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Research article

Physiological Responses and Technical-Tactical Performance of Youth Basketball Players: A Brief Comparison between 3x3 and 5x5 Basketball

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Abstract

This study aims to examine youth players' physiological responses and technical-tactical performance when playing simulated 3x3 and 5x5 basketball games. Fifteen well-trained male basketball players (16.6 ± 0.2 years old) participated in scrimmage basketball games under two different conditions: 3x3 (half-court) and 5x5 (full-court). The players' heart rate, muscle oxygen saturation and total hemoglobin data were collected and computed to describe physiological responses, while video analysis was used to characterize their technical-tactical performance. A Bayesian one-way analysis of variance (ANOVA) was used to quantify the predictive influence of both game conditions on the physiological and the technical-tactical variables. The results indicated that different game conditions influenced the players' physiological responses slightly, as only hemoglobin sample entropy increased between the 3x3 and 5x5 game scenarios. Conversely, statistical differences in most of the technical-tactical variables were moderate and decisive in favour of the game condition model. Overall, this study emphasizes that playing 3x3 and 5x5 basketball games lead to relatively negligible differences in the players' physiological response but pronounced variations in their technical-tactical performance. Therefore, important implications may be drawn to the applied field as the specificity of technical-tactical adaptations when playing 3x3 or 5x5 formats should be considered by basketball coaches to better design the training sessions for players that fall within our sample age category.

Key words: Youth basketball competitions; performance analysis; technical-tactical skills; physiological response.

Introduction

Basketball is a team sport involving intermittent high-intensity activities interspersed with low intensity and recovery periods (Garcia et al., 2021). Thus, the players are required to perform repetitive maximal or near-maximal efforts that require high levels of agility and power to achieve an advantage during a competition (Vazquez-Guerrero et al., 2019). According to literature, the players perform an average of 105 high-intensity and short-duration actions (2 - 6 seconds) during a basketball game, each attempt occurring every 21 seconds. Therefore, during competitive games, the players' mean heart rate values fluctuate between 80% - 95% of the maximal heart rate and the mean blood lactate concentrations range between 3.2 mmol/L and 6.8 mmol/L (Ben Abdelkrim et al., 2007; Puente et al., 2017). Other studies quantified the sprint intensity during competitive games at about 15.3 ± 14·8 $m \cdot min^{-1}$ (Scanlan et al., 2011) and about 19.1 ± 4.2 $m.min^{-1}$ with junior elite players (Ben Abdelkrim et al., 2010).

Basketball is also a highly strategic game, as the teams set up and run multiple standardized offensive plays and sophisticated defences with constant tactical adjustments, which require the players to co-adapt their behaviours to the intrinsic variability of the game dynamics (Ramos-Villagrasa et al., 2012). Therefore, it is extremely important for basketball coaches to recognize the events that can interfere with the individual and collective performance during a competition, to optimize the training planning and periodization, and thus, to improve the probability of being successful (Mateus et al., 2021; Sampaio et al., 2018). In this context, the players' technical-tactical performance has been widely studied in order to identify the actions that relate the most with successful performances (Sampaio et al., 2016). For instance, Ibanez et al. (2009) revealed that in different competitive contexts (i.e., regular season or playoffs), variables such as free throws, three-point field goal attempts and assists may emerge as key performance indicators. Further, Sampaio et al. (2010) showed that stronger teams present better results in 2-point field goals and passes, while weaker teams tend to perform poorly on defensive rebounds. Thus, the key technical-tactical actions for successful performances are widely used by coaches, leading to the development of effective training environments that maximize the learning opportunities (Mateus et al., 2020; Mateus et al., 2019).

In line with this reasoning, it is widely known that basketball coaches often use *3x3*scrimmages to improve the players' ball handling skills, which make the workouts more effective (i.e., the players become more actively involved, focused and pleased with the task) while affording similar perceptual-motor demands to the competitive events (Sampaio et al., 2009). With recent introduction into the Olympic program of the 2020 Summer Olympics, 3x3 basketball has enjoyed a notorious growth in popularity and started to be played in various competitive professional and amateur leagues. Although it is often misconceived as a simple version of regular basketball, 3x3 owns its specific dynamics due to different rules of the game (FIBA, 2018). Such differences include

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rosters of four players (i.e., three starters and one reserve, without substitution restrictions), a small court (i.e., the length of a regular basketball half-court minus one meter) with just one basket, a specially engineered ball (same weight but smaller size), a shot clock of twelve seconds long and a single period of ten minutes (i.e., game over at 21 points) (FIBA, 2018). However, few studies have addressed the players' profiles during 3x3 basketball games so far. For instance, Montgomery and Maloney (2018) found that male and female basketball players presented a high cardiovascular response (i.e., approximately 83% of the average peak game heart rate) during 3x3 games. Besides, in 3x3 games the players are required to perform constant high-speed inertial movements, which result in more jumps, distance covered at high-speed thresholds, accelerations and decelerations (Willberg et al., 2022). Regarding the players technical-tactical performance, basketball research revealed that free throws, turnovers and recovered balls were the most discriminatory variables between winning and losing teams (Conte et al., 2019).

