

RESEARCH ARTICLE

Sebelasmaret Boccia Throw Test (SBTT) Instrument Development

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Abstract

This research aims to design Sebelasmaret boccia Throw Test (SBTT) instrument and test its validity and reliability. The research used Research and Development (R&D) method through six steps of instrument development by Gall, Gall, & Borg. 50 Indonesian boccia athletes with cerebral palsy (25 elite and 25 non-elite) participated to evaluate this instrument. In SBTT, players were instructed to throw boccia balls to the jack placed within the square, with each player given six throwing opportunities. The validity construct was tested by comparing throwing test results of elite and non-elite boccia athletes. Reliability testing was conducted by testing correlation between tests and retests. Data analysis was performed using the independent t test and Pearson correlation with the help of SPSS 16 software. Results show that there was a significant difference in SBTT test scores with p value < 0.05 and $t_{stat} (6.340) > t_{table} (2.011)$. Elite player group had higher average test score than non-elite player one, with average score of 18.56 and 8.20 respectively. This means that the SBTT is a test that can differentiate a boccia player's throwing skills based on playing experience. Test and retest results show a medium correlation on tests and retests ($r = 0.707$) with significant relation with p value (0.000) < 0.05 . This means that boccia players have consistent performance in the SBTT test. Therefore, it is concluded that SBTT instrument is a valid and reliable instrument to assess boccia players' throwing skills.

Keywords

Development, Accuracy, Throwing, Boccia

INTRODUCTION

Calado *et al* stated that boccia is a sport of ball precision (Calado, Leite, Soares, Novais, & Arezes, 2019). Kataoka *et al* stated that boccia was designed for cerebral palsy (Kataoka, et al., 2020). Players are classified in five classes, namely BC1, BC2, BC3, BC4, and BC5 based on their throwing skill performance (Roldan, et al., 2017). In boccia, players should have high movement control in throwing red- or blue-colored ball to achieve accuracy of approaching jack ball (Fong, et al., 2012). This game is scored based on the proximity of red- or blue-colored ball to the jack which will be ranked and given points accordingly. At the end

of each round, the referee measures the distance of the closest red- or blue-colored ball to the jack and gives points. The team/player awarded the highest points at the end of the game becomes the winner (Fong, et al., 2012). Boccia demands muscle control, high accuracy and concentration, and tactical awareness that should be owned by each player (Fong, et al., 2012). Therefore, boccia players need to train their throwing techniques. In line with this, research by Kataoka et al shows that throw training is effective in improving competitive performance of boccia players (Kataoka et al., 2020). In addition, Fong et al also stated that in determining sport success, training level is one of independent variables influencing

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competitive performance (Fong, et al., 2012). In implementing planned, regular, and repeated boccia throwing technique training, one needs to apply some principles in the form of training frequency, overload, training specification, individualization, training quality, training variation, training model, training method, target, and monitoring/evaluation.

In boccia, approaching the color (red/blue) boccia ball with a jack ball is the main goal so that players will get points (Paula, Alves, Castro, Miceli, & Barbosa, 2018). Training results should be periodically and continuously evaluated to understand if the training program implemented has resulted in improved accuracy. Therefore, a boccia throwing test instrument is needed to measure throw training results. In the game's rules, points are counted based on the proximity of the colored ball to the jack. Previous test instrument was performed by placing jack balls on three-, five-, and nine-meter distances. Scoring was determined by the distance proximities of the boccia ball to the jack ball. Three points are given for 9 cm proximity, two points are given for 18 cm proximity, and one point is given for 27 cm proximity. No point is given for proximity of more than 27 cm (Morris & Wittmannova, 2010). boccia game needs accuracy. In training accuracy, boccia balls are thrown at various targets (Barak et al., 2016). Therefore, this research developed an instrument with red or blue boccia ball throwing targeted to distances of 3, 5, 7, and 9 meters. This instrument offers novelty in which the jacks are placed within six 25 cm x 25 cm squares. Each square has different points depending on its position. The squares' dimension is based on the penalty area regulated by boccia game rules while the number of squares is based on the number of boccia balls thrown in the game, in which each player is equipped with six balls in each round.

