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Original article

Defensive pressure affects basketball technical actions but not the time-motion variables

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Abstract

Background: Novel player tracking technologies can change the understanding of performance determinants in team sports by allowing to accurately measuring the activity demands. The aim of this study was to identify how the defensive pressure affects the time-motion variables and the technical actions in basketball.

Methods: Twenty international male players (age: 16.05 ± 2.09 years, weight: 73.13 ± 8.10 kg, height: 183.10 ± 5.88 cm) played two 10 min basketball quarters, where they used a man-to-man 1/4-court defense until the 4th min (F1/4), changed to man-to-man full court (FULL) for 3 min and, from the 7th to the 10th min returned to 1/4-court defense (S1/4). A computerized notational analysis was performed using Simi Scout and positional data were captured with the Ubisense Real Time Location System (mean sampling rate 3.74 ± 0.45 Hz per transmitter/player).

Results: The time-motion variables presented similar results between defensive conditions, showing a total distance covered around 90 m/min. However, results suggested possible vertical jump impairments in S1/4 periods. There was more distance covered while jogging in the offensive court (38.15 ± 12.17 m/min offensive court *vs.* 32.94 ± 10.84 m/min defensive court, $p < 0.05$) and more distance covered while running in the defensive court (16.41 ± 10.27 m/min offensive court *vs.* 19.56 ± 10.29 m/min defensive court, $p < 0.05$).

Conclusion: These results suggest how to improve task representativeness during specific conditioning or game-based training situations and also to help coaches' strategic decisions during the games.

Keywords: Activity demands; Performance analysis; Performance indicators; Team sports

1. Introduction

Performance analysis in team sports aims to measure and process data from training sessions and competitions in order to use the information to enhance future performances.[1] Therefore, important information may be provided about players and teams' strengths and weaknesses,[2,3] which allow coaches to improve their training sessions.[4] Novel player tracking technology is changing the way we understand team sports.[5] In fact, current radio-signals or camera-based systems track the movements of every player on the court,[6,7] measuring accurately, for example, speed and distance covered.[8] In basketball, some examples include how fast a player moves, how far he/she traveled during a game, and much more. Unfortunately, research using these systems is still very scarce.[6,8]

The available research is focused on performance described by the game-related statistics, as variables that capture the frequencies of technical actions.[9–11] Research using these variables allowed identifying the actions most related to successful performances.[12] For example, the defensive rebounds, 2-point

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field goals and assists are considered as strong discriminants between winning and losing teams.[2,13–15] Overall, these variables appear to help coaches to develop the most appropriate training tasks and increase the teams' probability of winning.[13] The physiological demands of basketball games have been described earlier.[16,17] For instance, it was found that young players covered a total distance of 115 m/min during a game,[18] while in adult players values ranged from 130 to 133 m/min.[19] Apparently, maximum benefits are obtained when the training stimulus is closer to competition requirements.[20] Therefore, it is vital to provide valid information to coaches about the physical demands of the game so they can set up more specific and adequate conditioning programs.[21]

Despite the available research focused on performance analysis, information about the effects of manipulating defensive systems during the games is very scarce. Anecdotally, it is believed that defensive systems with constant pressure on the opponents are to be effective strategies to win a game.[22,23] For example, Wissel[23] stated that an optimal defensive system will increase the number of steals, interceptions and increase the number of missed shots in the opponents' team.

The most frequent level of defensive pressure is the man-to-man 1/4-court defense. In this level of pressure, the players defend their direct opponent' only when he is positioned in the offensive 1/4-court.[17,24] During the game, coaches frequently ask the players to extend the man-to-man defense to a full court level, aiming to delay the ball transition from defense to offense and impair the opponents concentration in offense.[24] There is a coaching belief that changing the defensive pressure to full court increases energy demands and impairs offensive performances, however, there is no available research confirming this hypothesis.

