

REACTION TIME AND DEFENSIVE SLIDING TEST VERSUS T-TEST: WHICH IS BETTER?

TEMPO DE REAÇÃO E TESTE DE DESLIZAMENTO DEFENSIVO CONTRA T-TEST: QUAL É MELHOR?

TIEMPO DE REACCIÓN Y PRUEBA DE DESLIZAMIENTO DEFENSIVO CONTRA T-TEST: ¿QUÉ ES MEJOR?

Igor Vučković¹
(Physical Education Professional)
Aleksandar Gadžić²
(Physical Education Professional)
Željko Sekulić¹
(Physical Education Professional)
Mladen Mikić³
(Physical Education Professional)
Zoltan Boros⁴
(Physical Education Professional)
Marko Stojanović³
(Physical Education Professional)

1. University of Banja Luka, Faculdade de Educação Física e Esporte, Bósnia e Herzegovina.
2. Singidunum University, Faculdade de Educação Física e Gestão Esportiva, Belgrado, Sérvia.
3. University of Novi Sad, Faculdade de Esporte e Educação Física, Sérvia.
4. Hungarian University of Sports Science, Escola de Estudos de Doutorado, Budapeste, Hungria.

Correspondence:

Aleksandar Gadžić
Singidunum University, Faculdade de Educação Física e Gestão Esportiva, Danijelova, 32, Belgrade, Sérvia. 11000.
agadzic@singidunum.ac.rs

ABSTRACT

Introduction: During basketball, players' movements represent a reaction to an unpredictable single or complex external stimulus (nonplanned agility). **Objective:** The present study aimed to compare the test of nonplanned agility to the planned agility test and to increase the knowledge of perception, decision-making, anticipation, and motor abilities of female basketball players. **Methods:** Thirty-six female basketball players (age: 18.81 ± 2.58 years) performed The Reaction Time and Defensive Sliding Test (RTADST) on the first day and the T-test the following day. **Results:** there were no statistically significant correlations between the RTADST and T-test at the whole sample level or between perimeter and post players. The T-test and Fat % correlation is significant at the 0.05 level, while the other analyzed correlations were insignificant. Perimeter players achieved better results on the RTADST test. There were no significant differences between perimeter and post players on the T-test. **Conclusion:** The RTADST and T-test are testing different abilities. We recommend the use of the RTADST to coaches and conditioning experts. **Level of Evidence II; Diagnostic Study Investigating a Diagnostic Test.**

Keywords: Reaction Time; Basketball; Female; Perception.

RESUMO

Introdução: Durante o basquete, os movimentos dos jogadores representam uma reação a um estímulo externo imprevisível, simples ou complexo (agilidade não planejada). **Objetivo:** O presente estudo teve como objetivo comparar o teste de agilidade não planejada com o teste de agilidade planejada no intuito de aumentar o conhecimento sobre percepção, tomada de decisão, antecipação e habilidades motoras em jogadoras de basquete. **Métodos:** Trinta e seis jogadoras de basquete (idade: $18,81 \pm 2,58$ anos) realizaram o Teste de Tempo de Reação e Deslizamento Defensivo (RTADST) no primeiro dia e o Teste T no dia seguinte. **Resultados:** não houve correlações estatisticamente significativas entre o RTADST e o teste T em toda a amostra ou entre jogadores de perímetro e de poste. A correlação entre o teste T e o percentual de gordura é significativa no nível de 0,05, enquanto as outras correlações analisadas foram insignificantes. Os jogadores de perímetro obtiveram melhores resultados no teste RTADST. Não houve diferenças significativas entre os jogadores de perímetro e de poste no teste T. **Conclusões:** O RTADST e o teste T estão testando habilidades diferentes. Recomendamos o uso do RTADST para treinadores e especialistas em condicionamento físico. **Nível de Evidência II; Estudo de Diagnóstico que Investiga um Teste de Diagnóstico.**

Descritores: Tempo de Reação; Basquetebol; Feminino; Percepção.

