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Validity and Realibility of Badminton Reactive Agility Tests System (Brats) to Measure Changes of Direction Speed and Reactive Agility Performance

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Abstract:
The aim of this study was to determine the validity and reliability of Badminton Reactive Agility Tests System (BRATS) to measure changes of direction speed (CODS) and reactive agility (RA) performance. Next, the effectiveness and strength of BRATS were measured through questionnaires and Methodological Triangulation. The researcher adapted the quantitative approach through descriptive analysis and statistical test using parametric test analysis in this research. The population of the study involves 55 male badminton players under 15 years old and their coaches in Skudai district, Johor Bahru. Findings of this research revealed that the validity and reliability of BRATS are high. BRATS obtained a high value in Methodological Triangulation, thus making it an effective tool. In conclusion, BRATS is an instrument that are capable of assessing badminton as a whole based on CODS and RA aspects. Detailed concepts of badminton players are implemented in BRATS to ensure that lessons can be evaluated holistically. The implication of this study is to produce BRATS that are able to assess badminton players' CODS and RA performances.

Keywords*: Changes of Direction Speed (CODS), Reactive Agility (RA), performances.*

INTRODUCTION

Badminton is a highly exclusive sport that involves a unique movement technique on a relatively small court area (1). It is a brief sport that requires a long period of high intensity exercise interspersed with rest periods and entails quick and strong movement of both lower and upper body parts (2). It requires the players to do quick sprints, stops, starts, lunges, jumps, rapid changes of direction, twists, stretches, smashes, clearing, dropping, and trying to win the opponent (3, 4). The players must always be alert and have quick response to movements of the opponent, the shuttle, the footwork, and the strokes of other players (5).

According to Lees (6), racket sports have their own physical requirements comprising a number of fitness components. To be able to execute advanced strokes or compete effectively against opponents, especially the stronger ones, a player would need to develop a higher level of basic physical qualities such as strength, power, muscular endurance,

TEST Engineering & Management

May-June 2020
ISSN: 0193-4120 Page No. 8972 - 8980

flexibility, coordination, and agility. Body composition is also important to badminton sport, as excess fat tends to disadvantage the players in moving quickly across the court and hitting the shuttle (7, 8).

The traditional definition of agility emphasizes on the speed in the directional change as the defining component (9). Young et al. (10) claimed that agility consists of two key sub-components: speed in changing direction and cognitive factors. More recently, agility is identified as "a rapid whole body movement with change of velocity or direction in response to a stimulus" (11, 12). The newer definition of agility includes cognitive skills in determining agility performance and the definition applies to open skills only. Open skills cannot be pre-planned, whereas closed skills such as sprint running or pre-determined changes of direction can be pre-planned (13).

Agility test is a common assessment that has been used for some period of time to evaluate the performance of many sports athletes (14, 15) including badminton players. It is remarkable on how this test has the ability to read the hidden potentials of badminton players based on their current performances. In an agility test, there are two common factors that must be taken into consideration: perceptual and decision making, and change-of-direction speed.

The training of the agility component in badminton does not focus on the movement pattern used in the actual game but is usually trained using general agility movements,thus not allowing the players, especially juniors, to fully grasp the proper movement and become proficient in moving around the court. Training also requires the use of shuttlecocks, which can be costly in the long run, seeing that they are consumables. In order to requires/achieve excellent to court coverage, players must acquires perfect reactive agility.

Until now, lack of study has been conducted on instrument to measure reactive agility. Based on the movement pattern and Theoretical Model of Agility, researcher developed a Badminton Reactive Agility Test System (BRATS). The aim of this study was to determine the validity and reliability of BRATS to measure changes of direction speed and reactive agility performance. Next, the effectiveness and strength of BRATS were measured through questionnaires and Methodological Triangulation.

