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# Heart rate response and technical demands of different small-sided game formats in young female basketballers

# Respuesta de la frecuencia cardíaca y demanda técnica en diferentes formatos de juegos reducidos realizados por jugadoras jóvenes de baloncesto

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## Abstract

The aim of the present study was to describe the physiological and technical responses in young female during a basketball 3 vs. 3 small-sided games (SSG) with and without verbal coach encouragement and dribbling. Six young female basketball players (age: 14.3 ± 0.5 years; height: 167.8 ± 0.8 cm; body mass: 56.5 ± 5.7 kg) were recruited to participate in the present pilot study. The games were video recorded and afterwards the technical demands were notated with observational ad hoc software. The peak of maximum heart rate was increased from set 1 to set 3 during both the SSG with dribble and coach encouragement, as well as in the SSG without dribble and coach presence. With coach encouragement caused greater responses of heart rate and rate of perceived exertion than without both dribble and coach encouragement. There were no differences in technical actions, exception of the number of offensive rebounds showing a higher number in the coach encouragement task. In conclusion, the SSG with verbal encouragement should be selected to focus in physiological load, and SSG without might be useful to enhance collective behavior, without limitations in physiological load.

**Key Words**: coach encouragement; technical indicators; internal load; basket.

## Resumen

El objetivo del presente estudio fue describir las respuestas fisiológicas y técnico-tácticas en mujeres jóvenes durante juegos reducidos (SSG) de baloncesto 3 contra 3 con y sin el estímulo verbal del entrenador y el bote. Seis jugadoras de baloncesto (edad: 14.3 ± 0.5 años; altura: 167.8 ± 0.8 cm; peso: 56.5 ± 5.7 kg) tomaron parte del estudio piloto. Los juegos fueron grabados en video y después las demandas técnicas fueron registradas con software ad hoc de observación. El pico de frecuencia cardíaca máxima se incrementó de la serie 1 a la 3 durante el SSG con bote y estímulo del entrenador, así como en el SSG sin bote y presencia del entrenador. Con el estímulo del entrenador se produjo mayores respuestas de frecuencia cardíaca y esfuerzo percivido que sin bote y estímulo del entrenador. No hubo diferencias en las acciones técnicas, excepto en el número de rebotes ofensivos que fue mayor en la tarea con estímulo del entrenador. En conclusión, el SSG con estímulo verbal debería elegirse para centrarse en la carga fisiológica, mientras que el que se realiza sin él, puede ser útil para mejorar el comportamiento colectivo, sin limitaciones en la carga fisiológica.

**Palabras clave**: motivación del entrenador; indicadores técnicos; carga interna; baloncesto.

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# Introduction

Team-sports performance benefits largely from training methods that involve similar stimulus to those demanded during competition (Aguiar, Botelho, Lago, Maças & Sampaio, 2012). A very common practice is the usage of small-sided games (SSG) as they likely reproduce similar technical, tactical and physical competition requirements (i.e., specificity principle) (Hoff, Wisløff, Engen, Kemi & Helgerud, 2002). In basketball, the SSG maintain both the nature of the sport and the most important features, overemphasizing players' intervention (Gracia, Garcia, Cañadas & Ibáñez, 2014) through activities with a smaller court and lower number of players in comparison to the formal game (Sampaio, Abrantes & Leite, 2009). Firstly, SSG were used to improve technical-tactical concepts (Jones & Drust, 2007), but they are now used to specifically improve conditioning (Dellal, Chamari, Pintus, Girard, Cotte & Keller, 2008; Hill-Haas, Coutts, Rowsell & Dawson, 2009; Owen, Wong, Paul & Dellal, 2012). The cardiovascular stress prompt throughout a SSG can be similar to that observed during traditional athletic exercises (Hill-Haas, Dawson, Coutts & Rowsell, 2009). Notwithstanding, in comparison to high intensity running, the ball introduction and the specific roles can concurrently involve fitness and perceptive/decisional factors (Gabbett & Mulvey, 2008) in fatigue and stressful competitive conditions (Gabbett, Jenkins & Abernethy, 2009). Moreover, with training time at a premium in most recreational teams, the search of methods that concurrently affect to physiological, physical, technical and tactical aspects is crucial for performance improvement. These considerations convert the SSG in excellent tasks to develop endurance in basketball due the relationship between aerobic power and the ability to repeat high intensity efforts throughout the game (Matthew & Delextrat, 2009). Thus, it seems that SSGs might be very appropriate to simultaneously improve the most important basketball requirements.

The SSG have been widely investigated in team-sports such as soccer (Hill-Haas, Dawson, Impellizzeri & Coutts, 2011) and in highly-trained subjects or athletes (Halouani, Chtourou, Gabbett, Chaouachi & Chamari, 2014). It has allowed to understand what variables can be modified to focus in the main training objectives (Aguiar et al., 2012). Nevertheless, there is a lack of information about the constraints manipulation in basketball, where it has been described the physical or technical-tactical responses associated to different number of players (Castagna, Impellizzeri, Chaouachi, Ben Abdelkrim & Manzi, 2011; Delextrat & Kraiem, 2013; Montgomery, Pyne & Minahan, 2010), with/without dribble (Conte, Favero, Niederhausen, Capranica & Tessitore, 2016), court dimensions (Klusemann, Pyne, Foster & Drinkwater, 2012; Marcelino, Aoki, Arruda, Freitas, Mendez-Villanueva & Moreira, 2016)) and work-to-rest-ratio (Kluseman et al., 2012). For example, several studies about the SSG have focused in the number of players (i.e., 3 vs. 3, 4 vs. 4), identifying a higher exercise intensity as the number of participants decreases (Delextrat et al., 2013; Gracia et al., 2014; Mccormick, Hannon, Newton, Shultz, Miller & Young, 2012; Ortega, Palao & Puigcerver, 2009; Sampaio et al., 2009). However, it would be interesting to identify the influence of other variables, because SSG intensity might depend on the combination of several aspects such as game area, task objective, type of feedback or game rules (Hill-haas, Coutts, Rowsell & Dawson, 2008).