MATERIALS AND METHODS

Type of research

The researcher used Research and Development (R&D) method to design and test Sebelasmaret boccia Throw Test (SBTT) instrument. R&D research is a research activity to identify and investigate viable ideas to be applicable solutions or made into a product (Levin & Green, 2015). Measurement development steps according to Gall, Gall, & Borg (Borg, 2014) are

as follows: (1) product definition; (2) target population definition; (3) needs analysis; (4) product development and identification of assessed items; (5) field test; (6) revision or final product.

a. Product definition

The product developed was an instrument of boccia throwing accuracy test named Sebelasmaret boccia Throw Test (SBTT).

b. Target population

This instrument was targeted to boccia athletes.

c. Needs analysis

This instrument was made due to the existing necessity for a boccia throwing accuracy test instrument to assess boccia players' throwing skills in approaching the jack ball. This necessity is due to boccia being a game played by throwing colored boccia ball (red/blue) to approach the jack and the scoring being based on the colored balls' proximity to the jack. Therefore, a boccia throwing accuracy test instrument is needed in order to be able to understand players' ability in throwing accuracy.

d. Product development

In developing this instrument, the researcher initially reviewed previous boccia throwing accuracy test instruments, especially those employed in previous researches. The review found a boccia throwing accuracy test instrument used in the research by Morris & Wittmannova, which became the basis of SBTT's development. The instrument by Morris & Wittmannova used jack balls as targets placed at 3, 5, and 9 meter-points. Points for scoring are based on the proximity of boccia balls to jack balls (Morris & Wittmannova, 2010). Meanwhile, this research used jack balls as targets placed within squares of 25 cm x 25 cm at 3, 5, 7, and 9 meter-points. Points for scoring are based on the balls' position within the square targets, with the highest point awarded to boccia balls touching the jack. No point is awarded for boccia balls located outside the square. This instrument was designed to test throwing ability of elite boccia players.

e. Field test

Field tests were conducted to test validity and reliability of SBTT instrument by employing 50 players with cerebral palsy. Evaluation was conducted by using SBTT in accordance with instrument guidelines.

f. Revision and final product

SBTT instrument was revised accordingly. Then, the final product was produced after the

instrument successfully generated a valid and reliable assessment.

Subjects

This research evaluated 50 Indonesian boccia players with cerebral palsy. Of the 50 players, 25 are elite players and 25 are non-elite players. Elite

players here were players who had participated in the 2018 Asian Paragames while non-elite players were players who had participated in Peparнас XVI 2021. Table 1 shows a description of the subject's age, anthropometry, and playing experience data.

Table 1. Description of the subject's age, anthropometry, and playing experience data

Subject	Age (year)	Height (m)	Weight (kg)	Game experience (year)
Elite (n = 25)	27.64±1.52	1.41±0.01	46.70±2.39	7.52±0.51
Non elite (n = 25)	26.20±3.71	1.40±0.02	48.15±2.53	4.92±1.12
Total (n = 50)	26.92±2.90	1.41±0.02	47.43±2.54	6.22±1.57