METHODS

Participants

Researcher has selected the male under 15 years' old badminton players and the coach (teacher) who coached the school's badminton team representing the schools, district, and state levels of Johor Bahru as participants as they have learned the basic skills of badminton at the age of 12.Figure 1 showed the design schematic illustration testing procedure using Badminton Reactive Agility Testing System (BRATS).

Badminton Reactive Agility Test System (BRATS) Execution

Name of Test:

Badminton Reactive Agility Test System (BRATS)

Purposes: To test badminton athlete Reactive Agility (RA) performance

Level: Badminton Players

Gender: Male and Female

Equipment:

1. Flashlight LED
2. Footpad sensor
3. Microcontroller-MC

May-June 2020
ISSN: 0193-4120 Page No. 8972 - 8980

4. Shuttlecock
5. Racket

Management and Organization:
1. A single test trial consisted of 6 point.
2. Single test trial was completed when the examinee touch the central footpad sensor point of the court with at least one of their feet after returning from the twelve program.
3. Two trials were performed using the same scenario, and after reliability analyses, the best score was retained as the final result.

Procedure:
1. The flashlight LED will light up randomly. The subjects began running from the central footpad sensor of the court when ready.
2. Timing began the moment each subject step the central footpad sensor.
3. When the subject step the footpad sensor, a hardware module (Microcontroller-MC) ignited 1 of the 6 LED lights placed on the indicator light badminton board.
4. The subjects had to assess which LED lit, and run to those particular corners, then swing the shuttlecock post with player hand holding the racket, and return to the central of the court as quickly as possible, which was marked by a 90cm x 70cm square, with at least one of their feet.
5. This is repeated until the completion of 6 repetitions (1 for each shuttlecock post).
6. The movements are based on the signal indicated (0-6-0-2-0-4-0-1-0-3-0-5-0).
7. The subject must return to the central base each time after completing a swing at each shuttlecock post sensor.

Name of Test: Changes of Direction Speed (CODS)

Purposes: To test badminton player Change of Direction Speed (CODS) performance
Level: Badminton Player
Gender: Male and Female

Equipment:
1. Flashlight LED
2. Footpad sensor
3. Microcontroller-MC
4. Shuttlecock
5. Racket

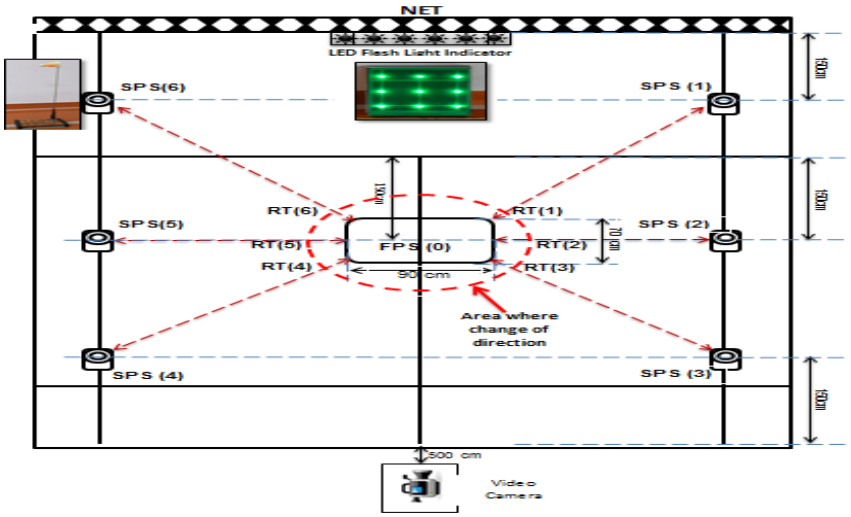
Management and Organization:
1. Performed on the same testing court as that for the (BRAT)
2. Throughout the test, the testing scenario was sequenced, and the subjects knew it in advanced.
3. Two trials were performed using the same scenario, and after reliability analyses, the best score was retained as the final result.