RESUMEN

Introducción: Durante el partido de baloncesto, los movimientos de los jugadores de baloncesto representan la reacción a un estímulo externo único o complejo impredecible (agilidad no planificada). **Objetivo:** El presente estudio tuvo como objetivo comparar la prueba de agilidad no planificada con la prueba de agilidad planificada y aumentar el conocimiento sobre la percepción, la toma de decisiones, la anticipación y las habilidades motoras de las jugadoras de baloncesto. **Métodos:** Las treinta y seis jugadoras de baloncesto (de la edad: 18.81 ± 2.58 años) realizaron la Prueba de tiempo de reacción y deslizamiento defensivo (RTADST) el primer día y el siguiente día la prueba T. **Resultados obtenidos:** no hubo correlaciones estadísticamente significativas entre el RTADST y la prueba T, a nivel de toda la muestra ni entre jugadoras del perímetro y del poste. La correlación entre la prueba T y el % de Grasa es significativa al nivel de 0,05, mientras que el resto de las correlaciones analizadas no resultaron significativas. Las jugadoras del perímetro lograron mejores resultados en la prueba RTADST. No hubo diferencias significativas entre las jugadoras del perímetro y las del poste en la prueba T. **Conclusión:** El RTADST y la prueba T están probando habilidades diferentes. Recomendamos el uso del RTADST a entrenadores y expertos en acondicionamiento. **Nivel de Evidencia II; Estudio de Diagnóstico que Investiga una Prueba Diagnóstica.**

Descriptores: Tiempo de Reacción; Baloncesto; Femenino; Percepción.



INTRODUCTION

The highly intermittent nature of basketball match-play highlights the importance of implementing agility training in conditioning drills for players.¹ The term “change of direction speed” (CODS; closed-skill agility, planned agility) is considered as the ability to change direction in the shortest possible time into a predetermined location and space on the field, pitch, or the court.² In most situations, during the game, the movements of basketball players represent a reaction to an unpredictable single or complex external stimulus (e.g., dribbling, passing, or shooting).³ Agility manifested in this way is called reactive agility (RA; i.e., open-skill agility, non-planned agility). Therefore, it seems logical that it is necessary to include cognitive factors in testing and developing the agility of athletes.⁴

One of the most important components of the defensive game in basketball is defensive sliding (lateral agility). A time-motion analysis revealed that male basketball players spent 31% of the playing time in shuffling movements, where 20% were high-intensity shuffling movements.⁵ Another study on female basketball players has shown that they spend 4±1% of live time shuffling.⁶ Matthew and Delextrat⁷ suggest that in female basketball there are more shuffling movements than running or jumping movements.

Earlier, some authors found relatively low correlations between test results of RA and CODS indicating that specific methods are required for training and testing RA and CODS as independent variables.^{8,2} Weak to moderate correlations between basketball-specific COD tests and basketball-specific non-planned agility tests were found by Sekulic et al.⁹ and moderate correlations between CODS and RA were observed by Sattler et al.¹⁰ in college-age female and male athletes. On the contrary, a high correlation coefficient between RA and CODS was obtained in other studies.^{11,3} Research has also shown that reactive agility tests better discriminate between higher and lower-level players than COD tests, highlighting the importance of perception, decision-making, anticipation, and tactical knowledge in situational sports.^{12,2} In the research of Wilke et al.,¹³ results from motor-cognitive testing do not correlate substantially with traditional assessments of cognitive and motor function. Due to the ambiguity of the previous study results, the potential relationship between CODS and RA remains unclear.

