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Testing Basic Basketball Skills: Evaluating Validity and Reliability in the Context of Gross Motor Development

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Abstract Objective: This study aims to measure the validity and reliability of the basketball ability test and the Test of Gross Motor Development (TGMD) as a tool for assessing motor and basketball abilities in early childhood. Methods: Research subjects consisted of 21 young basketball players from clubs and academies in the Jakarta Region, with $\bar{x}$ age of 5.9 years old (SD ±.831) and $\bar{x}$ BMI of 16.2 (SD ± 1.23). The basketball ability test includes running, jumping, changing direction, and throwing and catching the ball. TGMD is used to assess locomotor skills and object control. Results: The results of the analysis show that both tests have high validity and reliability in measuring children's basketball and motor skills. Correlations between tests indicate effectiveness in evaluating important aspects of motor skills. A significant relationship between test results and measured motor abilities supports construct validity. High reliability shows the consistency of test results over time. Conclusion: The basketball ability test and TGMD were proven to be valid and reliable for assessing motor skills and basketball in early childhood. Both tests can be used in physical education and motor skill development, providing valuable insight for coaches and educators. Further research is needed to test the applicability of this test to a broader population.

Keywords Basketball, Motor Development, Manipulative Skill, Physical Education, Reliability, Validity

1. Introduction

Basketball tests are designed to evaluate motor skills and coordination that are important in the game of basketball. This test involves four main components: running, jumping, changing direction, and throwing and catching the ball [1]. Each component measures a specific aspect of motor ability that is relevant to the game of basketball [2], which requires good physical conditions [3], [4]. First, the running component measures the speed and efficiency of leg movements in running [5]. In the context of basketball, the ability to run quickly and nimbly is essential to moving oneself efficiently around the court and keeping up with the rhythm of the game. This test usually involves running a short distance that assesses the child's strength and agility in moving quickly. Explosive power and speed are two main components of a basketball player's physical fitness [5]. The jumping component focuses on the child's ability to perform vertical and horizontal jumps. In basketball, the ability to jump both high and far plays a crucial role, whether it's for taking shots, retrieving the ball mid-air [6],

or evading opponents [7], [8]. The change position and component measure a child's ability to make quick and effective changes of direction in basketball in an agile and fast manner which is key to avoiding opponents, managing position, and responding to dynamic game situations. This requires good body coordination [9], balance, and reaction speed when changing the direction of movement. The ball throwing and catching components assess ball control skills that are crucial in the game of basketball [10]. The ability to throw accurately and catch the ball well is a fundamental aspect of the game. This test measures throwing and catching techniques as well as a child's ability to control the ball in moving situations.

The success of basketball players is greatly influenced by both their physical attributes or motor skills and psychological factors, including emotional expression, emotional regulation, and self-confidence [11], as well as mental toughness, confidence [12], and motivation [13]. The players' ability of perception, good competence, self-evaluation and a positive influence on their psyche also influence the ability to play basketball [14].

The Test of Gross Motor Development (TGMD) is a standardized assessment tool designed to evaluate gross motor skills in children. This test aims to assess basic movement patterns that are important for a child's motor development and overall physical fitness [15]. The instrument for assessing Fundamental Motor Skill (FMS) among students was the TGMD (Ulrich, 1985, 2000, 2013) [16]. TGMD is designed for use in children aged between 3 to 10 years, and serves to identify children who may be experiencing delays or difficulties in motor development, allowing for earlier intervention and support [17]. Additionally, these tests help in assessing how well children can perform basic motor skills, monitor their progress over time, and support research in the areas of motor development and physical education. This test consists of two main subtests: locomotor skills and object control skills [18]. Overall, the Test of Gross Motor Development is a valuable tool for assessing gross motor skills in children. By evaluating locomotor skills and object control, TGMD provides in-depth insight into children's motor development, helping various parties to support children's physical development and well-being. The standardized and consistent approach used in TGMD ensures the accuracy and reliability of the assessment, making it an effective tool in a variety of contexts. This study aims to assess the validity and reliability of the basketball ability test and TGMD as a tool for evaluating motor skills and basketball abilities in early childhood, which aims to be used in other research regarding the development of basketball training models for early childhood, as shown in the following image.

2. Materials and Methods

The subjects sampled in this study were early childhood basketball players in basketball clubs and academies, age group $\bar{x}$ 5.9 years SD ± .831 in the Jakarta Province area with an $\bar{x}$ BMI of 16.2 SD ± 1.23, consisting of 21 junior basketball players (9 females and 11 males) with training experience ranging from 1-3 years ($\bar{x}$ = 2.05, SD ± .86), all of whom are healthy and without a history of orthopedic or cardiovascular disease.

Data collection on basketball abilities was conducted through basic basketball tests consisting of running, jumping, changing direction, and throwing and catching tests as shown in Table 1, while to measure the motor skills of the samples, TGMD carried out three approaches consisting of locomotor, non-locomotor and object manipulation abilities. Statistical analysis was carried out using JAMOVI 2.5.6 software [19], to measure the validity and reliability of the test.

