

Physical and physiological demands of basketball small-sided games: the influence of defensive and time pressures

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ABSTRACT: Different small-sided games (SSG) can be used by coaches to induce specific demands on athletes during team sports training. In basketball, defensive and time pressures are common stressors experienced by players during official matches. However, no studies have investigated the effect of changing these variables in SSG during training. We compared the physical and physiological demands of three basketball SSG performed in a half court with two hoops: 3vs3 with man-to-man defence in the half playing area, 3vs3 with man-to-man defence in the full playing area, and 3vs3 with a reduced shot-clock (3vs3HALF, 3vs3FULL, 3vs3RT, respectively). Twelve male U-17 basketball athletes formed four balanced teams. Each team played the three SSG against each other in a random order, totalling 18 SSG. During the SSG, the players wore triaxial accelerometers and heart rate monitors. SSG were filmed to record the players' motor actions. The results showed that 3vs3FULL ($p=0.004$, $d=0.42$, small-to-moderate effect) and 3vs3RT ($p=0.026$, $d=0.33$, small-to-moderate effect) increased the time spent in higher acceleration zones compared to 3vs3HALF. Both 3vs3FULL and 3vs3RT presented more transition sprints compared to 3vs3HALF. The 3vs3FULL also presented more fakes and the 3vs3RT presented more jumps compared to the 3vs3HALF. Physiological responses presented no differences between the SSG formats. In conclusion, defensive and time pressures increase the physical demand in 3vs3 SSG performed in the half court. The three SSG investigated in this study presented mean heart rate values close to 90% of the maximum heart rate, which suggests that these SSG may be used to increase athletes' aerobic performance.

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INTRODUCTION

Small-sided games (SSG) are commonly used during training in team sports because they simultaneously stimulate technical, tactical, and physical requirements of the formal game [1,2]. Coaches and physical trainers can choose SSG characteristics, such as the playing area, to emphasize different tactical-technical behaviours [3,4], motor actions [5], or physiological responses [6,7]. From the perspective of physical conditioning for basketball, studies have investigated the acute effects of varying numbers of players per team [8,9], playing areas [10,11], work-to-rest ratios [5,12,13], and the offensive and defensive phases [13] on the physical and physiological demands imposed on athletes.

Nevertheless, two important aspects in basketball that have not been investigated in SSG are the type of defence adopted and shot-clock duration. During a formal game (i.e. 5vs5 with all official rules), coaches may change the type of defence for many reasons, such as opponents' ability to play near/far from the basket, match status (i.e.

winning/losing), and time left for the match to end [14,15]. Defensive pressure, such as man-to-man defence in the full court, can be adopted to induce offensive mistakes and decrease the time available for the opposing team to organize the offense [15,16]. Additionally, basketball is a highly time-constrained game, which requires athletes to manage their time efficiently in many situations (e.g. transporting the ball to the offensive court, playing post inside the opponents' lane), including shooting near the end of the match, quarter, or any ball possession. Therefore, the use of defensive and time pressures during game-based training activities, such as SSG, is essential to prepare athletes for game conditions. These activities may also be designed to improve athletes' physical conditioning [17], which requires knowledge of its physical and physiological demands.

Only two studies have investigated the influence of the type of defence on the physical and physiological responses in basketball SSG. Dehesa et al. [18] reported a higher mean heart rate (HR)

during SSG with man-to-man defence compared to zone defence in professional basketball players. Roman, Molinuevo, and Quintana [19] also found a longer time spent in high-intensity exercises when the level of opposition was higher in elite basketball athletes (aged 17–18 years). However, regarding man-to-man defence, most of the studies did not present clear information about where on the court the defence should be set [10,20,21]. Considering that man-to-man defence can be set in the full court, half court, or quarter court [14,16], the investigation on the different types of man-to-man defence is important to better understand the demands imposed on athletes during the training process. Considering the previous results, we can expect that an increase in the area where man-to-man defence is performed would increase the physical and physiological demands imposed on athletes.

