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HEART RATE DIFFERENCES IN SMALL SIDED GAMES IN FORMATIVE BASKETBALL

Diferencias en la frecuencia cardíaca en situaciones de juego modificadas en baloncesto de formación

Diferenças na frequência cardíaca em situações de jogo modificadas de basquetebol formativo

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Abstract

The aim of this study was to determine and learn the heart rate responses of basketball players in small-sided or modified games, in order to develop a more effective workout plan in the future. The study sample consisted of 19 basketball players from a National Championship Club, 12 of them in the U'14 category and the remaining 7 belonging to the U'16 category. Small-sided games were 3x3 and 4x4 with a duration of 4 minutes and an active break of 3 minutes. Significant differences (p<0.05) were found referring to the relations established between 3x3 without feedback and 3x3 with feedback in vigorous exercise; in 3x3 without feedback and 3x3 with feedback in moderate exercise; in 3x3 and 3x3 with average heart rate; in 4x4 and 4x4 with average heart rate and in 4x4 and 4x4 with average heart rate related to game categories.

Keywords: small-sided games, training, feedback.

Resumen

El objetivo de este estudio fue determinar y conocer las respuestas cardíacas de los baloncestistas en situaciones modificadas o reducidas de juego, para, en un futuro, desarrollar un plan de entrenamiento más eficaz. La muestra del estudio estuvo formada por 19 jugadores de baloncesto, 12 de ellos de categoría infantil y los 7 restantes de categoría cadete, pertenecientes a un club participante en Campeonatos de España de Baloncesto. Las situaciones de juego fueron 3x3 y 4x4, con presencia y ausencia de feedback por parte del entrenador, con una duración de 4 minutos y descanso activo de 3 minutos. Se encontraron diferencias significativas (p<0.05) en las relaciones establecidas entre 3x3 sin feedback y 3x3 con feedback en ejercicio vigoroso; situación de 3x3 sin feedback y 3x3 sin feedback en ejercicio moderado; en situación de 3x3 y 3x3 con frecuencia cardíaca media; en situación de 4x4 y 4x4 con frecuencia cardíaca media; y en situación de 4x4 y 4x4 con frecuencia cardíaca media en relación a la categoría.

Palabras clave: juegos reducidos, entrenamiento, feedback.

Resumo

O objetivo deste estudo foi determinar e conhecer as respostas cardíacas dos basquetebolistas em situações modificadas ou reduzidas de jogo para, no futuro, desenvolver um plano de treino mais eficaz. A amostra deste estudo foi formada por 19 jogadores de basquetebol - 12 dos quais de categoria infantil e 7 dos quais de categoria cadete – que pertencem a um clube participante nos Campeonatos espanhóis de basquetebol. As situações de jogo foram 3x3 e 4x4, com presença e ausência de feedback por parte do treinador, com uma duração de 4 minutos e com um descanso ativo de 3 minutos. Encontraram-se diferenças significativas (p<0.05) nas relações estabelecidas entre 3x3 sem feedback e 3x3 com feedback em exercício árduo; situação de 3x3e de 3x3 com frequência cardíaca média; situação de 4x4 e 4x4 com frequência cardíaca média; e em situação de 4x4 e 4x4 com frequência cardíaca média em relação à categoria.

Palavras chave: jogos reduzidos, treino, feedback.

Introduction

Basketball is played by two teams with five players each in a 450m² court, thus meeting FIBA regulations. However, during training sessions, it is quite common to reduce both; the number of players in each team as well as the size of the court (Sampaio, Abrantes, & Leite, 2009). These types of sessions are known as modified or small-sided games and have gained more interest in the scientific and sports communities (Arias, Argudo, & Alonso, 2009).

