International Journal of Sports Physiology and Performance, 2024, 19, 1367-1373
https://doi.org/10.1123/ijspp.2024-0218

Human Kinetics
ORIGINAL INVESTIGATION

Inside the Defensive Playbook: Pick-and-Roll Tactical Adjustments Impact the External and Internal Loads During Small-Sided Games in Female Basketball Players

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Purpose: This study aimed to assess the effect of playing different pick-and-roll (PnR) defensive tactical options during small-sided games (SSGs) on external and internal loads in female basketball players. ***Methods:*** Twelve female basketball players (age 28 [2] y; stature 175 [6] cm; body mass 65 [7] kg; playing experience 18 [4] y) belonging to a team competing in the Lithuanian second division were recruited for this study. Across 3 experimental sessions and in a randomized order, players performed 3 SSGs sharing the same features but using 3 defensive strategies on the middle PnR action: Switch, Trap, and Drop. External load was measured using PlayerLoad (PL); the number of accelerations, decelerations, and changes of direction, classified based on their intensities as low (<2.5 $m \cdot s^{-2}$), medium (2.5–3.5 $m \cdot s^{-2}$), and high (>3.5 $m \cdot s^{-2}$); and jumps categorized as low (<40 cm) and high (≥40 cm). Internal load was measured via rating of perceived exertion (RPE). ***Results:*** Higher PL values in SSGs including Trap defense were found compared with Drop ($P < .001$, ES = 0.69, moderate) and Switch ($P = .001$, ES = 0.60, moderate). Additionally, a higher number of accelerations was registered in Trap defense compared with Drop defense ($P = .027$, ES = 0.99, moderate). Trap defense also led to higher RPE compared with Switch ($P = .003$, ES = 1.49, large) and Drop ($P = .004$, ES = 1.42, large) defense. ***Conclusions:*** Different defensive strategies on the middle PnR can influence the external and internal loads during SSGs, and female basketball coaches should consider the high demand of the Trap defense when designing SSGs.

Keywords: ball drills, basketball tactics, physical demand, inertial movement units

Basketball is an intermittent team sport characterized by high-intensity activities such as jumping, sprinting, and changes of direction.[1] Previous research has shown that during female basketball games, there is a change of action (ie, sprinting, shuffling, jumping, etc) every 2.56 seconds, with 8.5% of live time spent performing high-intensity actions.[1] The physical aspect is essential, but not the only parameter to consider when analyzing female basketball performance. Indeed, basketball performance is multifactorial, and the complex interactions between multiple domains (physical, physiological, hormonal, individual, and technical–tactical) should be taken into consideration[2] when implementing training methodologies that can effectively provide a positive transfer to match-play.

One of the most common training methodologies used by basketball coaches are game-based conditioning drills or small-sided games (SSG). These training methods have the advantage of allowing players to spend a long time under game-based situations compared with other traditional training methods, while also providing substantial physical and physiological training stimuli. The multifactorial benefits of SSG in basketball have been largely investigated[3,4] and include positive adaptations in relevant physical qualities (eg, intermittent endurance and repeated sprint ability) as well as technical skills. Various parameters have been found to influence the external and internal loads during basketball SSGs, such as the number of players involved,[5] rule changes,[6,7] players' rotation status,[8] and training regimes.[9] Nevertheless, research has not focused extensively on the tactical tasks implemented during SSGs. Along these lines, one study by Sansone et al[9] showed that, during a 3vs3 SSG played in a half-court setting, offensive tasks induced higher external and internal loads compared with defensive tasks. While this study only provided general information about the offensive and defensive tasks to be adopted for players, the use of specific tactical elements typically implemented during basketball games such as pick-and-roll (PnR) would facilitate a better transfer from the SSGs to the different tactical game scenarios.