Regarding the time pressure, only Klusemann et al. [5] justified the use of a 12-second shot-clock during SSG performed on the half court. This shot-clock duration was based on the results of a pilot study, which showed that 24 seconds was excessive to promote high-intensity exercise. Thus, a reduced shot-clock could increase the physical and physiological demands during SSG compared to a longer shot-clock, possibly due to higher speeds reached during the offensive movements, as well as a higher number of transitions within a given bout duration. However, to our knowledge, most of the studies on basketball SSG did not report any information on shot-clock duration.

Therefore, this study aimed to determine the physical and physiological demands of three basketball SSG: i) 3vs3 with man-to-man defence in the half playing area, ii) 3vs3 with man-to-man defence in the full playing area, iii) 3vs3 with a reduced shot-clock. We selected these SSG formats because of the importance of defensive and time pressures during the formal game and their possible effects on the physical and physiological demands during SSG training.

MATERIALS AND METHODS

Participants

Twelve male U-17 basketball athletes (four guards, four forwards, four centres) from one club participated in the study (age: 17.01 ± 0.24 years, stature: 186.8 ± 7.0 cm, body mass: 72.2 ± 9.0 kg). The team participated in state-level competitions and had five technical-tactical (approx. 90 minutes) and three strength-conditioning (approx. 60 minutes) training sessions per week. This study is part of a larger research project on basketball SSG and was conducted in accordance with the current national and international laws and regulations governing the use of human subjects (Declaration of Helsinki II).

Experimental approach to the problem

This was a crossover study that compared the physical (accelerations, motor actions) and physiological demands (heart rate, time spent in lactate zones) of three different SSG performed in the half court (3vs3 with man-to-man defence in the half playing area – 3vs3HALF, and

3vs3 with a reduced shot-clock – 3vs3RT). The participants were divided into teams and took part in the three experimental conditions, randomly performing all the possible combinations of game types between teams, as discussed in detail later in this section. Data collection occurred within a 5-week period at the beginning of the season, comprising 9 sessions always carried out at the beginning of the team's regular training session (20:00–22:00).

In the first session, we assessed athletes' body mass, stature, and aerobic performance (Yoyo Intermittent Recovery Test level 1 – Yo-YoIR1). Then, the coach of the squad chose one guard, one forward, and one centre to compose each team (A, B, C, and D), so that these teams could be balanced to play 3vs3. The coach's intentional allocation of players to teams was performed to avoid possible technical-tactical imbalances between teams caused by random allocation of players. In addition, previous studies on soccer reported that SSG played by teams balanced for aerobic performance presented a higher intensity exercise [22] compared to other teams' composition criteria. For this reason, we calculated the mean distance covered by each team during the Yo-YoIR1. The difference between the best and worst conditioned teams was approximately 180 m – 10% of teams' mean performance. Therefore, the teams were also considered balanced for aerobic performance and kept for the whole study.

In the second session, the athletes were familiarized with the SSG, performing one 5-minute bout of each SSG type, and any questions with respect to the rules of each SSG were clarified. In the third session, the athletes performed an incremental aerobic test and blood samples were collected at the end of each test stage for further

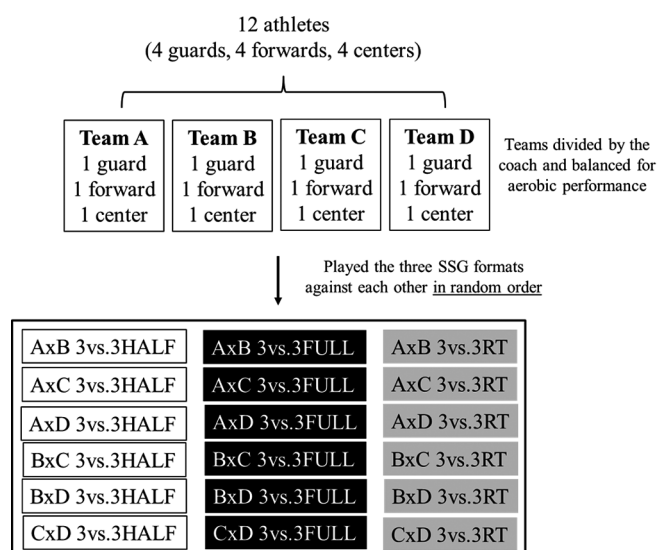


FIG. 1. Experimental design of the study.

