, whereas in the POS they had to keep the ball as long as possible. No detailed designs were given for each format and performance was not compared to competition. In other cases, and with the aim of evaluating modifying the rules on some tactical principles (attacking game patterns), Machado et al. (2016) used two types of POS called "small-sided conditioned games" or SSCG (6 vs. 6) in which ball possession time, number of passes, players involved in each attacking action, etc. were compared, although no physical and physiological parameters or transfers to specific game situations were evaluated.

Against this backdrop, the first objective of this study was to compare physical and physiological demands between POS and competition, since the former seek to reproduce basic principles of play which will subsequently be applied during competition. The second objective was to examine these demands in relation to the player's position during competitive matches on the assumption that the metabolic load rates in all POS formats are close to the levels observed in competition.

Methodology

Participants

A descriptive observational study was carried out with 19 players belonging to the same club in the Argentinian Professional Football League, Series B, during the 2016-17 season (age: 24.7 ± 4.8 years; body mass: 74.5 ± 6.2 kg; height: 176.3 ± 5.3 cm; fat percentage: 9.7 ± 2.5 %).

The players were grouped by their position on the pitch: central defenders (CD: $n=4$), full-backs (FB: $n=3$), midfielders (CM: $n=5$), wingers (WIN: $n=5$) and forwards (FOR: $n=2$). The goalkeepers were involved in the activities but excluded from the study because the distance and intensities evaluated during training and/or matches differed from those for outfield players (Clemente et al., 2013). Furthermore, they were only involved in the POS in their specific role as goalkeepers.

Before the start of the season, the players were evaluated using FIFA's medical protocol. None of them presented any ailments, pathologies or injuries and no medical prescriptions were issued. All the participants were informed of the research objectives and volunteered to participate in the study, which did not disrupt scheduled training. The study protocol was approved by the local Institutional Review Board and drafted in accordance with the Declaration of Helsinki (as revised at Fortaleza, 2013).

Procedure

The data for each match were gathered during the 2016-17 season. In terms of the two tactical formations used by the coach in the course of the competition, 52% of the games were played using the 1-3-4-3 formation (goalkeeper; three central defenders; two full-backs, two midfielders; one forward and two wingers) and 48% using the 1-4-2-1-3 formation (goalkeeper; two central defenders, two full-backs; three midfielders; one forward and two wingers). All the matches were played on natural grass football pitches with standard dimensions.

During the season, each player's GPS and heart rate were monitored 16 times (eight observations for each tactical system). In order to rule out possible effects of performance loss due to mental fatigue or incidents related to match strategies, only players who completed the first half of each game (Paul et al., 2015; Lacombe et al.,

2017) under normal conditions and with the same role on the pitch were considered.

In each competitive micro-cycle, the players performed five sessions with the ball lasting 45 minutes net (average) in each session, one to two weekly strength sessions and the match (the average total distance per micro-cycle was 31.6 km).

Instruments and measurements

All the physical and physiological parameters were assessed using the Zephyr™ GPS 10 Hz monitoring system and telemetric heart rate measurement (previously validated by Brooks et al., 2013; Kim et al., 2013). In order to limit inter-unit error, each player used the same GPS module and frequency meter for both POS and matches (Buchheit et al., 2013). The units were switched on 15 minutes before the beginning of each activity following the Zephyr™ (USA) instruction manual. After the recording of the activity, the data were downloaded to a laptop and analysed with the OmniSense™ v4.1.4 software.

The following parameters were monitored: distance travelled at moderate intensity, in metres (14.9-19.8 kph); distance travelled at high intensity, in metres (19.9-25.2 kph); distance travelled at sprint, in metres (above 25.2 kph); average heart rate (AHR; bpm), and maximum heart rate (MHR; bpm). Speed classification was based on the system used by Di Salvo et al. (Di Salvo, et al., 2009; Di Salvo, Pigozzi, González-Haro, Laughlin & De Witt, 2013) and the four study variables were obtained from these parameters (Table 1).

Possession games: design

Three basic principles of play were considered when the POS was designed: a) ball possession through individual movements towards group movements (deep movements, diagonal movements, etc.); b) passing, depending on the unoccupied space and on the different movements (side

Table 1
Study variables and their definitions.

Variable	Definition
High speed load rate (HSLR)	Quotient between distance travelled at moderate intensity, high intensity and sprint by the amount of time of each activity in metres per minute.
High intensity/sprint load rate (HILR)	Quotient between distance travelled at high intensity and sprint by the amount of time of each activity in metres per minute.
Average heart rate (AHR)	Average heart rate obtained during the observed period in beats per minute.
Maximum heart rate (MHR)	Maximum heart rate obtained during the period observed in beats per minute

pass looking for width, vertical pass looking to advance, through pass between the lines, etc.); and finally, (c) ball recovery, which involves intercepting an opposing player in possession of the ball and thus prevent him from moving forward in the attack. Based on these principles, three POS formats were selected: 6 vs. 6, 7 vs. 7 and 8 vs. 8. As a proposal, different specific POS options were designed by the authors of this study, each one with well-defined objectives for the attacking and defensive system (Table 2). In order to establish a common denominator, the same combined design was established and tested for the different formats, hence four designs with a clearly-defined structure and objectives were ultimately obtained for each POS format (Table 2).

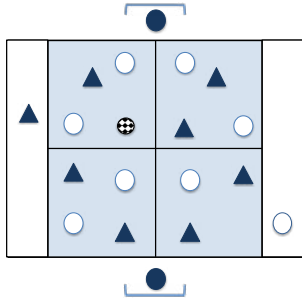
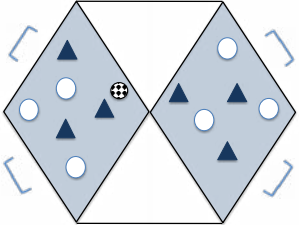
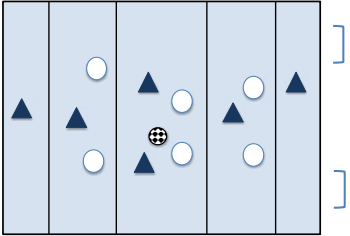
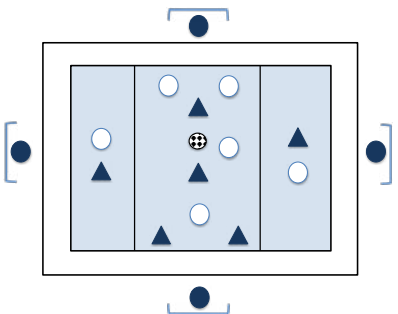
The games were played “with no limit on the number of touches” (except at the time of shooting) on natural grass football pitches with standard dimensions.