The PnR is one of the most used tactical elements during women basketball matches.[10] During this action, 2 offensive players are involved: the ball handler (ie, the screened player) and the picker (ie, the screener) who are supposed to generate an advantage for the ball handler and, consequently, an opportunity to score.[11] Previous research showed that PnR effectiveness was lower in female compared with male basketball games (37.4% vs 48%–75%)[10]; however, it is still one of the main tactical actions adopted by female teams.[10] Therefore, drills including PnR with an emphasis on technical and tactical skills should be implemented based on their relevance for game performance. It is important to note that PnR actions can be defended in different ways.[12] For instance, middle PnR occurring at the top of the key can be defended using trap (ie, the 2 defensive players double on the ball handler), switch (ie, the 2 defensive players change their assigned offensive player), or drop (ie, the defender on the ball handler follows the assigned opponent, while the defender of the screener drops in the lane).[12] These 3 defensive scenarios require different

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movement patterns and displacements on court, which might lead to different external and internal loads. However, there is lack of information about the demands of game-based conditioning drills played with different defensive PnR options. This information would be useful for basketball coaches and practitioners due to the frequency of PnR scenarios required by basketball competition, which should therefore be sufficiently tried during training. Therefore, the aim of this study was to assess the effect of playing different PnR-defensive tactical options on the external and internal loads during SSGs in female basketball players.

Methods

Participants

Twelve female basketball players (age: 28 [2] y; stature: 175 [6] cm; body mass: 65 [7] kg; playing experience: 18 [4] y) belonging to a team competing in the Lithuanian second division (Moterų Lyga, B divizionas = LML, competitive level 3 according to previous categorization[13,14]) were recruited for this study. Players were training twice a week and competing in one official weekly match. Moreover, players did not suffer any injury in the 4 weeks preceding the beginning of the study during the experimental period. Before the commencement of the study, players were informed about the aims, procedures, requirements, risks, and benefits of the study and provided written informed consent for their participation. Ethics approval was obtained from the Institutional Scientific Board for Research of the Kaunas Regional Research Ethical Committee review board (number: 2021-01-08 Nr. P1-BE-2-97/2019).

Design

This experimental study was carried out across 4 sessions during the 2020/21 in-season period. In the first session, players were familiarized with the devices and scales used to monitor the internal and external loads, and each drill typology including the different defensive strategies to be adopted (ie, switch, trap, and drop). Players were extensively familiar with the defensive strategies adopted during the experimental sessions, as these were commonly used during their typical training sessions and games. One week after the first session, the remaining 3 experimental sessions were completed over 2 weeks. Each experimental session implemented one of the 3 defensive strategies investigated in a random order (session-1: Switch; session-2: Trap; session-3: Drop). Each drill was played at the beginning of the training session and was preceded by at least 48 hours of rest. Moreover, each drill was performed at the same time of the day to avoid any possible circadian effects.

Procedure

Experimental sessions were preceded by a standardized 10-minute warm-up characterized by mobility exercises, running, basketball-specific movements, and plyometrics. Each drill was played using 3vs3 in a half-court setting, with 4 sets of 3-minute play interspersed by 1.5 minutes of passive rest. During the rest phases between bouts, players passively recovered (ie, sitting or standing) and were allowed to consume water ad libitum. The description of the rules adopted in each drill is reported in Table 1. The 12 recruited players were allocated in 4 balanced teams by the coaching staff, based on their playing positions. Specifically, each team was composed of 2 guards (positions 1–3) and one power forward and/or center (positions 4–5). Overall, the drills only differentiated for the defensive strategies adopted. The movements performed by each playing position (on offense and defense) are displayed in Figure 1. Specifically, offensive players were required to play a middle PnR offense, while defensive players were required to play the 3 previously documented defense typologies (Figure 1). Across the 3 experimental sessions, each team always played versus the same opponent. The offensive teams were allowed to attack for the following ball possession in case they scored a basket; otherwise, they were playing on defense.

Before warm-up, players were asked to quantify their perceived level of recovery using a modified 10-point Total Quality Recovery (TQR) Scale previously adopted in basketball studies[14–16] and that has been shown to be significantly related to biomarkers of training stress as well as RPE loads.[17] Within the scale, higher TQR scores reflect better perceptions of recovery (eg, 3 = poor recovery; 7 = very good recovery). To provide their TQR score, players were instructed to pay attention to psychophysical cues of recovery (eg, mood states, soreness, and heaviness) according to the indications of Kenttä.[18]

Inertial movement units (ClearSky T6, Catapult Innovations) were used to assess players' external loads. Before the beginning of the warm-up procedures, each player was provided with the inertial movement unit, which was placed between the scapulae in neoprene vests worn underneath regular sporting attire for secure attachment. The devices' internal triaxial accelerometers were used to assess the dynamic movements in all 3 planes (transverse, coronal, and sagittal) sampling at 100 Hz. The Player Load (PL) index, which represents the square root of the sum of the squared instantaneous rate of change in acceleration across the transverse, coronal, and sagittal planes (x, y, and z, respectively), was measured.[19] Additionally, the

