Reactive agility of U19 female basketball players and its relationship with speed and power characteristics

Tomas Vencurik, Dominik Bokuvka, Jiri Petru, Marcos Michaelides, Koulla Parpa, Ana Carolina Paludo

Abstract

This study aimed to find a relationship between the reactive agility of U19 female basketball players and speed and power characteristics. This study involved twelve U19 female basketball players from the first division who participated in various tests aimed at evaluating different aspects of their physical performance. These tests included assessments of power through the squat jump, countermovement jump and drop jump, linear speed through 5, 10, and 20-meter sprints, change of direction speed through the 505 test, and reactive agility through the Y-shaped test. Correlation coefficient showed large association (r = 0.64, p = 0.02) between Y-shaped test and 20 m linear sprint. Association of Y-shaped test with other power and speed test was small or moderate. These findings suggest that basketball coaches working with young female players can leverage the enhancement of reactive agility to concurrently develop linear speed.

Keywords: Y-shaped test, vertical jumps, reactive agility, change of direction speed

Introduction

In the context of basketball gameplay, the effective resolution of game scenarios hinges upon physical conditioning and coordination skills. Consequently, basketball imposes substantial physiological demands on its participants' cardiovascular and neuromuscular systems. This assertion finds support in numerous studies employing methodologies like heart rate monitoring and time-motion analysis (Ben Abdelkrim et al., 2007; Matthew & Delextrat, 2009; Reina et al., 2020; Scanlan et al., 2011; Scanlan et al., 2012; Svilar et al., 2019; Vencúrik et al., 2015). Across these analyses, the frequency of physical activities performed (such as walking, running, sprinting, jumping, etc.) varied notably, ranging from 21.2 to 56.9 movements per minute. According to Stojanović et al. (2018), alterations in movement activity arise approximately every 1 to 3 seconds, necessitating rapid responses to diverse environmental stimuli (e.g., teammate movements, opponent movements, ball movements, etc.). Effective management of game scenarios presupposes elevated levels of speed and power and proficiency in agility and cognitive processes, the latter encompassing decision-making abilities, constituting integral components of agility. As Sheppard and Young (2006) posited, agility is construed as an autonomous motor skill characterized by swift whole-body movements entailing alterations in speed or direction in reaction to specific stimuli. Accordingly, agility assessments hold pivotal significance in delineating player profiles. Traditional evaluations such as the T-test, the Illinois agility test, or the 505 test have conventionally been employed to gauge agility in basketball contexts (Ben Abdelkrim et al., 2010; Delextrat & Cohen, 2009; Chaouachi et al., 2009).

Nevertheless, these conventional tests primarily focus on assessing the velocity of directional changes among basketball players, yet they neglect the cognitive aspects integral to agility performance (Scanlan et al., 2014). Recently, there has been a surge in studies wherein researchers endeavor to formulate agility testing protocols. A noteworthy advancement in these protocols involves the inclusion of cognitive elements, particularly decision-making processes (Čoh et al., 2018; Gabbett et al., 2008; R. Lockie et al., 2014; Matlák et al., 2016; Oliver & Meyers, 2009; Sekulic et al., 2017). These assessments, termed reactive agility tests, incorporate perceptual and decision-making dimensions and are characterized by an open-skill framework. Notably, according to Scanlan et al. (2014), cognitive metrics exert a substantial influence on performance in reactive agility tests, whereas the impact of factors such as speed, change of direction speed, strength, and power remains ambiguous in some studies (Horníková & Zemková, 2022; Paul et al., 2016). This study elucidates the speed and power components associated with reactive agility performance among U19 female basketball players.

Material and methods

Participants

Twelve U19 female basketball players participated in this study (mean age 17.1 ± 0.9 years, mean body height 173.9 ± 9.3 cm, mean body weight 66.1 ± 8.2 kg). Players played in the 1st U19 division of the Czech basketball competition. They completed 4 training sessions per week and played 2 games every second week. Players participated voluntarily and signed (or their legal representatives) informed consent before the study. The study was conducted in accordance with the Declaration of Helsinki and was approved by the Research Ethics Committee of Masaryk University (EKV-2021-114).

Procedures

The participants underwent a series of assessments to evaluate their power, linear speed, change of direction speed, and reactive agility. All evaluations were conducted on an indoor basketball court featuring a wooden surface. Prior to the commencement of the testing regimen, the players engaged in a collective warm-up session lasting 15 minutes, supervised by the coach. The warm-up regimen comprised 4 minutes of jogging with the ball, followed by 8 minutes of dynamic stretching exercises, and concluded with 4 progressive speed runs spanning the length of half the court. Following a brief intermission, the players proceeded with the field tests in the following sequence: squat jump (SJ), countermovement jump (CMJ), drop jump (DJ), Y-shaped test (Y test), a 20-meter linear sprint with split times recorded at 5- and 10-meter intervals and the 505 test.

The SJ, CMJ and DJ assessments were conducted utilizing Kistler dual portable force plates, type 9260AA6 (Kistler Group, Winterthur, Switzerland). Participants were instructed to maintain their hands on their hips throughout the movement and execute a jump to attain maximum height. Each participant completed three attempts with a rest interval of 1 minute between trials (Chaouachi et al., 2009). For the CMJ and SJ assessment, the jump height (in centimeters) from the best attempt was utilized for statistical analyses. In SJ, participants were instructed to flex their knees approximately at 90°, hold this position for 2–3 seconds, and then jump. In the DJ assessment, participants performed jumps from a 40-centimeter-high box, and the jump height (in centimeters) from the best attempt was employed for statistical analyses.