The information given by the coach affects the performance of the team (Cushion & Jones, 2001). For this reason, previous studies have analyzed the speech coach (Lorenzo, Rivilla & Navarro, 2015). Verbal encouragement during the execution has shown to increase athletic performance (Mazzetti, Kraemer, Volek, Duncan, Ratamess, Gómez, Newton, Häkkinen & Fleck, 2000). Furthermore, it enhances the adherence to resistance training schedules (Coutts,

Murphy & Dascombe, 2004) and increase the competitiveness in young athletes (Reinboth, Duda & Ntoumanis, 2004). In soccer, the participation of coaches (i.e., verbal encouragement) throughout a SSG modifies the intensity of the activity (Rampinini, Impellizzeri, Castagna; Abt, Chamari, Sassi & Marcora, 2007), increasing the heart rate (HR) response (Sánchez-Sánchez, Luis, Guillén, Martín, Romo, Rodríguez & Villa, 2014), the lactic acid accumulation and the rate of perceived exertion (RPE) (Rampinini et al., 2007). In basketball, a greater HR response has been found in young basketball players with the inclusion of feedback (Gracia et al., 2014). However, available research has not identified the influence of verbal encouragement over technical-tactical and physiological (objective and subjective) responses in young female recreational basketball players. Knowing such responses more in detail would likely allow to fine-tune exercise prescription to optimize health and performance-related benefits.

Technical alterations are another component that have been shown to influence physiological and technical responses in male young basketball players. It is possible that dribble prohibition can promote passing as a key element of the game, avoiding the appearance of too much individual actions (Conte et al., 2016). In these research, the dribbling prohibition induced statistically higher physiological load, RPE and number of passes in young male basketball players (4 vs. 4).

To date, no study investigated the physiological and technical responses of the combination of restricted technical actions (i.e., dribbling) and coach feedback on female basketball players. Therefore, the aim of the present study was to describe the physiological and technical responses during a basketball 3 vs. 3 SSG with and without verbal coach encouragement and dribbling in young female recreational basketball players.

## Methods

*Subjects*

Six young female basketball players (age: 14.3 ± 0.5 years; height: 167.8 ± 0.8 cm; body mass: 56.5 ± 5.7 kg; YoYo IR1: 833.3 ± 184.9 m) were recruited to participate in the present pilot study. Participants were chosen for convenience. All players were of a regional playing standard category and were engaged in 4 hours of basketball training (2 sessions) plus one competitive match per week. In one session, the players performed conditioning exercises and SSG; in the other session, they performed shooting exercises and tactical-derived tasks. Written informed consent was obtained from both players and their parents before beginning the investigation. The present study was approved by the institutional research ethics committee, and conformed to the recommendations of the Declaration of Helsinki.

*Small-Sided Games*

A total of 12 repeated measures were obtained for each variable (each player performed three sets in four different sessions). A 3 vs. 3 SSG (always with the same participants) was performed in a half basketball synthetic court (14 x 15 m) using four different formats: regarding positive verbal coach encouragement (with or without) and dribbling constraint (with or without) (Table 1). In the coach's encouragement tasks offensive and defensive players received positive messages and technical corrections during game. Positive verbal coach encouragement consisted of a set of encouraging statements read from a prepared text. The statements included: `Way to go!', `Come on!', `Good job!', `Excellent!' , `Come on, push it!' , `Keep it up!' , `Push it!' and `Let' s go!' (Andreacci, Lemura, Cohen, Urbansky, Chelland & Duvillard, 2002). The coach was familiarized with the procedure in the week prior to data collection. The volume of verbal encouragement was monitored continuously using a one every

15-20 seconds. The SSG were randomized into 4 sessions (2 per week) during the month of April in the competition period. Prior to start of each SSG, a 15-min warm-up compounded by 5-min low-intensity running, 5-min dynamic stretching exercise and short acceleration efforts for 10-m, and 5-min simple technical-tactical tasks was developed. SSG were comprised by 3 sets x 3 min with 90 s of passive recovery between sets. The second coach served as referee. The basic rules in every SSG were as follows: a) individual defense, b) the ball must be outside the zone after a defensive rebound to allow a shoot, c) after each personal foul the game continues from lateral bounds, d) the team which gets points maintained the ball possession as attacker starting from the midcourt, and e) every set starts with the ball in the air.

Table 1. Small Sided Games developed by players.

| SSG | Coach encouragement | Player intervention | Format | Field size |
|---|---|---|---|---|
| SSG1 | with positive coach encouragement | with dribbling | 3 vs. 3 | 14x15 m |
| SSG2 | without coach encouragement | | | |
| SSG3 | with positive coach encouragemente | without dribbling | | |
| SSG4 | without coach encouragement | | | |

Note: SSG: small-sided game.

*SSGs Load*

During the different SSG formats, HR was monitored in every player to obtain the internal load in each task. All players were familiarized with these devices and data was registered each 5 s (Polar Team System 2, Polar® Electro OY, Finland). The mean HR ($HR_{mean}$) corresponding to each set was calculated through the Polar Pro Trainer 5 software (Polar® Electro OY). $HR_{mean}$ was expressed as the percentage of the maximum HR ($\%HR_{max}$) achieved during the YoYo IR1 (Bangsbo, Iaia & Krustrup, 2007). One week before starting the experimental protocol, the YoYo IR1 test was performed in the same basketball court using HR monitors (Polar Team System 2, Polar® Electro OY, Finland) and a specific software in a laptop with portable speakers (Sony ENG203®). Two intensity zones were established based on the maximum HR obtained in the YoYo IR1: 80-89.9% and 90-100%. It was considered the time within each intensity zone. Furthermore, one minute after each set corresponding to each SSG format, all players were asked about their RPE through the Borg CR10 scale (Borg, 1998). Participants were familiarized with the scale one month before starting the intervention. Every player answered the next question individually without both the presence of the rest of players and knowing the points granted by other players: "how hard has been the SSG bout for you? (Borg, 1973).