For the past fifteen years, a very popular unplanned agility test is the Y-shaped agility test. However, Horníková and Zemková¹⁴ showed that the performance assessed by the Y-shaped test is determined more by the motor and less by the sensory component. They attribute this to the structure of the Y-shaped agility test, which is predominantly speed-oriented, with a small contribution of responses to visual stimuli. Furthermore, existing criticism of the Y-shaped test indicates that this test does not reflect the real movements of the players in the game, so we decided not to use it in our research.¹⁵ It is important to note that there are researchers (psychologists) who have standardized reliable reactive agility tests, although these tests mainly assess perceptual-cognitive function and no other factors such as explosive strength, balance, and sprint speed.¹⁶

In this study, we compared and analyzed the quality of the most commonly used CODS test (T-test) and the new reactive agility test (RTADST). To reduce the unnecessary use of both of these tests within one team in the future, we recommend coaches use a better test. The first goal of this research was to identify the relationship between two types of agility and selected anthropometric characteristics. Second, the study aimed to examine whether the T-test assesses the same physical performance as the RTADST. We assumed that this is about two tests that assess different motor and cognitive abilities.

MATERIAL AND METHODS

Subjects

Thirty-six female basketball players were recruited from three professional basketball clubs (age: 18.81 ± 2.58 years; body mass: 70.11 ± 7.72; body height: 180.03 ± 6.62; BMI = 21.63 ± 1.98; fat percent = 20.98 ± 4.57). The number of perimeter players was 22 (body mass: 67.43 ± 6.36; body height: 176.55 ± 5.28; BMI = 21.61 ± 1.73; fat percent = 20.56 ± 5.08). The number of post players was 14 (body mass: 74.31 ± 8.02; body height: 185.50 ± 4.49; BMI = 21.66 ± 2.40; fat percent = 21.64 ± 3.72). Post players were significantly taller (.000) and heavier (.007), while BMI (.940) and fat percentage (.501) showed no differences. Average training hours per week were 10.5 with one official game.

A randomized, controlled, within-subject design was utilized to explore whether the RTADST and T-test assess the same physical performance in female basketball players. All players voluntarily participated in this research. Parents of underage basketball players have signed consent for their children. All participants were healthy and had no injuries at the time of testing. This study was approved by the local Ethics Committee (11/1.479/21), according to the Declaration of Helsinki.

Procedure

Basketball players were tested with two tests on two consecutive days, toward the end of the preparatory period. The Reaction Time and Defensive Sliding Test (RTADST) measures the unplanned agility of basketball players and it was constructed by Vučković et al.¹⁷ A video presentation of this test is available at <https://youtu.be/fciRufgH1HI>. The test was performed two times on the first day at evening basketball sessions. A T-test was performed on the second day. T-test is very widespread and is recommended as a test for the Change-of-direction speed (Morrison et al, 2022).¹⁸ This test provides information on the rate of change in basketball players’ direction, and their pre-planned closed-skill construct does not consider the cognitive components of agility performance.¹⁹

Statistical analyses

Statistical data processing was performed using the statistical software SPSS, version 20 (IBM, USA). The results are presented in the form of descriptive statistics (arithmetic mean and standard deviation). The Pearson correlation coefficient was used to determine the correlation between the results of the agility tests (T-test and RTADST). The same test was used to determine the relationship between agility tests and anthropometric variables. The t-test for independent samples was used to test the differences in the arithmetic means of agility tests and anthropometric variables between subsamples of perimeter and post players. Statistical significance was set at p< .05.

RESULTS

Of the 6 analyzed correlations, only the correlation between the T-test and Fat% is significant at the 0.05 level. (Table 1)

Perimeter players have statistically significantly lower body height and body mass (Table 2). There are no significant differences in Fat% between perimeter players and post players.

Table 1. Correlation between agility tests and anthropometric variables for whole sample.

		Height	Weight	Fat %
RTADST	r	.131	.029	.171
	Sig.	.445	.867	.318
T test	r	.253	-.060	-.352*
	Sig.	.137	.727	.035

* Statistically significant correlation at .05 level.

The results from Table 3 indicate that the obtained correlations between the T-test and RTADST are not statistically significant either at the level of the entire sample or at the level of perimeter players and post players.