Although these findings provide an important comprehensive understanding of the 3x3 basketball, to our best knowledge, there is no research exploring the differences between 5x5 and 3x3 basketball in U-17 youth players both at the physiological and technical-tactical levels. Considering the specific features of 3x3 game and insufficient ability of adolescent players to accurately perceive the environmental information (Esteves et al., 2011; Sampaio et al., 2004), different technical-tactical profiles may emerge. Concomitantly, different physiological responses are expected, as young players are still reaching maturation (Guimaraes et al., 2021; Torres-Unda et al., 2012). Therefore, further research is required to clarify these assumptions. Indeed, the assessment of these particular aspects would enable coaches to improve the training periodization and their ability to administer proper training plans, contributing to the youth basketball players' development and ultimately promoting readiness to perform in 3x3 and 5x5 competition events. Therefore, the purpose of this study was to examine youth players' physiological responses and the differences in technical-tactical performance when playing simulated 3x3 and 5x5 basketball games. Based on the above rationale, we expected changes in the players' techno-tactical performance in the 3x3 and 5x5 basketball games due to their slightly different characteristics (i.e., number of players, game rules and court characteristics), which might result in distinct physiological demands for game conditions and rules.

Methods

Participants

Fifteen Lithuanian well-trained male basketball players under-17 (age: 16.6 ± 0.2 years; height: 1.86 ± 7.1 m; weight: 81.1 ± 8.8 kg; wingspan: 1.86 ± 7.2 m) from the same team, competing in 3x3 and 5x5 competition events organized by the Lithuanian Basketball Federation volunteered to participate in the study. The players were engaged in four training sessions per week (120 minutes per session) and participated in a match during the weekend. The training sessions had the following structure of warm-up; basketball drills, focusing on the acquisition and improvement of technical and tactical skills; small-sided basketball games; and 3x3 and 5x5 basketball games. All the participants were healthy, without muscular, neurological and tendon injuries. The players, their legal guardians, and their coach were fully informed about their rights and commitment to participation in this study, and provided informed and written consent before the study commenced. Besides, the participants were informed that they were free to withdraw at any time without any penalty. The study protocol was approved by the local Institutional Research Ethics Committee (SA-EK-21-04) and conformed to the recommendations of the Declaration of Helsinki.

Design

Familiarization procedures were performed one week before the data collection. To ensure the assembly of balanced teams, the players were divided into three homogeneous 5x5 and five 3x3 teams according to the coach's perception of their ball control, field-goal shooting, passing skills and knowledge of the game. Each team completed four games in both game formats (first all 3x3 games and then 5x5 games) during two in-season training sessions. The duration of each game was five minutes interspersed with a five-minute passive recovery period (i.e., the players were allowed to drink water during the recovery period) to ensure that the players maintained an adequate performance potential (Paulauskas et al., 2018). To encourage high work-rate, free verbal support was given to all players by their coach, but no technical-tactical feedback was allowed. In the offence, the players used the set plays of the team, but in the defence man-to-man defence was prescribed. All the games were refereed by the head coach and played following the official 3x3 and 5x5 basketball rules (i.e., different court dimensions, offense time and ball size were applied). To reduce the stoppage time, no free-throws were awarded and in the case of the ball going off, several balls were placed around the court to ensure that the ball was replaced as fast as possible.