Procedure:
1. The timing began the moment each subjects step on the central footpad sensor on the central of the court.
2. The subjects ran as quickly as possible to corner shuttlecock post sensor 1 (programme 1), swing the shuttlecock post with players hand holding the racket and ran back to the central footpad sensor of the court.
3. This is repeated until the completion of 6 repetitions (1 for each shuttlecock post sensor).
4. The movements are based on the signal indicated (0-1-0-2-0-3-0-4-0-5-0-6-0). The subject must return to the central footpad sensor each time after completing a swing at each shuttlecock post sensor.

Testing Setup

May-June 2020
ISSN: 0193-4120 Page No. 8972 - 8980

Figure 1. Design Schematic illustration testing procedure using Badminton Reactive Agility Testing System (BRATS)



Legend:
SPS – Shuttlecock Post Sensor
DT – Decision Time
FPS – Foot Pad Sensor

Findings

Validity and Reliability Assessment

Three experts are in charge of evaluating BRATS by filling up the Expert Validity Form. The three aspects they evaluate are contents, design and technical writing.

Table 1. Validity (r) Alpha Cronbach Items from Experts (Pre-Test)

Test 1					
Aspects	Expert 1	Expert 2	Expert 3	∑	**M**
Contents	0.84	0.76	0.79	2.39	0.79
Design	0.84	0.76	0.76	2.36	0.78
Technical writing	0.80	0.79	0.78	2.37	0.79
Total	**0.82**	**0.78**	**0.78**	**2.38**	**0.79**

Based on Table 1, the validity value achieved is *r=79 (n=3)*. Validity value which reach 0.70 and above are considered as good achievement of something. Then, researcher work on the enhancement of BRATS based on the comments and feedback receives from the first test. To further validate the instrument, researcher conducted second test using the same Expert Validity Form.

Table 2. Validity (r) Alpha Chronbach Items from Experts (Post-Test)

Test 2					
Aspects	**Expert 1**	**Expert 2**	**Expert 3**	∑	**M**
Contents	0.94	0.84	0.95	2.73	0.91
Design	0.94	0.84	0.94	2.72	0.90
Technical writing	0.90	0.83	0.94	2.67	0.89
Total	**0.92**	**0.83**	**0.94**	**2.70**	**0.90**

Based on Table 2, the validity value achieved in second test is *r=90 (n=3)*. Therefore, the results sums up that the instrument can highly cater to badminton games and agility model.

In conducting the test-retest reliability, fifty-five male junior badminton players that are under 15

TEST Engineering & Management

May-June 2020
ISSN: 0193-4120 Page No. 8972 - 8980

years old are tested. Among the 55 players, 30 of them are presenting their schools, 15 are presenting the district and 10 of the players are presenting the state. After that, the test are administered with the players chosen using the BRATS to measure CODS and RA performances. The gap between Test 1 and Test 2 is 1 day apart. This is because the suitable time for test retest range is between one day and one year. The value for the test-retest reliability coefficient for CODS are r= 0.97. While for RA performances, the value for the test-retest reliability coefficient is r= 0.99.

Table 3. Reliability of BRATS based on badminton players' RA performances scores between two coaches (N=55)

	Analysis Technique	Coach 1	Coach 2
Coach 1	Pearson Correlation	1	0.99**
	Sig. (2 tailed)	.000	.000
	N	55	55
Coach 2	Pearson Correlation	0.99**	1
	Sig. (2 tailed)	.000	.000
	N	55	55
Correlation is significant at the 0.01 level (2 tailed)			

Table 4. Reliability of BRATS based on badminton players' CODS performances scores between two coaches (N=55)

	Analysis Technique	Coach 1	Coach 2
Coach 1	Pearson Correlation	1	0.97**
	Sig. (2 tailed)	.000	.000
	N	55	55
Coach 2	Pearson Correlation	0.97**	1
	Sig. (2 tailed)	.000	.000
	N	55	55
Correlation is significant at the 0.01 level (2 tailed)			

Referring to the table 3and table 4 above, the correlation coefficient of CODS performances scores between coach 1 and coach 2 is r= 0.97. While for RA performances scores between two coaches is r= 0.99. The r value with at least 70 percent (0.7) is high and acceptable. A high objectivity and reliability test are achieved when it reach significant agreement between two or more coaches. Apart from that, the test-retest reliability is also functioned in evaluating the objectivity of an instrument.