*Technical Demands*

The technical demands analyzed after performing SSG were the defensive rebounds, offensive rebounds, total succeed passes, total number of three point shoots, total number of two point shoots, number of performed lay-outs, total number of possessions, success in actions with the possibility to score points and total number of official stops. The game was recorded through a video-camera (Sony Handycam HDR-PJ240E®, SONY China) positioned at 15 m of the game play and at 7 m height. The video-recordings were handled with observational ad hoc software (Match Vision®) (Casamichana & Castellano, 2010). In order to ensure validity and reliability, the same expert researcher visually observed the recordings twice: 2 different

sessions corresponding to the first SSG set with positive verbal coach encouragement and free game separated by 2 weeks (Casamichana & Castellano, 2009). The results showed a high reliability with an average of 99% of intra-observer agreement.

*Statistical Analyses*

Data is presented as mean ± standard deviation (SD). All data were first log-transformed to reduce bias arising from non-uniformity error. The standardized difference or effect size (ES, 90% confidence limit) in the selected variables was calculated using the pre-pooled SD. Threshold values for Cohen ES statistics were >0.2 (small), >0.6 (moderate), and >1.2 (large) (Hopkins, Marshall, Batterham & Hanin, 2009). The chances that the differences in either physiological (i.e., RPE, $HR_{peak}$, $HR_{max}$, $\%HR_{max}$, time in intensity zones: 80-89.9% and 90-100%) or technical variables during different SSG were better/greater (i.e., greater than the smallest worthwhile change, SWC [0.2 multiplied by the between-subject standard deviation, based on Cohen's d principle]), similar or worse/smaller were calculated. Quantitative chances of greater or poorer effect were assessed qualitatively as follows: <1%, almost certainly not; 1–5%, very unlikely; 5–25%, unlikely; 25–75%, possible; 75–95%, likely; 95–99%, very likely; and >99%, almost certain (Randers, Andersen, Rasmussen, Larsen & Krustrup, 2014). A substantial effect was set at >75%. If the chance of having greater or poorer physiological/technical demands was both >5%, the true difference was assessed as unclear. Other changes were interpreted as chance (Hopkins et al., 2009).

## Results

*Perceived Exertion and Heart Rate Responses within the SSG Sets*

All descriptive statistics are shown in Table 2 and the within-SSG responses presented in Table 3. The RPE substantially increased throughout the sets in all SSG (Set1<Set2<Set3). In reference to HR responses, the peak of maximum HR ($HR_{peak}$) was *possibly* to *very likely* increase from Set1 to Set3 during the SSG with dribble and coach presence, as well as in the SSG without dribble and coach presence. Substantial differences were found in $HR_{mean}$ between Set1 and Set2 during SSG with dribble and coach, SSG without dribble and with coach and SSG without dribble and coach. The $\%HR_{max}$ substantially augmented as increased the number of sets in SSG with both dribble and coach (Set1<Set2<Set3). Furthermore, a substantial higher $\%HR_{max}$ from Set1 to Set2 was provided during SSG without dribble, with and without coach presence. Lastly, SSGs without coach substantially increased their time at 90-100% $HR_{max}$ from Set1 to Set3.

*Perceived Exertion and Heart Rate Responses between the SSG*

The Between-SSG responses are shown in Table 4. Both SSG with coach presence achieved substantially higher responses (RPE, $HR_{peak}$, $HR_{max}$ and $\%HR_{max}$) than SSG without both dribble and coach encouragement. In addition, *possibly* to *likely* higher HR responses were found in SSG with dribble and coach in comparison to SSG with dribble and without coach.

*Technical Responses between-SSG*

The descriptive technical responses were normally distributed and are shown in Table 5. Between-SSG technical differences are presented in Table 6. The total number of scored baskets was substantially higher during the SSG with dribble and coach encouragement, than in the SSG without dribble and coach encouragement. Furthermore, a substantially higher number of official stops were reported during both SSGs with and without dribbling and with coach presence, in comparison to the SSG with dribbling and without coach encouragement.

Table 2. Descriptive statistics of the rate of perceived exertion and heart rate responses during different small-sided games in female basketball players (n=6).