As described by Lockie et al. (2014), the Y test assessment utilized a timing-light system Speedlight (Swift Performance, Wacol, Australia). Participants initiated the test, positioned 30 centimeters behind the starting line, and sprinted maximally through the first two gates placed at the starting line and 5 meters. Upon passing the second (trigger) gate, participants visually identified the flashing gate and executed a 45° cut to sprint through it. Each participant completed three trials with a rest interval of 3 minutes between trials, and the fastest trial was selected for analysis.

For the 20-meter sprint assessment, gates from the Speedlight system (Swift Performance, Wacol, Australia) were positioned at 0 meters, 5 meters, 10 meters, and 20 meters (Lockie et al., 2013). Participants initiated the sprint from a position 30 centimeters behind the starting line and completed three trials with a rest interval of 3 minutes between trials. The fastest time recorded at each distance was utilized for statistical analysis.

In the 505 test, participants sprinted a distance of 15 meters, executed a 180° change of direction, and sprinted 5 meters back (Nimphius et al., 2018). A single gate from the Speedlight system was placed 10 meters from the starting line. Participants performed three trials with a rest interval of 3 minutes between trials, and the fastest trial was selected for analysis.

Statistical analysis

Data are presented as mean ± standard deviation. Shapiro-Wilk's test checked the normality of distribution. In most cases, the data were normally distributed, but in one case, the normality was violated; therefore, Pearson's product-moment correlation was used for normally distributed data and the Spearman's rank correlation coefficient determined the relationship between variables for data where the normality was violated. The magnitude of the correlation coefficient was interpreted as trivial (0–0.1), small (0.11–0.3), moderate (0.31–0.5), large (0.51–0.7), very large (0.71–0.9), and almost perfect (0.91–1.0) (Hopkins, 2000). The proportion of the variance was defined by the coefficient of determination (r^2). The level of statistical significance was set at $p \leq 0.05$. All tests were performed using the statistical software IBM SPSS 28 (IBM Corporation, Armonk, NY, USA).

Results

Descriptive statistics of performances in selected tests are presented in Table 1. A small correlation was found between the Y test and the 5 m sprint and between the Y test and CMJ. The 10 m sprint, 505 test, SJ, and DJ produced a moderate correlation with the Y test. The correlation between the Y test and the 20 m sprint was large. The relationship of Y test with selected tests is shown in Table 2.

Table 1 Descriptive statistics of speed and power tests

	Y test [s]	**5 m [s]**	**10 m [s]**	**20 m [s]**	**505 test [s]**	**SJ [cm]**	**CMJ [cm]**	**DJ [cm]**
Mean	3.09	1.2	2.06	3.6	2.61	23.37	25.2	24.01
SD	0.21	0.05	0.07	0.14	0.09	2.88	3.4	3.79

Table 2 Correlation between Y test and speed and power tests

	Correlation coefficient	**p value**	**Coefficient of determination**	**Magnitude descriptor**
5 m	0.24	0.46	0.06	small
10 m	0.47	0.12	0.22	moderate
20 m	0.64	0.02	0.41	large
505 test	0.46	0.14	0.21	moderate
SJ	-0.39	0.21	0.15	moderate
CMJ	-0.25	0.43	0.06	small
DJ	-0.44	0.15	0.19	moderate

Discussion

The study revealed a large correlation between reactive agility and the 20 m linear sprint test (r = 0.64). These findings align with similar observations reported by Gabbett et al. (2008) and Scanlan et al. (2014), where correlations demonstrated an augmentation with increasing sprint distances. Conversely, these outcomes stand in contrast to those of other investigations wherein a lack of significant correlation was observed between reactive agility and linear sprint at the 10-meter distance (Sheppard et al., 2006; Young et al., 2015). Horníková and Zemková (2022) reported a large correlation between reactive agility and 20 m sprint but also found a very large correlation between reactive agility and 10 m sprint. These inconsistencies suggest that the choice of specific reactive agility tests or the nature of the team sport in question may influence the relationship between linear sprinting and reactive agility. Basketball coaches overseeing female players may benefit from incorporating reactive agility exercises into training regimens to enhance linear speed.

The jump heights observed in SJ, CMJ, and DJ tests exhibited moderate or small correlations with reactive agility, with coefficients of -0.39, -0.25, and -0.44, respectively. These correlations are in line with those reported in studies by Matlák et al. (2016), Northeast et al. (2019), and Young et al. (2015). These findings could highlight the nature of reactive agility and emphasize the significance of cognitive elements, including perception and decision-making processes.

In this investigation, a moderate correlation (r = 0.46) was identified between reactive agility and the change of direction speed test (505 test), consistent with prior research findings (Gabbett et al., 2008; Henry et al., 2011). This suggests that athletes' performance in a reactive agility assessment is partly impacted by their ability to change direction. While both tests involve altering direction, they differ in the change angle (approximately 45° in the Y test and 180° in the 505 test). However, presented results indicate that the performance in reactive agility tests can be affected by factors beyond sprint and power (Scanlan et al., 2014). Future studies could be appropriate to investigate other force and power characteristics from vertical jumps concerning reactive agility.

Conclusion

According to the findings of this study, there is a large association between the Y test of reactive agility and 20 m linear sprint in youth women's basketball. The association of reactive agility with performance in other speed and power tests is small or moderate. Consequently, if coaches focus on enhancing the speed capabilities of female basketball players, as mentioned, they will indirectly enhance their reactive agility as well. However, further research with a larger sample size and inclusion of additional performance variables is warranted to draw more universally applicable conclusions.

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