Legend: 3vs.3HALF, 3vs.3FULL, 3vs.3RT = small-sided games with man-to-man defense on half court, small-sided games with man-to-man defense on full court, and small-sided games with reduced shot clock, respectively.

analysis of lactate concentration. Lactate data were further used to characterize the physiological demand of the SSG.

In the following sessions, the teams played each SSG type against each other team once (i.e., Avs.B, Avs.C, Avs.D, Bvs.C, Bvs.D and Cvs.D = 6 SSG). Therefore, eighteen SSG were performed, six of each type, in a random order (Figure 1). Each SSG was played as two 5-minute bouts with a 3-minute passive recovery between bouts.

Small-sided games

The 3vs3HALF was performed on a 15x14 (length x width – half court) meter court with two hoops opposite the 15 m length [5]. We chose this playing area because it allows players to perform fast breaks towards the opposite basket, which is more specific to the formal game (5vs.5) dynamics. All the rules provided by the International Basketball Federation were adopted, except for the time-outs and free throws, which were excluded. The shot-clock was also changed to 12 seconds in order to induce a high physiological demand, as suggested by Klusemann et al. [5]. We also found, based on pilot data, that professional athletes from the same club took 7–8 seconds to shoot to basket during a 3vs3 SSG with no shot-clock played on the playing area chosen for this study. Therefore, we decided to keep the 12-second shot-clock suggested by Klusemann et al. [5] and believed that it would be appropriate for the U-17 athletes who participated in the study. After any fouls or scored shots, the ball was quickly put back into the game from the side or base lines. Two chronometers near the base lines indicated the shot-clock. The athletes were asked to play man-to-man defence in the half playing area (i.e. from the midcourt line that divided the playing area in two halves).

In the 3vs3FULL, the athletes were asked to play man-to-man defence in the full playing area after a shot was scored. In the 3vs3RT, the shot-clock lasted 6 seconds, and man-to-man defence was set in the half playing area. Based on the pilot study, we believed that the 6-second shot clock would guarantee time pressure on the athletes during the SSG. All other conditions in both SSG were the same as in the 3vs3HALF.

Physical demand – accelerations and motor actions

Acceleration in the three movement axes (i.e., “a_x”, “a_y” and “a_z” – vertical, side-side, and backward-forward) were recorded using tri-axial wireless accelerometers (Delsys Trigno Wireless EMG System, Delsys Inc., Boston, EUA) with a 148 Hz sampling rate. We tested the reliability of the accelerometers during a repeated task of mechanical vibration at three frequencies (8, 10, and 12 Hz), using specially designed equipment with an eccentric axis driven by a motor (SIEMENS, Germany) and controlled by a frequency inverter (WEG, Germany). The magnitude of accelerations was the same in repeated trials with the same vibration frequencies. During the SSG, the accelerometers were positioned near the athletes’ lower back, inside a pouch attached to an elastic belt.

Acceleration data were smoothed and analysed using the software MATLAB R2010a (The MathWorks Inc., Natick, Massachusetts, USA). We calculated the instantaneous resultant acceleration for each time point of the acceleration signal, through vector summation. Then, the gravity acceleration was subtracted from the resultant acceleration value calculated for each time point. The data were smoothed using a Butterworth low-pass filter (zero-lag, 4th order, 15 Hz cut-off frequency), similar to previous studies on team sports [23].

In indoor sports, the acceleration data are directly collected from accelerometers and not differentiated from the position data recorded by the GPS as in outdoor sports [24]. For this reason, the magnitude of accelerations recorded and the selection of intensity zones cannot be used like data provided by a GPS. We considered the time spent in acceleration zones as an informative variable that describes the volume of activities of different exercise intensities. As there are still no recommendations that support magnitude zones for acceleration data in basketball, we determined four arbitrary zones and calculated the time athletes spent in each zone: zone 1 (0–0.5 g), zone 2 (>0.5–1.0 g), zone 3 (>1.0–1.5 g), and zone 4 (>1.5–2.0 g). Acceleration data above 2.0 g represented a very low frequency among all athletes (around 6 seconds or 2% of the data) and therefore were excluded from the analyses.

TABLE 1. Criteria defined for the motor actions performed during the small-sided games.