| | | DRIBBLE/COACH | DRIBBLE/NO COACH | NO DRIBBLE/COACH | NO DRIBBLE/NO COACH |
|---|---|---|---|---|---|
| RPE | S1 | 5.3 ± 1.5 | 5.0 ± 0.9 | 5.3 ± 1.5 | 4.5 ± 0.8 |
| | S2 | 6.2 ± 1.5 | 5.3 ± 0.8 | 6.2 ± 1.5 | 5.0 ± 1.1 |
| | S3 | 7.0 ± 1.3 | 6.2 ± 1.2 | 7.0 ± 1.3 | 6.5 ± 1.8 |
| | Mean | 6.2 ± 1.4 | 5.5 ± 0.9 | 6.2 ± 1.4 | 5.3 ± 1.2 |
| $HR_{peak}$ (b·min) | S1 | 195.0 ± 7.5 | 197.5 ± 11.0 | 196.8 ± 10.6 | 189.5 ± 13.4 |
| | S2 | 200.3 ± 10.5 | 195.7 ± 13.8 | 198.0 ± 12.8 | 193.0 ± 10.7 |
| | S3 | 203.2 ± 10.7 | 195.2 ± 12.8 | 197.8 ± 12.6 | 195.8 ± 9.3 |
| | Mean | 199.5 ± 9.4 | 196.1 ± 12.4 | 197.6 ± 12.0 | 195.8 ± 9.3 |
| $HR_{mean}$ (b·min) | S1 | 181.3 ± 7.7 | 183.3 ± 11.2 | 183.0 ± 12.3 | 176.2 ± 13.0 |
| | S2 | 188.3 ± 10.6 | 182.8 ± 11.2 | 187.5 ± 11.9 | 183.2 ± 10.2 |
| | S3 | 190.8 ± 10.8 | 184.7 ± 12.0 | 186.2 ± 11.2 | 183.8 ± 10.5 |
| | Mean | 186.8 ± 9.2 | 183.6 ± 12.3 | 185.6 ± 11.7 | 181.1 ± 11.1 |
| $\%HR_{max}$ (%) | S1 | 90.5 ± 2.5 | 91.5 ± 3.2 | 91.0 ± 3.6 | 87.8 ± 4.8 |
| | S2 | 93.5 ± 2.6 | 91.0 ± 4.0 | 93.3 ± 3.6 | 91.2 ± 2.8 |
| | S3 | 94.7 ± 2.4 | 92.0 ± 3.3 | 92.8 ± 2.8 | 91.7 ± 4.1 |
| | Mean | 92.9 ± 1.9 | 91.5 ± 3.3 | 92.4 ± 3.2 | 90.2 ± 3.9 |
| Z4 (s) | S1 | 67.8 ± 57.3 | 51.7 ± 38.9 | 57.7 ± 54.6 | 57.7 ± 44.6 |
| | S2 | 41.2 ± 54.6 | 37.0 ± 26.5 | 53.0 ± 59.4 | 68.2 ± 66.2 |
| | S3 | 31.5 ± 47.9 | 41.3 ± 35.8 | 52.5 ± 52.4 | 64.0 ± 57.8 |
| | Mean | 46.8 ± 50.0 | 43.3 ± 30.1 | 54.4 ± 54.2 | 63.3 ± 54.2 |
| Z5 (s) | S1 | 94.7 ± 60.1 | 104.5 ± 57.6 | 101.0 ± 69.2 | 80.5 ± 68.7 |
| | S2 | 125.5± 62.9 | 109.3 ± 62.0 | 111.8 ± 66.5 | 99.3 ± 71.5 |
| | S3 | 131.7 ± 62.7 | 117.3 ± 58.2 | 103.7 ± 55.9 | 100.0 ± 64.4 |
| | Mean | 117.3 ± 57.9 | 110.4 ± 58.3 | 105.5 ± 61.0 | 93.3 ± 67.2 |

Note: RPE: rate of perceived exertion; $HR_{peak}$: heart rate peak during the SSG; $HR_{mean}$: heart rate mean during the SSG; $\%HR_{max}$: percentage of maximum heart rate achieved during the SSG; b·min: beats per minute; Z4: seconds within zone 4; Z5: seconds within zone 5; S1: set 1; S2: set 2; S3: set 3.

Table 3. Within-Small Sided games (SSGs) differences through the rate of perceived exertion and heart rate responses in female basketball players (n=6).

| | | **SSG with DRIBBLE AND COACH** | | | **SSG with DRIBBLE AND without COACH** | | | **SSG without DRIBBLE AND with COACH** | | | **SSG without DRIBBLE AND COACH** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **ES (90%CL)** | **Chances** | **Outcome** | **ES (90%CL)** | **Chances** | **Outcome** | **ES (90%CL)** | **Chances** | **Outcome** | **ES (90%CL)** | **Chances** | **Outcome** |
| RPE | 1st vs 2nd | 0.41 (0.21; 0.62) | 95/4/0% | Very Likely | 0.31 (-0.09; 0.72) | 70/27/2% | Possibly | 0.41 (0.21; 0.62) | 95/4/0% | Very Likely | 0.39 (0.04; 0.75) | 84/15/1% | Likely |
| | 1st vs 3rd | 0.77 (0.46; 1.09) | 99/1/0% | A.C. | 0.95 (0.40; 1.51) | 98/2/0% | Very Likely | 0.77 (0.46; 1.09) | 99/1/0% | Almost Certainly | 1.41 (0.87; 1.95) | 100/0/0% | A.C. |
| | 2nd vs 3rd | 0.45 (0.25; 0.66) | 97/3/0% | Very Likely | 0.71 (0.18; 1.25) | 94/5/1% | Likely | 0.45 (0.25; 0.66) | 97/3/0% | Very Likely | 0.84 (0.60; 1.09) | 100/0/0% | A.C. |
| $HR_{peak}$ | 1st vs 2nd | 0.58 (0.20; 0.95) | 95/4/0% | Very Likely | -0.15 (-0.38; 0.08) | 1/64/34% | Possibly trivial | 0.08 (-0.12; 0.29) | 15/83/2% | Likely trivial | 0.23 (0.03; 0.43) | 61/39/0% | Possibly |
| | 1st vs 3rd | 0.88 (0.43; 1.33) | 99/1/0% | Very Likely | -0.18 (-0.44; 0.08) | 2/53/45% | Possibly trivial | 0.07 (-0.10; 0.25) | 10/89/1% | Likely trivial | 0.41 (0.04; 0.77) | 85/14/1% | Likely |
| | 2nd vs 3rd | 0.22 (0.13; 0.31) | 67/33/0% | Possibly | -0.03 (-0.18; 0.12) | 1/95/3% | Very Likely trivial | -0.01 (-0.05; 0.03) | 0/100/0% | A.C trivial | 0.23 (-0.07; 0.53) | 57/42/2% | Possibly |
| $HR_{mean}$ | 1st vs 2nd | 0.74 (0.08; 1.40) | 92/6/2% | Likely | -0.05 (-0.32; 0.22) | 6/78/16% | Unclear | 0.31 (0.20; 0.41) | 95/5/0% | Very Likely | 0.45 (0.22; 0.69) | 96/4/0% | Very Likely |
| | 1st vs 3rd | 1.00 (0.42; 1.58) | 98/2/0% | Very Likely | 0.10 (-0.16; 0.35) | 22/74/3% | Possibly trivial | 0.22 (-0.02; 0.46) | 56/43/1% | Possibly | 0.49 (0.28; 0.71) | 98/2/0% | Very Likely |
| | 2nd vs 3rd | 0.19 (0.09; 0.29) | 43/57/0% | Possibly trivial | 0.11 (-0.08; 0.30) | 20/79/1% | Likely trivial | -0.09 (-0.30; 0.11) | 2/81/17% | Likely trivial | 0.05 (-0.17; 0.28) | 13/84/4% | Likely trivial |
| $\%HR_{max}$ | 1st vs 2nd | 0.99 (-0.02; 2.01) | 91/6/3% | Likely | -0.14 (-0.60; 0.32) | 10/50/40% | Unclear | 0.54 (0.31; 0.77) | 98/2/0% | Very Likely | 0.58 (0.24; 0.92) | 96/3/0% | Very Likely |
| | 1st vs 3rd | 1.37 (0.53; 2.21) | 98/1/1% | Very Likely | 0.13 (-0.33; 0.60) | 39/51/11% | Unclear | 0.43 (0.05; 0.81) | 86/13/1% | Likely | 0.66 (0.40; 0.92) | 99/1/0% | A.C. |
| | 2nd vs 3rd | 0.37 (0.11; 0.64) | 88/11/0% | Likely | 0.21 (-0.09; 0.52) | 53/45/2% | Possibly | -0.11 (-0.44; 0.21) | 5/64/31% | Unclear | 0.14 (-0.27; 0.55) | 39/53/8% | Unclear |
| Z4 | 1st vs 2nd | -0.61 (-1.13; -0.09) | 1/8/91% | Likely lower | -0.28 (-0.66; 0.10) | 3/32/65% | Possibly | -0.08 (-0.30; 0.15) | 3/81/16% | Likely trivial | 0.10 (-0.33; 0.53) | 33/56/11% | Unclear |
| | 1st vs 3rd | -0.89 (-1.53; -0.25) | 1/3/96% | Very Likely | -0.22 (-0.51; 0.07) | 2/42/56% | Possibly | -0.06 (-0.52; 0.40) | 15/56/29% | Unclear | 0.12 (-0.18; 0.42) | 30/66/4% | Possibly trivial |
| | 2nd vs 3rd | -0.26 (-0.69; 0.18) | 4/36/60% | Possibly | 0.07 (-0.62; 0.76) | 36/41/23% | Unclear | 0.01 (-0.51; 0.54) | 25/52/22% | Unclear | 0.02 (-0.23; 0.27) | 10/83/7% | Unclear |
| Z5 | 1st vs 2nd | 0.31 (-0.12; 0.74) | 69/28/3% | Possibly | 0.09 (-0.32; 0.49) | 29/61/10% | Unclear | 0.12 (-0.08; 0.32) | 22/77/1% | Likely trivial | 0.47 (-0.27; 1.21) | 77/17/6% | Unclear |
| | 1st vs 3rd | 0.18 (-0.27; 0.64) | 47/45/8% | Unclear | 0.39 (-0.10; 0.88) | 78/19/3% | Likely | 0.05 (-0.25; 0.35) | 17/75/8% | Unclear | 0.38 (-0.06; 0.82) | 79/18/3% | Likely |
| | 2nd vs 3rd | 0.35 (-0.31; 1.01) | 68/25/7% | Unclear | 0.13 (-0.07; 0.34) | 27/72/1% | Possibly trival | -0.08 (-0.75; 0.59) | 21/43/36% | Unclear | 0.06 (-0.28; 0.39) | 21/69/9% | Unclear |

