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Validity and reliability of technology-based reactive agility tennis test (RATT)
Validez y fiabilidad de la prueba de tenis de agilidad reactiva basada en tecnología (RATT)

*Rekyan Woro Mulaksito Mulyadi, *Tomoliyus, *Abdul Alim, *Cerika Rismayanthi, *Wisnu Nugroho, **Dima Krisna Wiedarjati, *Wahyu Dwi Yulianto
*Universitas Negeri Yogyakarta (Indonesia), **Universitas Terbuka (Indonesia)

Abstract. Background: Reactive agility ability is part of a vital motor component in tennis that requires a more specific assessment according to the needs of the sport. Aim: This study analyzed the validity and reliability of technology-based reactive agility tests on tennis. Method: It is a research and development (R&D) research, which involves developing a measuring instrument for a reactive agility tennis sports. The research subjects were divided into four groups; first, based on a literature review of SINTA/international accredited journals; second, seven sports evaluation experts; third, 13 certified practitioners/coaches and 78 tennis athletes obtained from coaches; fourth, 40 randomly obtained tennis athletes. The data collection technique used the Likert scale, while the data analysis technique used the Aiken V validation test. Reliability test used person product moment statistics. Results: Research on the construction of the tennis Reactive Agility measuring instrument has good content validity with a V value of 0.85, and the Intraclass Correlation Coefficient (ICC) value of 0.8 is categorized as good inter-rater reliability. Conclusion: The results show high content validation and high inter-rater test reliability in the construction of technology-based reactive agility tests for tennis sports, and this developing reactive agility test instruments can be used by coaches to evaluate and train the ability of tennis athletes.
Keywords: Validity, Reliability, Reactive Agility Test, Court Tennis Sports

Resumen. La capacidad reactiva forma parte de un importante componente biomotor en el tenis de campo que requiere una valoración más específica según las necesidades del deporte. El objetivo de este estudio es analizar la validez y fiabilidad de las pruebas de agilidad reactiva basadas en la tecnología deportiva de tenis de campo. Método: Este tipo de investigación es investigación y desarrollo (I&D), mediante el desarrollo de un instrumento de medición de la agilidad reactiva en el campo del tenis deportivo. Los sujetos del estudio se dividieron en cuatro grupos; El primero se basa en la revisión literaria de SINTA / revistas acreditadas internacionales, el segundo son siete expertos en evaluación deportiva, el tercero son practicantes / entrenadores con un total de 13 que han sido certificados en regiones y 78 atletas de tenis obtenidos de entrenadores, el cuarto son atletas de tenis obtenidos aleatoriamente con un total de 40 atletas. La técnica de recolección de datos utiliza una escala Likert, mientras que la técnica de análisis de datos utiliza la prueba de validez de Aiken V. Resultado: La investigación de construcción del instrumento de medición de tenis Reactive Agiltiy, tiene una buena validez de contenido con un valor V de 0.85. El valor de Coefident de correlación interclase (ICC) de 0,8 se clasifica como buena fiabilidad entre evaluadores. Conlusion: se han desarrollado resultados de validación de alto contenido y alta confiabilidad de pruebas entre contadores en la construcción de pruebas de agilidad reactiva basadas en tecnología para deportes de tenis de campo e instrumentos de medición de pruebas de agilidad reactiva para deportes de tenis de campo, que pueden ser utilizados por entrenadores para evaluar y entrenar las habilidades de los atletas de tenis de campo.
Palabras clave: Validez, Fiabilidad, Test de Agilidad Reactiva, Pista de Tenis Deportiva

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Rekyan Woro Mulaksito Mulyadi
rekyanworo.2023@student.uny.ac.id