Data collection and processing

The physiological analysis consisted of using the players' heart rate (HR), muscle oxygen saturation (SmO_2) and total hemoglobin (tHb) values for each game scenario. HR data were collected using individual Polar® heart-rate monitors at 0.2 Hz (Polar Team System, Polar Electro, Kempele, Finland) while SmO_2 and tHb values were recorded using a Near-infrared spectroscopy (NIRS) device - Moxy® (Moxy, Fortiori Design LLC, Minnesota, USA). One NIRS monitor was affixed using a double-sided adhesive tape over the dominant leg in the distal part of the vastus lateralis muscle belly (i.e., 10 cm above the proximal border of the patella). Skinfold thickness at each site was measured using a skinfold calliper (Harpenden, C-136) to ensure that the skinfold thickness was less than half the distance between the emitter and the detector (25 mm). The signals were captured at 10 Hz and the data were smoothed using the10th order low pass-zero phase Butterworth filter (cut-off frequency 0.1 Hz) provided by recording the data by OxySoft software (Artinis Medical System, Netherlands) (Figueira et al., 2018). Further, black elastic bandages were used to shield the probes from the ambient light and to minimize their movement during the exercise. Following these procedures, HR values were used to calculate HR monotony and sample entropy (SampEn). The monotony was calculated by dividing the players' average HR by the standard deviation of the HR over the game (Comyns and Flanagan, 2013; Mateus et al., 2019). SampEn was used to assess each players' HR regularity during the games. The definition of SampEn was previously reported and the calculation and interpretation of the results are documented elsewhere (Richman and Moorman, 2000; Silva et al., 2016). Regarding the SmO_2 and tHb data, the mean (i.e., mean SmO_2 and mean tHb) and SampEn (i.e., SmO_2 SampEn and tHb SampEn) achieved during each game were calculated for each player.

Additionally, all the games were recorded using a digital camera (Sony HDR-CX240E HD). Then, the following performance variables were registered: <6.75-m field goals made (<6.75-m FGM), <6.75-m field goals missed (<6.75-m FGMs), >6.75-m field goals made (>6.75-m FGM), >6.75-m field goals missed (>6.75-m FGMs), offensive rebounds (OREB), defensive rebounds (DREB) steals (STL), assists (AST), dribble drives (DD), ball touches (TCHS), ball screens and off-ball screens (see Table 1). To ensure high inter-rater reliability for all variables, the analysis was accomplished by two experienced researchers in basketball coaching and performance analysis and the results of interrater reliability were deemed to be high (kappa coefficients >.90).

Table 1. **Selected technical-tactical variables**

Variables	Operational definitions
<6.75-m FGM	The number of field goals made within a range of 6.75-m from the basket
<6.75-m FGMs	The number of field goals missed within a range of 6.75-m from the basket
>6.75-m FGM	The number of field goals made from a distance more than 6.75-m from the basket
>6.75-m FGMs	The number of field goals missed from a distance more than 6.75-m from the basket
OREB	A rebound made off a missed shot when the player is attacking
DREB	A rebound made off a missed when the player is defending
STL	Defensive actions that lead to gaining possession of the ball
AST	Passes to a teammate who immediately scores
DD	Dribbles drives toward the basket to penetrate the defence
TCHS	Total number off ball touches in offense
Ball screen	The screen on a defender who is defending an opponent with the ball
Off-ball screen	The screen on a defender who is defending an opponent without the ball

Statistical analysis

First, a boxplot and a Shapiro-Wilk test were used for all data sets to identify outliers and the distribution of samples. Afterwards, a Bayesian ANOVA was used to quantify the predictive influence of the game condition on the physiological and the technical-tactical variables (van den Bergh et al., 2020). Accordingly, all the physiological and technical-tactical variables were considered to be dependent variables, the game condition (i.e., 3x3 and 5x5 basketball games) was used as a fixed factor, and the players as random factors. The Cauchy prior width was set at *r* scale fixed effects = 0.5 (Wagenmakers et al., 2018). The testing procedures were carried out using JASP software (JASP Team 2019. JASP for Windows, Version 0.16.0.0, computer software).

Results

Table 2 presents the mean, standard deviation, and quartiles for the physiological and the technical-tactical variables among the game conditions. In addition, Figure 1 and Figure 2 illustrate the distribution of all variables according to both game conditions.

Table 2. **Descriptive analysis of the physiological and the technical-tactical variables according to game conditions.**