Motor Action	Criteria
Jumps	Jump actions involving the loss of contact of both feet with the ground.
Defensive actions	The adoption of a defensive stance (half squat position) with knees and hips’ flexion used to avoid opponent’s progression.
Fakes	Displacements involving change of direction or rhythm with or without the ball performed to overcome or mislead the opponent and receive a pass, cut towards the basket, or shoot. Shoot and pass fakes, reversing movements, and cross over running were also considered in this category.
Dribbles to the basket	Displacements towards the basket (must go through the lane area) while dribbling the ball.
Transition sprints	Fast displacement from the defensive to the offensive court (and vice-versa) to overcome the opponent or perform/avoid a fast-break (i.e. offense with numeric superiority or against a disorganized defense).

The motor actions performed by the athletes during the SSG were recorded by an observer who watched the videos of all SSG. A second observer also analysed part of the videos for reliability purposes. The recording of motor actions aimed to better understand the possible differences found for the acceleration values in each SSG format. Therefore, we chose some motor actions that are considered to require a high acceleration magnitude in the different movement axes (Table 1). Some of these actions have been reported in studies on the official basketball game, such as jumps, sprints, and shuffling movements [25].

Within- and between-observer reliability for the motor actions were assessed based on the reanalysis of three SSG (i.e. 16% of the SSG, more than the 10% recommended in previous studies) [26]. Reanalyses were carried out 21 days after the end of the initial analyses to reduce observers' familiarity with the games. The Krippendorff alpha (a reliability coefficient for nominal data) [27] values were 0.76 (95% CI 0.73–0.79) and 0.98 (95% CI 0.98–0.99) for between- and within-observer reliability, respectively.

Physiological demand – mean heart rate and time spent in different lactate concentration zones

The physiological demand was characterized by the percentage mean heart rate (HR_{MEAN}) and the percentage time spent in three intensity zones: below the aerobic threshold (lactate concentration < 2 mM); between the aerobic and anaerobic threshold ($2 \text{ mM} \leq$ lactate concentration < 4 mM); and above the anaerobic threshold (lactate concentration ≥ 4 mM).

The HR_{MEAN} was calculated as the mean of all values recorded by HR monitors (Polar RS800, Polar, Finland) during two 5-minute SSG bouts (HR values of the rest intervals were excluded). The HR values were relativized by the peak HR presented by each athlete in the Yo-YoIR1.

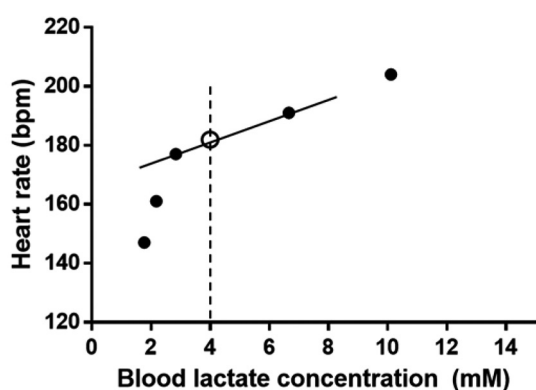


FIG. 2. Heart rate and blood lactate concentration values presented by an athlete during the incremental aerobic field test. Legend: the full line indicates the line established for calculating the heart rate associated to the 4mM threshold using linear interpolation.

The HR related to aerobic and anaerobic thresholds were assessed associating the HR with the blood lactate concentration recorded during an incremental aerobic field test [28,29]. The test consisted of a shuttle running on a 20-meter path during successive 4-minute stages with 1 minute of passive recovery between stages. A blood sample was collected from the fingertips during the 1-minute intervals for further analysis of lactate concentration. The running speed during the test started at 8 km/h and incrementally increased by 1.2 km/h at each stage. The mean HR value recorded during the last 15 seconds of each stage was associated with the lactate concentration found in that stage. The highest lactate concentration value observed below 4 mM and the lowest lactate concentration value observed above 4 mM and the mean HR values recorded in those stages were used to establish the coefficients of a linear equation (Figure 2).

This equation was used to calculate the HR corresponding to the 4 mM lactate concentration, using linear interpolation. The same procedure was performed to calculate the HR associated with the 2 mM threshold. These thresholds were used to calculate the percentage of time spent in each intensity zone using the HR values recorded during the SSG.