The dimensions of each design were selected based on the observations described in the paper by Fradua et al. (2013): the relative playing area (m² per player) between 65-110 m² and the ratio between the pitch length-width distances from 1:1 to 1:1.3. The average measurements of each format are shown in Table 3. The same monitoring procedure was performed for each POS design as in matches. It was conducted in two rounds in series lasting eight minutes (two minutes of recovery between series) and each design was evaluated

Table 2

Proposed seven POS designs for the three formats studied.

N	Format*	Design: organisation and objectives	Diagram
1	8 vs.8 (34x48)	Organisation: 5 areas arranged vertically with 6 mini-goals placed five metres from each touchline. Objective: possession of the ball between the areas to generate movement from one side to the other in order to clear the areas around the goals. Meanwhile, the defenders have to move based on the ball, occupying the area where the ball is and the two adjacent strips and attempt to recover it as quickly as possible. No more than one player from each team can occupy each square and goals may be scored in any of the six goals.	
	6 vs. 6 (25x38)		
2	8 vs. 8 (34x48)	Organisation: 8 squares and two 5-metre strips at the sides; a goal (with a goalkeeper) five metres from each goal line. The game begins with 1 vs. 1 in each square. Objective: possession of the ball to generate spaces between the squares. For a player to be eligible to shoot, the ball must travel from one side to the other through at least four squares. The defenders have to press, trying to recover the ball as quickly as possible. No more than one player from each team can occupy each square and goals may be scored in either goal.	
	7 vs. 7 (30x40)		
3	8 vs. 8 (30x32 + banda lateral de 5 metres)	Organisation: 1 square comprised of 4 triangles plus a 5-metre strip at the base of each triangle; a mini-goal five metres from each base; 4 players from each team are arranged in two opposite triangles and try to win possession of the ball between the triangles. Objective: for a player to be eligible to shoot, five passes must be made, followed by a pass between the lines to set up a player on the same team, but from the opposite triangle and coming from the sides. No more than two players from each team may occupy each triangle and goals may be scored in any of the four goals.	

4	8 vs. 8 (34x44) 7 vs. 7 (30x40)	<p>Organisation: 4 squares and a 5-metre strip on each of the sides; two goals (with goalkeeper) five metres from each goal line.</p> <p>Objective: possession of the ball with the aim of creating clear spaces between the squares to create scoring opportunities.</p> <p>The defenders have to press to recover the ball. Variations: for a player to be eligible to shoot, the ball must: 1. travel through at least three squares; 2. travel through all the squares; 3. travel from one side to the other. No more than two players from each team may occupy each square. Goals may be scored in either goal.</p>	
5	7 vs. 7 (25x30 cada rombe) 6 vs. 6 (22,5x25 cada rombe)	<p>Organisation: double diamonds joined together forming 2 triangles in the middle; four mini-goals (five metres from one side of each diamond); 2 teams of 6 or 7 players divided equally (3-3 or 4-3).</p> <p>Objective: possession of the ball between the diamonds until 5 passes are made, then 1 player from the same team has to "go down" or move to the adjacent triangle to shoot with a single touch. No more than two players from each team can occupy each diamond and goals may be scored in any of the four goals.</p>	
6	6 vs. 6 (25x34)	<p>Organisation: 5 areas arranged vertically with 2 mini-goals placed five metres from each goal line. Objective: possession of the ball between the areas to reach the final zone with a through pass.</p> <p>The defenders have to press to recover the ball as quickly as possible. Variations: for a player to be eligible to shoot, the ball must: 1. travel through at least two areas; 2. travel through three areas, and 3. travel through four areas, reaching the end zone in each variant in order to score. Goals may be scored in any of the four goals.</p>	
7	7 vs. 7 (30x46) 6 vs. 6 (26x36)	<p>Organisation: 3 areas arranged vertically, with a 5-metre strip around the pitch; 4 goals (with goalkeeper) five metres away from each side of the pitch. Objective: possession of the ball between the areas with the aim of reaching the aforementioned strip with a through pass.</p> <p>The defenders have to press to recover the ball. Variations: for a player to be eligible to shoot, the ball must: 1. travel through at least two areas; 2. travel through all three areas, and 3. move from one side to the other. Goals may be scored in any of the four goals.</p>	

* In brackets, the width and length of the pitch used in each design (in metres).

on different days during the season (total: eight observations for each format).

Statistical analysis

A preliminary exploratory analysis was carried out followed by a normality and homogeneity test. Descriptive statistical measurements such as mean and standard deviation (SD) were calculated for each position

and condition. A linear mixed-effects model was used to determine position and condition effects. For each response variable the fixed effects were the condition and the position. The player was considered to be a random effect. This model makes it possible to calculate the condition and position effect separately, considering an autocorrelation between observations made about the same player. The model was adjusted using the restricted maximum likelihood (REML) method. The results

Table 3*Dimensions and time spent on the three POS formats (mean \pm SD)*

POS format	Time (min)	Pitch area (m ²)	m ² per player	Length/width ratio
6 vs. 6	2 x 8	895 \pm 48,4	74,6 \pm 4,0	1:1,3 \pm 0,1
7 vs. 7	2 x 8	1207,5 \pm 116,9	87,6 \pm 6,7	1:1,3 \pm 0,1
8 vs. 8	2 x 8	1585 \pm 55,6	99,1 \pm 3,5	1:1,3 \pm 0,1

include the table with the estimation of the model's parameters, standard errors and *p*-values. Statistically significant differences were reported at a level of 5% (probability of type I error). The statistical calculations

were performed with the R statistical software version 3.4.3. The statistical report was prepared with the knitr statistical package which makes it possible to replicate all aspects of the analysis.

Table 4

Values obtained for each study variable by tactical position for the three POS formats and the two tactical systems (mean \pm SD). n=19 corresponds to sample data.

