

# Heart rate analysis of high level basketball players during training sessions

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## HEART RATE ANALYSIS OF HIGH LEVEL BASKETBALL PLAYERS DURING TRAINING SESSIONS

KEYWORDS: Basketball, Small-Sided-Games, Heart Rate

ABSTRACT: The aim of the study was to assess through the heart rate (HR) the intensity of training sessions with elite basketball players. Eleven basketball players belonging to a *Leb Oro* team used HR monitors during 12 training sessions providing 238 HR files. In each exercise the number of players, type of exercise, type of defense, dimensions of the field and time were analyzed, calculating their HRmax, % HRmax, HRmed, and % HRmed depending on their specific positions (Guard, Forward and Centers). No significant differences were found based on the number of players or dimensions of the field, however more intensity was observed in the individual defense ( $p < .01$ ). Moreover, there is a tendency to have greater intensity at SUP and INF drills. Centers reached the highest intensity in drills with more spaces (1x1, 2x2, SUP, INF) while Guards showed greater intensity in 3x3, 4x4 y 5x5 drills. The results of this study will help improve the planning and scheduling of workouts.

One of the great challenges in team sports is to optimize the exercises used in training sessions and to monitor and improve the performance of players. To accomplish to this, integrated training exercises are used in order to combine the technical-tactical fundamentals with the physical qualities (Aguar, Botelho, Lago, Maças and Sampaio, 2012; Hill-Haas, Coutts, Rowsell and Dawson, 2009). Within this integrated training, many authors mention the Small-Sided-Games (SSG) as specific exercises. This is effective technique to maintain the essence of the game, increase the ratio intervention-participation of player, allow a large number of decision-making and technical-tactical executions while simultaneously decreasing tactical possibilities (McCormick, Hannon, Newton, Shultz, Miller and Young, 2012).

The use of HR as an indicator of the intensity in team sports is validated in basketball (Montgomery, Pyne and Minahan, 2010; Castagna, Impellizzeri, Chaouachi, Ben Abdelkrim and Manzi, 2011) and even authors like Terrados and Calleja (2008) considered it a useful tool to estimate exercise intensity.

Therefore, the objective of this study is to describe and understand the internal load (HRmax and HRmed) of SSG used in technical-tactical training of an elite team in order to determine the possible implications on the physical level that this kind of exercise can have.

## Method

In this study, eleven professional elite basketball players participated ( $26.45 \pm 3.7$  years,  $91.9 \pm 3.85$  kg,  $195.7 \pm 10.46$  cm), each belonging to a team from the *Leb Oro* (2nd National Division) and were distributed by playing positions (2 Guards (G), 5 Forwards (F) and 4 Centers (C)).

During 3 weeks, 12 technical-tactical training sessions, of approximately 120 min duration, were recorded, to analyze a total of 39 exercise and 285 HR records. This was completed in the competitive period only and was not implemented during the preparation of training.

The variables studied were; the number of player (N<sup>o</sup>PLA) (1x1, 2x2, 3x3, 4x4, 5x5, numerical inferiority (INF) and numeral superiority (SUP)), the size of the court (half court (HC) or full court (FC)) and the type of defense (individual (ID) or zone (ZD)).

To know the intensity of exercise, HR obtained by Suunto heart rate monitors (*Suunto Pro Team Pack*, Vantaa, Finland), that did not need a clock were used and the data was analyzed with the "2.3.0 *Suunto team manager*" software to get the HRmax, the HRmed, of each exercise, of the global team and by playing positions. HRmax was calculated by the formula " $202 - 0.55 * \text{age}$ " (Whyte, George, Shave, Middleton and Nevill, 1982).

For data analysis we used the statistical package SPSS 20. A descriptive analysis was applied through the mean and standard deviation (Mean  $\pm$  SD) and an inferential analysis, which has been used as a one-way analysis of variance (ANOVA). If significant values were obtained, the Bonferroni test was applied. The  $p < .05$  values were considered statistically significant.