Note: SSG: small-sided game; ES: effect size; 90%; CL: 90% confidence limit; Chances: probabilities to have greater/trivial/smaller demands; RPE: rate of perceived exertion; $HR_{peak}$: heart rate peak during the SSG; $HR_{mean}$: heart rate mean during the SSG; $\%HR_{max}$: percentage of maximum heart rate achieved during the SSG; Z4: zone 4; Z5: zone 5; A.C: Almost certainly.

Table 4. Between-Small Sided Games (SSGs) differences (Effect size and qualitative outcome) through the rate of perceived exertion and heart rate responses in female basketball players (n=6).

| | **DRIBBLE/COACH VS DRIBBLE/NO COACH** | **DRIBBLE/COACH VS NO DRIBBLE/COACH** | **DRIBBLE/COACH VS NO DRIBBLE/NO COACH** | **DRIBBLE/ NO COACH VS NO DRIBBLE/COACH** | **DRIBBLE/ NO COACH VS NO DRIBBLE/NO COACH** | **NO DRIBBLE/COACH VS NO DRIBBLE/NO COACH** |
|---|---|---|---|---|---|---|
| RPE | ES: 0.50 (-0.81; 1.80) | ES: 0.00 (0.00; 0.00) | ES: 0.50 (0.13; 0.86) | ES: -0.35 (-1.26; 0.56) | ES: 0.14 (-0.57; 0.86) | ES: 0.50 (0.13; 0.86) |
| | 67/17/17% Unclear | 0/100/0% Almost certainly trivial | 92/7/1% Likely | 14/27/62% Unclear | 44/37/19% Unclear | 92/7/1% Likely |
| $HR_{peak}$ | ES: 0.23 (0.00; 0.47) | ES: 0.14 (-0.10; 0.39) | ES: 0.52 (0.24; 0.80) | ES: -0.10 (-0.39; 0.19) | ES: 0.25 (-0.18; 0.68) | ES: 0.36 (0.17; 0.56) |
| | 60/39/1% Possibly | 33/65/2% Possibly trivial | 97/3/0% Very Likely | 4/69/27% Possibly trivial | 59/37/4% Possibly | 92/8/0% Likely |
| $HR_{mean}$ | ES: 0.22 (0.03; 0.42) | ES: 0.10 (-0.18; 0.38) | ES: 0.44 (0.05; 0.83) | ES: -0.15 (-0.45; 0.16) | ES: 0.19 (-0.24; 0.62) | ES: 0.34 (0.12; 0.55) |
| | 59/40/0% Possibly | 26/70/4% Possibly trivial | 87/12/1% Likely | 3/60/36% Possibly trivial | 48/46/7% Unclear | 87/12/0% Likely |
| $\%HR_{max}$ | ES: 0.36 (-0.03; 0.74) | ES: 0.14 (-0.37; 0.65) | ES: 0.59 (0.03; 1.15) | ES: -0.24 (-0.79; 0.32) | ES: 0.28 (-0.31; 0.88) | ES: 0.48 (0.19; 0.77) |
| | 77/21/2% Likely | 41/47/12% Unclear | 89/9/2% Likely | 9/36/55% Unclear | 60/31/8% Unclear | 94/5%0% Likely |
| Z4 | ES: -0.13 (-0.41; 0.15) | ES: -0.10 (-0.30; 0.11) | ES: -0.31 (-0.61; -0.01) | ES: -0.01 (-0.29; 0.27) | ES: -0.21 (-0.52; 0.09) | ES: -0.20 (-0.37; -0.04) |
| | 3/65/31% Possibly trivial | 2/80/18% Likely trivial | 1/24/75% Possibly | 10/79/11% Unclear | 2/45/53% Possibly | 0/48/51% Possibly |
| Z5 | ES: 0.10 (-0.04; 0.25) | ES: 0.13 (-0.03; 0.29) | ES: 0.22 (-0.14; 0.58) | ES: 0.03 (-0.03; 0.09) | ES: 0.10 (-0.29; 0.49) | ES: 0.07 (-0.26; 0.40) |
| | 11/88/0% Likely trivial | 22/78/0% Likely trivial | 55/42/3% Possibly | 0/100/0% Almost certainly trivial | 32/59/9% Unclear | 23/69/8% Unclear |