Modified or reduced games are those training situations which gather the essence of a sports game, maintaining its problematic and exaggerating tactical principles. It also reduces the demands, both physical and tactical, of a sports game (Thorpe, Bunker, & Almond, 1986). Due to these characteristics, small-sided games are usually used by coaches to develop technical-tactical skills (Jones & Drust, 2007; Reilly, 2005). Modified sports games have been widely used in the sports field. Some studies have been found regarding rugby (Suárez-Arrones, Nuñez, Portillo, & Méndez-Villanueva, 2011), soccer (Katis & Kellis, 2009), five-a-side football (Duarte, Batalha, Folgado, & Sampaio, 2009) or field hockey (Konarski & Strzelczyk, 2009).

Nowadays, it is more frequent to use small-sided games with the objective of developing condition-skills in players which, in turn, is an effective interval-based training method (Hill-Haas, Coutts, Rowsell, & Dawson, 2009). This alternative method has the advantage of simultaneously working with technical-tactical and physical skills, thus granting the training session with greater specificity (Reilly, Morris, & White, 2009), introducing the ball as mean of training (Mallo & Navarro, 2008; Arias et al., 2009).

Existing studies show that physiological responses, heart rate, blood lactate concentrate and perceived effort indices can modify tactical and technical skills during small-sided games by adjusting the number of players, the size of the court area, rules of the game or the coach's stimuli (Aguiar, Botelho, Lago, Maças, & Sampaio, 2012). Modifying the number of players can change the physiological aspect of the exercise, just as the change in perception (Aroso, Rebelo, & Gomes-Pereira, 2004; Hill-Haas et al., 2009; 2010; Katis & Kellis, 2009; Sampaio, García, Maças, Ibañez, Abrantes, & Caixinha, 2007; Owen, Twist, & Ford, 2004; Rampinini et al., 2007). In general, these studies have shown that in small-sided games, with fewer players, there is a higher heart rate than in those games with more players (Hill-Haas, Coutts, Rowsell, &

Dawson, 2009; 2010; Impellizzeri et al., 2006; Katis & Kellis, 2009; Little & Williams, 2006; 2007; Owen et al., 2004; Rampinini et al., 2007).

However, other investigations, such as the one carried out by Sampaio et al. (2009), reveal no significant differences in heart rate levels during 3x3 and 4x4 games. In the same line, McCormick, Hannon, Newton, Shultz, Miller and Young (2012) concluded that there are no significant differences in the percentage of time players spend while engaged in vigorous or moderate exercise in 3x3 and 5x5 games.

The presence of feedback of the coach is another one of the aspects that can be modified. Scientific literature has studied the influence of feedback in athletes. Mazetti et al. (2000) found that the coach's supervision during training sessions increased the performance of athletes and the effectiveness of the training program. Ratamess, Faigenbaum, Hoffman and Kang (2008) found similar results regarding strength training. The group training under the coach's supervision showed greater levels in maximum repetition, the selection of exercise intensity and in subjective perception of effort. Rampinini et al. (2007) modified training situations in amateur soccer. They found higher heart rates, blood lactate indices and perceived effort when these training sessions had explicit instructions of the coach.

Existent studies show certain discrepancies in players respond to these stimuli; therefore, it is highly important to unify the criteria behind incentive modification so that results can be projected to different situations. At the same time, there is little information related to the presence or absence of feedback and, above all, regarding category comparison and training conditions. Consequently, the objective of this study is to specify and analyze heart rate levels in basketball players during modified or small-sided games in function of game category.

Methodology

Sample

The sample of the study consisted of 19 basketball plays (ages: 14,5 ± 1,5; height: 179 ± 17 centimeters; weigh: 69,9 ± 21,1 kilograms). They belonged to the u´14 team (13-14 years old) and u´16 category (15-16 years old) of a club involve in national championships and competed in the 2012-2013 game season. The study took place during the preparation for the Spain Clubs Championship, at the end of the regional league.

Procedure

Before doing the intervention with the players, the technical director and the coaches of each of the two teams were informed. Data collection was done during training sessions for each team, supervised by the coach and guided by the physical trainer of the club. Independent variables were the 3x3 and 4x4 game situation and the presence or absence of feedback. The only dependent variable was heart rate. Data was collected in two sessions for the u`14 team and other two sessions of the u`16team.