	6 vs 6	7 vs 7	8 vs 8	1-3-4-3	1-4-2-1-3
HILR (mpm)					
CD	2,7 \pm 1,1	2,8 \pm 1,7	2,4 \pm 1,2	4,3 \pm 1,0	5,1 \pm 0,4
FB	3,1 \pm 1,2	3,1 \pm 1,7	2,6 \pm 1,2	8,8 \pm 2,3	9,0 \pm 0,8
CM	2,2 \pm 1,3	3,4 \pm 2,5	3,1 \pm 1,3	5,1 \pm 1,0	5,3 \pm 1,5
FOR	2,8 \pm 1,0	5,0 \pm 2,2	3,3 \pm 1,2	9,7 \pm 1,4	10,4 \pm 1,1
WIN	3,0 \pm 1,7	2,3 \pm 1,5	3,7 \pm 1,6	7,3 \pm 1,9	11,6 \pm 2,2
n=19	2,7 \pm 1,1*	3,5 \pm 2,1*	3,0 \pm 1,2*	7,0 \pm 2,6	7,9 \pm 2,8
HSLR (mpm)					
CD	15,7 \pm 3,3	13,9 \pm 5,1	11,5 \pm 4,2	14,8 \pm 1,4	17,7 \pm 0,5
FB	19,1 \pm 5,0	17,4 \pm 3,6	15,9 \pm 2,3	25,4 \pm 6,1	24,4 \pm 2,4
CM	14,6 \pm 2,3	15,0 \pm 5,2	16,1 \pm 2,8	18,0 \pm 3,2	21,0 \pm 3,7
FOR	15,4 \pm 2,9	19,6 \pm 4,4	15,7 \pm 1,1	25,3 \pm 2,9	25,3 \pm 0,8
WIN	12,5 \pm 4,4	13,4 \pm 6,6	11,0 \pm 4,2	19,5 \pm 2,9	24,9 \pm 0,1
n=19	15,5 \pm 3,5*	16,2 \pm 4,9*	14,4 \pm 3,3*	20,5 \pm 5,2	22,3 \pm 3,8
AHR (bpm)					
CD	172,6 \pm 11,6	168,7 \pm 14,3	166,8 \pm 12,1	167,8 \pm 9,5	170,9 \pm 2,1
FB	173,9 \pm 4,3	174,1 \pm 8,5	166,3 \pm 5,7	178,2 \pm 5,3	176,1 \pm 7,9
CM	170,8 \pm 4,6	170,9 \pm 8,5	169,5 \pm 10,6	173,0 \pm 6,4	175,7 \pm 6,8
FOR	172,2 \pm 13,7	171,5 \pm 4,7	165,2 \pm 5,0	173,9 \pm 4,6	174,6 \pm 2,4
WIN	166,3 \pm 12,2	163,7 \pm 13,0	160,1 \pm 4,9	159,8 \pm 14,4	161,7 \pm 14,0
n=19	171,6 \pm 6,7	170,3 \pm 9,0	166,3 \pm 8,2*	171,6 \pm 8,4	173,0 \pm 8,5
MHR (bpm)					
CD	186,0 \pm 9,2	184,2 \pm 11,0	182,2 \pm 10,6	191,7 \pm 8,8	192,8 \pm 5,8
FB	186,4 \pm 4,7	189,2 \pm 2,1	183,1 \pm 0,4	197,4 \pm 3,6	196,5 \pm 3,5
CM	186,1 \pm 2,4	188,6 \pm 5,8	184,9 \pm 7,5	195,0 \pm 4,6	196,8 \pm 3,4
FOR	189,3 \pm 13,5	188,0 \pm 1,9	181,9 \pm 8,7	197,5 \pm 4,9	198,2 \pm 3,9
WIN	178,6 \pm 12,7	182,7 \pm 7,1	170,6 \pm 9,3	183,1 \pm 7,6	183,2 \pm 10,6
n=19	186,2 \pm 6,2*	187,0 \pm 6,1*	181,8 \pm 8,4*	194,1 \pm 6,9	194,8 \pm 6,3

* *p* < 0,001 vs. 3-4-3 and 4-2-1-3

Results

The box plots for each study variable are set out in figures 1, 2, 3, 4, 5 and 6. The means (\pm SD) of the metrics for the different playing positions are shown in Table 4.

When the values obtained in the means between the POS formats and the two tactical systems are compared, both the HILR and the HSLR are significantly lower than the means obtained in matches ($p < 0.001$). In the case of the HILR, these values represent between 38.6 and 50% in the 1-3-4-3 formation, and between 37.5 and 48.6% in the 1-4-2-1-3 formation (Figure 1). For the HSLR, the values represent a higher percentage: 70 to 75.2% for 3-4-3 and 69.2 to 72.3% for 4-2-1-3 (Figure 1).

With regard to cardiovascular performance during effort, the AHR value in POS was no different from in matches, with the exception of 8 vs. 8 where between 5 and 7 fewer bpm were observed in both tactical formations (3.1 to 3.9% less) (Figure 2). However, for MHR the sample averages in POS are significantly lower than in matches (4 to 7% lower, 7 to 13 fewer bpm) ($p < 0.001$) (Figure 2).

To compare performance between playing positions on the pitch, the values of all the POS formats were grouped together and compared with the ones obtained in matches (both tactical formations): significant differences were observed in the HILR and HSLR variables in the positions FB ($p < 0.01$), WIN ($p < 0.001$) and FOR ($p < 0.01$) (figures 3 and 4). These differences represent 29.9%, 30.7% and 44.6%, respectively, in the HILR, while the percentage differences are even greater for the HSLR (67%, 63.2% and 68.3 %, respectively).

With regard to the cardiovascular response to effort obtained for each position, no significant differences were observed in the AHR between the three POS formats and matches. By contrast, the mean MHR values differed significantly between POS and matches in all playing positions (figures 5 and 6).

Discussion

The primary objective of this study was to compare the physical and physiological demands between POS and competition and subsequently to examine these demands in relation to player position during competitive matches. The analysis of the POS data describes competition-like

Figure 1

Box plots for the high intensity/sprint load rate (HILR; mpmin) and high speed load rate (HSLR; mpmin) variables for each POS format and the two tactical formations in matches.