Introduction

Tennis is a sport that requires skills and techniques. Tennis sports have many factors that can affect the outcome of a match, such as technical, tactical, mental, strategic, and physical factors (Gallo et al., 2017). Previous studies have also shown the importance of physical factors for tennis performance (Fernandez et al., 2006; Ferrauti et al., 2011; Girard & Millet, 2009; Kovacs, 2007; Reid dan Schneiker, 2008). In a recent study, Fernandez (2017) explains that tennis athletes require good physics because the game of tennis involves intermittent high-intensity performance interspersed with periods of low-intensity activity, during which active recovery (between points) and passive periods (between alternating pauses of play) take place, over long periods (i.e., in some cases more than five hours). The problem is that many coaches need an excellent physical training program to improve the athletes' abilities. Because tennis athletes play with a duration (two to four hours) of high-intensity play interspersed with standard rest periods, tennis games can last more than five hours (Reid & Duffield, 2014). Take Novak Djokovic and Rafael Nadal's journey through the Australian Open 2012 as a case in point. It means that the athletes played more than 12 hours for 13 days before competing in the final which lasted 5 hours and 53 minutes (Reid & Duffield, 2014). Fernandez (2017) explains that athletes who do not have an excellent physical component can experience a decrease in punch accuracy as high as 81% with increased duration of play. Reactive agility is one of the main supporting factors in the performance of tennis and specific sports because players must move and change direction quickly in anticipation of the ball from the opponent (Paul et al., 2016). Agility, in general, is the ability of the whole body to move quickly without losing balance (Munivrana et al., 2022). However, in reality, the performance of a tennis athlete must take into account the movement, speed, and direction of the spin of the ball and taking into account the direction of the spin (Kilit & Arslan, 2019; Nababan & Sinulingga, 2021). Currently, several studies (Munivrana et al., 2022) explain that the ability of the entire body to move in changing directions during a stimulus response is called reactive agility. More recently, reactive agility has been defined as rapid whole-body

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movements with changes in speed or direction in response to a stimulus (Sheppard & Young, 2006). The new reactive agility test also includes components of stimulus perception and decision-making in response to the movement of the tester. Based on the journal review, results from previous studies show the high validity and reliability of the reactive agility test for football (Veale et al., 2010). Moreover, it was also found that the validity was relatively high for the reactive test of the net game sports group (Farrow et al., n.d.). In addition, sufficient validity was found for the reactive agility test for rugby (Gabbett & Benton, 2009). Likewise, the results of the journal review, the results show that the reactive agility test was a valid and reliable test for agility compared to the previously planned traditional agility test (Inglis & Bird, 2016). In addition, it has also been found that a valid agility test must include a stimulus by the sport (Pojskic et al., 2019). Based on the review of the study results, there is no reactive agility test for tennis.

In a preliminary study conducted by researchers using a survey method and questionnaire instruments conducted on 7 (seven) national certified tennis coaches, the results showed that five coaches (70%) stated that the level of physical condition and tennis skills was still low, two coaches stated that the level of physical condition was sufficient. Six coaches (85%) stated that finding or choosing valid and reliable physical assessment tools and tennis skills was difficult, and one coach stated that preparing a physical condition test was difficult. Seven coaches (100%) stated insufficient financial support in the training process, and seven coaches (100%) stated that it was challenging to develop a reactive agility test. In other words, the results of the survey above can be concluded that the cause of the difficulty and low ability of athletes in both physical condition and tennis skill level is because coaches have difficulty preparing training programs that are relevant to the purpose of training, coaches have difficulty preparing assessment tools used for skill tests and physical tests, existing tests to assess physical or tennis bio motor are not yet valid and reliable, primarily reactive agility tests, the facilities and infrastructure used are not yet eligible for reactive agility training, and adequate funds do not yet support the training and assessment processes.

Based on the facts above, this study aims to examine the validity of the contents and the inter-rater reliability of technology-based reactive agility test for tennis sports.

Methods

This research used Research and Development (R&D) research method. The model used in this study was the development of the 4-D model (Thiagarajan, Sammel, dan Semmel, 1974: 6-9). The procedure consisted of four stages: Define, Design, Develop, dan Disseminate.

Research Subject

The research subjects were divided into four groups, namely (1) based on a literature review of SINTA/international accredited journals, (2) seven sports evaluation experts, (3) 13 practitioners/coaches who had been nationally certified and 78 tennis athletes obtained from coaches, and (4) 40 tennis athletes who were randomly selected.

Instrument and Data Analysis

Research document techniques

Mendeley uses document data collection techniques to collect textbook and journal data from Pubmed and Google Scholar databases.

Content Validity

Data collection of content validity used the Delphi technique (Hsu & Sandford, 2007; Cox et al, 2016; Green, 2014), where each expert still needed to be met in the assessment process. The results analyzed for revision are returned to the expert until they are completely accepted without further improvement (Fraenkel et al, 2012). The instrument used for data collection was a questionnaire with a scale rating of 1 to 4.

