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Research article

THE VALIDITY AND RELIABILITY OF THE REACTION TIME AND BASKETBALL DEFENSIVE SLIDE SPEED TEST

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Abstract. *The aim of the present study was to examine the content validity and reliability of the newly developed Reaction Time and Defensive Slide Test (RTADST). Thirty-six female basketball players were recruited from three professional State Basketball league of Bosnia and Herzegovina clubs (age: 18.81 ± 2.58 years) who completed three separate trials of the RTADST with each trial consisting of fast shuffling movements left and right. Each athlete performed the test 3 times in one day, and repeated testing was conducted the following day at evening basketball sessions. The RTADST relative reliability was evaluated by Cronbach's alpha and ICC. Cronbach's alpha coefficient was 0.81 which indicates good reliability. When recommendations from Bucheit et al. (2011) were taken into account, the value of ICC <0.69 indicated poor reliability. Absolute reliability of RTADST was assessed by CV, and its value was 5.3%, which is somewhat above the 5%, or the limit of acceptable reliability. Parameters of relative and absolute reliability after the exclusion of the first trial (familiarization with the test task), were more acceptable. Cronbach's alpha coefficient was 0.90 and ICC = 0.82 compared to the one from all three trials. Considering absolute reliability, it could be concluded that the test is reliable since the CV value is below 5% (3.9%). Reliability between two days was assessed by ICC, and its value was 0.74, which confirms good reliability. Finally, the RTADST can be considered as a valid test that discriminates female basketball perimeter players and post players in reaction time and basketball defensive slide speed, while conditioning programs for the development of these abilities need to be carried out with a tool such is RTADST for the initial and final evaluation of these abilities.*

Key words: *Assessment of agility, nonplanned agility, female basketball players.*

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INTRODUCTION

Modern basketball can be described as an open skill-sport characterized by different highly intermittent activities, with sustained contributions from both anaerobic and aerobic metabolic pathways. Performance analysis in basketball has primarily been quantified through measurement of players' physiological responses (Montgomery, Pyne, & Minahan, 2010; Narazaki, Berg, Stergiou, & Chen, 2009; Rodriguez-Alonso, Fernandez-Garcia, Perez-Landaluce, & Terrados, 2003). Modern basketball requires a well-developed physical aerobic and anaerobic fitness, especially at the elite level (Ben Abdelkrim, Chaouachi, Chamari, Chtara, & Castagna, 2010). All these components of the game of basketball differ significantly across varying competition levels, as previous research examining the differences in the activity demands in basketball revealed that elite players performed significantly more total movement changes, and experienced greater activity workloads while jogging and running (Scanlan, Dascombe, & Reaburn, 2011).

Understanding the demands of modern basketball as a competitive sport where the opposing sides are under constant alternations between offensive and defensive plays is essential when designing training programs. Findings of an earlier study of the quality of standard situational efficiency indicators in basketball identified six inter-independent latent dimensions with three dimensions that refer to defensive elements: defensive aggressiveness on the player in possession of the ball, basic defensive efficiency and defensive/offensive back line efficiency (Sporiš, Šango, Vučetić, & Mašina, 2006). There are several strategic decisions that constrain behavior during basketball games and one of the most important is the level of defensive pressure due to its strong influence on game pace and, consequently, on teams' performance and success (Leite, et al., 2014).

One of the most important components of the defensive game in basketball is the defensive slide (lateral agility). In a time-motion analysis, authors found that 31% of the playing time of male basketball players was spent in shuffling movements, of which 20% was spent in high-intensity shuffling movements (Mcinnes, Carlson, Jones, & Mckenna, 1995). The basketball defensive slide is not used only when playing defense on the dribbler, but in activities such as "help and recover", "deny"- defense, etc. From the available physiological and time–motion evidence, it can be suggested that high-intensity shuffling movements are very important in playing man-to-man defense in both situations, that is, guarding the offensive player with and without a ball (Morrison et al., 2022). The effective lateral cutting maneuvers from sliding can be performed if players are able to decelerate and accelerate their body's center of mass quickly (Krause, Meyer, D., & Meyer, J., 2008). During the game, basketball players must perform numerous lateral movements in both directions, as well as many cutting motions in all directions without the dominant leg for lateral cutting maneuvers (Shimokochi, Ide, Kokubu, & Nakaoji, 2013). Same authors indicate that lowering the body's center of mass followed by a powerful and fast hip extension before foot contact may be important for the efficiency of lateral cutting maneuvers from sliding. Roozen (2005) claims that improvement of the hip abductor strength is important for performing efficient lateral motions. The reaction time, as a second condition of a qualitative defense man-to-man, is defined as the time to initiate an athlete's body response after the presentation of a sensory stimulus (Sekulić et al., 2017). In the last 15 years, a number of authors understood the importance of perceptive components and decision-making components when assessing an athlete's agility (Farrow, Young, & Bruce, 2005; Henry, Dawson, Lay, & Young, 2011; Paul, Gabbett, & Nassis, 2016). Agility in basketball is definitely an important quality. A change of direction (COD) is performed as a reaction to unpredictable visual stimuli (e.g., opponent, teammate, and ball) (Sekulic, Krolo, Spasic, Uljevic, & Peric, 2014). Perceptual and decision-making components of agility are trainable (Serpell, Young, & Ford, 2011).