Physiological variables	Mean ± SD	IQR	Mean ± SD	IQR
HR monotony	14.36 ± 3.6	2.72	15.99 ± 4.2	5.76
HR SampEn	0.03 ± 0.0	0.02	0.03 ± 0.0	0.01
Mean SmO_2	39.23 ± 14.4	18.57	37.73 ± 12.4	15.84
SmO_2 SampEn	0.45 ± 0.2	0.28	0.38 ± 0.17	0.21
Mean tHb	12.39 ± 0.5	0.77	12.38 ± 0.5	0.61
tHb SampEn	0.16 ± 0.1	0.09	0.26 ± 0.1	0.14
Technical-tactical variables				
<6.75-m FGM	1.27 ± 1.29	2.00	0.75 ± 0.9	1.00
<6.75-m FGMs	0.98 ± 0.9	2.00	0.29 ± 0.5	1.00
>6.75-m FGM	0.83 ± 1	1.00	0.18 ± 0.4	0.00
>6.75-m FGMs	1.98 ± 1.5	2.00	0.35 ± 0.6	1.00
OREB	0.73 ± 0.8	1.00	0.24 ± 0.5	0.00
DREB	2.00 ± 1.7	2.25	0.35 ± 0.5	1.00
STL	0.37 ± 0.6	1.00	0.30 ± 0.5	1.00
AST	0.92 ± 0.9	2.00	0.30 ± 0.6	0.00
DD	2.21 ± 1.5	2.00	0.87 ± 1.1	1.25
TCHS	11.96 ± 3.5	5.50	6.43 ± 2.5	3.00
Ball screen	0.25 ± 0.6	0.00	0.36 ± 0.8	0.00
Off-ball screen	0.05 ± 0.2	0.00	0.36 ± 0.6	1.00

IQR = interquartile range.

Tables 3 and 4 show the inferences of the Bayesian ANOVA. Regarding the physiological variables (Table 3), the Bayes factor indicates a very strong evidence that the tHb SampEn is influenced by the game scenario, as the data were 83.33 times more likely to occur under the game condition model (null model: BF10 = 0.012, BF01 = 1/0.012 = 83.33). Indeed, the posterior model probability shows a probability of 98.8% in favour of the game condition model. Conversely, anecdotal (i.e., weak) evidence for the null hypothesis was observed for HR monotony, HR SampEn, mean SmO_2 and SmO_2 SampEn. Furthermore, moderate evidence in favour of the null model was observed in mean tHb (game model: BF10 = 0.276, BF01 = 1/0.276 = 3.62).

Regarding the technical-tactical variables (Table 4), moderate evidence for the game condition was observed for <6.75-m FGM (null model: BF10 = 0.123, BF01 = 1/0.123 = 8.13) while moderate evidence for the null hypothesis was observed in STL (game model: BF10 =

0.227, BF01 = 1/0.012 = 4.41) and ball screen (game model: BF10 = 0.314, BF01 = 1/0.314 = 3.18). The analysis also ascertained decisive evidence (i.e., BF10 > 100) that supports a relationship between the game condition and all the remaining technical-tactical indicators.

Moreover, we found a significant negative correlation between the diving time and the lactate produced during apnea executed after DRY warm-up (Pearson = -0.60; p = 0.045). It is plausible that the faster they go during apnea, the more lactate they produce, and the less time they take to complete the track. This hypothesis is supported by a further analysis, which showed a significant correlation between apnea duration and the cardiac autonomic nervous system parameters recorded at the end of the apnea (BRS = 0.62; p = 0.003, RMSSD = 0.47; p = 0.025, SDNN = 0.46; p = 0.032, and HF = 0.45; p = 0.030), suggesting that the slower the apnea is executed, the faster is the recovery process.

Discussion

This study examined youth players' physiological and technical-tactical performance in 3x3 and 5x5 basketball games. This comparative analysis disclosed a greater level of influence of the game format on the technical-tactical related variables. In turn, at the physiological level, the notable effect was observed only on the tHb SampEn.

Table 3. Model comparison (game condition) for the Bayesian ANOVA of the physiological variables.

Models	P (M|data)	BFM	BF10	Error %
HR monotony				
Null model	0.507	1.030	1.000	
Game condition	0.493	0.971	0.971	0.905
HR SampEn				
Null model	0.512	1.050	1.000	
Game condition	0.488	0.953	0.953	0.995
Mean SmO_2				
Null model	0.740	2.847	1.000	
Game condition	0.260	0.351	0.351	1.548
SmO_2 SampEn				
Null model	0.568	1.314	1.000	
Game condition	0.432	0.761	0.761	6.651
Mean tHb				
Null model	0.783	3.619	1.000	
Game condition	0.217	0.276	0.276	2.055
tHb SampEn				
Game condition	0.988	82.381	1.000	
Null model	0.012	0.012	0.012	1.076

The prior model probabilities were all equal (0.5). P (M|data) = posterior model probability; BFM = posterior model odds; BF10 = Bayes factor.