Note: ES: effect size; RPE: rate of perceived exertion; $HR_{peak}$: heart rate peak during the SSG; $HR_{mean}$: heart rate mean during the SSG; $\%HR_{max}$: percentage of maximum heart rate achieved during the SSG; Z4: zone 4; Z5: zone 5.

Table 5. Descriptive statistics of technical responses during different small-sided games in female basketball players (n=6).

| | **DRIBBLE/COACH** | **DRIBBLE/NO COACH** | **NO DRIBBLE/COACH** | **NO DRIBBLE/NO COACH** |
|---|---|---|---|---|
| Def. Reb | 3.67 ± 0.58 | 3.67 ± 1.53 | 3.67 ± 0.58 | 3.33 ± 2.52 |
| Of. Reb | 1.67 ± 0.58 | 3.00 ± 1.00 | 1.33 ± 1.53 | 2.33 ± 1.15 |
| Passes | 21.3 ± 2.9 | 19.0 ± 3.5 | 40.0 ± 5.6 | 41.7 ± 8.1 |
| Total shoots | 7.33 ± 2.31 | 7.33 ± 1.15 | 8.00 ± 1.73 | 6.67 ± 2.89 |
| 3p shoots | 1.00 ± 0.01 | 2.00 ± 1.00 | 1.33 ± 1.15 | 0.33 ± 0.58 |
| 2p shoots | 3.33 ± 1.53 | 2.00 ± 1.00 | 2.33 ± 1.15 | 2.67 ± 2.08 |
| Lay-outs | 4.67 ± 2.52 | 4.67 ± 2.52 | 4.00 ± 1.00 | 3.00 ± 0.01 |
| Total basket | 5.00 ± 1.00 | 5.00 ± 1.73 | 6.00 ± 3.00 | 3.00 ± 1.00 |
| Total pos. | 94.3 ± 4.6 | 86.3 ± 2.1 | 86.3 ± 1.15 | 84.7 ± 15.9 |
| Final success | 41.6 ± 7.3 | 40.1 ± 9.3 | 48.1 ± 17.2 | 34.3 ± 17.5 |
| Stops | 4.33 ± 1.53 | 2.00 ± 0.01 | 3.67 ± 1.15 | 3.33 ± 2.1 |

Note: Def. Reb: defensive rebounds; Of. Reb: offensive rebounds; Passes: total succeed passes; 3p shoots: total number of three point shoots; 2p shoots: total number of two point shoots; Lay-outs: number of performed lay-outs; Total pos: total number of possessions; Final success: success in those actions with the possibility to get points; Stops: Total number of official stops.

Table 6. Between-Small Sided Games (SSGs) differences (Effect size, chances and qualitative outcome) through technical action responses in female basketball players (n=6).