The existing tests of planned agility (i.e., closed-skill agility, COD speed) and non-planned agility (i.e., open-skill agility, reactive agility) include forward-backward-sideways running, which is basketball-specific agility. However, information about the connections between sprinting, change of direction speed (CODS), and reactive agility remains uncertain. Furthermore, it is not quite clear whether the fastest player at 5m, 10m or 20m forward-backward running is the fastest one in a lateral movement – the defensive slide.

Scientific literature on nonplanned agility in women's basketball is limited (Conte et al., 2015). Research results from elite female Polish junior players suggest that the most important factor describing game effectiveness included speed, power, anaerobic zone training volume, defensive efficiency (Mikolajec, Kubaszczyk, & Waskiewicz, 2005). Furthermore, the same authors reported a significant influence of conditioning on a player's defensive efficiency. Information on movement patterns in women's basketball is limited. Australian female players (n=12) were observed to spend 4±1% of live time shuffling (Scanlan, Dascombe, Reaburn, & Dalbo, 2012). Another study revealed that in female basketball there are more shuffling movements than running or jumping movements (Matthew & Delextrat, 2009).

Agility tests are considered a reliable and valid method of assessing the perceptual and physical components of agility in contemporary research (Paul, Gabbet, & Nassis, 2016). The lateral reactive agility of female basketball players is not significantly correlated to their speed (r=.160 in the 15m sprint from a flying start; r=.415 in the 15m sprint from a standing start) (Čoh et al., 2018).

Recently, the most frequently applied test for non-planned agility is the Y-shaped drill, where athletes receive a stimulus that directs them left or right at an angle of 45°. The results from the study of correlations between the 10-m sprint and Y-shaped agility test under planned and reactive conditions with cuts to the left and right in semiprofessional and amateur basketball players were mixed considering that out of 6 identified correlations, significance (p=.05) was noted in three (Lockie, Jeffriess, McGann, Callaghan, & Schultz, 2014). Previously, Green, Blake, & Caulfield (2011) reported the intraclass correlation coefficient analysis of test–retest Y-shaped drills was r=0.88, and the standard error measure was 0.09. In Oliver & Meyers' research (2009) the reliability Y-shaped drill's data sets was high, with a coefficient of variation of approximately 3%. Another study assessed the nonplanned test (Y-shaped drill) on the sample of female basketball players and intraclass correlation coefficient (ICC) value was 0.86 for tests time using light (Sekulic et al., 2014). The ICC of the nonplanned test in the left and right side for male basketball players were 0.81 and 0.88 (Sekulic et al., 2017). Agility tests definitely contribute the information with respect to the interaction of perceptual-cognitive capacity in conjunction with physical performance (Nimphius, Callaghan, Bezodis, & Lockie, 2018).

Before commencing any program for the improvement of reaction time and defensive slide speed, a coach should know the initial status of his/her players. Consequently, it is very important for a coach to gather precise and reliable data about reaction time and the defensive slide speed abilities of his/her players.

In the specter of the basketball tests, to the authors' knowledge, there is no test that evaluates both the reaction time and basketball defensive slide speed. Therefore, the authors of the present study devised a test that assess these two intertwined abilities and named it the Reaction Time and Defensive Slide Test (RTADST). Given this, the aim of this study was to assess the validity and reliability of the newly devised test in female basketball players. The authors hypothesized that the RTADST will have acceptable validity and reliability, and practical use when designing conditioning programs for female basketball players.

METHODS

The Experimental Approach to the Problem

The majority of the known and standardized agility tests estimate the ability of the combined movement of players, like forward-backward, left-right, etc. (Horníková & Zemková, 2022). In the most cases those are preplanned tests. To the best of our knowledge, there is no nonplanned test that assesses the reaction time in interaction with the defensive slide. Due to the importance of these two abilities for the defense quality of female basketball players, the Reaction Time and Defensive Slide Test (RTADST) was developed using the Witty SEM devise (Microgate 2015, Italy). Witty SEM was originally designed as a devise for optimal planning and management of specific training for reactivity, agility, and motor-cognitive abilities. Supplementary video material is available at https://youtu.be/fciRufgH1HI.

The participants

Thirty-six female basketball players were recruited from three professional State Basketball league of Bosnia and Herzegovina clubs. Their demographic characteristics are shown in Table 1.

Table 1 Descriptive statistics of the basic anthropometric parameters of the participants

n	Age (years)	Weight (kg)	Height (cm)	BMI	Fat (%)
36	18.81 ± 2.58	70.11 ± 7.72	180.03 ± 6.62	21.63 ± 1.98	20.98 ± 4.57

The number of perimeter players was 22 (weight: 67.43 kg ± 6.36; height: 176.55 cm ± 5.28; BMI = 21.61 ± 1.73; fat percentage = 20.56% ± 5.08). The number of post players was 14 (weight: 74.31 kg ± 8.02; height: 185.50 cm ± 4.49; BMI = 21.66 ± 2.40; fat percentage = 21.64% ± 3.72). The post players were significantly higher (.000) and heavier (.007), while BMI (.940) and fat percentage (.501) showed no differences. The average number of training hours per week was 10.5 with one official game. All players voluntarily participated in this study. The parents of underage basketball players signed consent for their child. All of the participants were healthy and had no injuries at the time of testing.