Sebelasmaret boccia Throw Test (SBTT) instrument product design

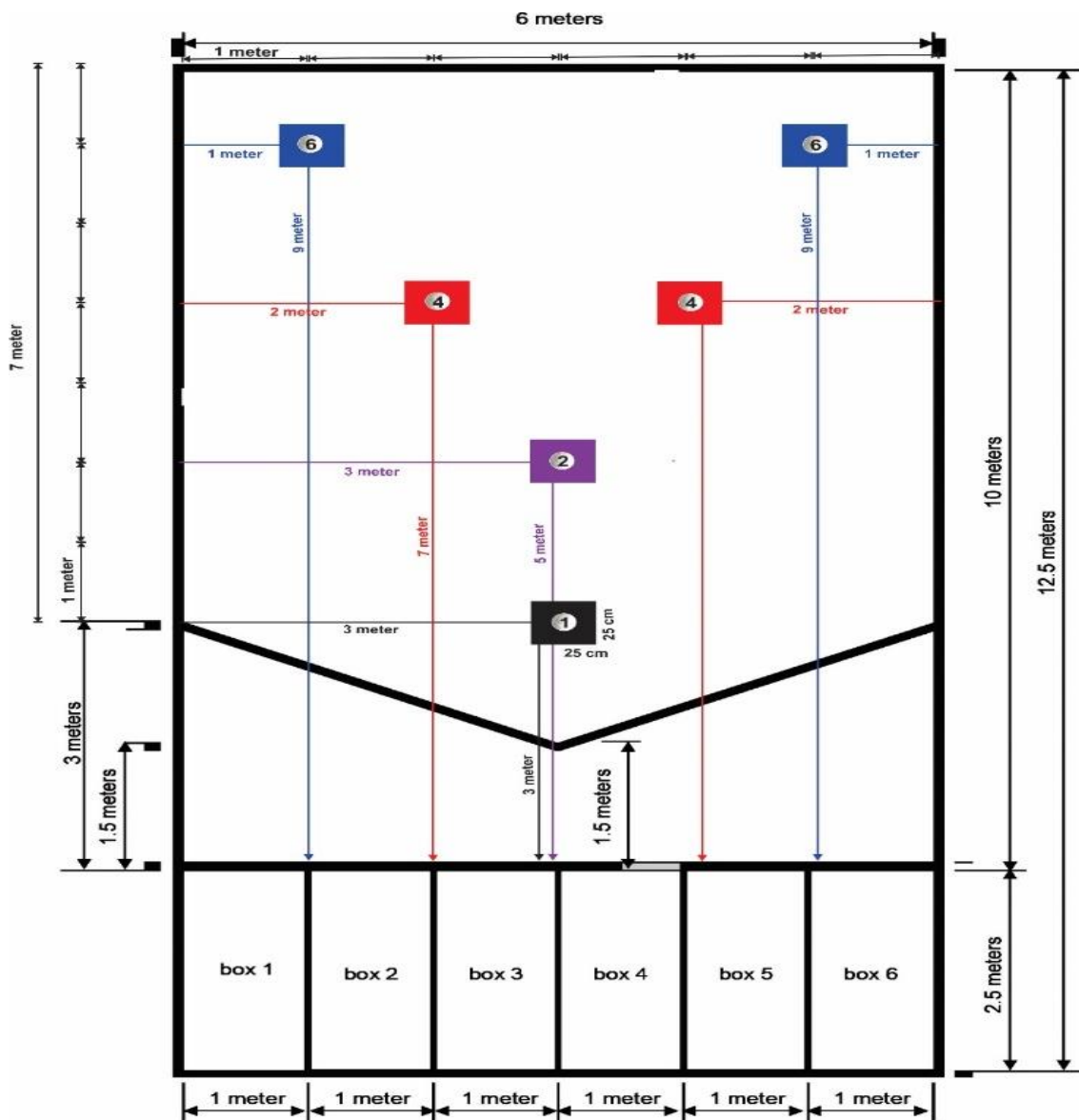


Figure 1. Systematics of sebelasmaret boccia throw test (SBTT) instrument

a. Layout

Figure 1 illustrates SBTT's layout consisting of a boccia field of 12.5 m x 6 m with six ball throwing areas (2.5 m x 1 m) and six square targets (25 cm x 25 cm) placed as illustrated.

b. Procedures

SBTT requires testees to conduct colored boccia ball (red/blue) throwing attempts targeted at the jacks within the squares. The testee was positioned in the ball throwing area and six colored boccia balls (red/blue) were provided for throwing attempts (1 ball per ball throwing area). By tester's call, the testee threw red or blue leather ball to the square targets.

c. Scoring

Assessment was based on the colored boccia ball position within the square targets, with the highest point awarded to those touching the jack ball. Testees were notified that they could only be awarded points if they could throw their boccia balls to the square targets and place them touching the jack ball. If the boccia balls thrown landed outside the square targets, they got no score. Testees showed their best throwing ability. Six throwing attempts were provided for one try. Performance score is the cumulative number of points from all correct throws at the box goal. One

point is awarded if the colored boccia ball is three meters away, two points are awarded if the colored boccia ball is five meters away, four points are awarded if the colored boccia ball is at distance of seven meters, and six points are awarded if the colored boccia ball is at a distance of nine meters.