Statistical analyses

The physiological variables and the time spent in the different acceleration zones were analysed as the mean of the two SSG bouts. The motor actions were analysed as the sum of the actions performed by each athlete during the SSG. Therefore, the values obtained for each athlete were used to calculate the mean and standard deviation of each variable. The variables did not present any significant deviations to normality or sphericity. A one-way repeated-measures analysis of variance and the least significant difference post hoc test were used to compare the means of each variable between SSG formats. Cohen's d effect size was calculated to characterize the magnitude of the significant differences in paired comparisons and classified as small (0.2), moderate (0.5), or large (0.8) [30]. Intermediary classifications were assigned to intermediary values (e.g. if $d = 0.30$, the effect size was considered small-to-moderate) [30]. All the analyses, except for effect size, were carried out in SPSS 19.0 (IBM, Chicago, USA). Statistical significance was set at a p value of 0.05.

RESULTS

Two athletes did not participate in the field test for the assessment of lactate thresholds. Therefore, the variables $T < 2$ mM, $T2-4$ mM, and $T > 4$ mM represent the data of only 10 athletes. The accelerometers presented technical problems in three SSG, one of each type. Therefore, the variables related to acceleration represent the data of fifteen SSG.

Figure 3 shows the motor actions performed in the three SSG formats. The 3vs.3RT presented a higher frequency of jumps compared to 3vs.3HALF ($p=0.009$, $d=0.51$, moderate effect) and 3vs.3FULL ($p=0.001$, $d=0.75$, moderate-to-large effect). The

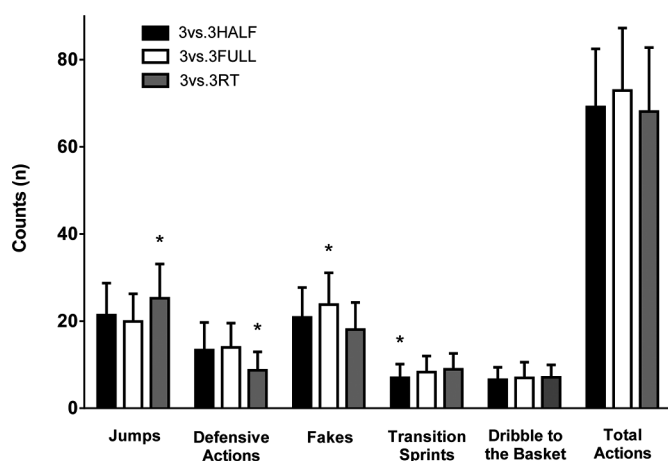


FIG. 3. Means (standard deviations) of the frequency of motor actions performed per athlete in the three SSG formats. Legend: 3vs.3HALF, 3vs.3FULL, 3vs.3RT = small-sided games with man-to-man defense on half court, small-sided games with man-to-man defense on full court, and small-sided games with reduced shot clock, respectively. Values represent the mean of the three playing positions.

*significantly different compared to the other two SSG formats

3vs.3RT also presented a lower frequency of defensive actions compared to 3vs.3FULL ($p=0.002$, $d=1.05$, large effect) and 3vs.3HALF ($p=0.001$, $d=0.87$, large effect). The 3vs.3FULL presented a higher frequency of fakes compared to 3vs.3HALF ($p=0.010$, $d=0.41$, small-to-moderate effect) and 3vs.3RT ($p=0.001$, $d=0.85$, large

effect). The 3vs.3HALF presented a lower frequency of transition sprints compared to 3vs.3RT ($p=0.006$, $d=0.57$, moderate effect) and 3vs.3FULL ($p=0.054$, $d=0.38$, small-to-moderate effect).

Table 2 shows the physical and physiological variables in the three SSG formats. The 3vs.3HALF presented significantly lower TZ2 compared to 3vs.3FULL ($p=0.004$, $d=0.42$, small-to-moderate effect) and 3vs.3RT ($p=0.026$, $d=0.33$, small-to-moderate effect). For the physiological variables, only $T<2$ mM was significantly lower in 3vs.3RT compared to 3vs.3HALF ($p=0.025$, $d=0.64$, moderate effect).