Table 1 Description of the Adopted Rules Across the Ball Drills

Task	Description
Beginning of the ball possession	Always from the coach positioned outside the 3pt lines at 45° (free throw line extension), first 2 bouts on the left side and last 2 bouts on the right side.
Drill continuity	If the offensive team scored a basket or got an offensive rebound, they passed the ball to the coach and kept playing on offense. If the offensive team missed the shot, did not get the offensive rebound, or in the case of a steal, turnover, out of bounds, or foul, the ball possession switched to the defensive team to start the new possession from the coach.
Time restriction	Although no shot clock was used, players were required to complete their actions as soon as possible and to quickly take their offensive position in the half-court before starting each new ball possession.
Free throws	No free throws were assigned.
Score	The score was kept across each drill, following official FIBA (International Basketball Federation) rules.
Encouragement	Coaches provided constant verbal encouragement across each performed drill.

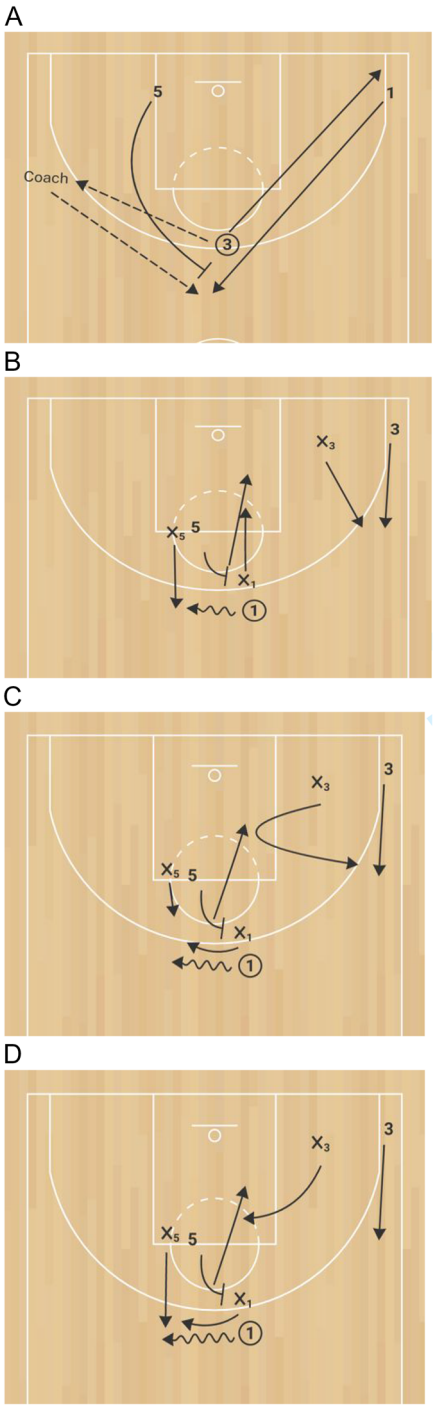

Figure 1 — Scheme of the middle pick-and-roll action. (A) General representation of the starting and execution of each ball possession from an offensive standpoint. Player 3 passes the ball to the coach on the side and cuts to the opposite corner. Player 1 lifts up to the top of the key. The coach passes back the ball to Player 1. Player 5 runs up to make a middle pick to Player 1 and then rolls to the basket. Player 1 uses Player 5's screen to take the shot, or executing a roll pass to Player 5 or an outside pass to Player 3. (B) Switch defense in which X5 and X1 exchange their marking players; thus, X5 takes O1 and X1 takes O5. (C) Drop defense in which X5 stays in the paint while X1 follows O1. (D) Trap defense in which X5 and X1 double-team the O1 while X3 is the safety player. Note: O represents the offensive players, X represents the defensive players, → indicates movements without ball, ⇝ represents movements while dribbling the ball, indicates movements to bring the screen, and ⇢ indicates the pass.