Table 1. Model Effectiveness Test Instrument (Basketball Game Skill Test for Early Childhood)

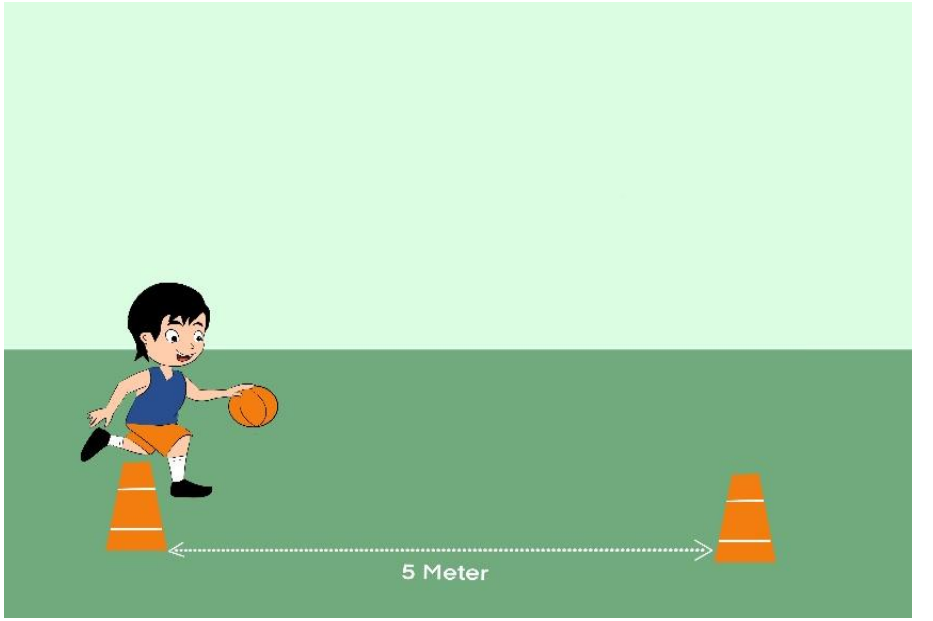
Dimensions	**Observation Indicator**	**Basic Skills**	**Mark**		
			1	**2**	**3**
Running	(1) Hand dribble stationary and moving forward	Ø Implementation Rules			
		Dribble the ball 3x towards the first cone, then dribble the ball from the first cone to the next cone. Dribble the ball as best as possible.			
		Prepare 2 cones 4 meters apart			
					
		Ø Description;			
		DEFICIENT (point 1) If you cannot control the ball when it is stationary or moving, eye-hand coordination is absent.			
		ADEQUATE (point 2) If you are able to control the ball when it is still and moving, your movements will not be smooth when changing from still to moving and moving to still. Adequate eye-hand coordination.			
		GOOD (point 3) If you are able to dribble with good control in place for repetition. Demonstrate smooth movement from a still position to a moving position, the body, lower limbs and upper body are in sync. Strong eye, hand and foot coordination.			

Table 1 continued

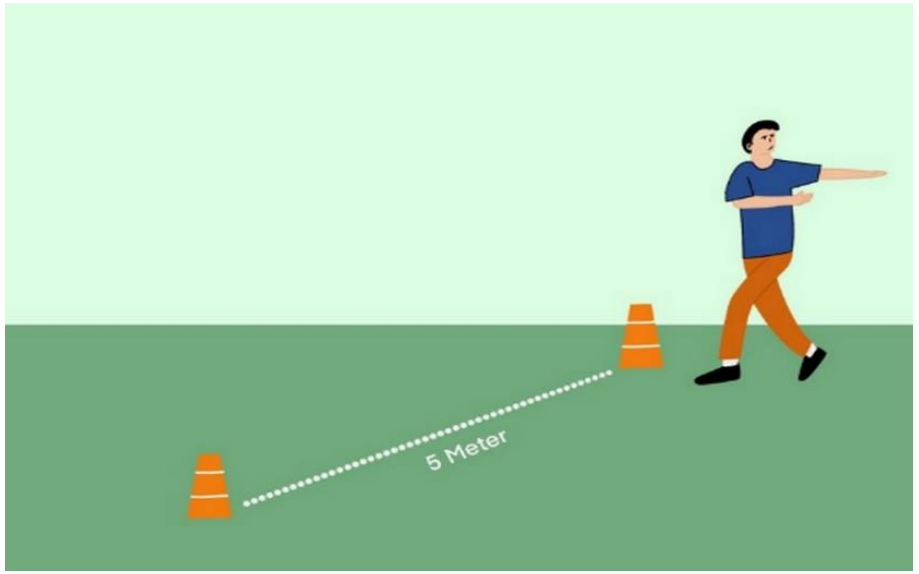
	(2) Crossovers/ Carioca	Ø Implementation Rules			
		Perform crossover steps or crossing steps from the first cone to the next cone.			
		Prepare 2 cones 5 meters apart.			
					