Data analysis

Validity assessment was carried out by evaluating the underhand throw skills of 25 elite players and 25 non-elite players. The reliability assessment was carried out by re-testing underhand throws on 50 players. Data distribution normality was tested by using Kolmogorov-Smirnov for each validity and reliability testing data. Independent t-test was applied to compare two boccia player groups in the validity test. To test the reliability, Pearson's correlation was applied on the test and retest results to measure to what extent scores of different individuals stay consistent (Borg, 2014). Significance value on the Pearson's correlation was determined to be $p < 0.05$. Correlation value of < 0.20 means minuscule, $0.20 - 0.50$ means little, $0.51 - 0.80$ means medium, and > 0.80 means large (Farhani et al., 2019).

RESULTS

Table 2. Normality test results

Group		Kolmogorov-Smirnov ^a		
		Statistic	df	Sig.
Underhand_Throw_	Elites	.183	25	.200
SBTT	Non-elites	.235	25	.147

Table 2 shows the results of data normality tests. The sig. value of each group was > 0.05 , meaning that the data was distributed normally. Data distribution was also shown in the Figure below.

Table 2, Figure 2, and Figure 3 show that data of validity test were distributed normally. Therefore, the next test was conducted by using independent t-test.

Table 3 shows that there was a significant difference on the SBTT test scores with p -value < 0.05 and $t_{stat} (6.340) > t_{table} (2.011)$.

Elite players had higher average test scores than non-elite ones, with average test scores of 18.56 and 8.20 respectively. This is also apparent in the difference of average scores between elite and non-elite players, amounting to 10.360.

Table 4 shows the correlation test results by using Pearson's correlation. Test and retest results show medium ($r = 0.707$) and significant relation with p -value (0.000) < 0.05 .

