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ORIGINAL

PHYSICAL AND PHYSIOLOGICAL DEMAND OF YOUTH FOOTBALL PLAYERS DURING OFFICIAL MATCH AND SMALL-SIDED GAME

DEMANDA FÍSICA Y FISIOLÓGICA DE JÓVENES FUTBOLISTAS DURANTE JUEGOS OFICIALES Y REDUCIDOS

Menegassi, V.M.[1]; Jaime, M.O.[1]; Rechenchosky, L.[2]; Borges, P.H.[3]; Zavalla, S.R.A.[4]; Rinaldi, W.[2]

[1] PhD Student of Physical Education, State University of Maringá (Brazil)
vah.menegassi@hotmail.com, matheus.o.jaime@gmail.com
[2] Professor of the Department of Physical Education, State University of Maringá (Brazil)
rechenchosky@yahoo.com.br, wrinaldi@uem.br
[3] Professor in Department of Physical Education, Federal University of Santa Catarina (Brasil)
pauloborges.uem@gmail.com
[4] Master Student of Physical Activity and Health, Catholic University of Maule (Chile)
sebarenazavalla@gmail.com

Spanish-English translator: Robin Hambly, robin@hambly.net

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ABSTRACT

Present study aims to compare the physical and physiological demands of youth football players in official match and small-sided game. 17 players (16.0 ± 0.2 years of age) participated in the study. Seven small-sided games (GK3-3GK) and two official matches were monitored. In small-sided games, 71.9% of the time was spent above 90% of HRmax, against 44.4% in the official matches. The HRmax was higher ($p < 0.01$) in the official match situation and the HRmean did not differ significantly ($p \geq 0.05$). Sprints and total distance were higher in the small-sided games ($p < 0.01$). During both situations, players present intense physical and physiological responses. However, the GK3x3GK elicits more efforts in high intensity and superior external demand per playing minute than official matches.

KEY WORDS: sport, physiology, youth.

RESUMEN

El presente estudio tiene por objetivo comparar la demanda física y fisiológica en jóvenes jugadores de fútbol en juegos oficiales y juegos reducidos. Participaron 17 jugadores (16,0 ± 0,2 años de edad) siendo evaluados en siete juegos reducidos (3X3+porteros) y dos partidos oficiales. En los juegos reducidos, en 71,9% del tiempo se trabajó al 90% de la FC máx., versus el 44,4% en los juegos oficiales. La FC máx. fue mayor ($p < 0,01$) en la situación oficial del juego y la media de FC no difirió significativamente ($p \geq 0,05$). El número de sprints y la distancia recorrida fueron mayores en los juegos reducidos ($p < 0,01$). Durante ambas situaciones de juego, los jugadores tienen respuestas físicas y fisiológicas intensas. Sin embargo, el modelo 3X3+porteros exige más esfuerzos de alta intensidad y mayores cargas externas por minuto jugado que los juegos oficiales.

PALABRAS CLAVE: deporte, fisiología, joven.

INTRODUCTION

In recent decades, football has been one of the most commonly studied and investigated invasion modalities by the scientific community. Football is practiced by children, adolescents, and adults - men and women - and in different contexts: street, schools, sports schools, and professional clubs, making it the most practiced modality in the world. Football performance depends on the interaction of several factors related to tactical, technical, physical, physiological, and psychological dimensions (Salinero, González-Millán, Ruiz-Vicente, Abián Vicén, García-Aparicio & Rodríguez-Cbrero et al., 2013; Ballesta Castells, García Romero, Ferández García & Alvero Cruz, 2015).

Monitoring the physical and physiological responses in football matches contribute not only to the evolution of these indicators specifically, but also to the tactics, that is, to the management of the playing space, as a result of the organization in the field and the decision making (Teoldo, Guilherme & Garganta, 2015). Small-sided Games (SSG), as a pedagogical strategy originated from unstructured informal street football games (Hill-Haas, Dawson, Impellizzeri, & Coutts, 2011), have been used to produce different responses in the performance of football players (Clemente, Martins & Mendes, 2014; Reche-Soto, Cardona, Díaz, Gómez-Carmona & Pino-Ortega, 2019).