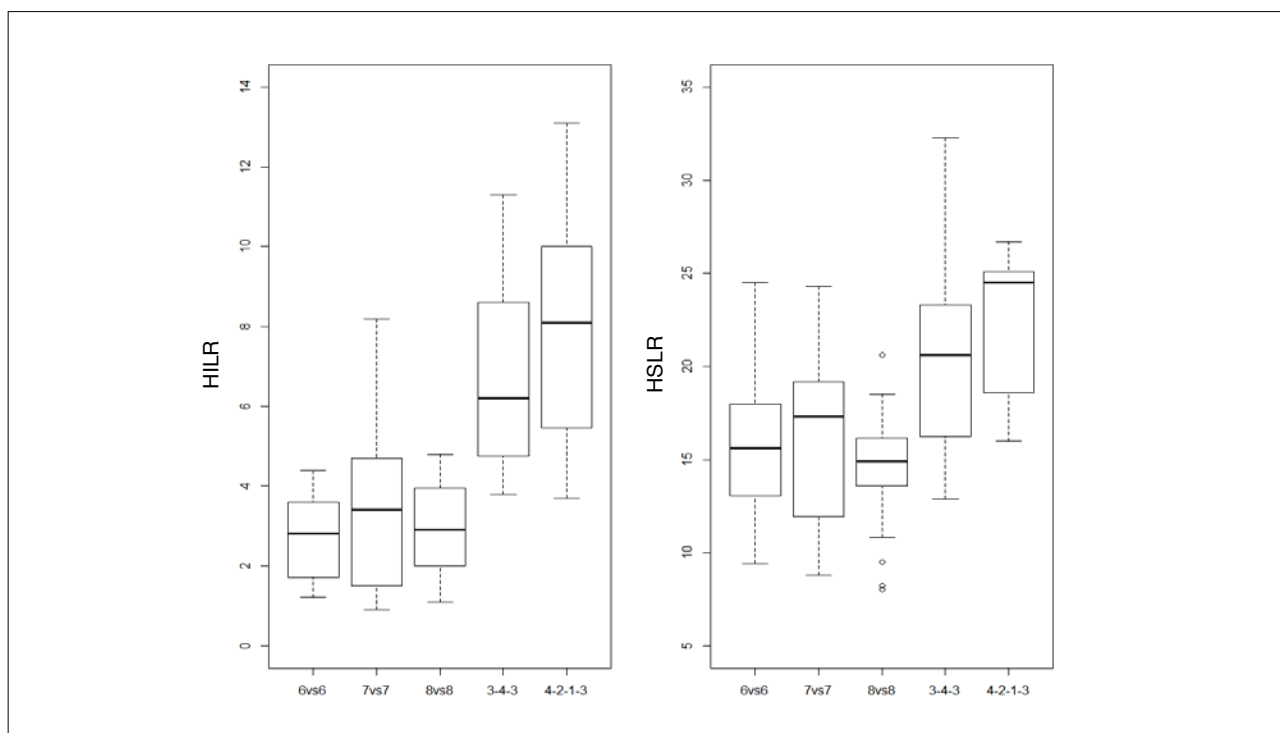
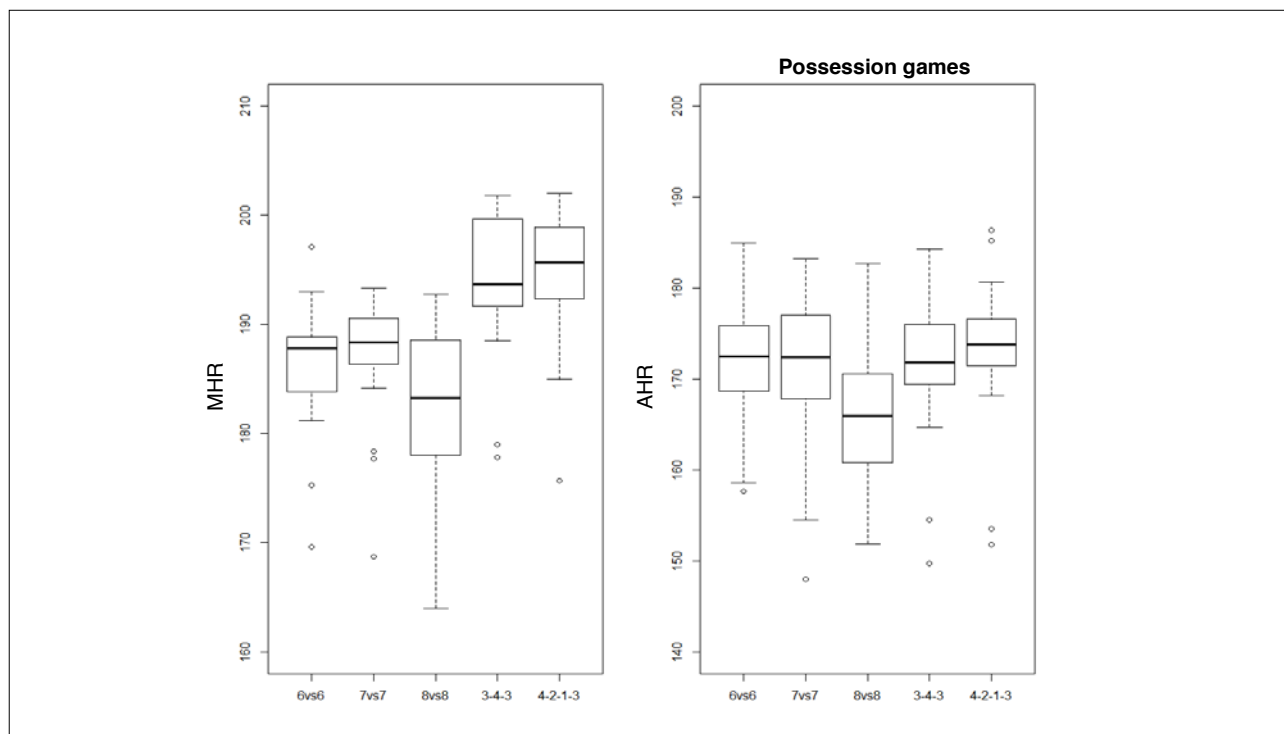


Figure 2

Box plots for the maximum heart rate (bpm) and average heart rate (bpm) variables for each POS format and the two tactical formations in matches.

**Figure 3.**

Box plots for the high intensity/sprint load rate (HILR; mpm) variable for each playing position between POS and matches (both tactical formations).