In fact, research under this topic examined the efficacy of different defensive strategies and suggested that 1/4-court defense and full-court press showed efficacies above 50%.[25] There is also evidence that more points are scored against man-to-man defenses and that this defense generates more turnovers, while the zone defenses increase the number of committed faults.[26] From a physiological standpoint, the man-to-man and the zone defense seem very similar for game-activities changes (1.053 *vs.* 1.056), frequency of high-intensity bouts (253 *vs.* 224), or heart rate (93.3% ± 2.1% *vs.* 92.8% ± 1.8% from the maximum heart rate).[17]

Therefore, it might be expected to identify several differences in game-related statistics and time motion variables between these 2 levels of defensive strategies (1/4-court defense and a full court press). These results would be very helpful to improve basketball practice specificity and coaches' strategic decisions during the games. Thus, the aim of the present study was to identify the effects of defensive pressure on technical actions and time-motion variables in basketball.

2. Methods

2.1. Experimental approach to the problem

A cross-sectional field study was used to identify the effects of defensive pressure (1/4-court defense and a full–court press) on technical actions and time-motion variables in basketball. The data were collected during a simulated basketball game, played in official court (28 × 15 m) with official rules and 3 referees. The players were rated by the national head coach according to their overall playing performances: passing ability, ball control, shooting, game perception, and decision.[27] Based on this classification, the players were assigned alternately into 4 balanced teams (A, B, C, and D). Each team played two 10 min quarters (A *vs.* B played 1st and 3rd periods; C *vs.* D played 2nd and 4th periods) interspaced with 15 min of passive recovery. Two time-outs were conceded at the 4th and 7th min to allow changing the defensive system. The players were instructed to use 1/4-court defense until the 4th min (F1/4). After that, the defense changed to man-to-man full court (FULL) and, from the 7th to the 10th min returned to 1/4-court defense (S1/4).

2.2. Participants

Twenty semi-professional male basketball players volunteered to participate in this study (age: 16.05 ± 2.09 years; weight: 73.13 ± 8.10 kg; height: 183.10 ± 5.88 cm; weekly practice: 10.9 ± 1.94 h and playing experience: 7.1 ± 1.1 years). All participants were part of a International Basketball Federation (FIBA) mid-level European national team and the players competed in their different clubs during the 2011/2012 season. The players, their parents and coaches agreed with the protocol description and were notified that they could withdraw from the study at any moment. An informed written consent was obtained from each participant's parents. This study was conformed to the Declaration of Helsinki and was approved by both the Ethics Committee of the University of Vienna (Austria) and the Portuguese Foundation for Science and Technology (Portugal, PTDC/DES/098693/2008).

2.3. Procedures

The identification of performance predictors in team sports should be preferentially done directly in game situations[28] and manipulating task constraints.[29] These research approaches allow overcoming several limitations from descriptive studies, which only provide statistics of performance.[29,30] From a research design perspective, this study could be counterbalanced in order to account for the order effect in the defensive situations; however, the FULL situation has no coaching interest, unless used in the course of the game. Consequently, we have only counterbalanced the man-to-man 1/4-court defense.

2.4. Instruments

The game was recorded with a standard digital camera located 5 m above the basketball court. The video files were downloaded to a computer and a notational analysis was performed using Simi Scout software (Version 2.0.0.174; Simi Reality Motion Systems GmbH, Unterschleissheim, Germany). The following individual and team performance variables were registered: field goals, rebounds, steals and block shoots, free-throws, fouls, team number of ball possessions, team effective field goal percentage, team offensive rebounding percentage,

and team free throw rate.[11,15] The individual performance indicators were normalized according to game ball possessions in order to account for differences in game pace.[12,31] In order to allow comparisons between the defensive strategies, all team variables were normalized per minute of play. An experienced performance analyst gathered the data and reliability was inspected by retesting 17.5% of the sample. The obtained intraclass correlation (ICC) coefficients were high (>0.86).[32] The time motion analysis was accomplished using the Ubisense Real Time Location System (Ubisense RTLS; Ubisense, Cambridge, UK), which allows to measure the distance covered in game sports activities with a mean deviation 0.09% ± 5.43%.[33] The Ubisense system is composed by 6 base stations mounted around the basketball field (outside of the court at each corner and in the middle of the long side lines) with a height of approximately 5 m, covering an area of about 33 × 18 m. The basketball players' positions were calculated via time-difference-of-arrival and angle-of-arrival measurements of ultra-wide band radio-signals that were sent by mobile transmitters (worn by the players in brackets atop their heads) to the base stations.[33] The mean sampling rate of the position measurements was 3.74 ± 0.45 Hz per transmitter/player. The data obtained with the Ubisense software were processed through a combination of Kalman and low pass filtering. The position data for all transmitters were provided consecutively by used location system, meaning that only the values for 1 transmitter are available for each time instance of position measurement. Nevertheless, to obtain the pairs of *x*-/*y*-coordinates of each tag for all time instances the data were interpolated accordingly. The considered variables were the total distance covered and distances covered at different speed zones:[34] stand (0.0–0.1 m/s), walk (0.2–2.0 m/s), jog (2.1–3.7 m/s), run (3.8–6.0 m/s), and sprint (>6.1 m/s).