		Ø Description;			
		DEFICIENT (point 1) If you are unable to perform crossover movements and steps, you can perform half of a crossover step (front foot, or back foot, but not both).			
		ADEQUATE (point 2) If you are able to carry out front and back crossing movements and steps for the entire distance covered, with moderate speed and no jerking, it is evidence of your upper body coordination.			
		GOOD (point 3) If you are able to perform smooth crossing movements and steps, coordinated upper and lower body movements, with excellent speed.			

Table 1 continued

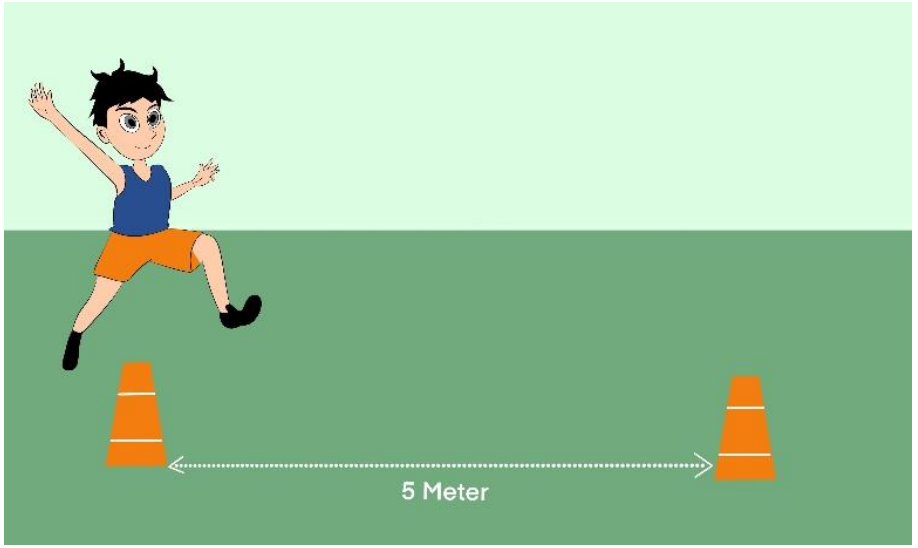
Jumping	(1) Hops	Ø Implementation Rules			
		Jump on one foot from the first cone to the next cone.			
		Prepare 2 cones 5 meters apart.			
					
		Ø Description;			
		LACK (point 1) If you fail to maintain support on one leg and land on the opposite leg, performing a jumping action, the upper body and lower body are not in sync.			
		ADEQUATE (point 2) If you are able to jump on one leg from start to finish with a medium distance jump, clear air flow phase, may not use the opposite foot to assist, distance may vary from jump to jump in the medium distance. Start and stop controls may be limited.			
		GOOD (point 3) If you are able to jump a substantial distance consistently in the middle distance. Direct transitions to jumps and jumps to a stationary position at the end of the movement, as well as continuity in the movement. Good horizontal and/or vertical speed, using opposing lower limbs and upper body in unison with the other lower limbs.			

Table 1 continued

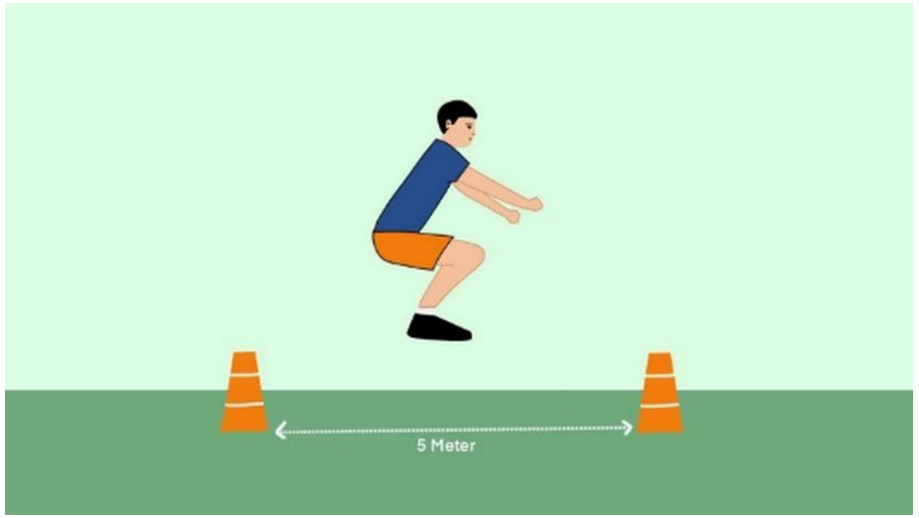
	(2) Jump	Ø Implementation Rules			
		Jump from the first cone to the next cone.			
		Prepare 2 cones 5 meters apart.			
					
		Ø Description;			
		LESS (point 1) If you don't do a two-foot jump. Perform an unbalanced landing or takeoff with unsteady legs. Cannot perform more than one jump in a row.			
		ENOUGH (point 2) If you do a continuous jumping movement from start to finish, limited arm swing, triple flexion of the lower body (hips, knees, ankles used for propulsion). The distance traveled is limited (less than one full distance). Speed may be limited due to limited jump distance.			
		GOOD (point 3) If you are able to jump a long distance (body length). Clear lower body triple flexion (hips, knees, ankles used for pushing). Arm swing is clearly visible and the urge to start and stop is smooth. Movement speed when jumping is very good.			