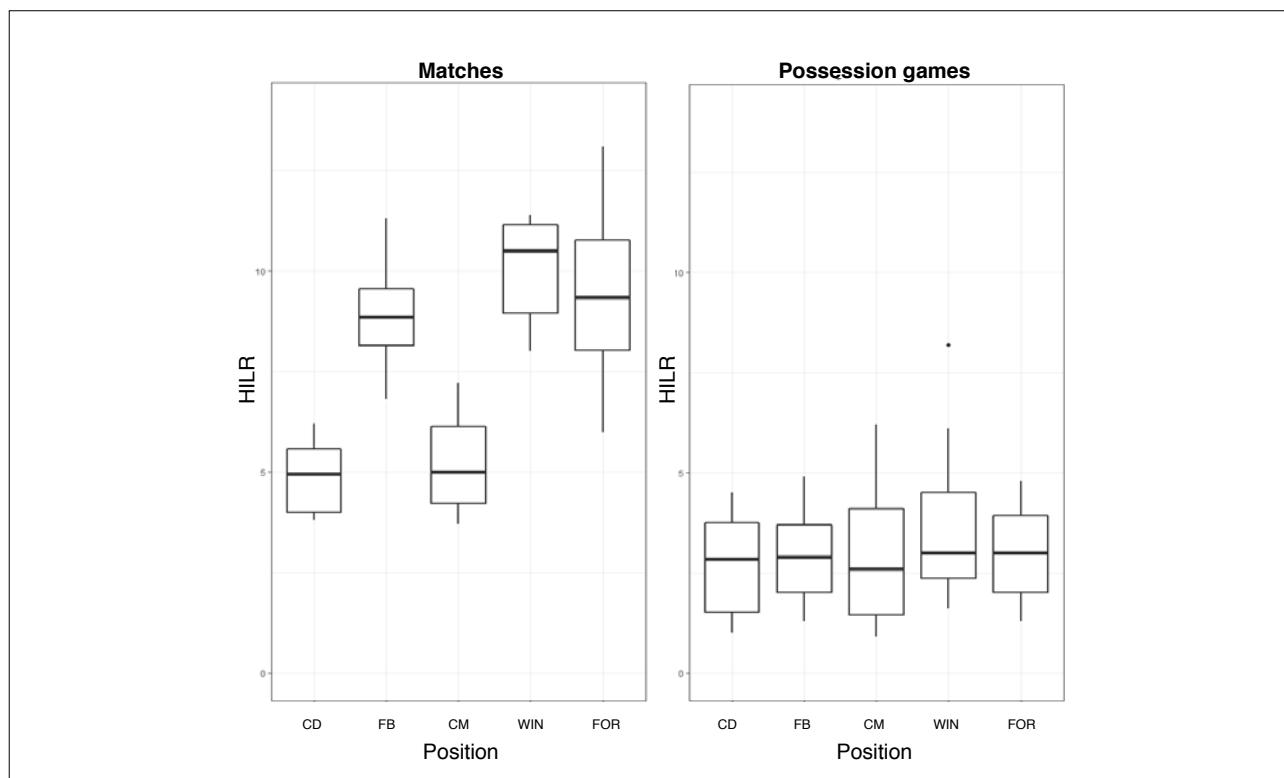
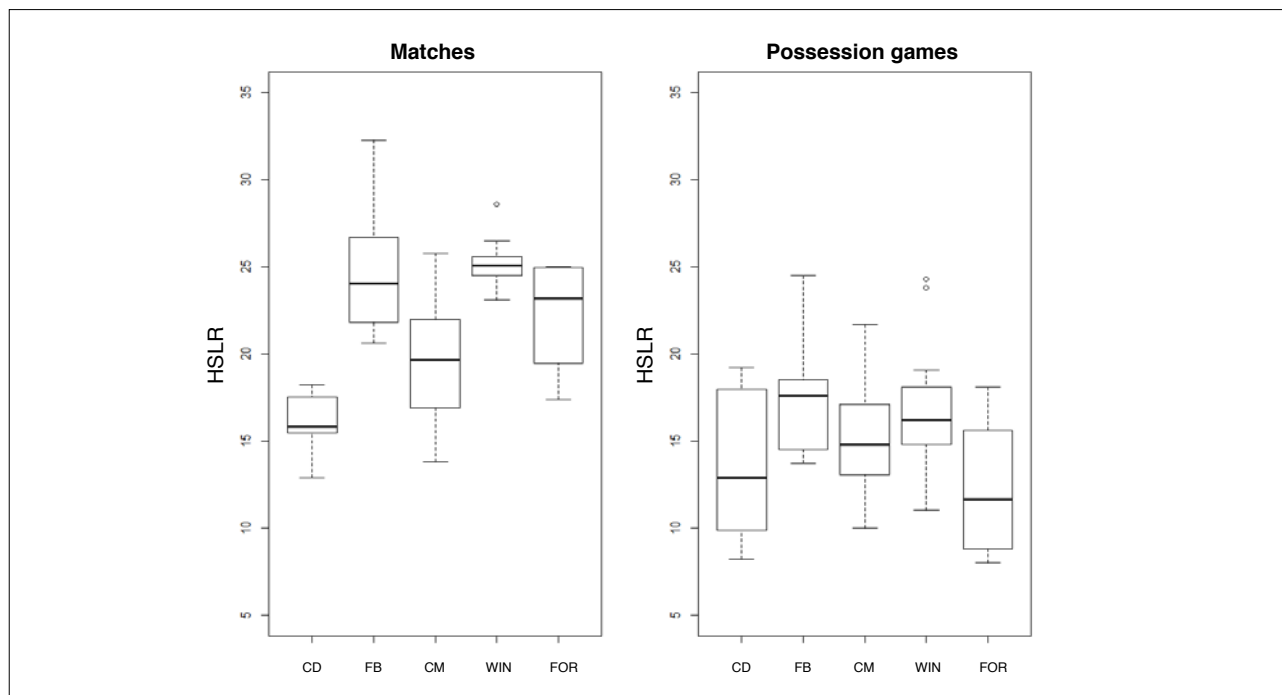


Figure 4.