The small-sided game model composed of 3 players in each team (with or without the presence of goalkeepers) has been widely used and recommended (Pérez, Rodríguez, Sánchez, De Mena, Fuentes & Castaño et al., 2019; Brandes, Heitmann & Muller, 2012) as this allows athletes to be in more frequent contact with the ball, in addition to providing greater interaction between players. Considering this SSG model, Pedro, Machado & Nakamura (2014) found, in U-15 players, that the 3x3 SSG provided sufficient stimuli for improvement in cardiovascular conditioning and increased the number of accelerations and activities that require high physiological demand when compared to SSG with greater tactical complexity (7x7). There is evidence that SSG models with a lower number of players are associated with high internal demands, expressed as Maximum Heart Rate (HRmax), Ratings of Perceived Exertion (RPE), and blood lactate concentrations (La-) (Da Silva, Impellizzeri, Natali, de Lima, Bara-Filho, & Silami-Garçia et al., 2011; Katis & Kellis, 2009). Although SSG promote training of tactical and technical contexts (Abrantes, Nunes, Maçãs, Leite & Sampaio, 2012; Borges, Costa, Oliveira, Pereira & Rinaldi, 2015) and important physical and physiological adaptations for the football player (Rojas-Inda, 2018; Hill-Haas, Dawson, Impellizzeri & Coutts, 2011), it is fundamental to compare the physical and physiological responses obtained in SSG with those observed in official matches (OM). This information could clarify whether the stimuli imposed by the SSG can simulate the pattern and external and internal demands presented in an official match, especially when it comes to football players of young ages, where, despite its relevance, the amount of information is still small. Therefore, the objective of the present study is to compare the physical and physiological demands of youth football players in official match and small-sided game situations. For this purpose, the time-motion characteristics and the HR responses were evaluated.

MATERIAL AND METHODS

Participants

In the Regional Center for Football Training at the State University of Maringá, approximately 50 youth players participate in the U-15 and U-17 categories. The inclusion criteria were: I) participate in an SSG session; II) participate in at least 30 minutes of the first half of an official match of the Regional League; III) not present lesions at the moment of data collection; IV) train at least three times a week; and V) present the informed consent form signed by legal guardians. The sample consisted of 17 players between 14 and 17 years old (16.0 ± 0.2 years, height 172.5 ± 1.3 cm, and body mass 65.9 ± 2.7 kg). The

study was approved by the ethics committee of the State University of Maringá (opinion number 2.424.058 / 2017).

Procedures

The players were submitted to three stages of evaluation. The first consisted of the anthropometric and functional evaluations, considering the measures of chronological age, body mass, height, VO_2max, and HRmax. These tests were conducted in the pre-training period, in the locker room and football field of the Physical Education Department. The second stage of evaluation consisted of an official football match (OM) valid according to the Regional League. The players were evaluated only during the first half of the match (30 minutes for the U-15 match and 35 minutes for the U-17 match), as in the second half the teams made several substitutions. Two official matches were evaluated. The third stage consisted of a small-sided game session, performed in the format GK3-3GK, with dimensions of 36x27 meters (Costa, Garganta, Greco & Mesquita, 2009) and two bouts of 4 minutes with a 2-minute recovery of passive rest. The game was composed of two teams with three players, separated into similar teams according to coach opinion. Before the SSG, players performed 15 minutes of warm-up, consisting of low-intensity movements with and without the ball and static stretches. The SSG were conducted with frequent ball replacement and active participation of the coach. The official rules were adopted, except for the corner kick and the offside, and the ball was replaced in game by the goalkeepers. In total, 7 sessions of SSG were played, being 3 sessions with 6 teams in U-15 category and 4 sessions with 8 teams in U-17 category.