number of accelerations (ACC), decelerations (DEC), changes of direction (COD), classified based on their intensities as low (<2.5 $m \cdot s^{-2}$), medium (between 2.5 $m \cdot s^{-2}$ and 3.5 $m \cdot s^{-2}$), and high (>3.5 $m \cdot s^{-2}$), were measured. Furthermore, the number of jumps (JUMP) was monitored, and categorized as low (<40 cm) and high (≥40 cm). Data were processed and exported using the OpenField software (version 1.18, Catapult Innovations). For each drill, the four 3-minute bouts and the 1.5-minute rest phases were considered (total time = 16.5 min). Internal load was measured a few minutes after the end of each drill using the rating of perceived exertion (RPE) using the CR-10 scale modified by Foster et al,[20] which has previously shown good validity in basketball. Players were required to report their RPE using a paper and pencil method, without peer influence.[14,16,21]

Statistical Analysis

Mean and SD were calculated as descriptive statistics. The assumption of normality for residual values was checked using the Kolmogorov–Smirnov test. An alpha level of $P < .05$ was set at a priori for statistical significance. Linear mixed models were used to assess the differences between the drills including the 3 defensive options (switch, trap, and drop). Specifically, the defensive option was used as fixed effect, the external and internal load measures, and TQR were used as dependent variables, and players were inserted as random effects. All random effects were considered with random intercept and fixed slope. Post hoc analysis with Bonferroni correction was used in case of significant differences. Moreover, Cohen *d* effect sizes were also calculated for statistically significant post hoc analyses and interpreted as follows: trivial < 0.20; small = 0.20 to 0.59; moderate = 0.60 to 1.19; large = 1.20 to 1.99; and very large > 2.0[22]. All statistical analyses were performed using the Jamovi software (the Jamovi project, version 2.3.21.0).

Results

Players entered the experimental sessions in similar perceived recovery conditions ($P = .741$; Figure 2).

Mean (SD) for the external load measures are displayed in Table 2. Results revealed a statistically significant difference between the 3 defensive conditions for PL ($P < .001$) and high ACC ($P = .028$). Post hoc analyses revealed higher PL values for drills including trap defense compared to Drop ($P < .001$, ES = 0.69, moderate) and Switch ($P = .001$, ES = 0.60, moderate) defense, while no differences were found between Drop and Switch ($P > .05$) defense. Additionally, higher high ACC values were registered in Trap defense compared to Drop defense ($P = .027$, ES = 0.99, moderate). All the other investigated external load variables showed no differences across experimental conditions ($P > .05$).

A main effect for RPE was found ($P = .001$), with post hoc analysis highlighting how Trap defense led to higher internal loads compared with Switch ($P = .003$, ES = 1.49, large) and Drop ($P = .004$, ES = 1.42, large) drills, while no differences were found between Switch and Drop drills ($P > .05$; Figure 3).

Discussion

Performance in team sports such as basketball is determined by the interactions between different domains, including the physical and

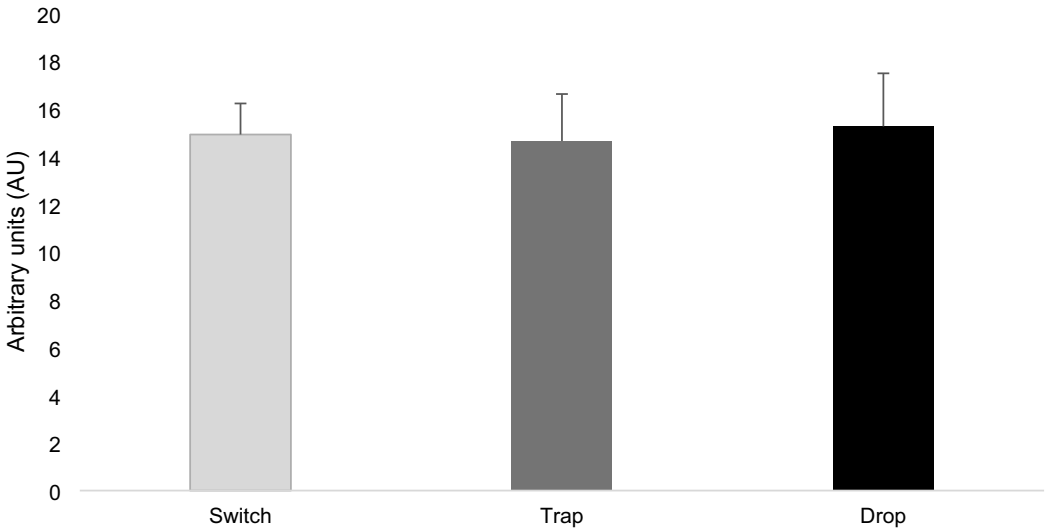

Figure 2 — Mean and SD of the Total Quality Recovery Scale for each defensive typology.