Box plots for the high speed load rate (HSLR; mpm) variable for each playing position between POS and matches (both tactical formations).



performance in central defender and midfielder positions, and cardiovascular response is also similar to match performance in the 6 vs. 6 and 7 vs. 7. Although

the metabolic rate variables are significantly lower than in competition, the accumulated distances based on the number of metres above 14.9 kph is a sufficient yardstick

Figure 5

Box plots for the average heart rate (bpm) variable for each playing position between POS and matches (both tactical formations).

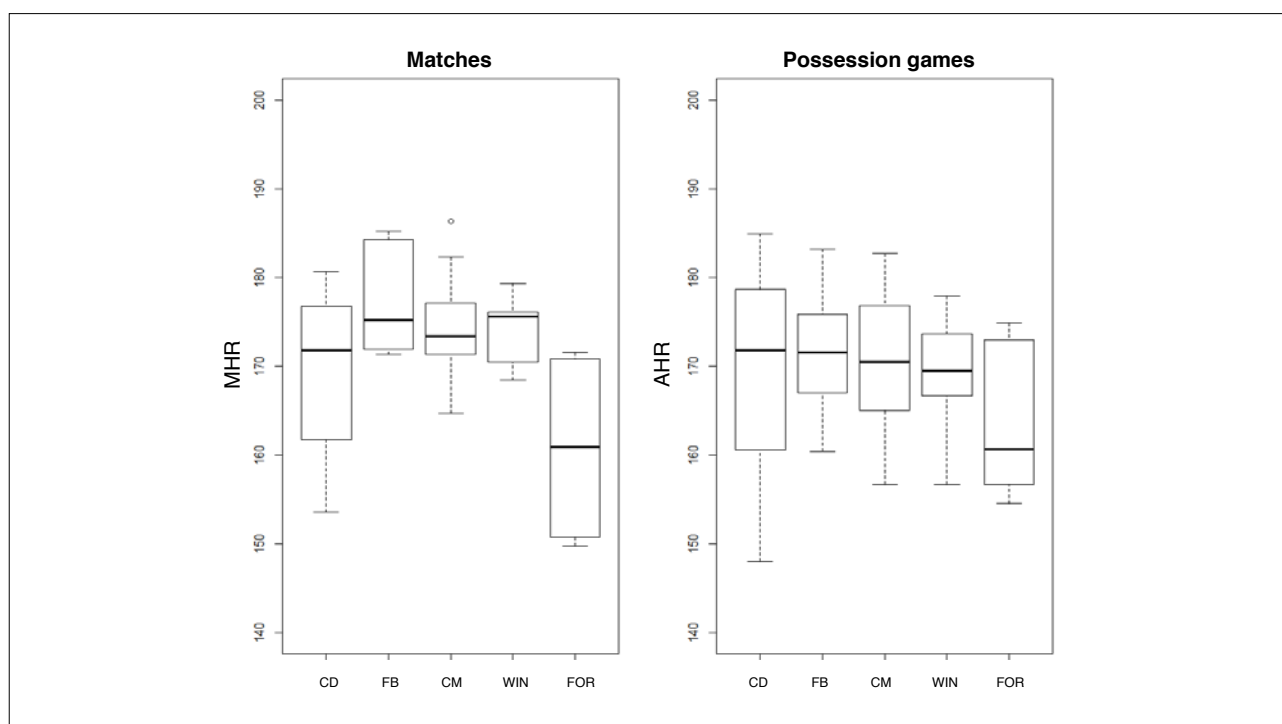
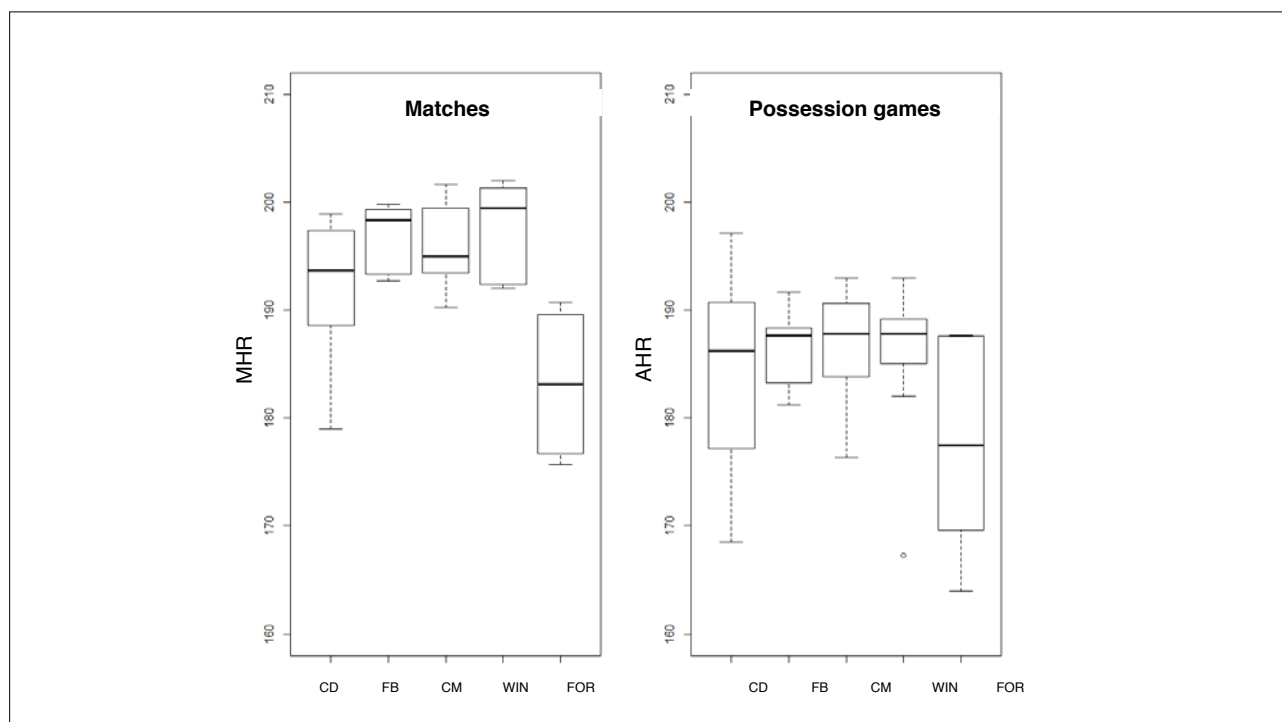


Figura 6.

