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Validity and Reliability of Reactive Agility Measurements of Tennis Performance

Wisnu Nugroho, Tomoliyus*, Abdul Alim, Fauzi, Hari Yuliarto

Department of Sport Science, Yogyakarta State University, Indonesia

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Abstract Reactive agility measurement tool recently has become one of the important issues in the physical training for tennis performance. Therefore, finding a valid and reliable reactive agility measuring instrument for tennis performance is needed. This study aimed to do a validity and reliability test of the reactive agility measuring instrument for tennis performance. This study used a mixed-methods approach. The seven experts participants were determined by the criteria of an evaluation expert and a tennis expert, or both. This study had three stages. The first was document analysis (international journal). It is used to develop a construction design for the reactive tennis agility measuring instrument. The second stage was content validation. The participants were seven experts. Then, the data collection technique used the Delphi technique. The research instrument uses a scale of one to four, namely very relevant, relevant, less relevant, and irrelevant. The data analysis used the Aiken formula for content validity and Reliability Analysis between raters using ICC. The first stage of research results has found the operational definition of reactive agility tennis: the ability to move in seconds after receiving a stimulus. In addition, the "Y" shape construction design of the reactive tennis agility measuring instrument has been arranged. The second stage resulted in the contents validation of a large tennis reactive agility measuring instrument. The third stage found the reliability between raters of a large tennis reactive agility measuring instrument.

Keywords Tennis, Content Validity, Reactive Agility Measuring Instrument

1. Introduction

Tennis is an intermittent sport that requires acceleration for changing the direction, reaction, and balance for repeated and varied strokes, such as different ball speeds, varying ball spins and moving at various field angles. Tennis athletes require very fast neuromuscular coordination in responding to the ball [1,2]. Neuromuscular coordination requires reaction speed, agility, balance, and coordination [3,4,5]. Therefore, tennis coaches need a training program and a measuring instrument to measure the elements of reaction, agility, and balance, which is called reactive agility. Reactive agility measuring instrument can be described as the ability to adjust the motion change as quickly as possible and maintain balance in responding to a stimulus [6]. However, many tennis available reactive agility measurement tools cannot measure the movement of holistic tennis skills. Therefore, a valid and reliable reactive agility measurement instrument is needed to assess reactive tennis agility accurately.

Sheppard et al. [7] have researched developing a reactive agility measurement instrument for football. The results showed that the reactive agility test was valid and reliable for football. Morland et al. [8] also researched the development of a reactive agility test for hockey. The results showed that the reactive agility test was valid and reliable for hockey. In addition, Yudistira and Tomoliyus have conducted research on developing a reactive agility test in karate. The results showed that the reactive agility test in karate has high content validity and high inter-rater

reliability. However, the measurement instrument is less effective for measuring reactive agility in tennis.

Furthermore, based on the data above, developing reactive agility for tennis is necessary. Indeed, the purpose of this study was to test the validity and reliability of the reactive agility measuring instrument for tennis performance. The finding of reactive agility measurement tools can be useful for tennis coaches, especially for measuring the reactive agility in tennis players. It can also contribute to the development of competitive sports evaluation science.

2. Materials and Methods

This research used mixed methods. This research combined two approaches, namely qualitative and quantitative, to obtain maximum and valid data [9]. The combination of qualitative and quantitative research methods is combined in a concept also called a mixed method. Alternatively, the study will be studied in detail sequentially or step by step [10].

The research procedure had three stages. The first stage is a qualitative approach using the literature review method, with a narrative review technique [11]. Then, the research materials were articles in international journals from 2011 and many years before related to reactive agility measuring instruments. It is used to develop a conceptual definition of reactive tennis agility and construct reactive tennis agility measuring instrument.

The second step is to check the validity of the content. Participants in this stage are seven experts with qualifications: 1 expert in sports evaluation, 3 lecturers in tennis, and three nationally certified trainers. Data collection used in this research was the Delphi technique [12,13,14]. This technique allowed every expert judgment separated in assessing the construction design of the reactive tennis agility measuring instrument. Then, it proceeds with qualitative analysis, namely input from expert judgment. The results were analyzed to be revised and returned to the expert until they did not need further improvement. The instrument in this study used a questionnaire with a rating scale of 1 to 4 that included very relevant, relevant, less relevant, and irrelevant indicators.

$$V = \frac{\sum(r_i - l_0)}{n(c-1)}$$

Note

V = the index rater agreement of the assessed item

r = number given by rater

l_0 = the lowest validity score

c = the highest validity score

n = number of experts performing the assessment

The third stage is the reliability test between raters using Intraclass Correlation Coefficients (ICC) analysis. The researcher uses ICC because this study uses more than two assessments [17].