Study Variables

To evaluate aerobic performance, the Yo-Yo Intermittent Recovery Test - Level 1, YYIRT-1 (Krustrup, Mohr, Amstrup, Rysgaard, Johansen & Steensberg et al., 2003) was adopted. The test is divided into stages consisting of 40 m runs (20 m back and forth) with 10-second intervals. By means of this evaluation, the players' VO_2max and HRmax were estimated using T34 Polar® Electro (Polar® Team System, Finland) cardiac monitors.

Within this, the players were equipped with monitoring straps 30 minutes before the small-sided game sessions and official match, the T34 Polar® Electro cardiac monitoring equipment was used to evaluate the physiological demand. Heart rate was monitored during exercise with a frequency of every 5 seconds. After data collection, the variables HRmax, HRmean, and percentage of time spent in four %HRmax zones were quantified according to Hill-Haas, Dawson, Coutts & Rowsell (2009): I) Zone 1 (<75.0% %HRmax); II) Zone 2 (75.0 – 84.9% %HRmax); III) Zone 3 (85.0 – 89.9% %HRmax); and IV) Zone 4 (≥90% %HRmax).

To quantify the time-motion characteristics, a portable Global Positioning System (GPS) was used (GPSports © SPI Pro X, Canberra, Australia). Positioning and displacement information was evaluated with a frequency of

15hz. Players were equipped with a vest to support the GPS units 30 minutes before the interventions to capture the satellite signal. The acquired data were analyzed by Team AMS software (GPSports © Team AMS software v2013). The variables measured were total distance (meters), number of sprints (speed above 2.5 meters/second), maximum acceleration (meters/second), maximum speed (km/hour), mean speed (km/hour), and distance covered in 4 speed zones according to Hill-Haas, Dawson, Coutts & Rowsell (2009): I) walking (0.0 – 6.9 km/h); II) low intensity run (7.0 – 12.9 km/h); III) moderate intensity run (13.0 – 17.9 km/h); and IV) high intensity run (≥18.0 km/h).

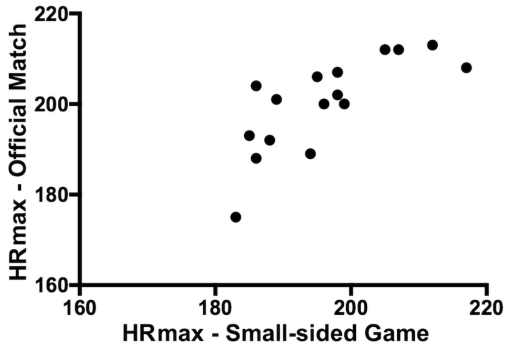
Statistical Analysis

In order to analyze the data, the Shapiro-Wilk normality test was used, assuming non-parametric distribution, presenting the results as median and quartiles (Q1-Q3). To compare the small-sided game session, the official match and the variables in each, the Wilcoxon test for repeated measures was used. To correlate the physiological demand in both situations, the Spearman Correlation Coefficient (R) was adopted. Significance was set at 5%. The data were analyzed in SPSS software version 20.0. The figures were designed in Prisma 7 for MacOSx.

RESULTS

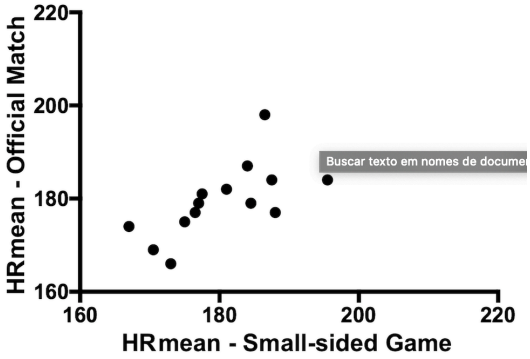
In official match situation the players presented higher values ($p<0.01$) for HRmax (202; 192-207 bpm) compared to the small-sided game (196; 187-202 bpm). Considering HRmean, there was no significant difference ($p>0.05$) between OM (179; 171-184 bpm) and SSG (177; 172-187 bpm). Figures 1 and 2 present the correlation of HRmax and HRmean variables in the OM and SSG. Significant associations of variables were found in the two situations, with $r=0.81$ ($p<0.01$) and $r=0.83$ ($p<0.01$) respectively.