Box plots for the maximum heart rate (bpm) variable for each playing position between POS and matches (both tactical formations).



for assessment when stimulating these intensities (69 to 75% in both tactical formations). In a study using a similar methodology, Lacome et al. (2017) compared conventional small-sided games (4 vs. 4, 6 vs. 6, 8 vs. 8 and 10 vs. 10) and competitive matches (1-4-3-3 formation) and concluded that only the 10 vs. 10 format allowed players to reach intensities and distances similar to those obtained during matches. In relation to the HILR variable, other research has found low percentages in high-intensity running and sprinting in small-sided games with the same format as this study (Owen et al., 2014). Owen et al. (2014) report that these formats do not induce high-speed movement compared to ones with larger pitches and therefore more players (9 vs. 9 to 11 vs. 11). In another study by Gaudino et al. (2014), the authors compared small-sided games with possession games in three different formats (5 vs. 5, 7 vs. 7 and 10 vs. 10) and reached the same conclusion as Owen et al. (2014), while further arguing that this effect was due to a larger pitch area and less pressure from opponents, with greater options for passing between players. In the comparison of performances between playing positions, significant differences were identified in the HILR and HSLR variables for the FB, WIN and FOR positions. Lacome et al. (2017) observed significant levels of differentiation when comparing SSG formats at speeds above 14.4 kph: central defenders covered a greater distance at

that speed than midfielders in the 6 vs. 6 format, while full-backs covered a greater distance than forwards in the 8 vs. 8.

With regard to effort-related cardiac response, the mean AHR values in POS are similar to matches (with the exception of 8 vs. 8), and the same applies when these values are compared by playing position. Research by Casamichana et al. (Casamichana et al., 2013; Casamichana et al., 2015) analysed physiological variables such as the AHR in three SSG formats (3 vs. 3, 5 vs. 5 and 7 vs. 7) and found significant correlations with external load measurements such as total distance travelled, although the strength of the relationships diminished when this variable was associated with actions performed at high speed (> 18 kph) or sprints (> 21 kph). Lacome et al. (2018) compared large SSGs (40x55 metres, 18 players, 118 m² per player) with smaller ones (25x30 metres, 13 players, 61 m² per player) and found an MHR of 79.3-80.6%, whereas in this study values ranging from 91.4 to 92.1% were observed. These differences might be explained by the design of each game: when comparing performances between POS and SSGs, it ought to be borne in mind that the continuous interaction of core concepts related to the basic principles of POS are very different in SSGs, where the instructions are contingent on one-, two- or three-touch play and scoring as quickly as possible. In fact, during POS there is a

compelling need to generate movement from the individual to the group to create free spaces and then, when the ball is lost, the obligation to recover it in fresh possession. This might well be a significant factor in the evaluation of physical performance parameters. Authors such as San Román-Quintana et al. (2013) found that the number of touches allowed per individual possession in SSGs (7 vs. 7) impacted physical and physiological demands and, unlike other authors, they noted a greater cardiac response and greater distances travelled in the formats with free-touch play (higher AHR during free-touch SSGs: 159.4 ± 10.7 bpm compared to two-touch SSGs: 146.9 ± 8.4 bpm). In contrast to the foregoing, Gaudino et al. (2014) concluded that all high-intensity-related parameters were higher during SSGs compared to POS. However, their study does not specifically describe the design of the POS except for some differences in relation to the SSGs: no goalkeepers were used, the pitch area per player was higher to make up for the absence of goalkeepers, and the only instruction mentioned was the highest possible possession of the ball versus the action of the opponent.

Study limitations

The main limitation of this study lies in the small number of players included by tactical role, since only 19 footballers were involved, with a range of two to five players in each subgroup. A study involving a larger number of players in each playing position is therefore suggested to achieve more robust conclusions.

Future lines of research

Further study of the various POS formats is a pressing need. Hitherto, the emphasis has been on an infinite number of exercises proposed, with variations in pitch size, number of players in each team, game instructions and different designs in the shape of the pitch to be used. Factors inherent to modifying particular rules and transfer to specific game situations should also be empirically investigated. It would additionally be crucial to inform coaches and fitness trainers about how changing the rules in the game, such as delimiting areas, their format and design, number of players, etc., impacts physical, physiological and motor demands.

Conclusions

The data obtained from this study describe a cardiovascular performance in the 6 vs. 6 and 7 vs. 7 formats

that is consistent with matches, whereas in the central defender and midfielder positions, the HSLR and HILR levels are similar to competition values. Based on the foregoing, possession games could be used to stimulate the physical and physiological demands to which players are subjected during competition, thereby profoundly influencing their internal and external load.

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References

- Brandes, M., Heitmann, A., y Müller, L. (2012). Physical Responses of Different Small-Sided Game Formats in Elite Youth Soccer Players. *Journal of Strength and Conditioning Research*, 26(5), 1353-1360. <https://doi.org/10.1519/JSC.0b013e318231ab99>
- Brooks, K., Carter, J., y Dawes, J. (2013). A Comparison of VO2 Measurement Obtained by a Physiological Monitoring Device and the Cosmed Quark CPET. *Journal of Novel Physiotherapies*, 1(3). <https://doi.org/10.4172/2165-7025.1000126>
- Buchheit M., Haddad Al H., Simpson B., Palazzi D., Bourdon P., Di Salvo V., y Mendez-Villanueva A. (2013). Monitoring accelerations with GPS in football: time to slow down? *International Journal of Sports Physiology and Performance*, 9(3), 442-445. <https://doi.org/10.1123/ijssp.2013-0187>
- 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. doi.org/10.1080/02640414.2010.521168
- Casamichana, D., Castellano, J., Calleja-González, J., San Román, J., y Castagna, J. (2013). Relationship between indicators of training load in soccer players. *Journal of Strength and Conditioning Research*, 27, 369-374. <https://doi.org/10.1519/JSC.0b013e3182548af1>
- Casamichana, D., y Castellano, J. (2015). The Relationship Between Intensity Indicators in Small-Sided Soccer Games. *Journal of Human Kinetics*, 45, 119-128. <https://doi.org/10.1515/hukin-2015-0040>
- Casamichana, D., San Roman J., Calleja J., y Castellano, J. (2015). *Cuantificación de las cargas durante los juegos reducidos*. Los juegos reducidos en el entrenamiento del fútbol. España, Barcelona: Fútbol de Libro.
- Casamichana Gómez, D., Gómez Díaz, A. J., Cos Morera, F., & Martín García, A. (2018). Wildcard Players during Positional Games. *Apunts. Educación Física y Deportes*, 133, 85-97. [https://doi.org/10.5672/apunts.2014-0983.es.\(2018/3\).133.06](https://doi.org/10.5672/apunts.2014-0983.es.(2018/3).133.06)
- Clemente, F., Couceiro, M., Martins, F., Ivanova M., y Mendes, R. (2013). Activity profiles of soccer players during the 2010 world cup. *Journal of Human Kinetics*, 8(38), 201-211. <https://doi.org/10.2478/hukin-2013-0060>
- Dellal, A., Chamari, K., Owen, A., Wong, D., Lago-Penas, C., y Hill-Haas, S. (2011). Influence of the technical instructions on the physiological and physical demands within small-sided soccer games. *European Journal of Sport Science*, 11, 353-359. <https://doi.org/10.1080/17461391.2010.521584>
- Dellal, A., Owen, A., Wong, D., Krstrup, P., Van Exsel, M., y Mallo, J. (2012). Technical and physical demands of small vs. large sided games in relation to playing position in elite soccer. *Human Movement Science*, 31, 957-969. <https://doi.org/10.1016/j.humov.2011.08.013>