Perimeter players had better score on the RTADST test (Table 4). In the T-test, there is no significant difference between perimeter players and post players.

DISCUSSION

Correlations of agility tests (CODS and RATDST) with anthropometric variables are low and insignificant, except for the variable Fat% (correlation with CODS significant at the 0.05 level). Next, perimeter players are significantly shorter and lighter than post players. Fat% did not differentiate perimeter players and post players. The second part of the analysis was related to correlations between CODS (T-test) and RA (RTADST). Those correlations did not show statistical significance neither at the level of the entire sample nor at the level of perimeter players and post players. Finally, in the RA test perimeter players achieved better results. In CODS, there is no significant difference between perimeter players and post players. In general, these results support the hypothesis of this study that the T-test and RTADST are two tests that assess different motor-cognitive abilities.

In our research, perimeter players had a significantly lower body height and body mass than post players. The body mass of players is not significantly correlated with any agility test, but the body height of perimeter players was significantly correlated ($p < .01$) with RA. Taller basketball players had worse results in RTADST. The results of previous studies that investigated predictors of CODS and RA are ambiguous. Scanlan et al.²⁰ reported that body height and body mass were not significantly correlated with CODS or RA. Garcia-Gil et al.²¹ observed a non-significant relationship between anthropometric parameters (body height and body mass) and CODS using the T-test in professional Spanish female basketball players. In the research by Pehar et al.,²² CODS did not significantly correlate with body height and body mass, while RA did. In Delextrat et al.²³ the body height and body mass of young elite female basketball players (age = 15.1 ± 0.4 y) did not prove to be a significant predictor of planned agility. However, among senior women, guards were significantly better in the T-test than centers.²⁴ Given that the pool

of players from which perimeter players are recruited is much larger, it would make sense that perimeter players are superior in the agility tests. Therefore, the absence of differences in favor of perimeter players is difficult to explain. In most research, the sample of participants consisted of elite basketball players, so this illogicality cannot be attributed to the "amateurism" of basketball players. It has been frequently reported that body fat posed as a factor with a negative influence on different types of physical performance, including agility.^{10,22} Our results correspond to these findings to a certain extent. We found that fat % had a significant negative correlation with the T-test but insignificant with the RTADST. Fat % likely had less influence on the results achieved in the RTADST due to the presence of a cognitive-perceptual component in this test. Second, observed by playing position, fat % significantly negatively correlated with the T-test on the subsample of perimeter players ($r = -.439$; $p = .041$) but not on the subsample of post players. Perimeter players with higher fat % achieved worse results, which is logical. The lack of significant correlations between the T-test and fat % in post players can be explained by better developed multi-directional reactive strength and anaerobic power in post players with higher fat %.

The RTADST was standardized by Vučković et al.¹⁷ as a new RA test on a sample of 36 professional basketball players, and it reflects the defensive activities of basketball players to a good extent (ICC = 0.82, $\alpha = 0.90$, CoV% = 3.9). In general, the reliability of the T-test is always stronger than that of RA tests due to the greater complexity of RA tests. Sekulic et al.⁹ argue that reactive-performance includes perceptual and reactive components, which are natural sources of mistakes, and potential sources of measurement error, and consequently may cause reliability disturbance. The reactive multi-change of direction test constructed by Brini et al.²⁵ differentiated between professional and semiprofessional basketball players. Čoh et al.²⁶ noted significant differences in 3 out of 4 CODS tests between team sport athletes, and in all 4 RA tests. In our research, the RTADST, as a test of RA, discriminated post players and perimeter players, while the T-test, as a CODS test, did not discriminate between them. Our findings indicate that the correlation between CODS and RTADST agility tests is low and insignificant ($r = .033$). Furthermore, there is no significant correlation between the two tests if calculated separately for perimeter players and post players, respectively. This is in agreement with earlier findings which proved that change-of-direction speed and reactive agility are independent skills even when using the same movement pattern.^{26,27} Likewise, previous studies that investigated a Y-shape reactive agility test and corresponding CODS noted a very low correlation between these two qualities.²⁸ Namely, Čoh et al.²⁶ compared CODS and RA according to the same movement patterns, but we did not. Even though in these two independent studies, planned and non-planned movements are analyzed according to different patterns, we believe that a piece of certain knowledge can be gained by comparing the T-test and RTADST. Furthermore, to the best of the author's knowledge, there is only one study in which significant ($p < 0.05$) but moderate ($r = 0.51$) correlations between CODS and RA were found.¹⁰ The authors explain this by the fact that previous studies of CODS and RA performance used continuous running tests, while they observed stop-and-go CODS and RA performance.