The procedure and the exercises were carried out identically from one session to another as break time and execution in each situation. The length of game-situations was reduced to 4 minutes with a 3-minute-break in between. The clock did not stop during the game. Fouls were noted but not sanctioned with a free throws. When the ball went out of the court, it was replaced as fast as possible by the coach, who had an extra ball at hand. The teams were balanced by considering technical-tactical skills of all the players involved. Teams were formed together by the coach and the physical trainer. 3x3 and 4x4 game-situations were played in the official size court (14x15 meters).

During the analysis of the 3x3 situation with feedback in u´16 team, a technical problem take place with one of the heart rate monitors when there were only 25 seconds left to the end of the exercise. This data was not considered in the final analysis.

To find the maximum heart rate level, a yo-yo test with intermittent recovery was carried out, according to the criteria set by Bangsbo, Iaia and Krustrup (2008). Heart rate has been usually used as an objective method to assess physical activity (McCormick et al., 2012; Sampaio, Gonçalves, Rentero, Abrantes & Leite, 2013). The use of this parameter lies in the fact that heart rate is widely known for having a direct relation to energy consumption in long duration activities (Strath, Swartz, Bassett, O'Brien, King, & Ainsworth, 2000).

Material

Heart rate frequency register was done using 20 wireless heart rate monitors Team Pack Pro from Suunto™. The variation in heart rate was registered by a wireless system during the whole training session on a computer. The software used were Suunto Team Manager 2.1.2™ and Suunto Team Monitor 2.1.1™.

Heart rate was analyzed for each player during every second while they were practicing certain situations of a modified game. These data was provided by the official software at the end of each of the training sessions.

Statistical Analysis

Statistical analysis of the data was done using statistics program SPSS 19.0 in Windows. In the first place, we carried out a descriptive analysis of the data. For the descriptive study we considered intensity intervals proposed by McCormick et al. (2012). These authors suggested that vigorous intensity activity (VI) exceeded heart rate in an 85% and moderate intensity activities (MVI) remained between a 70% and an 85%. For data differential analysis we ran ANOVA factorial. This analytic model - with no variance - help to assess individual effect or consider two or more factors influencing a dependent quantitative variable (Pardo & Ruiz, 2002).

Results

Table 1 shows the measure, in percentage, that each player remains active in the same intensity interval, moderate or vigorous and for both categories. Duration for each type of situation is of 240 seconds.

Table 1. Percentage of time that each player spends in MVI or VI during practice.

	3x3 without FB		3x3 with FB		4x4 without FB		4x4 with FB	
	MVI	VI	MVI	VI	MVI	VI	MVI	VI
U´14	50.6	40.8	27.3	68.0	36.9	52.5	33.0	47.0
U´16	41.7	47.4	30.5	56.9	25.2	74.0	31.2	67.7

Table 1 shows how the presence of feedback increases time in VI and decreases time in MVI when the percentage in game situation is reduced in the u´14 team. Regarding situational differences, it shows how players reach a higher time lapse in VI situations 3x3 than in 4x4. For players in the u´16 team, the table shows how in the 3x3 situation, the time lapse for VI is higher when the coach provides feedback. The opposite occurs in 4x4 situations. Regarding reduced situational differences, it shows how players reach a higher level in VI for 4x4 situations rather than in 3x3 situations, just like players from the u´14 team.

Table 2 shows results from the inferential analysis, related to the different situations with or without feedback, whether in VI or MVI. At the same time it considered the category; u´14 team or u´16 team. Moreover, it was related to average heart rate and results obtained were the following:

Significant differences were found (p<0.05) in established relationships between 3x3 without feedback and 3x3 with feedback in vigorous exercise; 3x3 without feedback and 3x3 with feedback in moderate exercise; 3x3 situation and 3x3 with average heart rate; 4x4 situation and 4x4 with average heart rate; and in 4x4 situation and 4x4 average heart rate in relation to category.