Procedure

For the RTADST, a course is arranged in rectangular shape with 4 Witty SEM sensors mounted on tripods in each corner of the rectangle. The height of the sensor is set at 120 cm. The distance between the sensors is: the longer rectangle side = 3.5m, the shorter rectangle side = 1.5m (Figure 1). The start line is inside the rectangle and it is 1.5m from the shorter rectangle side. The angle between the longer side of the rectangle and diagonal is ~ 23°.

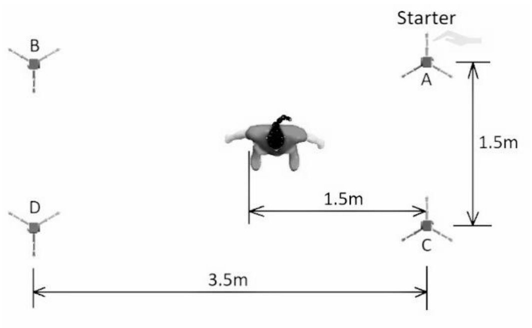

Fig. 1 Distance between the sensors

Fig. 2 Starting position

The athletes were tested just before the end of the preparatory period for the 2019/2020 season. Before the testing, the participants received instructions and a demonstration of correct movement in a defensive stance (without jumping or feet crossing). The starting position, with a straight back, flexed legs, feet slightly divergent and with active hands up is shown in Figure 2. After the instructions, all the athletes participated in 15 minutes of a basketball-specific warm-up: running in pairs or threes with a ball routine for 10 minutes (i.e., criss-cross), a dynamic warm-up, and dynamic stretching for 5 minutes. After that, 4 players were instructed to move to the testing court and the rest of the players continued with light basketball activities that were previously agreed on with their coach. Testing sessions were conducted on a hardwood court. Each test was relatively short in duration (~7-8 seconds), and athletes who were waiting for their turn did not cool down. The test was performed in consecutive order: first athlete, second, third, fourth, with 3 trials each. Consequently, each athlete had enough time to recover (work to rest ratio = 1:3). When one athlete was performing the test, the others were behind the screen in order to prevent their memorization of the order in which the LEDs were lit. When the first four athletes completed the test, they were replaced with another four from the basketball training. It took about 30 minutes to complete the testing of 12 athletes (one team). Testing sessions were conducted in two consecutive days during evening practice. Each athlete performed the test 3 times in one training session, and repeated testing was conducted the following day. The time was measured in intervals of 0.01 second.

The athlete is positioned in the middle of the rectangle with her right foot next to the start line. On the command "ready", the athlete assumes a defensive stance. As soon as the athlete assumes the correct defensive stance, the tester who is behind and to the left of the athlete activates the photocell beam. Automatically, time measuring and photocell B is activated (LEDs on). The athlete has to perform defensive slides from one photocell to another one in order to deactivate it (LEDs off). As soon as a photocell is deactivated, another one is activated and the athlete needs to move towards it. The scenario of LEDs lighting was: B-C-D-A-B-C. The timer stopped automatically when the last photocell was deactivated, and the Witty SEM device recorded all 6 sequence times, as well as the total time.

Statistical analyses

The statistical analyses were performed using statistical program SPSS (v. 20.0; IBM, Armonk, NY, USA). The normality was assessed by the Kolmogorov-Smirnov test. The mean values and standard deviations were reported for all the variables (M±SD) at a 90% confidence interval (90% CI). To evaluate measurement validity, an independent t-test was performed to compare the scores between perimeter and post female basketball players. The differences between three trials of agility tests and the assessment of the learning effect were identified using a repeated measures ANOVA with Bonferroni's post hoc comparisons. The magnitude of the differences obtained was interpreted by Cohen's effect size (ES). Effect sizes (*d*) were calculated based on the modified qualitative descriptors in the following classifications: trivial = <0.19; small = 0.20-0.59; medium = 0.60-1.19; large = 1.20-1.99; very large = >2.0 (Hopkins, Marshall, Batterham, & Hanin, 2009). Between-trial reliability of the RTADST was assessed by determining the relative reliability indicated by the intraclass correlation coefficient (ICC) and with Cronbach's alpha coefficient (α). ICC was assessed using the following criteria: trivial = <0.10; small = 0.11-0.30; moderate = 0.31-0.50; large = 0.51-0.70; very large = 0.71-0.90; nearly perfect >0.90; perfect =1 (Hopkins, Marshall, Batterham, & Hanin, 2009). Cronbach's alpha coefficient was interpreted as follows: unacceptable = <0.5; poor = 0.5-0.6; questionable = 0.6-0.7; acceptable = 0.7-0.8; good = 0.8-0.9; excellent = >0.9. The absolute reliability of the agility test was indicated by the coefficient of variation (CV). The following criteria were used to assess the reliability of the test: ICC>0.69 and CV<5% (Buchheit, Lefebvre, Laursen, & Ahmaidi, 2011). Statistical significance was set at $p \leq 0.05$.