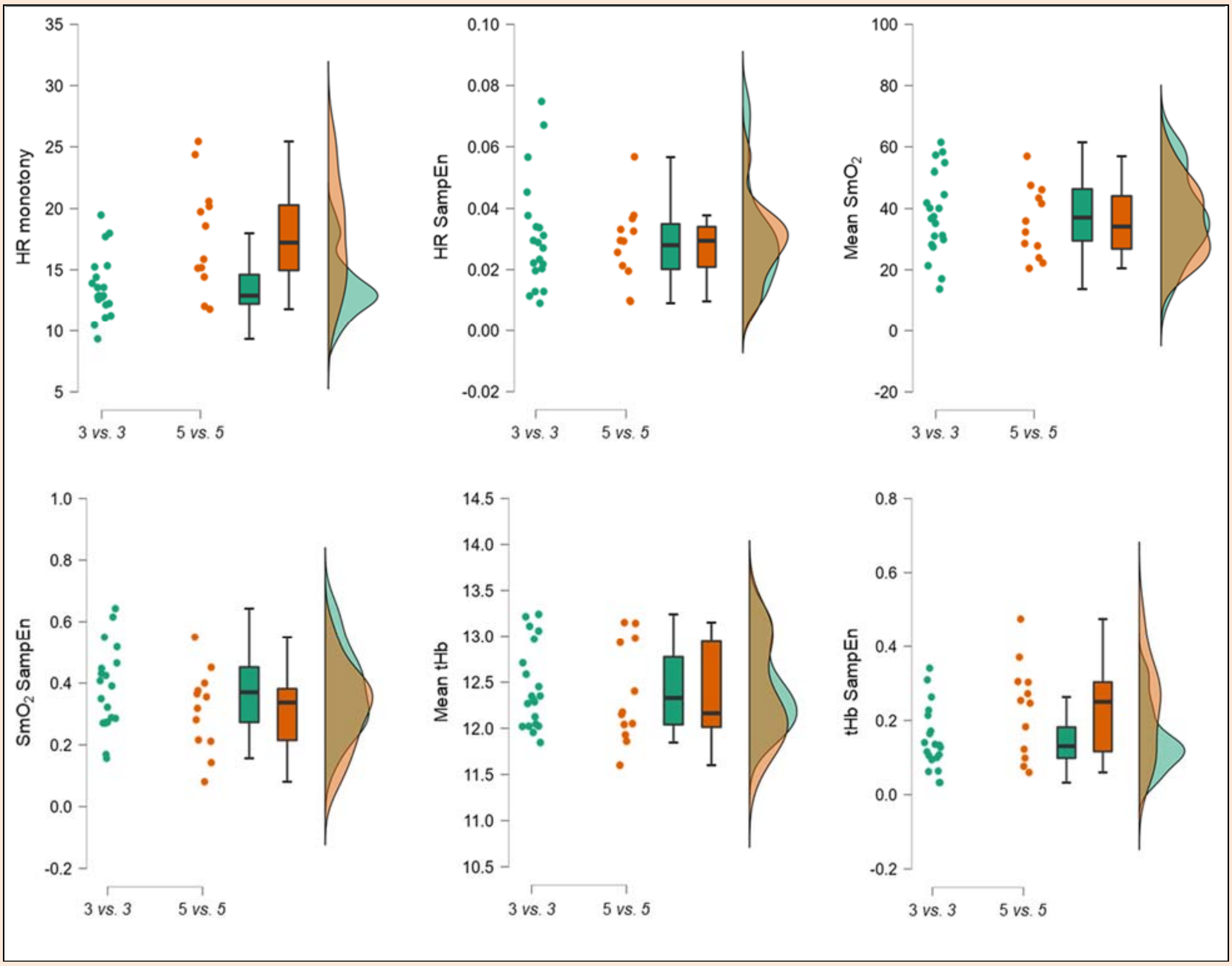

Figure 1. Raincloud plots showing the distribution of the physiological variables according to the game conditions. The clouds of points indicate all data points, the boxplots indicate the data distribution, the median and the 1st quartile (25th percentile) and the 3rd quartile (75th percentile), and the one-sided violin plots indicate the data distribution for each game condition.