2.5. Data processing and analysis

All data sets were assessed for the identification of outliers and assumption of normality. Both individual and team game-related statistics were described using median and interquartile ranges (IQR) and compared between defensive situations using a Friedman nonparametric ANOVA. When appropriate, the pairwise differences were assessed using Wilcoxon's matched-pair signed ranks test. A 2-way repeated measures ANOVA was performed to identify differences in distance covered at different speed zones. Also, repeated measures ANOVA was used to analyze the total distance covered, with pairwise differences assessed with Bonferroni *post hoc* test. Effect size was presented as η^2 and interpreted by the follow criteria: significant but weak ($\eta^2 \leq 0.04$), moderate ($0.04 < \eta^2 \leq 0.36$), and strong ($\eta^2 > 0.36$).[35] All data sets were tested for each statistical technique corresponding assumptions and were analyzed with the statistical software IBM SPSS statistics for Windows (Version 19.0; IBM Corp., Armonk, NY, USA). The computed statistical power for this study was 0.96 (G*Power, Version 3.1.9; Institutfür Experimentelle Psychologie, Düsseldorf, Germany) and the level of statistical significance was set at $p < 0.05$.

3. Results

Table 1 presents the results of the team performance variables for the different types of defensive strategies. There were only significant differences in ball possessions between F1/4 and S1/4, with higher values in the second situation. When considering the individual performances, the results obtained for each type of defensive situations showed differences mainly focused between the F1/4 and S1/4 periods for field goals, steals and blocked shoots, committed fouls and rebounds (Table 1). The performances during the S1/4 were poorer, except for the fouls.

The total distance covered was similar between the defensive situations (F1/4 = 91.22 ± 6.60 m/min, FULL = 89.04 ± 11.27 m/min, S1/4 = 89.84 ± 7.46 m/min). The distances covered at different speed zones for the F1/4, S1/4, and FULL situations showed a significant interaction for the effect of the zone ($F = 1797.08$, $p < 0.001$, strong; $F = 787.57$, $p < 0.001$, strong, respectively), with the exception of standing and sprinting distances. Overall, the distance covered per minute was higher for the walk zone (ranging from 30 to 45 m/min) and decreased with an increase in speed. Fig. 1 presents the results of distance covered at considered speed zones when in defensive and offensive court. No significant differences were found between the defensive situations. The distance covered in the offensive court indicated a significant effect for the different speed zones ($F = 73{,}787.02$, $p < 0.001$, strong) with the exception of both the standing/sprinting and walking/jogging pairwise zones. There was more distance covered while jogging in the offensive court (38.15 ± 12.17 m/min offensive court *vs.* 32.94 ± 10.84 m/min defensive court, $p < 0.05$) and more distance covered while running in the defensive court (16.41 ± 10.27 m/min offensive court *vs.* 19.56 ± 10.29 m/min defensive court, $p < 0.05$).

Table 1
Results of team and individual performance variables for each type of defensive situation.