RESULTS

Construct validity of RTADST was assessed based on the comparison of the results between perimeter players and post players. The best result of three trials are presented in Table 2.

Table 2 A comparison of the scores between perimeter and post female basketball players

	n	M±SD	t	Sig.	Mean Difference (90%CI)	Cohen's *d*
perpls	22	7.18±0.27	-4.07	0.01	-0.32 (-0.45;-0.18)	1.49
pospls	14	7.50±0.13				

perpls = perimeter players; pospls = post players; n = number of participants;
M = mean; SD = standard deviation; Sig. = level of significance; CI = confidence interval

Perimeter players had better results than post players on the agility test. With regard to the significant, large (p = 0.01, d = 1.49) difference in the RTADST score between the two group of players, the test can be considered a valid measuring tool due to its ability to discriminate between the players that play in diverse playing positions which demand different levels of agility.

Table 3 Differences between the three trials of RTADST

	M±SD	Wilks' Lambda	*p*	Cohen's *d*	Post-hoc tests	Mean difference (95%CI)	Sig.
trial 1	7.80±0.47	0.36	<0.01*	0.64	trial 1-trial 2	0.31 (0.16;0.46)	<0.01*
trial 2	7.49±0.28				trial 1-trial 3	0.48 (0.31;0.64)	<0.01*
trial 3	7.32±0.28				trial 2-trial 3	0.17 (0.10;0.24)	<0.01*

M = mean; SD = standard deviation; p = level of significance; CI = confidence interval,
Sig. = level of significance; * indicates statistical significance

The results of three consecutive trials of RTADST showed the presence of a learning effect since performance was better in each following trial (Table 3). The results of the repeated measures ANOVA confirm that (Wilks Lambda = 0.36, $p < 0.01^{*}$). Cohen's *d* difference was moderate. The post-hoc tests showed significant differences in all three trials.

Table 4 Relative and absolute reliability of RTADST within one day (*3 measurements on the first day*) and the indicator of relative reliability between the two testings

	reliability within the day					reliability between two days	
	RTADST score	relative reliability			absolute reliability		
	M±SD	α	ICC (95%CI)	*p*	CV (%)	ICC (95%CI)	*p*
trial 1	7.80±0.47						
trial 2	7.49±0.28	0.81	0.59 (0.41;0.75)	<0.01*	5.3	0.61 (0.35;0.78)	<0.01*
trial 3	7.32±0.28						

M = mean; SD = standard deviation, α = Cronbach's alpha, ICC = intraclass correlation coefficient, CV = coefficient of variation; p = level of significance; * indicates statistical significance

The reliability of the RTADST was assessed with measures of absolute and relative reliability. Three consecutive trials of RTADST for female basketball players were evaluated. Relative reliability was evaluated by Cronbach's alpha and ICC. Cronbach's alpha coefficient was 0.81, which indicates good reliability. Based on the recommendations of Hopkins et al. (2009), an ICC value of 0.59 indicates a large correlation. However, when recommendations from Bucheit et al. (2011) are taken into account, the value of ICC <0.69 indicates poor reliability. ICC was statistically significant at the 0.01 level. The absolute reliability of the RTADST was assessed by CV, and its value was 5.3%, which is somewhat above the 5%, or the limit of acceptable reliability (Bucheit et al., 2011). RTADST reliability between the two sessions within two days was assessed by ICC. ICC was 0.61, which again suggests poor reliability.

Table 5 Relative and absolute reliability of RTADST for female basketball players within one day (two testings on the first day, excluding the first testing) and relative reliability between the two days of testing

	reliability within one day (day 1)					reliability between two days (day 1 and day 2)			
	RTADST score	relative reliability			absolute reliability				
	M±SD	α	ICC (95%CI)	p	CV (%)		M±SD	ICC (95%CI)	p
trial 2 (day 1)	7.49±0.28	0.9	0.82 (0.68;0.90)	<0.01*	3.9	trial 2 (day 2)	6.99	0.74 (0.54;0.86)	<0.01*
trial 3 (day 1)	7.32±0.28					trial 2 (day 2)	6.93		

M = mean; SD = standard deviation; α = Cronbach's alpha; ICC = intraclass correlation coefficient; CV = coefficient of variation; p = level of statistical significance; * indicates statistical significance

Parameters of relative and absolute reliability *after the exclusion of the first trial*, which was the familiarization with the test task, are shown in Table 5. The indicators of relative reliability were higher compared to those when all three trials were included in the analysis.

Cronbach's alpha coefficient was 0.90, indicating excellent reliability of the test. ICC was significantly higher compared to the one from all three trials. Its value was 0.82 which suggests acceptable reliability. Considering absolute reliability, it could be concluded that the test is reliable since the CV value is below 5% (3.9%). Reliability between two days was assessed by ICC, and its value was 0.74, which confirms good reliability.