Table 1 continued

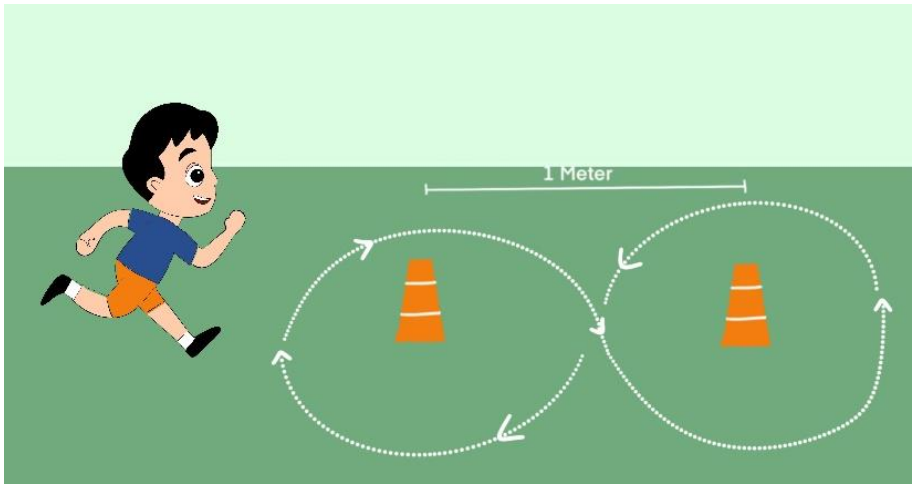
Changing direction	(1) 8 pattern run / running number 8	Ø Implementation Rules			
		Run along the line in the shape of the number 8. With a distance of 1 meter between each point.			
		Ø Implementation illustration			
					
		Ø Description;			
		DEFICIENT (point 1) If you are unable to show a good ready attitude, fail to carry out the stages of running forward, you can turn and cut sharply in the opposite direction (from left to right) properly.			
		ENOUGH (point 2) If you are able to show a good preparedness attitude, you are able to carry out the stages of running forward, turning and cutting sharply in the opposite direction (from left to right) well.			
		GOOD (point 3) If you are able to show a good preparedness, consistency and good transitions during the stages of running forward, you can turn and cut sharply in the opposite direction (from left to right) following a line shape without stopping.			

Table 1 continued

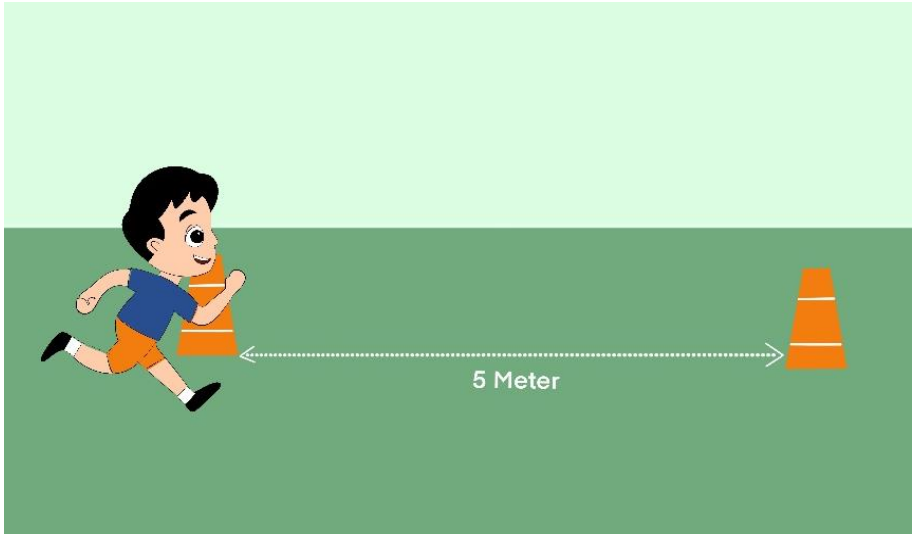
	(2) Run there and back	Ø Implementation Rules			
		Run straight through the cones, brake at speed then turn around and run back to the starting position as best as possible.			
		Prepare 2 cones 5 meters apart.			
					
		Ø Description;			
		LESS (point 1) If you make a running movement with arm swings and invisible footsteps, slow speed, do not show a turning direction transition and spin far from the reach of the cones.			
		ADEQUATE (point 2) If you are able to make running movements with arm swings and footsteps that are clearly visible at running speed, the rotation is not fast but moves well.			
		GOOD (point 3) If you are able to carry out running movements with consistent arm swings and foot steps from acceleration to movement efficiency, the balance of movement rotation is controlled when the direction you want to turn and run again, and the arms and legs are used for movement power when turning.			