Figure 1. Correlation between HRmax in official match and small-sided game situation.



Note: p <0,01; OM = official match; SSG = small-sided game; R = 81; HRmax in bpm.

Figure 2. Correlation between HRmean in official match and small-sided game situation.



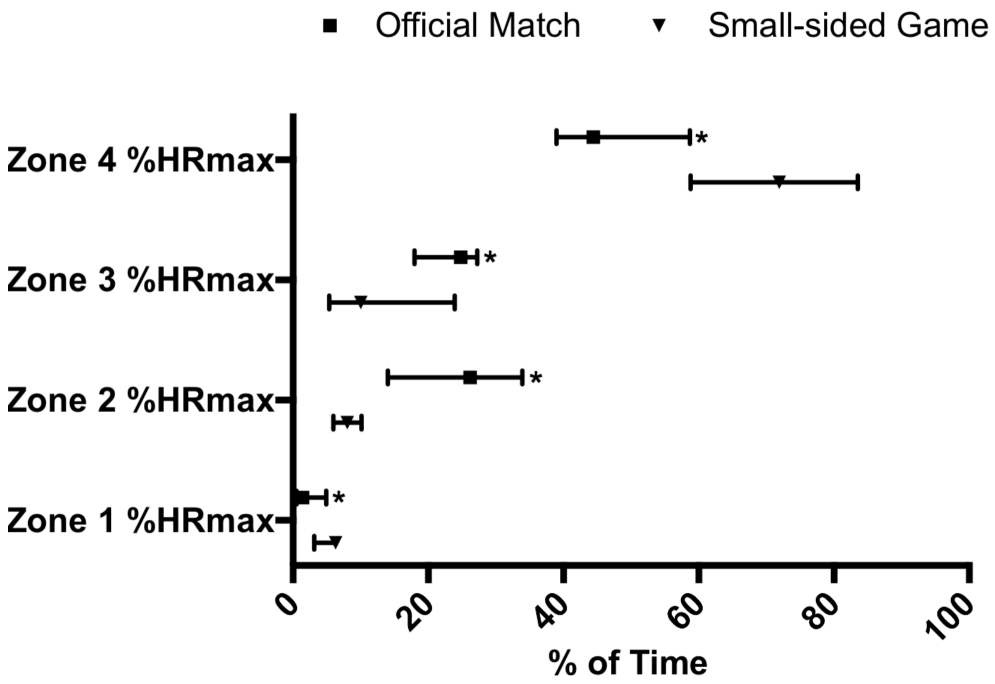
Note: p <0,01; OM = official match; SSG = small-sided game; R = 83; HRmean in bpm.

Figure 3 shows the comparisons between the percentage of time spent in four %HRmax zones during the OM and SSG. The results show that during the SSG,

players performed more (p<0.01) high intensity efforts (Zone 4 HRmax), 71.9% of uptime, compared to 44.4% in the OM. Regarding Zones 2 and 3 of %HRmax, the permanence was greater (p<0.01) during the OM situation compared to SSG, being 26.2% vs 8.0%; and 24.8% vs. 10.0%, respectively. Finally, during the SSG, the permanence in Zone 1 %HRmax was higher (p<0.01) than the time spent during the OM (6.3% vs 1.4%).

In both OM and SSG formats, the results indicate that the youth football players spent the majority of the time making efforts above 90% of HRmax (p<0.01), signaling high internal demand. The percentage of time spent in %HRmax zones during the SSG differed significantly (p<0.01), except for the comparison between Zones 2 and 3 %HRmax (p>0.05). Accordingly, when comparing the percentage of time spent in each of the %HRmax zones during the OM, only Zones 2 and 3 did not differ significantly (p>0.05) from the others.