DISCUSSION

The reaction time and basketball defensive slide speed are two interrelated and very important aspects of defensive play. Since there is no test that evaluates these two abilities of female basketball players, we developed the Reaction Time and Basketball Defensive Slide Speed Test (RTADST). Accordingly, this study aimed to investigate the validity and reliability of this basketball-specific test (RTADST) in order to evaluate nonplanned agility performances of female basketball players. Test validity was evaluated based on the differences between the perimeter and post players in achieved times (scores). Perimeter players yielded significantly better times (Cohen's d = 1.49; large difference, Table 1), hence the test can be considered valid. Also, the newly developed nonplanned agility test (RTADST) is found to be a reliable measuring tool. If the scores from the first trial could be treated as a familiarization of female basketball players with the test task, the indicators of reliability (Table 4) would be acceptable. In that case, Cronbach's alpha coefficient was 0.90, ICC = 0.82, and CV = 3.9%, which confirms the reliability of the RTADST. ICC reliability between two days was 0.74, which indicates good reliability. All obtained indicators suggest that RTADST fulfills the criterions of validity and reliability, with the notion that female basketball players should perform the first trial as a familiarization, while the second trial counts as a score of the RTADST. In regard to that, progression of scoring from the first to the third trial (trial 1 mean = 7.80; trial 2 mean = 7.49; trial 3 mean = 7.32, Table 3) probably depended more on the "adaptation to the task" than on strengthening of the active muscles while performing the defensive slides (mm. adductors and abductors, hip internal and external rotators). In accordance with the claim made by G. Del Rossi, A. Malaguti, and S. Del Rossi (2014), we assumed that the improved reaction times and basketball defensive slide speed in each subsequent test session were likely the result of visual feedback derived from completing earlier test trials.

Our hypothesis that the RTADST will possess acceptable validity and reliability has been confirmed. For unknown reasons there is an apparent lack of developed nonplanned agility tests for women or even smaller number of studies that investigated lateral movements. The most frequently used nonplanned agility test is the Y-shaped drill test, as are its modifications. That test does not include lateral movements. In a study on female basketball players (21 college-aged female athletes; Sekulić et al., 2014), it has been suggested that the shorter version of a Stop'n'go Reactive-Agility Test (a modified Y-shaped drill test - 3 unpredictable changes of direction vs. 5) is more suitable for women because it better discriminates more agile from less agile athletes. The reliability analyses suggested a high consistency for the applied tests (CA = 0.89, CV = 0.04, ICC = 0.86). McCormick (2014) confirmed the reliability and validity of Edgren's popular lateral side-step test. The study assessed 4 different lateral shuffle tests which combined different distances and durations on a sample of male basketball players. All of the tests had very good internal consistency (Cα>0.89), and test-retest reliability (ICC>0.89). However, lateral movement in Edgren's test is not the same as in the basketball defensive slide, but much different (hopping instead of sliding). Furthermore, this test does not include a perceptual-cognitive component. Farrow, Young, and Bruce (2005) developed a test for the measurement of nonplanned agility for netball. Their test covered lateral movements (hopping instead of sliding) and forward running. A post-hoc analysis showed that high and moderately skilled groups were faster than the lesser skilled group. Intra-class correlations of r> 0.80 indicated acceptable reliability. An original test for the evaluation of agility named the "Successive Choice Reaction Test" was developed by Uchida, Demura, Nagayama and Kitabayashi (2013). On a sample of 15 university students majoring in sports, every tempo test (1.3, 1.5, and 2.0 seconds) was also very reliable (ICC = 0.77–0.93). It is unclear whether the stimulus tempo used in this study is valid or not when using top players majoring in open skill sports as participants, or members of the general public with inferior physical fitness. Results of a study conducted by Spasic, Krolo, Zenic, Delextrat and Sekulic (2015) showed that the reliability of a newly-developed handball-specific reactive-agility test is high (ICC = 0.90, CV = 2.4%). The test included forward running, lateral shuffling and backward running. However, handball lateral shuffling is not the same as basketball sliding, i.e. basketball sliding is physically much different. Loureiro and Freitas (2016) constructed the Nonplanned Agility Test for Badminton Players. The ANOVA test for construct validity revealed that expert players performed the BADCAMP test in a shorter time than nonexpert ones ($p < .001$). The authors used log10 transformations of the real data for test–retest reliability, and the ICC was very high (ICC = .93, 95% CI .82– .97). Furthermore, a paired t-test revealed no difference between the performance on the test and retest ($p = .07$). Veale, Pearce, and Carlson (2010) tested the reliability and construct validity of a novel reactive agility test (RAT) on a sample of elite junior Australian Football players. More importantly, when testing the same population on two occasions separated by 1 week, the results of the RAT showed no significant difference ($p = 0.22$) and good reliability ($r = 0.91$) between the test results, indicating the absence of the learning effect through "test practice". On a population of 15 male and 15 female sport science students, Spiteri, Cochrane, and Nimphius (2013) evaluated test-retest reliability of the response times for the *simple* and *complex* reaction time (RT), movement time (MT), and total movement time (TMT) (ICC = 0.71-0.95; CV = 1.42-5.04). Their tests included leg movements, and both tests were reliable to determine lower body RTs during both conditions (simple and complex). MT and TMT during the Complex Reaction Time test were significantly different, suggesting that MT could be the discriminating factor between conditions, and also genders. The results of Sekulic et al. (2017) indicated that male basketball guards were more successful than centers and forwards in nonplanned agility tests executed on (both) the nondominant and dominant side. Intrasession reliability for a nonplanned agility test on (both) the nondominant and dominant side was high ($ICC_{domside}$=0.86, CV=5.2%; $ICC_{nondomside}$=0.85, CV=5%). Also, the intersession reliability of these tests was high ($ICC_{domside}$=0.88, CV=5%; $ICC_{nondomside}$=0.81, CV=5.4%). In our study, performances of the dominant and nondominant side were not the object of study, since the RTADST was designed to evaluate consecutive movements on the left (3) and right (3) side of female basketball players. An independent samples t-test showed that there are no significant differences in the performance scores on the left and right side (p=.413). A probable explanation for these findings lies in fact that working muscles (mm. adductors & abductors, hip internal & external rotators) in defensive slides (in both directions) were equally active during the training sessions. Zouhal et al. (2018) indicated that reaction time and movement time significantly differ in the dominant vs. nondominant side in soccer players. There are no sliding movements in football and this comparison might be unsuitable. Langley and Chetlin (2017) modified a 3-Cone Test (3CT) for testing agility and conducted a study on forty male students enrolled in classes in the Department of Physical Education. A modification of the 3-Cone that includes reaction and the choice of a cut to the left (3CTAL) or right (3CTAR), showed good reliability. Intra-class correlation coefficients (ICC) indicated a moderate to high reliability: for 3CTAR, ICC was 0.85 and CI was 0.74-0.92. For 3CTAL, ICC was 0.79 and CI was 0.64-0.88. According to the authors, the main limitation of the study was a lack of motivation among the sample of participants, and that highly motivated athletes should be considered instead.