Table 1 continued

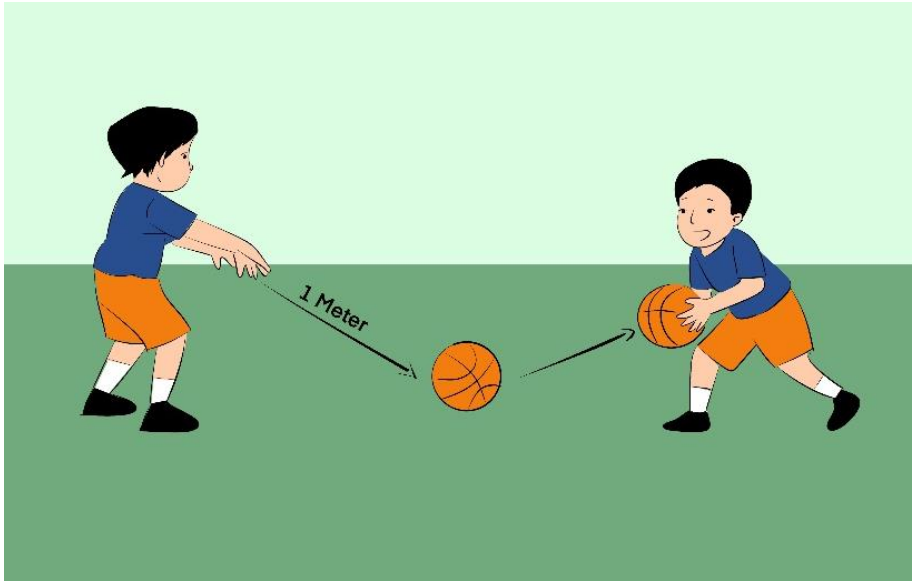
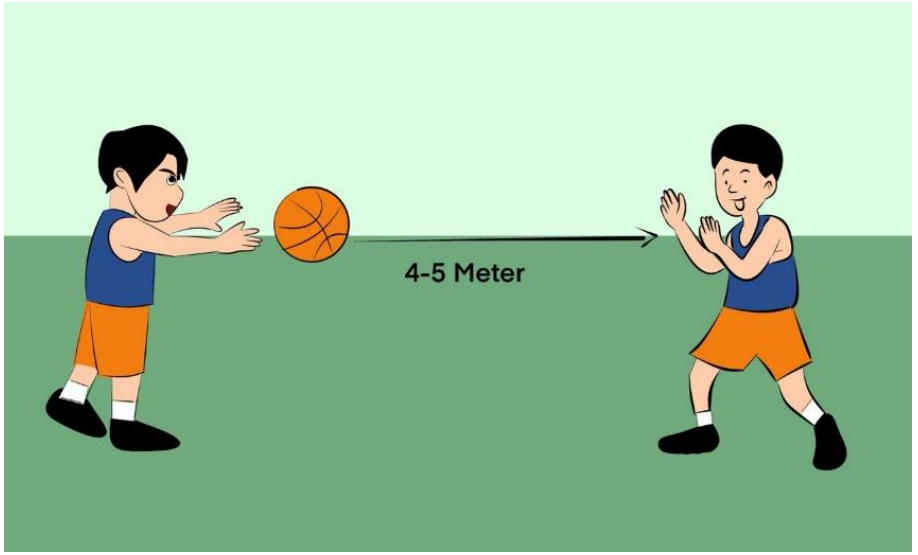
Throw and cath	(1) Throwing:	Ø Implementation Rules			
	Chest Pass (throwing the ball from the front of the chest) and Bounce Pass (throw bouncing off the floor)	Ready body posture with both feet parallel to the shoulders, hold the ball using two hands, first hold the ball in front of your chest, put your right foot in front (if left-handed, vice versa), and pass by directing the ball to the floor about 1.5 meters so that the ball can reach you. Bounce to a friend, and when passing, the right foot steps forward to increase the strength of the pass.			
		The ball on the floor is directed to a friend.			
		Size 5 basketball			
					
		Ø Description;			
		LESS (point 1) If the throw fails with the starting position of the ball in front of the chest, the direction of the ball is not towards the target.			
		ENOUGH (point 2) If you are able to show a good ready attitude, grip the ball in front of your chest. Throw from the front of the chest and do a bounce throw to the floor.			
		GOOD (point 3) If you are able to show a good ready attitude, grip the ball in front of your chest. Throw from the front of the chest until the arms are straight in front. And threw the bounce on the floor well. Eye, hand and foot coordination is good.			

Table 1 continued

	(2) Catching	Ø Implementation Rules			
		Ready body posture with both feet parallel to the shoulders, catch the ball from the front of the chest.			
		Ready body posture with both feet parallel to the shoulders, catch the ball from the bounce.			
					
		Ø Description;			
		DEFICIENT (point 1) If you are unable to catch the ball from the front of your chest and cannot catch it from the bounce.			
		ENOUGH (point 2) If you are able to catch the ball from the front of your chest and successfully catch the ball from the bounce.			
		GOOD (point 3) If you are able to show good preparedness, succeed in catching the ball from the front of your chest and succeed in catching the ball from the bounce with good movement.			