Coaches' perception towards BRATS

The effectiveness of BRATS are based on the coaches' (teachers) perceptions (*N=52)* on five items asked in the questionnaire, which are the uses of BRATS for badminton athlete's performance test, the uses of BRATS for coaches (teachers), the uses of BRATS for training standards, the advantages and disadvantages of BRATS. The analyses of the questionnaire are shown in the table 5.

Table 5. Percentage of Coaches (teachers) perception towards the uses of BRATS in assessing badminton players, under 15 years old CODS and RA performance (N=52)

Items	**% of coaches (teachers) perceptions**				
	SD	**D**	**PA**	**A**	**SA**
1.0 Uses of BRATS for badminton athlete's performance test.					

May-June 2020
ISSN: 0193-4120 Page No. 8972 - 8980

1.1	Athlete's performances are measurable.	-	-	7.7	63.5	28.8
1.2	Athlete gets enthusiastic during CODS and RA performance test using BRATS.	-	-	21.2	57.7	21.2
1.3	Athlete gets motivated during CODS/RA performance test using BRATS.	-	-	15.4	55.8	28.8
1.4	Athlete attempted to do their best during CODS/RA performance test using BRATS.	-	-	11.5	51.9	36.5
1.5	Athlete's performance while using BRATS is highly encouraging.	-	-	7.7	46.2	46.2
Total				**12.70**	**55.02**	**32.30**
2.0 Uses of BRATS for teachers/trainers.						
2.1	Helps teacher/trainer in evaluating athlete's CODS/RA performance.	-	-	3.8	38.5	57.7
2.2	Helps teacher/trainer in identifying badminton athletes' strengths and weaknesses.	-	-	5.8	46.2	48.1
2.3	Helps teacher/trainer in conducting CODS/RA badminton athlete's performance test.	-	-	7.7	55.8	36.5
2.4	Helps teacher/trainer in keeping badminton athlete's performance test running smooth.	-	1.9	15.4	40.4	42.3
2.5	Cause difficulties towards teacher/trainer.	28.8	51.9	19.2	-	-
Total		**5.76**	**10.76**	**10.38**	**36.18**	**36.92**
3.0 Uses of BRATS for training standards.						
3.1	Helps badminton athlete to achieve goals in CODS/RA performance test.	-	1.9	5.8	57.7	34.6
3.2	Helps badminton athlete to achieve standards in CODS/RA performance test.	-	-	9.6	46.2	44.2
3.3	Helps marking criteria to be clearer.	-	1.9	19.2	51.9	26.9
3.4	Suitable with content standards of CODS/RA performance test.	-	-	15.4	57.7	26.9
3.5	Match the standard of CODS/RA performance test.	-	-	13.5	51.9	34.6
Total			**0.76**	**12.7**	**53.08**	**33.44**
4.0 Advantages of BRATS.						
4.1	User friendly.	-	-	15.4	48.1	36.5
4.2	Ease badminton athletes' performance test.	-	-	7.7	48.1	44.2
4.3	Easy to understand the badminton athletes' performance tests procedure.	-	1.9	5.8	46.2	46.2
4.4	Less time consumption.	-	-	19.2	44.2	36.5
4.5	Rubrics used match the performance test scores.	-	-	9.6	53.8	36.5
Total			**0.38**	**11.54**	**48.08**	**39.98**
5.0 Disadvantages of BRATS.						
5.1	Makes CODS/RA performance test easy.	48.1	30.8	21.2	-	-
5.2	Makes badminton performance test process easy.	44.2	32.7	23.1	-	-
5.3	Performance test process is not limited by time.	50.0	32.7	15.4	1.9	-