The findings support the use of the RTADST in practice; however our study has some limitations. Due to the lack of tests for female basketball players, we focused strictly on that sample. However, future research should analyze the validity and reliability of RTADST in male basketball players. Second, many basketball teams do not have access to the equipment (Witty SEM) necessary to perform this type of assessment. And third, the somewhat weaker reliability of the RTADST, compared to the planned agility tests, is expected congruently with previous studies (Sattler et al., 2016; Sekulic, Krolo, Spasic, Uljevic, & Peric, 2014; Spasic, Krolo, Zenic, Delextrat, & Sekulic, 2015). Performances of nonplanned agility include perceptive and reactive components (Sattler et al., 2016; Sekulic, Krolo, Spasic, Uljevic, & Peric, 2014). They are a natural source of error, potential causes of measurement error, and consequently, factors that can affect reliability (Sattler et al., 2016). However, this does not mean that the design of new nonplanned agility tests should be abandoned.

CONCLUSION

The RTADST is a valid test that discriminates female basketball perimeter players and post players in reaction time and basketball defensive slide speed. Also, the RTADST showed acceptable relative and absolute reliability across multiple trials in professional female basketball players. Analyses have shown that testing should be performed 2 times, and the better result counted as the score. When performing the RTADST with a team, the coach should separately evaluate the results of perimeter players, and post players. If a coach wants to carry out a program of reaction time and defensive slide speed development, it ought to be done with a tool such is the RTADST for the initial and final evaluation of these abilities. Normally, between the two tests, a program should be implemented in order to develop basketball specific agility.

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REFERENCES

Ben Abdelkrim, N., Chaouachi, A., Chamari, K., Chtara, M., & Castagna, C. (2010). Positional Role and Competitive-Level Differences in Elite-Level Men's Basketball Players. *Journal of Strength and Conditioning Research,* 24(5), 1346–1355.

Buchheit, M., Lefebvre, B., Laursen, P. B., & Ahmaidi, S. (2011). Reliability, usefulness, and validity of the 30–15 intermittent ice test in young elite ice hockey players. *Journal of Strength & Conditioning Research,* 25(5), 1457–1464.

Conte, D., Favero, T., Lupo, C., Francioni, F., Capranica, L., & Tessitore, A. (2015). Time-Motion Analysis of Italian Elite Women's Basketball Games: Individual and Team Analyses. *Journal of Strength and Conditioning Research,* 29(1), 144–150.