3. Results

The data in Table 2 was obtained from three types of measurements, namely B-Bal Test, Re-test, and TGMD, involving 21 participants for each measurement. The average score on the B-Bal Test is 6.3, with a median of 60, indicating consistency of scores around the average. A standard deviation of 2.33 indicates that the variation in test scores is quite low. The minimum and maximum values obtained were 56 and 65. The normality test using Shapiro-Wilk showed that the B-Bal Test data was normally distributed, indicated by a W value of .952 and a p of .378. For the Re-test measurement, the average value was 16.7, with a median of 18, indicating a data distribution that was slightly more spread out compared to the B-Bal Test. A standard deviation of 3.23 indicates greater variation in the Re-test data. The minimum and maximum values recorded were 10 and 23. The Shapiro-Wilk normality test gave a W value of .959 and a p of .505, which also indicates that the data are normally distributed. Meanwhile, for TGMD, the mean value was 16.9 and the median was 17. The standard deviation recorded was 3.56, indicating the greatest level of variation among the three measurements. The minimum and maximum values in TGMD are 9 and 24. The Shapiro-Wilk normality test shows a W of .966 and p of .634, which indicates that the distribution of this data is also normal. Overall, descriptive analysis shows that the three measurements (B-Bal Test, Re-test, and TGMD) have a normal distribution, in accordance with the results of the Shapiro-Wilk test which shows a p value greater than .05. Although there is variation in each measurement, the mean and median values show a consistent distribution of data around the middle value. The largest variation was in the TGMD results, while the B-Bal Test showed the smallest variation. These findings illustrate that the three tests are consistent in assessing participants with a predictable distribution of results and continue to be tested using parametric statistical tests.

Table 2. Data Description

	B-Bal test	Re-test	TGMD	Age	Height	Weight	BMI
N	21	21	21	21	21	21	21
Mean	60.3	16.7	16.9	5.9	116	21.7	16.2
Median	60	18	17	6	115	22	16
SD	2.33	3.23	3.56	,831	4.93	1.32	1.23
Min	56	10	9	5	110	19	13.9
Max	65	23	24	7	130	24	18.3
Shapiro-Wilk W	.952	.959	.966	.796	.884	.925	.958
Shapiro-Wilk p	.378	.505	.634	< .001	.017	.109	.485

The data description display can be seen in Figure 1 below.

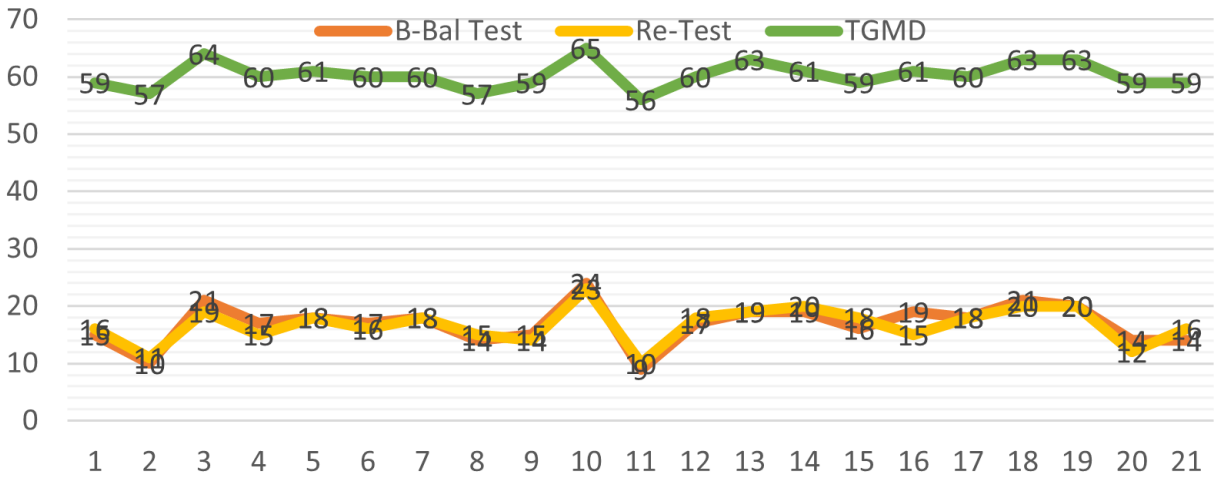


Figure 1. TGMD, B-Bal and Re-test chart

The following are the results of the correlation validity test between the basketball and TGMD tests.

Table 3. Correlation Matrix Validity of the B-Bal and TGMD Tests

	Stat	B-Bal Test
TGMD	Pearson's r	,844***
	df	19
	p-value	< .001

Note. * p < .05, **p < .01, ***p < .001

Table 3 above shows the results of the Pearson correlation analysis which was conducted to evaluate the relationship and reliability between two variables, namely the B-Bal Test and TGMD. The results of the analysis show that there is a strong correlation between the B-Bal Test and the TGMD, with a Pearson's r value of .844. This shows that there is a strong positive relationship between these two variables, where an increase in scores on the B-Bal Test tends to be followed by an increase in scores on the Re-test. The degree of freedom (df) for this analysis is 19, which is obtained from the number of participants minus two. The p value resulting from this analysis was less than .001, indicating that the correlation found was highly statistically significant at the .001 level of significance.