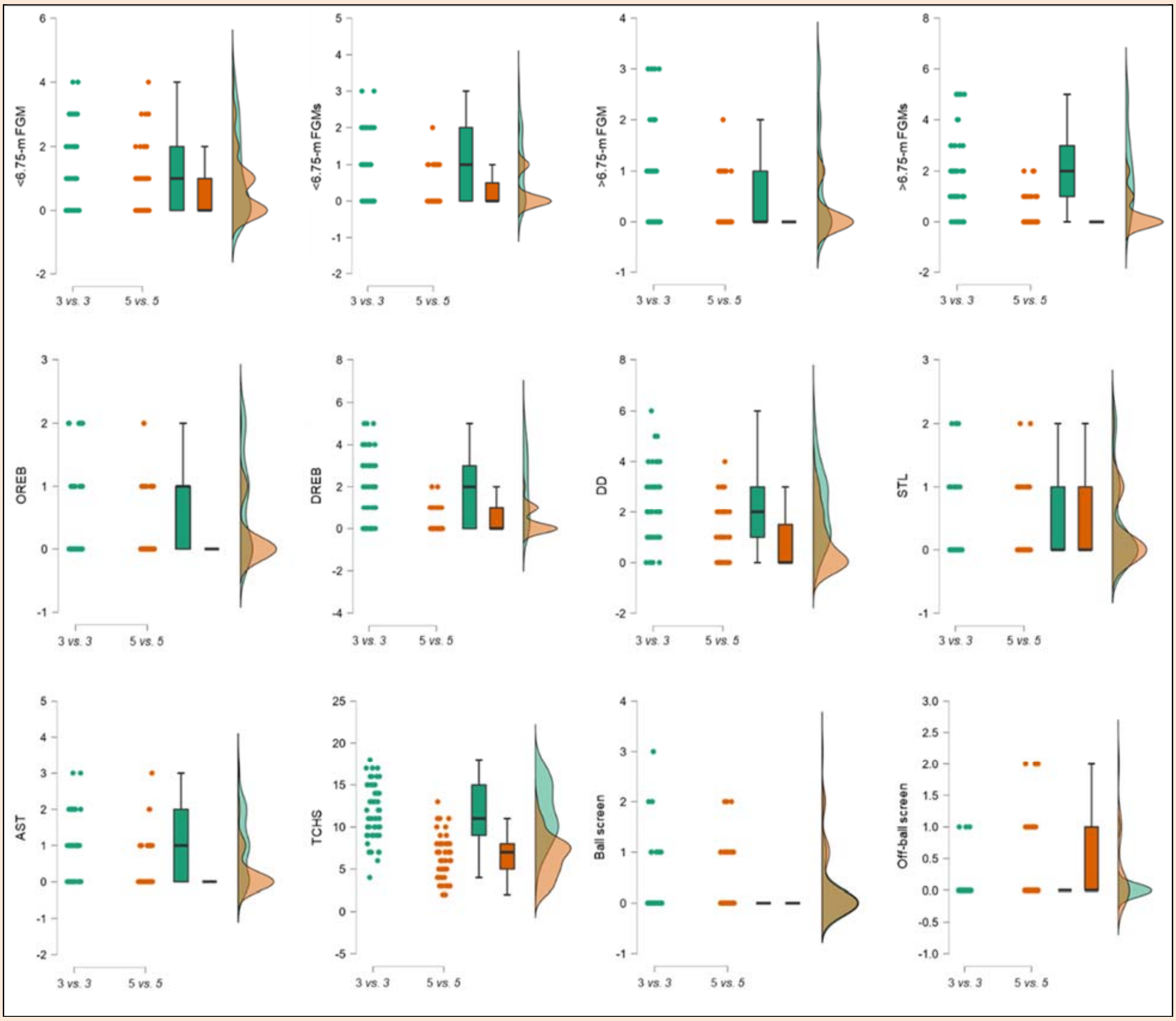

Figure 2. Raincloud plots showing the distribution of the technical-tactical variables according to the game conditions. The clouds of points indicate all data points, the boxplots indicate the data distribution, the median and the 1st quartile (25th percentile) and the 3rd quartile (75th percentile), and the one-sided violin plots indicate the data distribution for each game condition.

Interestingly, the results from this study demonstrated that the players' HR values were unaffected when switching between 3x3 and 5x5 basketball games. Our data is in line with the results obtained by other researchers showing marginal differences in HR responses between both game conditions (McGown et al., 2020; Willberg et al., 2022). Given the limited number of investigations dedicated to the physiological demands of the 3x3 basketball game, more evidence is needed to provide further support to this assertion.