3. Results

The document analysis produces a conceptual definition of reactive agility tennis. Reactive agility in tennis is the ability to move speed, change motion and maintain balance in response to a stimulus. In addition, an operational definition is found, which states the ability to move speed in seconds after receiving verbal and visual stimuli. The construction design of the reactive tennis agility measuring instrument is shown in Figure 1 as follows:

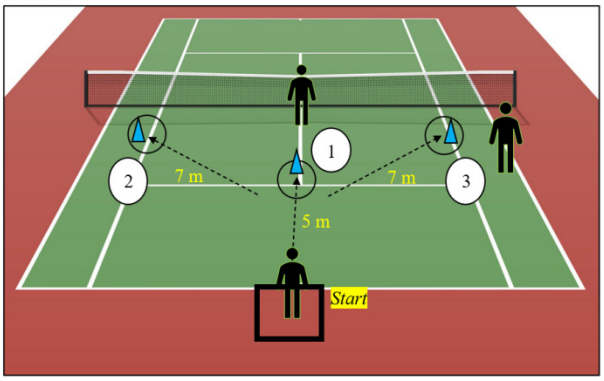

Figure 1. Construction design of reactive agility measuring instrument

Instrument size distance

- The distance from the start position to cone 1 is 5 meters.
- The distance between cone 1 and cone 2 is 7 meters.
- The distance between cone 1 and cone 3 is 7 meters.

Equipment used

- 2 flags.
- 3 cones.
- 1 Stopwatch.

Tester tool

- 1 meter holding flag.
- 1 meter holding a stopwatch.

Procedure V Tennis measuring instrument

- The testee stood behind the starting line and concentrated on hearing the signal "*YA*" from the tester while the stopwatch was turned on.
- Testee ran towards cone 1, without stopping. The testee concentrated on seeing the signal given using a flag.
- After the flag signal, if the tester raises the flag in the cone 2 section, the testee runs as fast as possible towards cone 2. If the tester raises the flag in the

cone 3 section, the teste runs as fast as possible towards cone 3.

- The tester stops the stopwatch after the testee passes in cone 2 or cone 3 after the flag signal.
- Testee do as much as 2 times with a break of 5 minutes, and the data is taken the fastest.
- Time is calculated per second.
- The best time is the fastest time.

Content Validity Test Results (Aiken)

Table Based on the analysis of Aiken's calculations, the value of V is obtained as shown in table 1.

Based on table 1, aspect one means the suitability of the measuring instrument material with foot movement in tennis has a coefficient value of V**0.952**; point two or the relevant construction for each element of tennis agility has a coefficient value of V**0.952**; three aspects or implementation procedures have a coefficient value of V**0.761**; the four aspects or cone distance relevant to the tennis foot movement has a coefficient value of V**0.761**. In table Aiken V [16], with a rater of 7 (seven) and a scale of 4 (four), the minimum Aiken criterion value is obtained with a range of 0.76-0.86. It shows that the raters strongly agree with each opinion.

Inter-Rater Reliability Test Results

Based on the analysis of the ICC calculations, the results are as in table 2.

Based on table 2, the ICC output is quite satisfactory, namely rxx = 0.500

4. Discussion

An assessment measuring instrument is considered a good instrument if it has validity and reliability value [18,19,20]. Validity and reliability are prerequisites to ensure the integrity and quality of measurement tools [21]. Content validity is to test the feasibility of assessment of a competent expert [22]. *Interrater Reliability* is the level of test measurement error associated with different ratings of scores assigned by different raters of the same event or phenomenon [23].

Table 1. Aiken Test Results

Evaluator	Aspect 1		Aspect 2		Aspect 3		Aspect 4	
	Score	S	Score	S	Score	S	Score	S
I	4	3	4	3	4	3	4	3
II	3	2	3	2	3	2	3	2
III	4	3	4	3	4	3	4	3
IV	4	3	4	3	3	2	3	2
V	4	3	4	3	3	2	3	2
VI	4	3	4	3	3	2	3	2
VII	4	3	4	3	3	2	3	2
∑S		**20**		**20**		**16**		**16**
V		**0,952**		**0,952**		**0,761**		**0,761**

Table 2. 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	,500[a]	,128	,941	8,000	3	18	,001
Average Measures	,875[c]	,506	,991	8,000	3	18	,001

This study resulted in the construction design content validity of the reactive agility tennis measuring instrument: aspect one, the suitability of the measuring instrument material with foot movement in tennis has a coefficient value of V**0.952**; aspect two, the relevant construction for each element of tennis agility has a coefficient value of V**0.952**; aspect three, the implementation procedure has a coefficient value of V**0.761**; aspect four, cone distance relevant to tennis foot movement has a coefficient value of V**0.761**. Based on the Aiken V table [16] with a rating of 7 (seven) and a scale of 4 (four), the minimum Aiken criteria value is obtained with a range of 0.76-0.86. Therefore, it can be concluded that all aspects of the construction of the reactive tennis agility measuring instrument have high content validity. The results of this study are by the research results [24,25], which state that the value of validity is largely determined by the number of items that represent the concept. The more items that represent the concept, the higher the validity value. It is also reinforced by research [26], which states that the more aspects that represent the factors of the concept being measured, the greater the validity result.

Moreover, this study shows that the reactive agility measuring instrument for tennis performance has inter-rater reliability of Rxx = 0.500[27]. It inferred that the ICC value of 0.40 or lower could be interpreted as a low level of agreement, an ICC value of 0.41-0.75 as a good agreement level, and an ICC 0.76-1.00 high deal rate. The reliability results between raters' ICC value of 0.500 means the reactive agility measuring instrument has high consistency.

5. Conclusion

Based on the research that has been done and the discussion that has been described, an instrument of reactive agility tennis has high content validity and high inter-rater reliability. It can be concluded that a tennis coach can use reactive agility measurement tools to assess the ability level of a tennis player's reactive agility. For this instrument to be optimal, further research is needed to determine the empirical validity and reliability of the test-retest.

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