| | **DRIBBLE/COACH VS DRIBBLE/NO COACH** | **DRIBBLE/COACH VS NO DRIBBLE/COACH** | **DRIBBLE/COACH VS NO DRIBBLE/NO COACH** | **DRIBBLE/ NO COACH VS NO DRIBBLE/COACH** | **DRIBBLE/ NO COACH VS NO DRIBBLE/NO COACH** | **NO DRIBBLE/COACH VS NO DRIBBLE/NO COAC** |
|---|---|---|---|---|---|---|
| Def. Reb | ES: 0.07 (-0.57; 0.72)<br>31/52/17% Unclear | ES: 0.00 (-1.67; 1.67)<br>38/24/38% Unclear | ES: 0.21 (-0.80; 1.21)<br>51/31/18% Unclear | ES: -0.21 (-3.39; 2.97)<br>37/13/50% Unclear | ES: 0.17 (-1.07; 1.41)<br>47/29/24% Unclear | ES: 0.21 (-0.90; 1.32)<br>51/30/20% Unclear |
| Of. Reb | ES: -0.98 (-2.52; 0.56)<br>8/6/86% Likely | ES: 0.12 (-1.19; 1.44)<br>44/29/27% Unclear | ES: -0.24 (-1.62; 1.13)<br>22/24/53% Unclear | ES: 0.62 (-0.34; 1.59)<br>84/10/6% Unclear | ES: 0.29 (-1.13; 1.72)<br>57/22/21% Unclear | ES: -0.49 (-1.94; 0.95)<br>15/16/69% Unclear |
| Passes | ES: 0.39 (-0.49; 1.28)<br>70/20/10% Unclear | ES: -2.52 (-2.83; -2.20)<br>0/0/100% Almost certainly | ES: -1.88 (-3.42; -0.34)<br>96/1/3% Very Likely | ES: -2.99 (-3.77; 2.22)<br>0/0/100% Almost certainly | ES: -2.22 (-3.99; -0.45)<br>96/1/3% Very Likely | ES: -0.10 (-1.71; 1.52)<br>32/24/44% Unclear |
| Total shoots | ES: -0.07 (-2.75; 2.60)<br>40/15/45% Unclear | ES: -0.29 (-2.32; 1.75)<br>28/18/54% Unclear | ES: 0.17 (-1.28; 1.63)<br>48/25/27% Unclear | ES: -0.23 (-1.11; 0.63)<br>15/32/53% Unclear | ES: 0.20 (-0.63; 1.04)<br>51/35/15% Unclear | ES: 0.32 (-0.15; 0.79)<br>73/22/4% Possibly |
| 3p shoots | ES: -0.61 (-1.58; 0.35)<br>7/10/83% Unclear | ES: -0.16 (-1.13; 0.80)<br>19/35/46% Unclear | ES: 0.66 (-0.30; 1.66)<br>85/9/6% Unclear | ES: 0.33 (-0.94; 1.60)<br>60/22/17% Unclear | ES: 1.65 (-0.90; 4.20)<br>88/4/8% Unclear | ES: 0.99 (-0.68; 2.66)<br>85/6/9% Unclear |
| 2p shoots | ES: 0.55 (-1.21; 2.31)<br>69/14/17% Unclear | ES: 0.36 (-1.26; 1.98)<br>60/19/21% Unclear | ES: 0.26 (-0.66; 1.18)<br>57/29/14% Unclear | ES: -0.12 (-0.48; 0.23)<br>6/65/29% Unclear | ES: -0.12 (-1.44; 1.20)<br>28/29/44% Unclear | ES: -0.02 (-1.20; 1.15)<br>32/33/35% Unclear |
| Lay-outs | ES: 0.00 (-1.86; 1.86)<br>39/22/39% Unclear | ES: 0.11 (-3.25; 3.48)<br>47/12/41% Unclear | ES: 1.32 (0.31; 2.33)<br>76/0/24% Unclear | ES: 0.11 (-1.39; 1.62)<br>44/26/30% Unclear | ES: 1.32 (0.31; 2.33)<br>76/0/24% Unclear | ES: 1.00 (0.60; 1.40)<br>89/0/11% Unclear |
| Total basket | ES: 0.05 (-1.06; 1.16)<br>37/35/29% Unclear | ES: -0.10 (-1.26; 1.05)<br>26/32/41% Unclear | ES: 0.88 (0.13; 1.63)<br>94/3/3% Likely | ES: -0.14 (-0.54; 0.27)<br>7/58/35% Unclear | ES: 0.82 (-1.15; 2.79)<br>77/9/13% Unclear | ES: 1.04 (-1.44; 3.53)<br>79/7/14% Unclear |
| Total pos. | ES: 2.07 (-0.35; 4.50)<br>92/2/6% Unclear | ES: 13.9 (12.5; 15.3)<br>100/0/0% Almost Certainly | ES: 0.38 (-0.85; 1.61)<br>64/21/15% Unclear | ES: 13.2 (11.9; 14.4)<br>100/0/0% Almost Certainly | ES: 0.10 (-0.84; 1.04)<br>39/38/23% Unclear | ES: -5.21 (-6.04; -4.38)<br>0/0/100% Almost Certain |
| Final success | ES: 0.07 (-0.89; 1.03)<br>36/39/25% Unclear | ES: -0.16 (-1.20; 0.88)<br>21/33/46% Unclear | ES: 0.27 (-0.61; 1.15)<br>59/29/13% Unclear | ES: -0.20 (-0.63; 0.23)<br>6/44/50% Possibly | ES: 0.25 (-1.02; 1.51)<br>54/26/21% Unclear | ES: 0.37 (-1.15; 1.90)<br>61/19/19% Unclear |
| Stops | ES: 3.06 (2.54; 3.58)<br>97/0/3% Very Likely | ES: 0.30 (-1.70; 2.30)<br>55/18/27% Unclear | ES: 0.28 (-1.03; 1.59)<br>56/24/20% Unclear | ES: -1.12 (-2.08; -0.15)<br>3/3/95% Very Likely | ES: -0.20 (-1.16; 0.76)<br>17/33/50% Unclear | ES: 0.18 (-0.71; 1.07)<br>47/36/17% Unclear |

Note: Def. Reb: defensive rebounds; Of. Reb: offensive rebounds; Passes: total succeed passes; 3p shoots: total number of three point shoots; 2p shoots: total number of two point shoots; Lay-outs: number of performed lay-outs; Total pos: total number of possessions; Final success: success in those actions with the possibility to get points; Stops: Total number of official stop.

# Discussion

The aim of the present study was to describe the physiological and technical responses during a 3 vs. 3 SSG with and without positive verbal coach encouragement and dribbling on a female young basketball players. The main findings showed that SSG with coach encouragement elicited greater HR responses and RPE in all formats (with and without dribble), than the SSG without verbal encouragement. In addition, the task constraints did not affect the physiological load but, as expected, promoted a higher number of passes when dribbling was restricted.

However, understanding the effects of task constraints during basketball SSG might allow optimizing practice planning and performance. In this regard, the average HR expressed as $\%HR_{max}$ (90.5 ± 2.5% to 94.7 ± 2.4%) during SSG with verbal encouragement was higher in comparison with SSG without encouragement (87.8 ± 4.8% to 91.7 ± 4.1%). These results are slightly greater than those observed in male junior basketball players (82.2-87.6 $\%HR_{max}$) (Delextrat et al, 2013). However, our results should be analyzed with caution, due to the low number of participants. Interestingly, players spent approximately 75% of total time within the maximal HR zone (>85% $HR_{max}$) during a basketball competition. Based on the present results, it seems that 3 vs. 3 SSG might be an interesting format to simulate the basketball competition intensity. In addition, aerobic high-intensity training has been shown to be superior to moderate continuous training in improving cardiorespiratory fitness (Nybo, Sundstrup, Jakobsen, Mohr, Hornstrup, Simonsen, Bülow, Randers, Nielsen, Aagaard & Krustrup, 2010). Indeed, a high HR achieved during SSG, irrespective of game format, is important for the health profile of female players participating in recreational basketball (Randers et al., 2014). Notwithstanding, future longitudinal studies are warranted to confirm the present assumptions.