Figure 3. Comparison of time spent in each zone investigated during official match and small-sided game.



Note: values expressed as median (Q1-Q3); *significant difference to SSG (p<0.01).

Regarding the external demand, Table 1 illustrates the comparison between acceleration and speed indicators in evaluated situations. The results indicate that the maximum acceleration did not differ between the evaluated models (p>0.05). The maximum speed reached was higher in the OM compared to the SSG (p<0.01), while the mean speed was higher in the SSG compared to the OM (p<0.01).

Table 1. Acceleration and speed indicators in official match and small-sided game situations.

Variables	Official Match Median (Q1-Q3) 30-35 min.	Small-sided Game Median (Q1-Q3) 8 min.	p
Maximum Acceleration (m/s)	4.1 (3.8 – 4.6)	3.8 (3.6 – 4.1)	0.08
Maximum Speed (m/s)	25.3 (24.0 – 29.4)	23.0 (21.9 – 23.9)	0.01*
Mean Speed (km/h)	5.6 (5.2 – 6.5)	7.3 (7.0 – 7.8)	0.01*

Note: * = significant difference p<0.05; m/s = meters per second; km/h = kilometers per hour.

Table 2 presents the comparisons of physical demand (number of sprints, total distance and distance per speed zone) per minute in the OM (30-35 min) and SSG (8 min). The sprints frequency, total distance, and distance covered in speed zones 2 and 3 were higher in the SSG than in the OM (p<0.01). In contrast, walking distance (speed zone 1) was higher during the OM (p<0.01), while there were no differences regarding distance covered in speed zone 4 (>18 km/h). between the two situations evaluated. The comparison related to distance covered in speed zones in each game situation showed differences in both the SSG and OM model (p<0.01). There was a tendency for players to move more in speed zone 1 (walking) than in other zones during the OM. In the SSG, players covered more distances in speed zone 2 (low intensity run) than in the others, reflecting the increase in mean speed compared to the OM.

Table 2. Physical demand per minute, in official match and small-sided game situations.

Variables	Official Match Median (Q1-Q3) 30-35 min.	Small-sided Game Median (Q1-Q3) 8 min.	p
Sprints (n)	0.7 (0.5 – 0.8)	1.9 (1.6 – 2.1)	0.01*
Total Distance (m)	90.6 (86.3 – 107.2)	121.5 (115.5 – 130.2)	0.01*
Speed Zone 1 (m)	43.3 (40.6 – 47.7)	37.7 (36.8 – 41.3)	0.01*
Speed Zone 2 (m)	29.4 (23.8 – 38.5)	55.3 (47.1 – 60.8)	0.01*
Speed Zone 3 (m)	15.0 (10.9 – 18.4)	23.9 (18.3 – 28.8)	0.01*
Speed Zone 4 (m)	6.4 (4.3 – 7.4)	5.4 (4.5 – 8.3)	0.94

Note: * = total values per minute of game; significant difference p <0.05; m = meters; n = number.

DISCUSSION

The present study aimed to compare the physical and physiological demands of youth football players in official match and small-sided game situations. The main findings suggest that both situations induce players to high internal and external demands of physical effort, however, indicate that during the two bouts of SSG (8 minutes), players spent the majority of the time (71.9%) with a heart rate higher than 90.0% of the HRmax and tended to cover approximately 1 km, whereas during the first half of the OM (30-35 minutes) they covered approximately 3km, and also remained for the majority of the time with their heart rate above 90% of HRmax. This information corroborates the findings of Hoff, Wisloff, Engen, Kemi & Helgerud (2002), Hill-Haas, Coutts, Dawson & Rowsell, Köklü, Asçcçi, Kocçak, Alemdaroglu & Dündar (2011), Koklu (2012), Paul, Marques & Nassis (2018), who identified that SSG proposals provided high percentages of heart rate maximum, indicating an intensity of effort at levels higher or similar to that of official match.