Variable	F1/4 (0′–4′)		FULL (4′–7′)		S1/4 (7′–10′)		Sig.
	Median	IQR	Median	IQR	Median	IQR	
Team ball possessions	2.13	0.22	2.83	0.29	3.33	0.13	[b]
Team effective field goal %	0.12	0.02	0.11	0.07	0.19	0.06	–
Team offensive rebounding %	0.10	0.02	0.04	0.04	0.14	0.14	–
Team free throw rate	0.13	0.06	0.13	0.16	0.13	0.07	–
Field goals	0.44	0.26	0.13	0.10	0.05	0.01	[a,b]
Fouls	0.22	0.06	0.21	0.14	0.04	0.02	[b]
Rebounds	0.24	0.15	0.21	0.10	0.04	0.01	[b]
Free-throws	0.44	0.23	0.23	0.14	0.42	0.20	–
Steals and blocked shoots	0.22	0.01	0.25	0.10	0.04	0.02	[b]

Notes: Values are median and interquartile ranges per minute forteams and frequencies per ball possession from individual performance variables. Significant differences are between: [a] F1/4 and FULL; [b] F1/4 and S1/4.
Abbreviations: F1/4 = first period with man-to-man 1/4-court defense; FULL = man-to-man full-court press; IQR = interquartile range; Sig. = significance; S1/4 = second period with man-to-man 1/4-court defense.

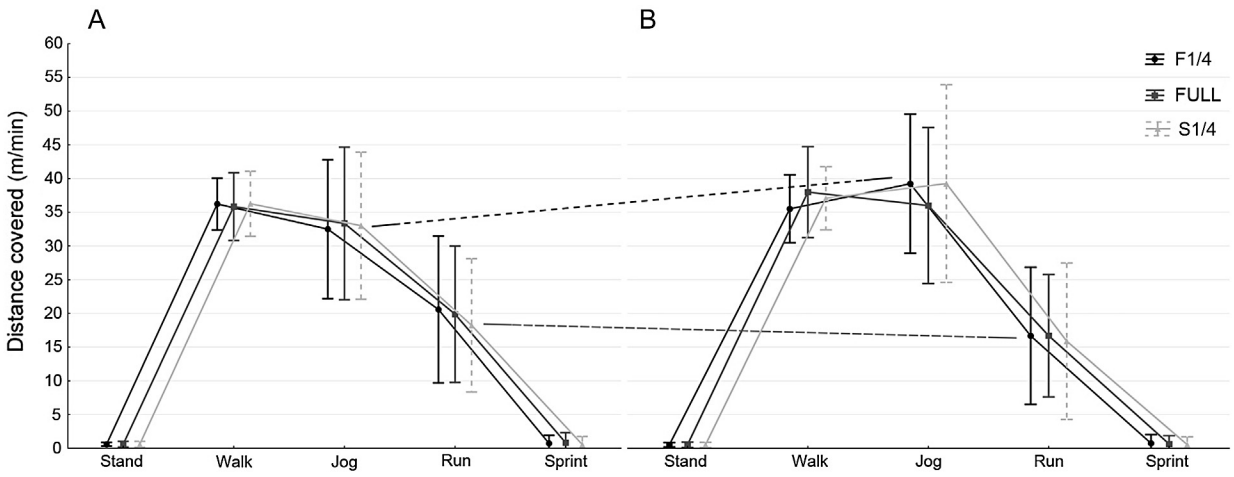

Fig. 1. Total distance covered at considered speed zones for the defensive (A) and offensive (B) court. F1/4 = first period with man-to-man 1/4-court defense; FULL = man-to-man full-court press; S1/4 = second period with man-to-man 1/4-court defense. The dotted lines identify the higher distance covered while jogging in the offensive court and the higher distance covered while running in the defensive court.

4. Discussion

The aim of the present study was to identify the effects of defensive pressure (1/4-court defense and a full–court press) on technical actions and time-motion variables in basketball. Although there is a coaching belief that changing the defensive pressure to full court increases energy demands and impairs offensive performances, the obtained results only confirmed these hypotheses for some of the game-related statistics. The time-motion variables also presented similar results between defensive conditions, showing a total distance covered around 90 m/min.

When compared to full court, the 1/4-court defense is primarily used to restrict the available space for the attackers in the defensive court, keeping the defenders nearer to each other, and reducing slow defensive movements.[26,36] This coupled behavior among defenders may improve the ability to increase the opponents' unforced errors and missed shots and, afterward, allows triggering fast-break situations.[13,26] On the other hand, full-court defense is used as an important team strategy to affect the game pace, force the opponent to play uncomfortably with poorer shoot selection and perform a higher number of turnovers.[37] Therefore, it was expectable to find substantial differences between these conditions.