Content validity test by using the Aiken formula

Small-scale, Broad-scale (Practicality test)

The coach learns and understands the skill tests developed, and then implements the tennis reactive agility test kits developed for athletes. The instrument used for data collection was a questionnaire with a scale rating of 1 to 4. The results of the data were then analyzed using a qualitative percentage.

Reliability Test

Reliability test data was collected using a reactive agility test developed twice (test re-test) with a 1-minute break.

Analysis of reliability test data between assessors used Intraclass Correlation Coefficients (ICC) with SPSS. The results of ICC calculations using four categories, according to Fleiss (1975) are as follows: an ICC value of 0.40 or lower can be interpreted as a low level of agreement, an ICC value of 0.41-0.75 as a good level of agreement, and a high level of agreement ICC of 0.76- 1.00.

Results

The literature review results have produced a technology-based Reactive Agility Test construction prototype for tennis.

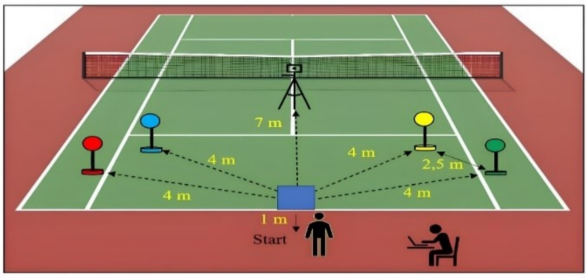

Figure 1. Technology-based Reactive Agility Test Construction Prototype

1) Goal: To measure the reaction speed and agility of tennis athletes
2) Facilities: Tennis court
3) Equipment: Tennis Reactive Agility Test Kit, laptop/PC, meter.
4) Reactive Agility Test Implementation Procedure.
a) Testee conducts a one-time trial
b) The testee stands at the start line and concentrates on looking at the Light Indicator installed by the light sensor in front of the test.
c) If any of the colours on the Light Indicator light up, testee quickly step/perform step forward step over the line/box in front immediately run to touch the ball on the Sensor TAP whose colour matches the colour of the Light Indicator that lights up.
d) The time is automatically recorded on the PC/ laptop after the ball is touched by hand.
e) Testee returns to the starting line.
f) Testee performs the reactive agility movement four times.
g) The final score is the average of four times the reactive agility movement performed.
h) Testee is allowed to do the test twice.

Expert Validation

The results of the expert validation on technology-based reactive agility test which were carried out three times, and then were analyzed by Aiken, are shown in Table 1 as follows:

Table 1.
Aiken Validation of Reactive Agility Test for Tennis

Assessor	Aspect 1		Aspect 2		Aspect 3		Aspect 4	
	Score	S	Score	S	Score	S	Score	S
1	4	3	4	3	4	3	4	3
2	3	2	3	2	3	2	3	2
3	4	3	4	3	4	3	4	3
4	4	3	4	3	3	2	3	2
5	4	3	4	3	3	2	3	2
6	4	3	4	3	3	2	3	2
7	4	3	4	3	3	2	3	2
ΣS	20		20		16		16	
V	0.952		0.952		0.761		0.761	

Based on Table 1, item one, or the suitability of the measuring instrument material/ media with foot movement in tennis games, has a coefficient value of V 0.952; item two of the clear or simple implementation procedure has a coefficient value of V 0.952; number three or the instrument design has a coefficient value of V 0.761; item four or the instrument effectiveness has a coefficient value of V 0.761. In other words, the Validation of three expert assessments showed that seven experts agreed to give good scores for the technology-based tennis reactive agility test.

Inter-Rater Reliability

The results of the test among assessors using Intraclass Correlation Coefficient analysis obtained the following results:

Table 2.
Intraclass Correlation Coefficient (ICC) Test Results

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	0.500[a]	0.128	0.941	8.000	3	18	0.001
Average Measures	0.875[c]	0.506	0.991	8.000	3	18	0.001

Based on Table 2, it is found that an average of 0.875 with a significance of 0.001. In other words, the assessors have similarities or constancies among them.