The correlation analysis between the Re-Test and TGMD was carried out to assess the relationship between the two variables as well as measure the construct validity of the two tests using Pearson correlation. The analysis results show a strong correlation between the Re-Test and TGMD, with a Pearson's r value of .944 (Table 4). This shows that there is a strong positive relationship between these two variables, where an increase in scores on the Re-Test tends to be accompanied by an increase in scores on the TGMD. The degree of freedom (df) for this analysis is 19, which is the number of participants minus two. The p value resulting from this analysis was less than .001, indicating that the correlation found was highly statistically significant at the .001 level of significance. This means there is a very small chance that the observed relationship occurred by chance. Overall, these findings indicate a very significant and strong relationship between the results of the Re-Test and TGMD, which may indicate that these two tests measure interrelated aspects of motor skills or physical capacity in participants. These results can be used to support the construct validity of the tests used in this study and provide valuable insight into the consistency of assessments across relevant variables in the context of measuring physical or motor abilities.

Table 4. Correlation Matrix Validity of the B-Bal and TGMD Tests

	Stat	Re-test
TGMD	Pearson's r	.944***
	df	19
	p-value	< .001

Note. * p < .05, **p < .01, *** p < .001

The reliability analysis of the B-Bal Test and Re-test above shows a very strong positive correlation with a Pearson's r value of .907, indicating that the two tests measure the same construct in a consistent manner (Table 5). The high correlation suggests that individuals who score well on the B-Bal Test also tend to score similarly on the Re-test, demonstrating strong test-retest reliability. The p-value of < .001 provides robust evidence that this correlation is statistically significant, meaning the consistency in scores is unlikely due to chance. In summary, the B-Bal Test and Re-test are highly reliable, yielding stable and repeatable results across different administrations, which supports their use for accurately assessing the intended construct over time. Overall, these findings show that there is a very significant and strong relationship between the results of the B-Bal Test and Re-test. This may indicate that the two tests measure interrelated aspects of the skill or ability being assessed, thereby providing reliability and consistency in measurement. These results can also be used to support the validity of the test used, as well as provide valuable insight into the effectiveness of the test in assessing participants' physical or motor capacity. Figure 2 is a display of the correlation between validity and reliability test data.