TEST Engineering & Management

May-June 2020
ISSN: 0193-4120 Page No. 8972 - 8980

Total	**47.43**	**32.06**	**19.9**	**0.63**	
Notes: SD=Strongly Disagree D=Disagree PA=Partially Agree A=Agree SA=Strongly Agree					

The strength of BRATS are analysed based on three sets of data which are badminton players' CODS and RA performances, expert validation report and coaches perception analysis. It is analysed by using the Methodological Triangulation Method. The outcome of this analysis is presented in the form of percentage, presenting each set of data in Figure 2. The badminton players' CODS and RA performances, expert validation report and coaches perception analysis used will produce the overall percentages of the strength of BRATS. Therefore, the strength of BRATS are analysed based on the claim that if there are more than one rater for an instrument, so percentage data are suitable to use in obtaining the value of an instrument.

Figure 2. Methodological Triangulation Method

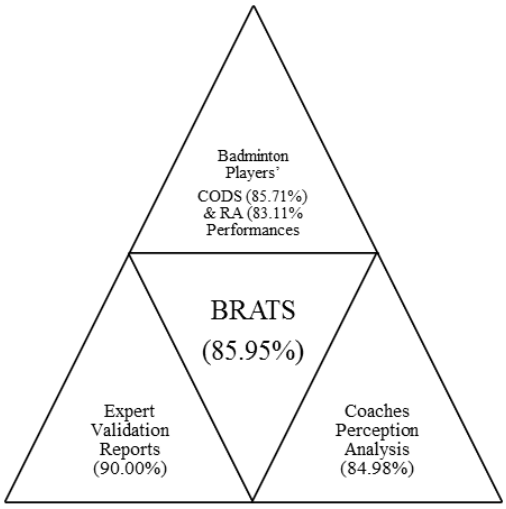


Figure 2 showed that Expert Validation Report recoded the highest value (90.00%) followed by Badminton Players' CODS (85.71%) and RA (83.11%) Performances and 84.98% of Coaches Perception Analysis. The overall percentage for the three values is 85.95%. An acceptable reliability value should be at least 70% of consent between the rater. Findings shows that BRATS is fit to be implemented as one of the testing instruments for Badminton game.

DISCUSSION AND CONCLUSION

The use of BRATS testing provides a systematic way to evaluate the performance of CODS and RA and is able to obtain results that cannot be measured by manual testing. The statement is also supported by the coaches' opinion that BRATS is viewed as more detail, the testing manuals are very clear and effective for coaches and badminton players, while the use of BRATS is easy to understand and implemented by the coaches (teachers) where coaches can test the performance of badminton players CODS and RA systematically.To conclude, the badminton coaches at the school agreed to use BRATS as an instrument to test the badminton players' talents and test the performance of badminton players after undergoing training conducted by badminton coaches. BRATS is considered to be a holistic instrument in testing badminton players as well as a clear and detailed methodology for evaluating performance in terms of CODS and RA for badminton players.

According to the study, BRATS has a high strength in terms of validity and reliability through Methodological Triangulation between badminton players performances, experts validation report and coachers perception. BRATS is an instrument that are capable of assessing badminton as a whole based on CODS and RA aspects. Detailed concepts of badminton players are implemented in BRATS to ensure that lessons can be evaluated holistically. This is supported by the opinion of a panel of experts who stated that the concepts presented in BRATS are seen

May-June 2020
ISSN: 0193-4120 Page No. 8972 - 8980

to be able to test students better as they are systematically evaluated based on the cycle set in BRATS. The coaches also views that BRATS is a straightforward instrument because the rubric can assess badminton players and students can see the true weaknesses and advantages of their CODS and RA performance after training. Also, BRATS is easy to use because it has clear guidelines and instructions.

As the conclusion, BRATS is a system that could be used as a tool for measuring both CODS and RA performance.

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