The interpretation of the results in a test will always be complicated by the combination of cognitive and motor affordances in finding out which factor dominates.¹⁶ The agility performance depends on the complexity of cognitive demands and Büchel et al.²⁹ suggest that movement speed decreases when information from the environment becomes more complex. Young and Willey,³⁰ argue that decision time has a strong influence on total time (agility performance) hence, perceptual skill should be involved in agility testing and training. Scanlan et al.¹⁹ found

Table 2. Differences between perimeter players and post players in anthropometric variables.

Variable	t	df	Sig. (2-tailed)	Mean Difference
Height	-5.25	34	.000	-8.96
Weight	-2.86	34	.007	-6.88
Fat %	-0.68	34	.501	-1.07

Table 3. Correlation between tests of planned and nonplanned agility for whole sample and subsamples (perimeter players and post players).

		RTADST	
		r	Sig.
T test	Whole sample	r	-.033
		Sig.	.849
	Perimeter players	r	-.31
		Sig.	.161
	Post players	r	.19
		Sig.	.515

Table 4. Differences between perimeter players and post players on agility tests (CODS vs RTADST).

	t	df	Sig. (2-tailed)	Mean Difference
RTADST	-4.39	34	.000	-.34
T test	-1.22	34	.230	-.17

that cognitive measures (response time and decision-making time) have the greatest influence on RA performance in male basketball players. Likewise, in our research, none of the other variables such as CODS, body mass, body height, and fat% had a significant correlation with RA.

Although it seems that nonplanned tests are more useful and basketball-specific, the results of Garcia et al.²¹ indicate that only T-test is associated with better performance index rating (PIR) per minute. Countermovement jump with arm swing, 20m-sprint test, and dribbling test were not associated with PIR. Since the T-test is proven to have the capacity to predict performance, it is useful in the evaluation of basketball-specific agility. In this regard, it seems that the T-test will be an indispensable tool for assessing CODS in basketball players in the foreseeable future. Future research should compare the RTADST scores with PIR per minute. If it were shown that RTADST is associated with better PIR per minute, it could be concluded that the RTADST is a better test than the T-test and that in the future the RTADST should be used instead of the T-test in female basketball players. However, we advise coaches and conditioning experts in the basketball field to use the RTADST because this newly developed test can measure both the cognitive and physical factors and has a basketball-specific design. However, taking into account the results of Garcia et al.,²¹ it seems that the T-test will be a tool for measuring CODS in female basketball players for some time ahead. Finally, our study presented some limitations. We compared only 2 tests: the T-test representing CODS

ability and RTADST representing RA. Nonetheless, we are convinced that the use of a large number of tests can cause resistance in professional basketball players and their working motivation would be questionable. Interpretation of the achieved results would certainly be confusing and perhaps impossible. Secondly, the sample of participants in our research is quite young. Further studies should include an older population of female basketball players.

CONCLUSION

Of all analyzed anthropometric variables, only Fat% correlates significantly negatively with the T-test. Second, RTADST and T-test are two tests that do not measure the same abilities. RTADST includes a perceptual and decision-making component, which makes it a more complete and basketball-specific test than the T-test. To reduce the unnecessary use of both of these tests within one team in the future, we recommend coaches use the RTADST.

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