Table 5. The reliability of the B-Bal test

	Stat	Re-test
B-Bal test	Pearson's r	.907***
	df	19
	p-value	< .001

Note. * p < .05, ** p < .01, *** p < .001

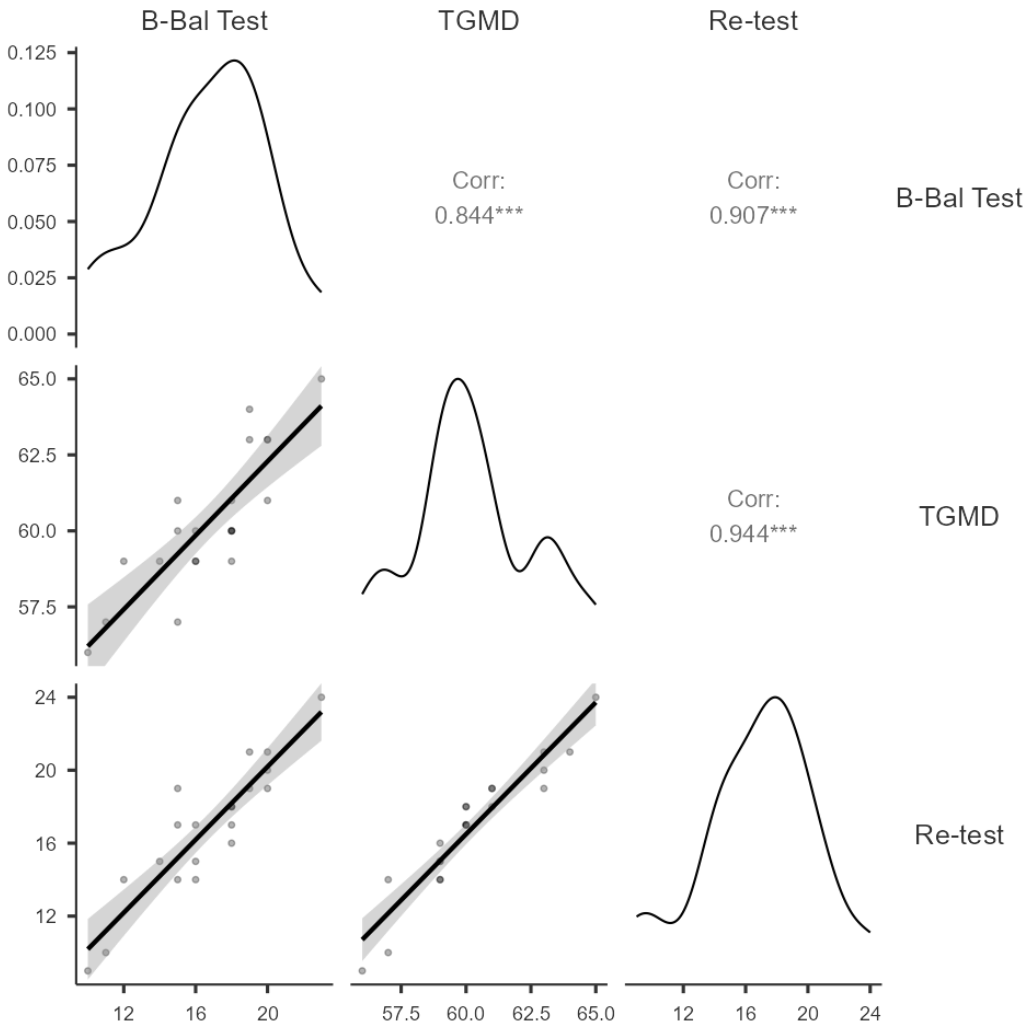


Figure 2. Validity and reliability graph

Based on the results of the correlation analysis between the B-Bal Test, re-test and TGMD, there are very strong and statistically significant correlations (Pearson's r = .844 and .944, p < .001). This shows that the tests have a very high relationship and are interrelated. Construct validity emerged based on the high correlation test results between the B-Bal Test and TGMD indicating that these two tests may measure the same or significantly related constructs, such as motor abilities or physical skills. This supports the construct validity of both tests, as the consistent and highly correlated test results suggest that the two measurement tools may be measuring similar aspects of skills or capacities. The strong relationship between the two tests also indicates consistency in the measurement of the motor or physical skills identified by the two tests. This means that the two tests can be used interchangeably or as complements to obtain a more complete picture of an individual's motor abilities. With significant correlation, the results of one test can be used to predict the results of other tests with high accuracy. This supports the criterion validity of both tests, because the results of one measuring tool can be considered a valid indication of the results of the other measuring tool in the context of measuring motor abilities.

Overall, these results support the validity of the B-Bal Test and TGMD as effective measurement tools in assessing motor skills or similar physical capacities. This highly significant correlation indicates that the two tests can complement each other in evaluation and measurement that is relevant in the context of this research. Based on the results of the correlation analysis between the B-Bal Test and Re-test, it can be concluded that the test has very high reliability. The Pearson correlation coefficient value of .907 indicates that there is a very strong and positive relationship between the scores obtained on the B-Bal Test and Re-test. This indicates that the measurement results of the two tests are very consistent and reliable for assessing the same skills or capacities in participants. With a p-value of less than .001, the correlation found is highly statistically significant, which strengthens the belief that the observed relationship is not the result of chance. The degrees of freedom of 19 support that these results are based on an adequate sample for reliability analysis. Overall, the conclusion from these results is that

measurements using the B-Bal Test and Re-test show very good reliability. This is important in the context of research or evaluation of physical or motor abilities, where accuracy and consistency of measurement are crucial. A reliable test ensures that the results obtained can be relied upon and used to make informed decisions regarding the participant's abilities. The implications of this test can be used as a basis for improving biomotor abilities related to basketball needs, according to the test, namely the ability to run, jump, and change direction, which can be done through plyometric training for athletes at the right time [20], [21], as well as throwing and catching in performance goals conditions [22]. Specific training procedures for each component of speed and agility must be implemented from a junior age [23]. Some psychological exercises such as imagery exercises [24] and cognitive abilities also influence the ability of specific basketball skills, as well as maintaining ideal body weight [25]. This test can also be combined with several tests in the sport of basketball such as the Basketball Exercise Simulation Test (BEST) [26], jump ergometer [27], and basketball-specific fatigue protocol [28].

4. Conclusions

The construct validity seen from the high correlation test results between the B-Bal Test and TGMD indicates that these two tests may measure the same or significantly related constructs, such as motor abilities or physical skills. This supports the construct validity of both tests, as the consistent and highly correlated test results suggest that the two measurement tools may be measuring similar aspects of skills or capacities. Based on the correlation analysis between the B-Bal Test and Re-test, it can be concluded that the test has a very high level of reliability, where there is a very strong and positive relationship between the scores obtained on the B-Bal Test and Re-test, indicating the results. The measurements from both tests are very consistent and reliable in assessing the same skills or capacities in participants. The correlation found was also highly statistically significant, strengthening the belief that the observed relationship was not the result of chance. In addition, these results are supported by an adequate sample for reliability analysis. Overall, measurements using the B-Bal Test and Re-test show a very good level of reliability. This is especially important in the context of research or evaluation of physical or motor abilities, where accuracy and consistency of measurement are crucial. A reliable test ensures that the results obtained can be relied upon and used to make informed decisions regarding the participant's abilities.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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