physiological aspects and technical–tactical scenarios elicited during competitive settings. It is therefore essential to approach basketball performance analysis with a multidisciplinary perspective which considers multiple domains. To the best of our knowledge, this is the first study that assessed the impact of implementing different defensive tactics in PnR scenarios on the external and internal loads experienced by female basketball players. The main finding is that external and internal loads differed between defensive scenarios, with higher loads induced by the Trap condition.

Our results showed that PL and ACC high were higher when defensive players had to play the Trap condition compared with both Drop and Switch. When playing the Trap drill, defensive players needed to cover longer distances and sprint toward the ball handler to put pressure on her. Additionally, the third defender was also required to perform substantial physical work, as she had to rotate toward the center of the area to defend the basket. These tactical requirements are implemented to pressure the ball handler and lead her to stop dribbling, to make a difficult choice of passing or even to force turnovers. As confirmed by our results, these defensive actions required more total, relative, and high-intensity physical work. Differently, the Switch condition allowed players to cover less distance and stay in their defensive position, as previously suggested while the Drop also represents a less demanding tactical scenario. In fact, different tactical tasks can lead to variations in the external loads imposed on players during game-based training drills.[9] The present findings can be considered by basketball practitioners and coaches when monitoring the various PnR defensive strategies adopted during SSGs, since they can impact physical demands.

The differences in external load were also reflected in a higher internal load (RPE) experienced by our players during the Trap condition. The external load can be considered the training "dose" which determines internal responses in the psychophysiological systems of players.[23] The present findings corroborate this notion, given that the higher physical demands of the Trap condition determined also higher perceived exertion scores. One previous study[24] examined the perceived load of playing only the offensive or only the defensive phase during a 3vs3 SSG and found a moderate difference between conditions, suggesting that different tactical tasks affect internal loads. Similarly, rule changes have been shown to influence the physiological and perceptual demands of basketball game-based drills.[6] In our study, the Trap condition was perceived as more than hard (RPE: 6.5), while Switch and Drop had lower scores (RPE: 4.2–4.3, less than hard). These results suggest that different defensive tactics led to specific external and perceived loads in female basketball players, confirming the complex relationships that exist between physical, psychophysiological, and technical–tactical aspects in team sports.

These data provide the first analysis of external and internal load experienced in game-based drills including different defensive tactics applied to PnR situations. Although this study provides interesting insights for basketball coaches and practitioners, some limitations should be acknowledged. Indeed, only 12 players were recruited for this study, while the adoption of a larger sample size would likely provide more robust outcomes. Moreover, only the physical and perceived demands were analyzed, while also examining these drills from technical and tactical standpoints could provide additional information on whether the physical demands are also associated with technical–tactical performance while using these defensive strategies on middle PnR. Moreover, these data were only referred to female players; thus, further research also including male players is necessary. Finally, our results only focused on the defensive strategies adopted on middle PnR, while different external and internal loads might be found for other court positions (eg, side PnR and corner PnR). Therefore, future studies should focus on the analysis of larger sample sizes, technical demands together with physical and perceived demands, male players, and other PnR defensive strategies.

Practical Applications

According to the current results, female basketball coaches can influence the external and internal loads imposed on their players during SSGs by manipulating the tactical scenarios when defending the middle PnR. Specifically, in training sessions aiming at having higher physical and perceptual demands, SSGs including Trap defense on middle PnR could be adopted compared with other defensive strategies. Differently, Switch and Drop have been