DISCUSSION

Physical demand

This study compared the physical and physiological demands of three basketball SSG formats. The results showed that the defensive and time pressures increased the physical demand of the 3vs3 SSG, with a higher number of different intense motor actions. These findings are in line with a previous study that found an increased exercise intensity (time spent in different heart rate zones) with a higher level of opposition in 1vs1, 2vs2, 2vs1, and 3vs2 basketball SSG. Although this study analysed athletes' physiological response, the authors suggested that the increase in exercise intensity was related to an increased physical effort to overcome defenders in the condition with a higher level of opposition [19]. This rationale is in line with the higher number of fakes found in the 3vs3FULL, which indicates that players had to perform more actions to become unmarked and create opportunities to shoot. Moreover, the 3vs3RT induced higher frequencies of jumps, transition sprints, and dribbles to the basket, as well as a lower frequency of defensive actions compared to the

TABLE 2. Mean (standard deviation) of the physical and physiological variables in the three SSG formats.

	3vs.3RT	3vs.3HALF	3vs.3FULL
TZ1 (0–0.5g) (s)	190.91 (28.62)	197.20 (25.97)	188.24 (25.13)
TZ2 (>0.5–1.0g) (s)	92.90 (26.38)	84.71 (23.12)*	94.34 (23.08)
TZ3 (>1.0–1.5g) (s)	10.46 (2.42)	10.53 (3.64)	11.86 (3.22)
TZ4 (>1.5–2.0g) (s)	2.14 (0.73)	1.93 (0.82)	2.07 (0.66)
HR _{MEAN} (%HR _{PEAK})	88.03 (5.38)	88.15 (4.16)	88.36 (3.76)
T<2mM (s)	1.29 (2.02) #	2.98 (3.08)	2.67 (3.70)
T2–4mM (s)	46.40 (30.51)	44.93 (29.45)	45.76 (31.47)
T≥4mM (s)	52.30 (31.43)	52.09 (30.27)	51.58 (32.81)

Legend: 3vs.3HALF, 3vs.3FULL, 3vs.3RT = small-sided games with man-to-man defense on half court, small-sided games with man-to-man defense on full court, and small-sided games with reduced shot clock, respectively. TZ1, TZ2, TZ3, and TZ4 = time spent in the zones of acceleration 1 (0–0.5g), 2 (>0.5–1.0g), 3 (>1.0–1.5g), and 4 (>1.5–2.0g), respectively. HR_{MEAN} (%HR_{PEAK}) = percentage mean heart rate; T<2mM = time spent in lactate concentrations below 2mM; T2–4mM = time spent in lactate concentrations between 2 and 4mM; T≥4mM = time spent in lactate concentrations above 4mM.

* significantly different compared to the other SSG formats.

significantly different compared to 3vs.3HALF, $d=0.64$, moderate effect.

3vs3HALF. These data suggest that the time pressure increased the number of rapid transitions, so that players in offense could prevent defenders from establishing an organized defence. In addition, the higher number of jumps was probably caused by the higher number of total ball possessions – determined by the shorter shot-clock in this SSG format. Therefore, the increase in the frequency of ball possessions led to a higher number of shots on basket, requiring players to jump.

Defensive and time pressures also increased the time spent in acceleration zone 2, which corresponds to 5–10 m/s². Previous studies reported acceleration values (measured with triaxial accelerometers, as in this study) of 5–10 m/s² during treadmill running at 8–12 km/h [31], which may be arbitrarily considered a moderate-intensity running for U-17 basketball athletes. Based on these data, we can state that defensive and time pressures increased the moderate-intensity activity of the 3vs3 SSG investigated in this study. It is important to highlight that the small court area (15x14 m) used in this study may have caused a ceiling effect on the speeds reached by the athletes during the SSG, which is supported by previous studies in soccer that found a decrease in mean speed (or total distance covered within a given time) with the reduction in the available area [32,33]. Thus, the speeds reached during the 3vs3 SSG investigated in this study may not be comparable to those that can be reached during a full court game. On the other hand, the significantly higher number of fakes and jumps found in 3vs3FULL and 3vs3RT are very short motor actions, which may have precluded the finding of significant differences in the higher intensity acceleration zones (i.e. TZ3 and TZ4).