Many studies have stressed the importance of the Near-Infrared Spectroscopy (NIRS) to provide information about the changes in oxygen saturation of muscle tissue and thus, to evaluate the players' ability to sustain performance and avoid fatigue in workouts (Denis et al., 2011). Despite the importance of the detrimental effect of fatigue on athletic performance, to date no study has attempted to characterize basketball players' SmO_2 and tHb when playing 3x3 and 5x5 basketball games. Our results showed that tHb SampEn was higher in 5x5 basketball games. Considering that SampEn estimates the randomness of a sequence of data points, such evidence suggests a higher variation in blood volume during 5x5 basketball games and thus, an increased muscle activation, given the important role of hemoglobin in transporting oxygen from the lungs to the tissue (Cettolo et al., 2007; Muthalib et al., 2010). Although speculative, these results can derive from the nature of 5x5 basketball, characterized by more uninterrupted transitions between short-periods of stability (e.g., half-court offensive plays) and instability (e.g., fast-breaks) (Sivils, 2009). Thus, a higher variability of tHb in observed 5x5 basketball may be interpreted as physiological adaptation to guarantee a sufficient supply of oxygen to the muscles in order to comply with the more random endurance demands of this game format. Indeed, it has been already documented that muscle reoxygenation is essential for aerobic conditioning in basketball (Buchheit and Ufland, 2011; Delextrat et al., 2018).

Factors related to the manipulation of the competitive environment are likely to influence the players' decision making and perceptual-motor relations (Mateus et al., 2019). In this context, basketball literature has consistently reported that reducing the number of players increases the number of skill executions (Sampaio et al., 2009) and increases the relative playing area (Halouani et al., 2014). Our results support these assertions as TCHS and DD were significantly higher in 3x3 games. Given the greater playing area per player, the 3x3 game format might have allowed better offensive spacing, favouring the emergence of individual behaviours (i.e., players drove to the basket more often), and increasing the game pace (i.e., the players were in possession more frequently). Indeed, previous studies reported that a higher area-per-player impairs team playing and facilitates individual technical performance (Sampaio et al.). Besides, basketball research suggests that youth basketball games have a higher pace and a lower percentage of assists than professional basketball, due to hurried decisions and a less ordered kind of play (Alsasua et al., 2018). The potential of manipulating practice conditions to promote specific adaptations is clearly manifested. In this view, the development process of youth basketball players may benefit from boosting opportunities for action while keeping up with an enhanced perception of competence and enjoyment and, consequently, intrinsic motivation (Gray et al., 2008).

Table 4. Model comparison (game condition) for the Bayesian ANOVA of the technical-tactical variables.

Models	P (M|data)	BFM	BF10	Error %
<6.75-m FGM				
Game condition	0.890	8.101	1.000	
Null model	0.110	0.123	0.123	0.883
<6.75-m FGMs				
Game condition	1.000	38260.804	1.000	
Null model	2.614e-5	2.614e-5	2.614e-5	0.939
>6.75-m FGM				
Game condition	1.000	3046.219	1.000	
Null model	3.282e-4	3.283e-4	3.283e-4	0.872
>6.75-m FGMs				
Game condition	1.000	4.109e+11	1.000	
Null model	2.434e-12	2.434e-12	2.434e-12	1.123
OREB				
Game condition	0.997	338.660	1.000	
Null model	0.003	0.003	0.003	1.206
DREB				
Game condition	1.000	3.008e+9	1.000	
Null model	3.325e-10	3.325e-10	3.325e-10	1.925
STL				
Null model	0.815	4.407	1.000	
Game condition	0.185	0.227	0.227	1.753
AST				
Game condition	0.999	1130.483	1.000	
Null model	8.838e-4	8.846e-4	8.846e-4	0.782
DD				
Game condition	1.000	7.815e+6	1.000	1.390
Null model	1.280e-7	1.280e-7	1.280e-7	1.390
TCHS				
Game condition	1.000	3.821e+19	1.000	
Null model	2.617e-20	2.617e-20	2.617e-20	0.915
Ball screen				
Null model	0.761	3.184	1.000	
Game condition	0.239	0.314	0.314	0.854
Off-ball screen				
Game condition	0.996	222.790	1.000	
Null model	0.004	0.004	0.004	1.809

The prior model probabilities were all equal (0.5). P (M|data) = posterior model probability; BFM = posterior model odds; BF10 = Bayes factor.