## Results

On the global team results (Table 1), slight significant differences were found in HRmed ( $p = .043$ ,  $F = 2.202$ ) and %HRmed ( $p = .044$ ,  $F = 2.189$ ), according as N<sup>o</sup>PLA decrease. In HRmax and %HRmax, although a tendency to decrease in the number of players can be seen, there were no significant differences.

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Furthermore, while FC exercises tend to be slightly more intense than HC exercise, they are very similar and not significantly different when presented (HRmax:  $p = .692$ ; %HRmax:  $p = .669$ ; HRmed:  $p = .564$  and % HRmed:  $p = .578$ ).

The ID generates greater intensity than the ZD, with significant differences in all variables (HRmax:  $p = .007$ ,  $F = 7.380$ ; % HRmax:  $p = .005$ ,  $F = 8.327$ ; HRmed:  $p = .001$ ,  $F = 11.782$  and % HRmed:  $p = .001$ ,  $F = 11.605$ ).

By playing positions, Centers are those who reach higher values in all the variables during the exercises: 1x1, 2x2, SUP and INF (HRmax, %HRmax, HRmed, %HRmed).

For the dimensions of the field depending on playing position (Table 2), except in Guards HRmax and % HRmax in FC, all other parameters (in HC as FC) it is Centers that show higher intensity.

Something similar happens in the ID, where Guards reach higher values in HRmax and %HRmax, while Centers reach larger values in HRmed and % HRmed. However, in the ZD, they are Centers who reached the highest values on all parameters: HRmax, %HRmax, HRmed and %HRmed.

## Discussion

The SSG found higher HRmax and %HRmax reached in the INF, SUP and DI. This is because when there is not a numerical equality, players must increase their physical strength. Data from this study corroborate that realized by Castagna et al. (2011) showing a tendency to decrease exercise intensity when the N°PLA increases; this is probably due to lowering intervention options.

By playing positions, note that Centers are those that reach the most intensity in 1x1, 2x2, SUP and INF, HC and ZD (except for % HRmax which is higher in Guards) and the most HRmed and % HRmed in the rest of SSG (except 4x4). This data contradicts the existing literature on competition, Vaquera et al. (2008) and Ben Abdelkrim, El Fazaa and El Ati (2007), where Guards showed greater intensity.

One of the most novel aspects of this study, in addition to the large volume of collected exercises, was that it was completed with an elite male team. Most of these studies are conducted with young players (Ben Abdelkrim et al., 2007; Montgomery et al., 2010; Castagna et al., 2011; Klusemann, Pyne, Foster and Drinkwater, 2012; McCormick et al., 2012; Delextrat and Kraiem, 2013). During the competitive season and without intervening in training, it accurately reflects what happens in technical-tactical sessions; the situations that are completed more frequently are 5x5 in FC with ID and a duration of 9min 40s, this coincides with the data already provided by Montgomery et al. (2010).

Ben Abdelkrim, Castagna, Jabri, Battikh, El Fazaa and El Ati (2010), were the only ones who have studied the intensity involved in the type of defense during games (ID vs. ZD), obtaining no significant differences, whereas this study show that ID is more intense than ZD, finds significant differences in all variables ( $p < .007$ ). These differences between the two studies may be due to the fact that in matches both types of defense are alternatively used, while in SSG exercises are performed without changing the type of defense.

On the other hand, the data of this study is opposed to the traditional belief, which determines that exercises in FC would be more intense (Montgomery et al., 2010) and conversely, is corroborated by studies like Klusemann et al. (2012) that state that both intensities are very similar.

## Conclusions

The information obtained in this work will help to adapt technical-tactical exercises in integrated training exercises in which physical qualities are worked at the same time as technical-tactical contents.

The significant differences obtained in the exercises depends on the field size and type of defense, as well as differences between playing positions will help to give a better understanding of the intensities of exercises and trainings, providing more efficient workouts.