The results above corroborated our hypothesis and suggest that coaches can use defensive pressure and time pressure to increase the physical demand imposed on athletes in a 3vs3 SSG performed in a half court. For practical application, it is important to highlight that, although these pressures induce similar increases in SSG accelerations, the types of actions performed are different (jumps in the 3vs3RT and fakes in the 3vs3FULL). The results of this study provide an insight for coaches to choose an SSG with an appropriate type of movement/action that matches the objectives of the training sessions. For instance, the SSG with a reduced shot-clock may be used as part of plyometric training, since the time pressure significantly increases the frequency of jumps. On the other hand, the SSG with defensive pressure could be used to complement agility training, since it increases the number of fakes (changes of rhythm/direction) performed by athletes, within a decision-making context.

Physiological demand

Regarding the physiological response, only the 3vs3RT presented a significantly lower time spent in the lowest lactate concentration zone (<2 mM). However, the time spent in this zone represented only 3% (approx. 10 seconds) of the total bout time in the three SSG formats. Therefore, we considered that this difference does not represent practical significance. Based on the reports of Roman,

Molinuevo, and Quintana [19] and Klusemann *et al.* [5], we expected an increased physiological response with both defensive and time pressures, respectively, which did not occur in this study.

Klusemann *et al.* [5] did not present the data of their pilot study on the effects of changing the shot-clock duration on the physiological demands, which limited the discussion of the effect of time pressure. Nevertheless, for defensive pressure, Roman, Molinuevo, and Quintana [19] observed an increase in the physiological response when the level of opposition was higher. The difference between the results of Roman, Molinuevo, and Quintana [19] and our findings may be related to the exercise intensity reached during the SSG investigated in the two studies. In that previous study, only 6% of the SSG's total duration was spent above the ventilatory threshold. In this study, 50% of the bout duration was spent in lactate concentrations above 4 mM and, approximately, 45% between 2 and 4 mM. These data show a higher exercise intensity in the SSG performed in the present study, reaching HR values close to peak HR, even in the 3vs3HALF (without defensive and time pressures). Considering that HR is directly related to oxygen consumption [34], the HR values in this study suggest that the aerobic energy production was near its maximum capacity during the three SSG formats. Therefore, the differences found in the physical demand between SSG formats (3vs3FULL and 3vs3RT > 3vs3HALF) were not accompanied by the HR response, which remained close to the individual's maximum values.

The HR results of the present study are in line with previous studies on 3vs3 basketball SSG [10,20,21,35,36], which found mean HR values between 80 and 90% of the peak HR in athletes aged between 15 and 18 years. In addition, these HR values were similar to those found in official matches, in which athletes spent 75% or more of the total duration with their HR above 85% of the maximum HR [37,38]. In practice, these data reinforce the usefulness of SSG for the improvement of aerobic performance in basketball. Therefore, coaches and physical trainers can align their training objectives, by creating a high-intensity physiological stimulus within a tactical-technical context.

Limitations of the study and future perspectives

Regarding limitations of this study, it is important to highlight that the results apply to the 3vs3 SSG investigated. The influence of defensive pressure and reduction of the shot-clock on the physical and physiological demands should be investigated in other SSG formats (i.e. larger court areas, different number of player), as well as in athletes of different categories and competitive levels. The conclusions for defensive pressure apply only for man-to-man defence, whereas other types of defensive pressures (e.g. zone, mixed) may be used by coaches. Therefore, more research is needed to fully comprehend the impact of different defensive pressures on the physical and physiological demands of basketball SSG. In addition, the establishment of the acceleration zones used in this study was arbitrary. Future studies should associate acceleration data with specific

motor actions and other intensity parameters to better support the acceleration zones.

CONCLUSIONS

In conclusion, both defensive and time pressures can be used by coaches to increase the physical demand imposed on athletes during 3vs3 SSG formats performed in the half court. Moreover, both defensive and time pressures increased the number of transition sprints performed by athletes. However, only the 3vs3FULL significantly increased the number of fakes and only the 3vs3RT significantly increased the number of jumps. The three SSG formats investigated in this study induced mean heart rate values to around 90% of the maximum heart rate and may be used to increase athletes' aerobic performance.

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