Similar to previous research, the number of shots to the basket also increased in the 3x3 game format. It has already been established that the transition to smaller formats of the basketball game is linked to the increased number of all shots per player (Conte et al., 2016; Klusemann et al., 2012). Interestingly, the number of >6.75-m FGM was considerably higher during 3x3. These findings are in concordance with previous studies, which reported that players perform more long-distance shots when playing 3x3 games (Erculj et al., 2020). These results can derive from the distinctive 3x3 scoring rules. According to 3x3 basketball rules, the shots inside the arc are worth a single point while the shots outside the arc are worth two points (FIBA, 2018). Thus, long-distance shots in 3x3 have a higher relative point value when compared to 5x5 (i.e., 50% and 33,4%, respectively), which may explain the preference for shots from beyond the arc. Another reasonable explanation for this finding could be the shorter offence time comprised of 12 seconds, which might lead the players to explore more long shots (Erculj et al., 2020). Besides, the results of the present study showed a lower number of missed shots (i.e., <6.75-m FGMs and >6.75-m FGMs) in the 5x5 game format. As it was mentioned before, the 3x3 formats increase the players' participation, while in the 5x5 format the players tend to perform fewer offensive actions and concomitantly the number of missed shots may diminish. Additionally, it is not unreasonable to suggest that in the 5x5 basketball the players may take advantage of their specific game roles to increase action effectiveness, such as in rebounding and setting screens, while in the 3x3 game the players are obliged to achieve a minimum level of offensive skills across different game roles.

Due to the increased number of field goals per player in the 3x3 games, the players' rebound chances also increase. Rebounds are considered one of the most differentiate indicator between the winning and the losing teams, and previous research has shown significant differences in technical actions between the formats, especially in the number of shots, passes and rebounds (Halouani et al., 2014). Thus, as rebounds are a key performance indicator to predict the game outcome, the coaches of young basketball players should emphasize 3x3 basketball scrimmage drills, aiming to enhance the rebound situations during practice and thus ensure a well-mastered skill (i.e., block out and jumping time) (Ribas et al., 2011).

Interestingly, the number of ball screens did not differ significantly between both game conditions. Ball screens are usually associated with pick-and-roll plays, that stand as one of the most prominent solutions to create and explore offensive advantage (Buñuel et al., 2009; Morillo-Baro et al., 2021). In this typical game situation, an offensive player urges to set a screen ("pick") for his ball handling teammate to gain an immediate advantage on their direct defender or, alternatively, the player who sets the screen moves to an open space to receive the ball (Morillo-Baro et al., 2021). According to our results, ball screens appear to be a recurrent solution for basketball players to explore shooting opportunities, irrespectively of the game format. In fact, the importance of visual perception and decision-making of skilled female players during pick-and-roll situations when playing within a 3x3 game format was stated recently (van Maarseveen et al., 2018). On the contrary, our data show that off-ball screens (i.e., blocking the defender of the attacker not in ball possession) was less explored in the 3x3 game format. This may be related with the fact that off-ball screens may alter the spatial distribution of players on the court by limiting the available space to drive to the basket. Moreover, the lack of functionality of this game solution may also be connected to the fact that the 3x3 game format is featured by a shorter shot clock duration (12s) compared to 5x5 basketball (24s). Therefore, the players may embrace a more straightforward range of solutions associated to the position of the ball with respect to the scoring target.

Although the current study adds relevant information concerning the physiological responses and technical-tactical performance of well-trained youth basketball players when playing 3x3 and 5x5 basketball games, the interpretation of these results should be taken cautiously because only one team was involved. The assessment of basketball players during the simulated games played within the training environment rather than an official competition, is an additional limitation that should be taken into consideration. Indeed, the factors related to the competition pressure, playing against different opponents rather than their teammates, referees' decisions, game interruptions and crowd noise might, directly and indirectly, affect young players' physiological responses and technical-tactical performance. In this vein, more research is needed to inspect the potential effect of additional game variables.

Conclusion

In summary, the current study identified that different basketball game formats influenced mostly the technical-tactical variables. Accordingly, in 3x3 basketball games the number of touches, dribble drives and long-distance shots was greater than in the 5x5 game format. Thus, this study highlights the need for coaches to comprehend the technical-tactical differences of 3x3 and 5x5 basketball games to maximize the efficiency of their training sessions, develop particular technical actions and foster different player and team behaviours. In turn, from the physiological standpoint, there was only a notable effect on the tHb SampEn, which increased between the 3x3 and 5x5 basketball game scenarios. This result contributes to better understanding of the potential impact of the game format on the physiological domain, encouraging basketball coaches and practitioners to make use of this information in the design of adequate training environments and ultimately promote the readiness to perform in different official competitions. 3x3

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Key points

- In 3x3 games the number of touches, dribble drives and long-distance shots were larger than in the 5x5 game format;
- In physiological standpoint, sample entropy increased between the 3x3 and 5x5 game scenarios;
- Important implications may be drawn to the applied field as the specificity of technical-tactical adaptations when playing 3x3 or 5x5 formats should be accounted by basketball coaches to better design their training sessions.

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