The team performance indicators showed that ball possessions increased along the quarter, and were significantly different between the F1/4 and S1/4 situation, suggesting an increase in game pace.[31] However, playing at these higher pacing did not affected the teams' efficacy in the analyzed variables. But from an individual perspective, player performance was particular impaired during the S1/4 situation, with poorer performances in 2-point field goals (both made and missed), blocked shoots and defensive rebounds. All these technical actions have a certain degree of dependence from the vertical jump performances,[38,39] probably due to the accumulated workload from F1/4 and FULL.[40]

Since the basketball activity patterns seem to depend on players' playing position and taking in consideration the individual role within team strategy, future investigations can also account for the specific playing positions.[41]

Interestingly, there were no differences in time motion variables between the 3 conditions, as measured by the positioning system. In fact, the system measures the time motion variables having a bi-dimensional perspective (using *x*- and *y*-coordinates). Therefore, it seems that in S1/4 periods, the players were able to keep similar court positioning, however, they could be limited to perform actions that demand vertical jump. In fact, basketball time-motion analysis studies describe very well the energetic and muscular demands of the game situations, however, they are still limited to the use of bi-dimensional analysis, which might be an important limitation to analyze a sport like basketball.[18,41,42] Although the distances covered in the 3 periods were similar, high variability was identified in FULL and S1/4, probably showing inter-player differences in fitness conditions. The values of the total distance covered in both defensive situations were lower than those previous reported in junior elite male competition (90–92 m/min *vs.* 115 m/min) and in female basketball players (90–92 m/min *vs.* 127–136 m/min).[18,21] Possibly, the players' expertise levels may account for some of these differences. The results from the distance covered in speed zones also showed that players presented stronger higher values in walking and jogging, in agreement with previous findings, showing that junior male basketball players spent 14.2% ± 1.3% in walking and 11.3% ± 1.6% in running, respectively.[18]

There was more distance covered while jogging in the offensive court and more distance covered while running in the defensive court. The available literature has shown that most of the offensive situations in basketball emerge based on controlled offensive sets.[43] Otherwise, the defensive pressure and the use of positional fluctuations (defensive help) have been identified as key-performance indicators.[10,25] Most likely, this

motion behavior elicits a high number of accelerations and decelerations (turning, shuffling, and changes of direction). In fact, this strategic and tactical behavior helps explaining why the defensive court holds higher intensity activity profiles.

These results indicate how to improve task representativeness during specific conditioning or game-based training situations and also to help coaches' strategic decisions during the games. For example, the man-to-man defenses were the most used during game situations,[26,44] therefore, changing to full-court defense has the consequence of forcing the opponents to change the offensive strategy.[45] The defense-based tasks used in training seem more demanding and probably best suited for the end of the practice session. During the game-based situations, manipulating the defense allows to develop different technical abilities and perception-action cycles, apparently without increasing the external workload. In this sense, players will benefit from performing tasks with different speed, space, and pressure requirements. Moreover, several psychological-related abilities could also be fostered with the manipulation of the defensive strategies during training sessions and game-based situations. In fact, these constraints may increase the teams' cohesion, communication, responsibility, and self-confidence.[46]

5. Conclusion

Overall, this exploratory study presents new insights about the effects of defensive pressure constraint on basketball players' technical actions, decision-making and time-motion variables. The obtained results can also contribute to enhance the coaches' understanding of individual and collective performance indicators in game context. Anecdotally, basketball coaches use FULL tactical constraint as an efficient defensive strategy, however, current results show much less differences than the expected. Nevertheless, the FULL can be a useful tactical solution in critical moments of the game to benefit from states of psychological crisis.[47,48]

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Authors' contributions

JS, RL, JCG, and NL carried out the design and data collection. DC and BG processed the data. JS, RL, AB, JCG, DC, BG, and NL drafted the manuscript. All authors have read and approved the final version of the manuscript, and agree with the order of presentation of the authors.

Competing interests

None of the authors declare competing financial interests.

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