Čoh, M., Vodičar, J., Žvan, M., Šimenko, J., Stodolka, J., Rauter, S., & Maćkala, K. (2018). Are Change-of-Direction Speed and Reactive Agility Independent Skills Even When Using the Same Movement Pattern? *Journal of Strength and Conditioning Research*, 32(7), 1929–1936.
Del Rossi, G., Malaguti, A., Del Rossi, S. (2014). Practice Effects Associated With Repeated Assessment of a Clinical Test of Reaction Time. *Journal of Athletic Training,* 49(3), 356–359.
Farrow, D., Young, W., & Bruce, L. (2005). The development of a test of reactive agility for netball: A new methodology. *Journal of Science and Medicine in Sport,* 8(1), 52–60.
Green, B., Blake, C., & Caulfield, B. (2011). A Valid Field Test Protocol of Linear Speed and Agility in Rugby Union. *Journal of Strength and Conditioning Research,* 25(5), 1256–1262.
Henry, G., Dawson, B., Lay, B., & Young, W. (2011). Validity of a Reactive Agility Test for Australian football. *International Journal of Sports Physiology and Performance,* 6(4), 534–545.
Hopkins, W., Marshall, S., Batterham, A., & Hanin, J. (2009). Progressive statistics for studies in sports medicine and exercise science. *Medicine Science in Sports Exercise*, 41(1), 3–13.
Horníková H, Zemková E. (2022). Determinants of Y-Shaped Agility Test in Basketball Players. *Applied Sciences*. 12(4), 1865. https://doi.org/10.3390/app12041865
Krause, J.V., Meyer, D., & Meyer, J. (2008). *Basketball Skills & Drills*. Champaign, IL: Human Kinetics.
Leite, N.M., Leser, R., Gonçalves, B., Calleja-Gonzalez, J., Baca, A., & Sampaio, J. (2014). Effect of Defensive Pressure on Movement Behaviour During an Under-18 Basketball Game. *International Journal of Sports Medicine, 35*(9), 743-748.
Lockie, R., Jeffriess, M., McGann, T., Callaghan, S., & Schultz, A. (2014). Planned and Reactive Agility Performance in Semiprofessional and Amateur Basketball Players. *International Journal of Sports Physiology and Performance, 9*(5), 766–771.
Loureiro, L. D. B. Jr., & Freitas, P. B. (2016). Development of an Agility Test for badminton players and Assessment of Its Validity and Test-Retest Reliability. *International Journal of Sports Physiology, 11*(3), 305-310.
Matthew, D., & Delextrat, A. (2009). Heart rate, blood lactate concentration, and time–motion analysis of female basketball players during competition. Journal of Sports Sciences, 27(8), 813-821.
McInnes, S.E., Carlson, J.S., Jones, C.J., & Mckenna, M.J. (1995). The physiological load imposed on basketball players during competition. *Journal of Sports Sciences, 13*(5), 387–397.
McCormick, B. T. (2014). The reliability and validity of various lateral side-step tests. *International Journal of Applied Sports Sciences, 26*(2), 67-75.
Montgomery, P., Pyne, D., & Minahan, C. (2010). The physical and physiological demands of basketball training and competition. *International Journal of Sports Physiology and Performance, 5,* 75–86.
Morrison, M., Martin, D.T., Talpey, S., Scanlan, A.T., Delaney, J., Halson, S., & Weakley, J. (2022). A Systematic Review on Fitness Testing in Adult Male Basketball Players: Tests Adopted, Characteristics Reported and Recommendations for Practice. *Sports Medicine*, Online first: https://doi.org/10.1007/s40279-021-01626-3
Narazaki, K., Berg, K., Stergiou, N., & Chen, B. (2009). Physiological demands of competitive basketball. *Scandinavian Journal of Medicine Science and Sports, 19,* 425–432.
Nimphius, S., Callaghan, S. J., Bezodis, N. E., & Lockie, R. G. (2018). Change of direction and agility tests: challenging our current measures of performance. *Strength and Conditioning Journal*, *40*(1), 26–38.
Oliver, J., & Meyers, R. (2009). Reliability and generality of measures of acceleration, planned agility, and reactive agility. *International Journal of Sports Physiology and Performance. 4*, 345-354.
Paul, D. J., Gabbett, T. J., & Nassis, G. P. (2016). Agility in team sports: Testing, training and factors affecting performance. *Sports Medicine, 46*(3), 421-442.
Rodriguez-Alonso, M., Fernandez-Garcia, B., Perez-Landaluce, J., & Terrados, N. (2003). Blood lactate and heart rate during national and international women's basketball. *Journal of Sports Medicine and Physical Fitness 43,* 432–436.
Roozen, M. (2005). Developing hip joint adduction and abduction strength. *NSCA Perform Train J* 4: 18–19.
Sattler, T., Sekulic, D., Spasic, M., Osmankac, N., Vicente, J. P., Dervisevic, E., & Hadzic, V. (2016). Isokinetic knee strength qualities as predictors of jumping performance in high-level volleyball athletes: multiple regression approach. *The Journal of Sports Medicine and Physical Fitness, 56*(1-2), 60-69.
Scanlan, A., Dascombe, B., & Reaburn, P. (2011). A comparison between the activity demands of elite and sub-elite Australian man's basketball competition. *Journal of Sports Sciences*, 29:11, 1153-1160.
Scanlan, A., Dascombe, B., Reaburn, P., & Dalbo, V. (2012). The physiological and activity demands experienced by Australian female basketball players during competition. *Journal of Science and Medicine in Sport 15,* 341–347.
Sekulic, D., Krolo, A., Spasic, M., Uljevic, O., & Peric M. (2014). The development of a new stop'n'go reactive agility test. *Journal of Strength and Conditioning Research, 28*(11), 3306-3312.