Table 2. Anova. Differences in function of game situations, presence of feedback and category.

Effect	F	Sig.
3x3 vs 3x3 FB VI	6.93	.01*
3x3 vs 3x3 FB VI*category	.56	.46
4x4 vs 4x4 FB VI	.55	.46
4x4 vs 4x4 FB VI*category	.09	.76
3x3 vs 3x3 FB MVI	8.09	.01*
3x3 vs 3x3 FB MVI*category	1.89	.18
4x4 vs 4x4 FB MVI	.01	.92
4x4 vs 4x4 FB MVI*category	2.63	.12
3x3 vs 3x3 FC average	23.64	.00*
3x3 vs 3x3 FCaverage category	2.94	.10
4x4 vs 4x4 FC average	7.18	.01*
4x4 vs 4x4FCaverage category	7.62	.01*

Discussion

The objective of this study was to identify the different effects in heart rate under reduced or modified game situations with or without feedback. Results show that both situations promote high levels of heart rate. At the same time, they confirm the recommendation suggested to coaches so that they use training methodology with a specific physical training, also known as integral formation (Sampaio et al., 2009).

McCormick et al. (2012), when comparing 3x3 and 5x5 game situations, established that there were no significant differences in MVI and VI. Results in the present study are different probably due to the duration of the game situations (8 minutes vs. 4 minutes). Players from the juvenile team tried to give their best during the whole session (Griffin & Unnithan, 1999). In 8 minutes without stopping the chronometer, heart rate will descend and equalize in modified situations. Sampaio et al. (2009) found no differences in heart rate during game situations 3x3 or 4x4 but instead propose the idea that both situations promote high physiological demands with heart rate at around an 80%, or as we can see in the present study, sometimes higher rates.

Duarte et al. (2009), concluded that 2x2, 3x3 and 4x4 situations (establishing feedback in all of them), situation 4x4 is the instance when heart rate reaches its lowest point. Consequently, it also confirms results for both, the u´14 team and the u´16 team. Ortega, Palao and Puigcerver (2009) found higher rates as the number of players decreases. They analysed the differences in 1x10, 1x1, 2x2 and 3x3. In the same line the study by Katis and Kellis (2009) revealed that heart rate will be higher when the number of players in modified games is reduced.

There are significant differences in 4x4 between categories regarding average heart rate. This might be due to the complexity of the game situation. When reducing the number of players, the ones who play have more space available for them only (increasing the effort they have to make). The number of stimuli is reduced, thus facilitating decision-making processes and the development of skills (McCormick et al., 2012). In a 4x4 game situation, there are a similar number of stimuli to that of a real game, consequently, complexity increases. Players from the u´14 category have greater difficulty in understanding the game, so they cannot make the same physical effort as u´16 players.

The presence of feedback intensifies the players' heart rate, thus also affects the effort they put in the exercises (Rampinini et al., 2007). McLaran (2003) suggests that the presence of a personal trainer changes sports habits and attitudes, increasing the amount of physical activity. The instructions the coaches provided in every activity were always positive, encouraging the players to put all their effort regardless of their mistakes. This positive feedback has a direct relationship with intrinsic motivation in any athlete and their perception of personal competences and skills (Reinboth, Duda, & Ntoumanis, 2004).

Conclusions

Coaches have to be always present in the training sessions, with a positive attitude and providing continuous correction to their players. This improves and increases players' work and learning. Likewise, coaches have to design training situations with fewer players if they wish to increase physical demands of the training sessions.

By using different combination of small-sided or modified games and the presence of feedback, coaches can plan and programme the intensity of the exercises, focusing on technical-tactics objectives they want to achieve also knowing that the intensity of the exercises is guaranteed by the dynamic of the game itself.

Some limitations of this study have been found, which will be taken into consideration for future research. The study has to be complemented with other variables so that we can generate information around physical condition (subjective perception of effort, lactate, ran meters, etc.) and technical-tactics factors (number of times players come into contact with the ball, decision-making processes, etc.).

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