- Di Salvo, V., Gregson, W., Atkinson, G., Tordoff, P., y Drust, B. (2009). Analysis of High Intensity Activity in Premier League Soccer. *International Journal of Sports Medicine*, 30, 205 – 212. <https://doi.org/10.1055/s-0028-1105950>.
- Di Salvo, V., Pigozzi, F., González-Haro, C., Laughlin, M., y De Witt, K. (2013). Match Performance Comparison in Top English Soccer Leagues. *International Journal of Sports Medicine*, 34, 526–532. <https://doi.org/10.1055/s-0032-1327660>
- Fradua L., Zubillaga A., Caro O., Fernández-García A., Ruiz-Ruiz C., y Tenga, A. (2013). Designing small-sided games for training tactical aspects in soccer: Extrapolating pitch sizes from fullsize professional matches. *Journal of Sports Sciences*, 31(6), 573–581. <https://doi.org/10.1080/02640414.2012.746722>
- Gaudino, P., Giampietro, A., y Iaia, M. (2014). Estimated metabolic and mechanical demands during different small-sided games in elite soccer players. *Human Movement Science*, 36, 123–133. <https://doi.org/10.1016/j.humov.2014.05.006>
- Hill-Haas, S., Coutts, A., Rowsell, G., y Dawson, B. (2009). Generic versus small sided game training in soccer. *International Journal of Sports Medicine*, 30(3), 636–642. <https://doi.org/10.1055/s-0029-1220730>
- 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), 199–200. <https://doi.org/10.2165/11539740-000000000-00000>
- Kim, J., Roberge, R., Powell, J., Shafer, A., y Jon Williams, W. (2013). Measurement accuracy of heart rate and respiratory rate during graded exercise and sustained exercise in the heat using the Zephyr BioHarness. *International Journal of Sports Medicine*, 34(6), 497–501. <https://doi.org/10.1055/s-0032-1327661>
- Lacome, M., Simpson B., Cholley, Y., Lambert, P., y Buchheit, M. (2017). Small-Sided Games in elite soccer: Does one size fits all? *International Journal of Sports Medicine*, 17, 1–24. <https://doi.org/10.1123/ijspp.2017-0214>
- Lacome, M., Simpson, B., Cholley, Y., y Buchheit M. (2018). Locomotor and Heart Rate Responses of Floaters During Small-Sided Games in Elite Soccer Players: Effect of Pitch Size and Inclusion of Goalkeepers. *International Journal of Sports Physiology and Performance*, 13, 668–671. <https://doi.org/10.1123/ijspp.2017-0340>
- Little, T. (2009). Optimizing the use of soccer drills for physiological development. *Strength and Conditioning Journal*, 31(3), 67–74. <https://doi.org/10.1519/SSC.0b013e3181a5910d>
- Machado, J., Alcántara, C., Palheta, C., Dos Santos, J., Barreira, D., y Scaglia, A. (2016). The influence of rules manipulation on offensive patterns during small-sided and conditioned games in football. *Motriz Revista de Educação Física* 22, 1–9.
- Owen, A., Wong, D., Paul, D., y Dellal, A. (2014). Physical and technical comparisons between various sided games within professional soccer. *International Journal of Sports Medicine*, 35, 286–292. <https://doi.org/10.1055/s-0033-1351333>
- Paul D., Bradley P., y Nassiss G. (2015). Factors affecting match running performance of elite soccer players: shedding some light on the complexity. *International Journal of Sports Physiology and Performance*, 10(4), 516–519. <https://doi.org/10.1123/ijspp.2015-0029>
- Porres D., Paz Fernández J., Fernandez Gonzalo R., Cervera J., y Yagüe Cabezón J. (2010). Variabilidad de la carga fisiológica en los pequeños juegos de fútbol en función del espacio. *Apunts. Educación Física y Deportes*, 102, 4to cuatrimestre, 70–77.
- Montoya Porres, D., de Paz Fernández, J. A., Fernández Gonzalo, R., Mercé Cervera, J., & Yagüe Cabezón, J. M. (2010). Variability in Physiological Burden in Reduced Area Football Games Based on Space. *Apunts. Educación Física y Deportes*, 102, 70–77.
- San Román-Quintana, J., Casamichana, D., Castellano, J., Calleja-González, J., Jukic´ I., y Ostojic´ S. (2013). The influence of ball-touches number on physical and physiological demands of large-sided games. *International Journal of Fundamental and Applied Kinesiology*, 45(2), 171–178.
- Silva, P., Vilar, L., Davids, K., Araújo, D., y Garganta, J. (2016). Sports teams as complex adaptive systems: manipulating player numbers shapes behaviors during football small-sided games. *Springerplus*, 5, 191. <https://doi.org/10.1186/s40064-016-1813-5>
- Vilar, L., Duarte, R., Silva, P., Chow, J., y Davids, K. (2014). The influence of pitch dimensions on performance during small-sided and conditioned soccer games. *Journal of Sports Science*, 32(19), 1751–1759. <https://doi.org/10.1080/02640414.2014.918640>

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