Sekulic, D., Pehar, M., Krolo, A., Spasic, M., Uljevic, O., Calleja-González, J., & Sattler, T. (2017). Evaluation of Basketball-Specific agility: applicability of preplanned and nonplanned agility performances for differentiating playing positions and playing levels. *Journal of strength and Conditioning Research, 31*(8), 2278–2288.

Serpell, B.G., Young, W.B. & Ford, M. (2011). Are Perceptual and Decision-Making Components of Agility Trainable? A Preliminary Investigation, *Journal of Strength and Conditioning Research, 25*, 1240- 1248

Shimokochi, Y., Ide, D., Kokubu, M., & Nakaoji, T. (2013). Relationships Among Performance of Lateral Cutting Maneuver From Lateral Sliding and Hip Extension and Abduction Motions, Ground Reaction Force, and Body Center of Mass Height. *Journal of Strength and Conditioning Research, 27*(7), 1851–1860.

Spasic, M., Krolo, A., Zenic, N., Delextrat, A., & Sekulic, D. (2015). Reactive agility performance in handball: Development and evaluation of a sport-specific measurement protocol. *Journal of Sports Science & Medicine, 14*, 501–506.

Spiteri, T., Cochrane, J. L., & Nimphius, S. (2013). The Evaluation of a New Lower-Body Reaction Time Test. *Journal of Strength and Conditioning Research, 27(1),* 174–180.

Sporiš, G., Šango, J., Vučetić, V., & Mašina, T. (2006). The latent structure of standard game efficiency indicators in basketball. *International Journal of Performance Analysis in Sport, 6*(1), 120-129.

Uchida, Y., Demura, S., Nagayama, R., & Kitabayashi, T. (2013). Stimulus Tempos and the Reliability of the Successive Choice Reaction Test. *Journal of Strength and Conditioning Research, 27(3),* 848-853.

Veale, J., Pearce, A., & Carlson, J. (2010). Reliability and validity of a reactive agility test for Australian football. *International journal of sports physiology and performance, 5*(2), 239-248.

Zouhal, H., Abderrahman, A. B., Dupont, G., Truptin, P., Le Bris, R., Le Postec, E., Coppalle, S., Ravé, G., Brughell, M., & Bideau, B. (2018). Laterality influences agility performance in elite soccer players. *Frontiers in Physiology*, 9, 807.

VALIDNOST I POUZDANOST TESTA ZA PROCENU VREMENA REAKCIJE I BRZINE KRETANJA U ODBRAMBENOM KOŠARKAŠKOM STAVU

Cilj aktuelnog istraživanja bio je da se ispita validnost i pouzdanost novoosmišljenog testa za procenu vremena reakcije i brzine kretanja u odbrambenom košarkaškom stavu (RTADST). Trideset šest košarkašica iz tri kluba profesionalne nacionalne lige Bosne i Hercegovine (godine: 18.81 ± 2.58) realizovalo je šest odvojenih izvođenja testa RTDST, gde se svako izvođenje sastojalo od brzih bočnih kretnji ulevo i udesno. Sportistkinje su izvele tri pokušaja u jednom danu, a ponovljeno testiranje je izvedeno sledećeg dana za vreme večernjeg košarkaškog treninga. Relativna pouzdanost RTADST testa je evaluirana putem koeficijenta Cronbach alpha i ICC. Cronbach alpha koeficijent je iznosio 0.81 što se smatra dobrom pouzdanosti. Uzimajući u obzir preporuke Bucheit i saradnika (2011), vrednost ICC <0.69 se smatra slabijom pouzdanosti. Apsolutna pouzdanost RTADST je procenjena putem CV, čija vrednost je iznosila 5.3%, odnosno nešto iznad 5%, što predstavlja granicu prihvatljive pouzdanosti. Međutim, pokazatelji relativne i apsolutne pouzdanosti nakon izostavljanja prvog pokušaja (familijarizacija sa motoričkim zadatkom), bili su prihvatljiviji. Koeficijent Cronbach alpha je iznosio 0.90, a ICC = 0.82 u poređenju sa pokazateljima koji su uključivali sva tri pokušaja. Imajući u vidu apsolutnu pouzdanost, može se zaključiti da je test pouzdan jer vrednosti CV su ispod 5% (3.9%). Pouzdanost između dva dana procenjena je putem ICC, čija vrednost je bila 0.74, što potvrđuje dobru pouzdanost. Na kraju, test RTADST se može smatrati validnim testom koji diskriminiše vanjske i unutrašnje košarkašice u vremenu reakcije i brzine kretanja u odbrambenom košarkaškom stavu. Kondicioni programi za razvoj ovih sposobnosti treba da budu sprovedeni uz primenu RTADST kao alata za inicijalnu i finalnu evaluaciju tih sposobnosti.

Ključne reči: *Procena agilnosti, neplanirana agilnost, košarkašice.*