Verbal coach encouragement has been investigated in sports such as soccer (Rampinini et al., 2007; Sanchez-Sanchez et al., 2014) or basketball (Gracia et al., 2014) during these SSG practices. Our study extends the finding previously published that verbal coach encouragement increases the physiological response in all SSG formats and, thus, it might be considered as a key variable to modify the players' internal load. Regarding our results, the tasks performed with coach encouragement showed a substantial $\%HR_{max}$ increase in both SSG with dribble (verbal: 92.9 ± 1.9%; no verbal: 91.5 ± 3.3%) and without dribble (verbal: 92.4 ± 3.2%; no verbal: 90.2 ± 3.9%). With effect size likely in this variable, except for SSG with dribble/no coach vs no dribble/coach (-0.24 [-0.79; 0.32]). Nevertheless, these differences might not be enough to produce any substantial adaptation in comparison to the no verbal encouragement condition. Consequently, it may be possible that the low number of participants during the tasks (3 vs. 3) could be the main responsible for the high $\%HR_{max}$ values in both conditions (Gracia et al., 2014; Castagna et al., 2011; Delextrat et al., 2013; Klusemann et al., 2012), irrespective of the SSG constraints.

The positive verbal coach encouragement produced a substantial increase in RPE when SSG was performed without dribbling (verbal: 6.2 ± 1.4; no verbal: 5.3 ± 1.2), i.e., players perceived higher intensity during the task. This psico-biological effect to increase the perceived effort during the verbal encouragement practice has been previously reported in soccer SSG (Rampinini et al., 2007). However, there is no study in basketball players describing the effect of positive verbal coach encouragement in players' RPE during SSG. Notwithstanding, RPE has shown to be sensitive to differ between several SSG based on number of players, court size and work to rest ratio (Klusemann et al., 2012). Based on the present results, it seems that positive verbal coach encouragement might have a great influence in the perceived effort during a SSG task.

One of the most important considerations to improve $VO_2$max is to be within the high intensity zone (>90% $HR_{max}$) as long as possible (Buchheit & Laursen, 2013). As such, a non-significant increment within >90% $HR_{max}$ zone was provided in those situations where dribbling was allowed (verbal: 117.3 ± 57.9 s; no verbal: 110.4 ± 58.3 s) as well as in the no dribbling condition (verbal: 105.5 ± 61.0 s; no verbal: 93.3 ± 67.2 s) when coach encouragement appears. These results are in line with those reported by Gracia et al. (2014) showing no significant differences between verbal and no verbal coach encouragement of U-14 and U-16 players. It may be possible that other SSG modifications (i.e., number of participants) might have more influence to increase the time within a high intensity HR zone. On the other hand, increasing the number of participants could increase the consistency of the results.

Although there is information about the influence of verbal coach encouragement on physiological load (Rampinini et al., 2007; Sanchez-Sanchez et al. 2014; Gracia et al., 2014), this is the first study to analyze the influence of positive verbal coach encouragement in technical actions during a basketball SSG. One of our assumptions was that positive verbal encouragement might have a greater effect during the defensive phase (increasing defensive intensity) and, thus, the offensive actions would be impaired. In this regard, a substantially higher number of stops appeared during dribbling and positive verbal coach encouragement SSG (verbal: 4.33 ± 1.53; no verbal: 2.00 ± 0.01). Interestingly, there were no substantial differences in the rest of variables with the exception of the number of offensive rebounds (verbal: 4.33 ± 1.53; no verbal: 2.00 ± 0.01). These results seem to suggest that positive verbal coach encouragement might have promoted increased in defensive intensity without a decrement in the number and type of shoots.

Technical alterations are one of the most adopted strategies to modify the training load in team sports (Conte et al., 2016). In our study, substantial differences existed during SSG with/without dribbling in passes and total number of possessions. Technical conditions may allow addressing the motor behaviors presented throughout an unexpected situation. Consequently, it may be possible that we can constrain specific behaviors instead of other technical actions. For example, it seems that dribbling prohibition might decrease individual actions chances and improve focus in collective actions, promoting passing as a key element of the game (Conte et al., 2016). Consequently, it is likely that limiting any technical action (dribbling) may influence the presence of other technical actions.

However, the dribbling prohibition did not induce statistically different physiological load or RPE, while Conte et al. (2016) reported statistically higher physiological load and RPE in young male basketball players (4 vs. 4). This discrepancy could be explained by different number of players or different gender. In addition, it is possible that this format (3 vs. 3) may improve aerobic power in female basketball players due to more than 50% of time was spent above the 90% intensity zone and this requirement is needed to improve $VO_2$max (Sampaio et al., 2009). Thus, it seems that this training drills (3 vs. 3) might be used to enhance the basketball players' conditioning.

Some limitations are presented in this study, which should be taken into consideration for future research. It is necessary to include other variables, if measured with highly reliable technology, such as distance covered and speed zones or accelerations/decelerations to better understand the external load during the SSG. Moreover, although each condition was performed using three bouts, the sample should include a higher number of subjects to improve the conclusion generalization. Data collected on young female recreational basketball players might not be generalizable to other gender and/or competitive level. Finally, the low number of participants can reduce the reliability of the results.

## Conclusion

The present findings should allow to those teams (i.e., recreational) which are involved in a few basketball sessions per week (2 sessions) to simultaneously optimize both physiological and technical responses through an appropriate modification within the SSG. Allowing or not the dribble will likely maintain the internal load while varying the technical actions. The higher HR observed in this study suggests that SSG can be used to improve physical fitness and technical skills. In particular, the SSG with verbal encouragement should be selected by coaches to focus in physiological load, and SSG without dribbling would be particularly useful to enhance collective behavior, without limitations in physiological load.

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