According to Barbanti, Tricoli & Ugrinowitsch (2004), during a training proposal, players should present an intensity of effort similar to those presented during situations of official competition. Hill-Haas, Dawson, Coutts & Rowsell (2009) classify %HRmax values higher than 90% as high intensity effort. Thus, the high %HRmax presented during the SSG (GK3x3GK) proposal compared to the values depicted during the first half of the OM suggests that a specific stimulus of high physical effort was achieved during the proposal.

Corroborating the present study, Coelho, Rodrigues, Condessa, Mortimer, Soares & Silami-Garcia (2008), when comparing the HRmean of youth players during SSG and OM, did not identify differences in SSG values (157 ± 5 bpm) in relation to the official match (166 ± 3 bpm). However, when considering %HRmax, the investigated models demonstrated similar values, being 79 ± 2.6% HRmax in the SSG and 84 ± 1.3% HRmax in the official match. The SSG proposal used was 8x8, with dimensions equivalent to 25% of the standard field of an official match. It is believed that these results are justified by the fact that the model with more players, different from the present study, includes time-motion characteristics and specific efforts closer to the official match.

Manipulating the number of players, number of ball touches allowed, and field dimensions directly influences the physical and physiological responses presented by players during SSG (Casamichana & Castellano, 2010; Aslan, 2013; Martínez, Ojeda & González-Jurado, 2019; Castellano, Puente, Echeazarra & Casamichana, 2015; Olthof, Frencken & Lemmink, 2018). In this way, a game of greater tactical complexity, with larger field dimensions and a higher number of players, makes players interact less frequently with the ball, as well as having less physical contact with the opponent, decreasing the intensity and, consequently, directing %HR to intermediate zones of effort.

The study findings regarding the frequency of sprints, total distance covered, and distance covered in speed zones 2 and 3 during the SSG compared to the OM (Table 2) have a direct influence on the playing space and, the number of players (Castellano, Puente, Echeazarra & Casamichana, 2015; Olthof, Frencken & Lemmink, 2018), as during an official match, there are times when the ball is far away or outside the field of play, providing a greater incidence of displacement in speed zone 1 (walking), while during the proposed SSG, conditions are better to due to cover distances in speed zones 2 and 3, due to the field dimensions, number of players, and quick ball replacement (Brandes, Heitmann & Muller, 2012; Pedro, Machado & Nakamura, 2014).

One of the limitations of this study is that only one SSG proposal (GK3-3GK) was analyzed in comparison to the first half of two OM. However, it is believed that both situations present high physical demands, since studies indicate that the proposed SG model shows similar and higher levels of effort compared to other proposals (Brandes, Heitmann & Muller, 2012; Pedro, Machado & Nakamura, 2014) and that the first half of the OM involves higher levels of effort in relation to the second half (Mortimer, Condessa, Rodrigues, Coelho, Soares & Silami-Garcia, 2006). It is suggested that the RPE could be a more accessible and practical alternative for monitoring the internal load in the training, as

evidence indicates that there is a relationship between the performance perceived by the players (RPE Borg-10) and the HR responses during the small-sided game in youth football players (Romero-Caballero & Campos-Vázquez, 2020).

CONCLUSIONS

Youth football players present similar physical and physiological responses in official matches and small-sided games. During SSG players spend more time in the higher heart rate zone (speed zone 4) in comparison to OM. In the 11x11 match, players achieved a higher HRmax, however, HRmean did not differ between situations. Regarding physical demand, when quantifying indicators per minute of effort, during the SSG players execute more sprints, cover longer distances, and walk less than in the OM, signaling a higher external demand in the GK3xGK3 configuration. For that, small-sided games could be an efficient tool to improve physical capacity of youth football players, allowing evolution in performance associated with technical and tactical aspects required during a match.

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