Discussion

This study aims to test the validity of content and inter-rater reliability of technology-based reactive agility tests for tennis. The results of the initial product in the form of a prototype construction of a reactive agility test for tennis using the Tripod Fitlight test tool are used to assess reactive agility. They can also be used to train reactive agility for tennis. Both of these equipment are assembled from electronic devices, namely ESP 8266 Microcontroller, RGB LED Lights, Speaker buzzer, TP 4056 charger module, 3.7-volt lithium 18650 Battery, Printed circuit board (PCB), Switch on off, and three cell 10 ampere BMS Module. The results of this research are in line with some of the results of research on Camera Tripod and Fitlight equipment that can be used to assess and exercise to increase reaction speed in open sports (Kolovelonis A, et al., 2022, Contreras-Osorio F at al., 2021, 2022). In addition, Fitlight equipment correlates with better athlete performance in several open-skill sports, such as volleyball, table tennis, football and basketball (Ishihara T et al., 2018, 2020; Wang J.G et al., 2020; Heilmann F et al; 2022; Scanlan et al., 2014).

This study suggests that the reactive agility test has good validation and can be used to measure the technology-based reactive agility test for tennis. The study results found high content or expert validation (average Aiken value above 0.76) of the prototype construction of a technology-based agility reactive test for tennis sports. The finding of the validity of this content was strengthened by Aiken (1985), who states that the validity above 0.76 is valid. It is also reinforced by Guilford (1956) who states as follows: 0.80 < rxy < 1.00: very high validity (excellent), 0.60 < rxy < 0.80: high validity (good), 0.40 < rxy < 0.60: moderate validity (fair), 0.20 < rxy < 0.40: low validity (poor), 0.00 < rxy < 0.20: very low validity (very poor), and rxy < 0.00: invalid. Then, it can be concluded that the prototype aspects of agility-based reactive test construction for tennis sport have high content validity (good). Likewise, the results of this study are in line with Hendryadi (Hendryadi, 2017), who states that a coefficient of 0.857 can be considered adequate content validity. In addition, research by Tomoliyus & Sunardianta (2020) which states that an excellent measuring instrument can measure precisely and accurately what is to be measured or said to have a high level of validity. These results are in line with the research of Pueo et al. (2020), which states that a measuring instrument can be used to measure the ability of a group or a person and must have good validity and reliability.

The results of the Intraclass Correlation Coefficients (ICC) reliability obtained an inter-rater agreement value of an average of 0.875 prototype construction of a technology-based agility reactive test for tennis sports. It is in line with Tavakol & Dennick, (2011) which states that the category of the value of inter-rater agreements is as follows: a value above 0.75 means an excellent agreement, and a value of 0.40-0.75 means a good agreement. From these results, according to Fleiss (1975), the value of inter-rater agreements has good reliability. These results align with research (Tomoliyus & Sunardianta, 2020) that the reliability of interclass or inter-rater is > 0.5, which means that the reactive agility measuring instrument has good reliability. Intraclass Correlation Coefficient is significant in assessment measurement and has been widely used to evaluate inter-rater, test-retest, and Intra-rater reliability (Koo & Y. Li, 2016). Thus, it can be said that the inter-rater agreement is excellent, and each rater has a perfect consistency.

Conclusion

Based on the discussion of the results of the study above, the results of this study can be concluded that the construction of technology-based reactive agility test gauges are as follows: (1) high content validation has been tested and (2) high inter-rater test reliability in the construction of technology-based reactive agility tests for tennis sports.

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Conflict of Interest

This study contains no material that could be considered a conflict of interest.

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Datos de los/as autores/as y traductor/a:

Rekyan Woro Mulaksito Mulyadi	rekyanworo.2023@student.uny.ac.id	Autor/a
Tomoliyus	tomoliyus@uny.ac.id	Autor/a
Abdul Alim	Abdulalim@uny.ac.id	Autor/a
Cerika Rismayanthi	Cerika@uny.ac.id	Autor/a
Wisnu Nugroho	wisnu.nugroho@uny.ac.id	Autor/a
Dima Krisna Wiedarjati	dimakrisna50@gmail.com	Autor/a
Wahyu Dwi Yulianto	wahyu525fikk.2022@student.uny.ac.id	Autor/a
Resna Suci Nurfalah	www.iel-kampunginggris.com	Traductor/a