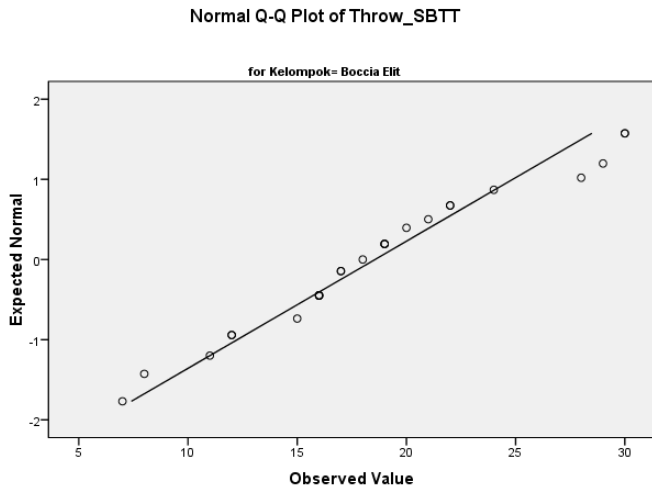


Figure 2. Data normality distribution of elite boccia players

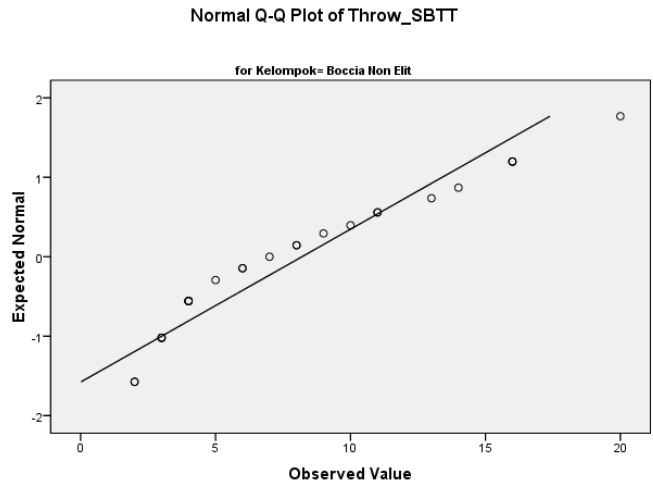


Figure 3. Data normality distribution of non-elite boccia players

Table 3. Difference of SBTT test between elites and non-elites

Testees	Mean	Mean difference	t	p-value
Elites	18.56			
		10.360	6.340	.000*
Non-elites	8.20			

*A significant difference was found between elites and non-elites (p < 0.05).

Table 4. SBTT tests and retests

SBTT	Pearson correlation	p-value
Tests	.707	.000
Retests	.707	.000

DISCUSSION

In this study, a newly developed instrument for assessing the throwing skills of boccia players was tested. It is important to note that all boccia players participating in this study were players with cerebral palsy. In evaluating the newly developed instrument, the researcher evaluates it with construct validity and test-retest reliability. When comparing the underhand throw skills of the two groups of players (elite and non-elite) for validity testing, the results show that there was a significant difference in SBTT test scores with p-value < 0.05 and $t_{stat} (6.340) > t_{table} (2.011)$. Elite players had higher average test scores than non-elite ones, with average scores of 18.56 and 8.20 respectively. This difference may be due to the

position of the throwing area which is in different positions, thus causing low throwing accuracy for non-elite players. Meanwhile, elite players have no problems when throwing the ball in different throwing areas. This can happen because of the playing experience of each player. Therefore, SBTT can differentiate boccia players' throwing skills based on the player's playing experience. When comparing the days of data collection conducted on two different days to test reliability, the results show medium correlation on SBTT in tests and retests ($r = 0.707$) having a significant relation with p-value ($0.000 < 0.05$). This means that boccia players had consistent performance in doing SBTT tests and no influence from training was present during test-and-retest implementation.

Although previous studies have also developed boccia throwing instruments such as Oliveira et al (2021). However, there are still differences in terms of methodology, scoring criteria, procedure design, instrument design, and the boccia players involved, limiting the differences with this study. If Oliveira et al (2021) designed an instrument with the concept of target sizes with different resolutions. In this study, the instrument was designed with the concept of different throwing distances, four throwing distances of three, five, seven, and nine meters were understood as the throw limits since boccia players need to have good response to reach accuracy of the proximity to the jack ball, such as changing in throwing movement pattern and throwing speed. Research by Reina et al shows the existence between movement and result variability

conducted by boccia players, in which a positive correlation was found between throwing speed and accuracy for 5-meter distance (Reina et al., 2018). SBTT was designed with four distance limits with six target positions to adjust with boccia game condition, in which jack balls are placed in various positions. Supporting this statement, Reina et al stated that in the game there will be situations in which ball position usually changes after each throw, and therefore necessitates different response by boccia players in handling the changing position, which becomes a challenge to them in reaching accuracy (Reina et al., 2018).

Based on the results, it is concluded that SBTT is a valid and reliable instrument for testing throwing skills of boccia players. SBTT is a test that can differentiate the levels of throwing skills of boccia players according to their playing experience. Boccia players employed in this research showed consistent results in SBTT testing. Thus, SBTT can be used to assess throwing skills of boccia players.

Acknowledgment

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Conflict of interest

The authors declare no conflict of interest. No financial support was received.

Ethics Statement

The approval of the Health Research Ethics Committee of Komisi Etik Penelitian Kesehatan (Protocol number 685/VI/HREC/-2021).

Author Contributions

Study Design, SYG and RID; Data Collection, RID; Statistical Analysis, SYG and RID; Data Interpretation, SYG and RID; Manuscript Preparation, SYG and RID; Literature Search, SYG and RID. All authors have read and agreed to the published version of the manuscript.

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