Table 2 Mean (SD) for the External-Load Measures for Each Defensive Condition

Defensive condition	PL, AU	ACC_{low}, n	ACC_{med}, n	ACC_{high}, n	DEC_{low}, n	DEC_{med}, n	DEC_{high}, n	COD_{low}, n	COD_{med}, n	COD_{high}, n	$JUMP_{low}$, n	$JUMP_{high}$, n
Switch	136.5 (18.3)	18.0 (4.6)	5.3 (2.9)	4.5 (2.4)	27.4 (7.6)	8.0 (3.2)	2.6 (1.4)	123.8 (50.0)	28.1 (11.9)	8.8 (4.3)	4.4 (3.4)	10.3 (4.9)
Trap	144.3 (19.1)*,#	15.2 (5.4)	6.7 (3.5)	5.5 (2.4)*	24.9 (8.0)	7.5 (2.6)	3.3 (1.7)	128.4 (39.9)	23.5 (8.9)	7.2 (3.5)	4.1 (3.0)	11.1 (6.3)
Drop	133.8 (18.0)	16.9 (5.2)	5.9 (2.7)	3.3 (2.1)	22.1 (7.4)	7.8 (3.6)	4.0 (2.6)	128.1 (47.8)	30.1 (11.3)	8.0 (2.4)	3.2 (2.7)	10.8 (4.5)

Abbreviations: ACC_{high}, acceleration >3.5 $m \cdot s^{-2}$; ACC_{low}, acceleration <2.5 $m \cdot s^{-2}$; ACC_{med}, acceleration 2.5–3.5 $m \cdot s^{-2}$; AU, arbitrary units; COD_{high}, change of direction >3.5 $m \cdot s^{-2}$; COD_{low}, change of direction <2.5 $m \cdot s^{-2}$; COD_{med}, change of direction 2.5–3.5 $m \cdot s^{-2}$; DEC_{high}, deceleration >3.5 $m \cdot s^{-2}$; DEC_{low}, deceleration <2.5 $m \cdot s^{-2}$; DEC_{med}, deceleration 2.5–3.5 $m \cdot s^{-2}$; $JUMP_{high}$, jump ≥40 cm; $JUMP_{low}$, jump <40 cm; PL, PlayerLoad.

*Statistical difference compared to Drop ($P < .05$). #Statistical difference compared to Switch ($P < .001$).

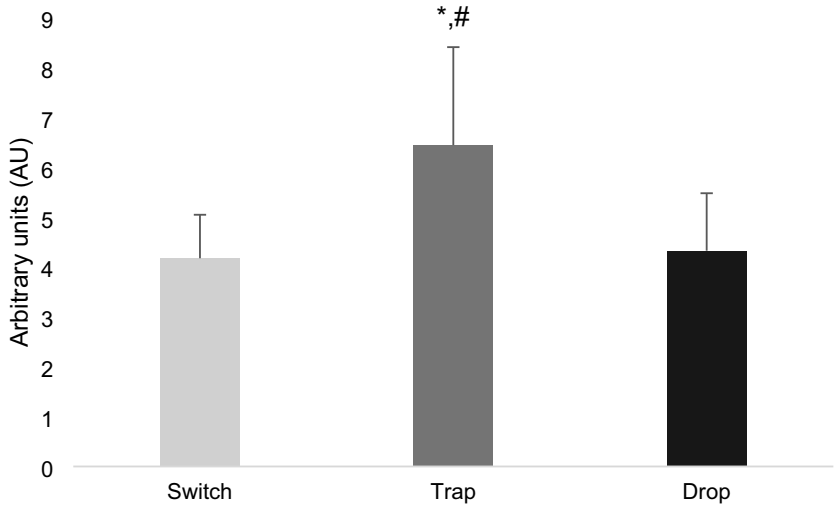

Figure 3 — Mean and SD of the rating of perceived exertion for each defensive typology. Note: *Difference from Switch; #Difference from Drop.

shown to lead to lower external and internal loads and might therefore be used in SSGs targeting a lower PL, ACC high and RPE. Altogether, this study corroborates previous research suggesting the interplay between physical, perceptual, and technical–tactical aspects during basketball training and games.

Conclusions

The present findings suggest that defensive strategies employed during middle PnR scenarios significantly affect external and internal loads in female basketball players. Specifically, the trap defense resulted in higher physical demands (ie, greater PL and high ACC), and increased perceived exertion (ie, higher RPE scores) compared with switch and drop defenses. These findings highlight the importance for coaches to consider the specific tactical demands when designing SSGs, particularly when running drills with trap defense during middle PnR situations.

Acknowledgment

The authors would like to thank all the players and coaches from the Lithuanian Sports University female team for participating in the study.

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