	<i>MAX HR (ppm)</i>	<i>% MAX HR</i>	<i>MED HR (ppm)</i>	<i>% MED HR</i>	<i>VOL (min)</i>
1x1	169.83 ± 9.30	90.92 ± 4.63	148.35 ± 10.92	79.15 ± 5.86	5.37 ± 1.18
2x2	167.68 ± 10.45	89.62 ± 5.46	147.41 ± 11.26	78.62 ± 6.09	7.59 ± 1.86
3x3	167.67 ± 11.72	89.70 ± 6.00	143.93 ± 12.12	76.80 ± 6.47	10.95 ± 3.12
4x4	166.80 ± 12.34	89.38 ± 6.32	141.20 ± 14.28	75.31 ± 7.60	10.50 ± 1.08
5x5	166.73 ± 13.93	89.24 ± 7.19	146.18 ± 14.40	77.97 ± 7.74	10.99 ± 3.77
INF	170.78 ± 11.81	91.48 ± 6.06	148.78 ± 12.46	79.36 ± 6.71	9.34 ± 2.77
SUP	170.28 ± 10.59	91.44 ± 5.58	156.22 ± 9.31	83.35 ± 5.05	4.95 ± 1.10

Table 1. HRmax, %HRmax, HRmed, %HRmed and Vol data obtained in the global team as a function of the number of players.

	<i>Position</i>	<i>MAX HR (ppm)</i>	<i>% MAX HR</i>	<i>MED HR (ppm)</i>	<i>% MED HR</i>	<i>VOL (min)</i>
FC	G	172.10 ± 15.19	92.00 ± 8.34	149.25 ± 16.71	79.75 ± 8.93	10.90 ± 3.88
	F	166.06 ± 13.56	89.35 ± 6.75	145.25 ± 12.60	77.25 ± 6.70	9.38 ± 3.91
	C	170.76 ± 8.42	90.85 ± 4.60	153.65 ± 10.51	82.22 ± 5.63	10.48 ± 4.07
HC	G	168.67 ± 11.31	90.17 ± 6.27	144.00 ± 12.96	76.94 ± 6.93	7.35 ± 1.89
	F	164.67 ± 11.50	88.59 ± 5.88	144.89 ± 10.94	77.06 ± 5.82	6.20 ± 1.77
	C	172.00 ± 8.20	91.62 ± 4.45	152.33 ± 10.16	81.52 ± 5.43	7.13 ± 0.94

Table 2. HRmax, %HRmax, HRmed, %HRmed and Vol data obtained by playing positions in function of the dimensions of the court.

**ANÁLISIS DE LA FRECUENCIA CARDIACA DE JUGADORES DE BALONCESTO DE ELITE EN ENTRENAMIENTOS TÉCNICO-TÁCTICOS**

**PALABRAS CLAVES:** Baloncesto, Juegos Reducidos, Frecuencia Cardiaca.

**RESUMEN :** El objetivo del estudio es conocer la intensidad, mediante la frecuencia cardiaca (FC), de los ejercicios utilizados por un equipo de elite de baloncesto. 11 jugadores pertenecientes a un equipo de LeB Oro utilizaron pulsómetros durante 12 sesiones, obteniendo 238 registros de FC. En cada ejercicio se registraron el número de jugadores, tipo de ejercicio, volumen, tipo de defensa y dimensiones del campo, obteniéndose la FCmáx, % FCmáx, FCmed y % FCmed en función de los puestos específicos (Base, Alero y Pívot). No hubo diferencias significativas en función del número de jugadores o las dimensiones del campo, aunque se observó que la defensa individual era más intensa ( $p < .01$ ). Asimismo los ejercicios de superioridades e inferioridades fueron los de mayor intensidad. Los Pívots obtuvieron mayor intensidad en ejercicios con mucho espacio, mientras que en 3x3, 4x4 y 5x5 fueron los Bases los que mostraron mayores intensidades. Los resultados de este estudio ayudarán a mejorar la planificación y programación de las sesiones y ejercicios.

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