Design and Standardization of a Test to Measure Defensive Movement Speed Endurance Within Half-Court for Basketball Players Aged 10–12 Years

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SPECIAL ISSUE ARTICLE

Design and Standardization of a Test to Measure Defensive Movement Speed Endurance Within Half-Court for Basketball Players Aged 10–12 Years

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Abstract

The significance of this research lies in the development of a standardized and scientifically validated test, providing coaches with a tool to assess players' speed endurance within the half-court area of a basketball game, with the aim of continually evaluating it during training sessions and official competitions. The research problem stems from the necessity of constructing a test that accurately measures speed endurance during defensive movement within the half-court under conditions that closely simulate competitive environments. Given the scarcity of such crucial tests for assessing and evaluating players, this gap constituted a research problem that needed to be addressed. Consequently, the researchers developed the required test and established standards and levels intended to contribute to raising the performance level in basketball. Research Objectives: 1. To construct and standardize a test for measuring defensive speed endurance within the half-court for basketball players aged 10–12 years. 2. To establish evaluation levels and standards for measuring defensive speed endurance within the half-court for basketball players aged 10–12 years. The study employed the descriptive method using the survey approach. The research sample consisted of basketball players aged 10–12 years from the Specialized School in Basra Governorate. Following the design of the test, the researchers reached the principal conclusion that the constructed test effectively detects the level of defensive speed endurance within the half-court area for basketball players aged 10–12 years. Recommendations: The researchers recommend adopting the current test as a reliable tool for detecting the level of defensive speed endurance within the half-court for basketball players aged 10–12 years, and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Quality Education).

Keywords: Test construction and standardization, Speed endurance, Defensive movement

1. Research introduction

1.1. Research background and significance

The achievements attained by individuals across various fields—whether scientific, educational, or athletic—cannot be accurately recognized or assessed without proper evaluation and measurement based on standards and criteria that reflect their true level.

For this reason, the science of testing and measurement is considered one of the fundamental disciplines across different areas, as it plays a vital role in facilitating advancement by identifying the current level of performance and determining the necessary interventions for improvement. In this regard, Al-Hakim (2004) emphasizes that "the use of evaluation becomes essential if we are to understand the benefit or effectiveness of the programs being taught, and whether these programs are achieving their intended objectives. Furthermore, evaluation assists in identifying the strengths and weaknesses of individuals and programs alike" (p. 16).

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In the field of sports, evaluation through standardized tests is essential for accurately identifying an athlete's true level of performance and measuring their progress within the sport. On this basis, the design and standardization of tests are regarded as critical stages in advancing athletic performance across various sports disciplines. As Farahat (2001) states, "Tests represent an individual's responses in a situation involving a deliberately organized stimulus characterized by specific attributes and presented to the individual in a particular manner that allows researchers to record and measure these responses with precision" (p. 68).

In the game of basketball, which often takes place on half the court, achieving high-level performance demands not only technical skill but also an appropriate level of physical fitness, particularly in defensive play. This requires continuous, high-speed movement throughout the duration of the game, necessitating speed endurance to effectively prevent opponents from scoring. As Abdul Khaliq (1999) explains, "Speed endurance is the athlete's ability to maintain high speed under conditions of sustained exertion, resulting from the capacity to resist fatigue during periods of high-intensity effort" (p. 175).

Most defensive movements in basketball occur within the half-court area. In this context, defenders are required to closely track offensive players, moving dynamically within the available spaces while matching the speed of the attackers throughout each possession and until the end of the game. To enhance speed endurance in defensive movement, it is essential to measure this ability accurately and monitor players' progress over time.

Thus, the significance of this research lies in the development of a standardized and scientifically validated test that coaches can use to assess the speed endurance of their players within the half-court setting, ensuring continuous evaluation during both training sessions and official competitions.

1.2. Research problem

Speed endurance is one of the critical physical abilities required in basketball, particularly in defense, where a defender must continuously move to keep up with an attacker without stopping. Therefore, assessing and understanding this ability necessitates the development and application of a specifically designed and standardized test.

Based on the researchers' practical experience in the fields of testing, measurement, and basketball, they identified a clear need to construct a test that accurately measures speed endurance during defensive movement within the half-court

area under conditions resembling actual competition. Given the scarcity of such important tests for evaluating and assessing players, this represents a research problem that warrants resolution. Accordingly, the researchers undertook the development of the required test and established corresponding standards and performance levels with the aim of enhancing the overall standard of basketball performance.

1.3. Research objectives

1. To develop and standardize a test for measuring defensive movement speed endurance within the half-court for basketball players aged 10–12 years.
2. To establish performance levels and evaluation standards for assessing defensive movement speed endurance within the half-court for basketball players aged 10–12 years.

1.4. Scope of the research

1.4.1. Human scope
Basketball players aged 10–12 years enrolled at the Specialized School in Basra Governorate.

1.4.2. Spatial scope
Basketball courts located in the indoor sports hall of the Ministry of Youth and Sports in Basra Governorate.

1.4.3. Temporal scope
From August 3, 2024, to September 16, 2024.

2. Research methodology and field procedures

2.1. Research method

The researchers employed the descriptive method using the survey approach to address the research problem and achieve its objectives.

2.2. Research population and sample

The research population was intentionally selected and consisted of basketball players aged 10–12 years from the Specialized School for Basketball in Basra Province, totaling 100 players.

The research sample, representing both the construction and exploratory experiment samples, was randomly selected and consisted of 80 players, as shown in Table 1.

Table 1. Details the sample and its distribution percentages.

Seq.	Samples		Sample Type	Total
1	Research Population		Age (10–12 years)	100
			Age (10–12 years)	20
2	Pilot Study Sample	Validity	Age (14–16 years)	20
		Reliability	Age (10–12 years)	Same sample used for test validity
3	Excluded Players		Age (10–12 years)	20
4	Standardization Sample		Age (10–12 years)	80
	Standardization Sample Percentage			80%

2.3. Instruments, devices, and tools used for data collection

2.3.1. Data collection instruments
- Arabic and foreign references and sources
- The designed test
- Standard scores (Appendix 1)

2.3.2. Devices and tools used for data collection
1. Basketball court
2. Measuring tape
3. Computer (HB type)
4. Stopwatch
5. Cones (4 pieces)
6. Coloured adhesive tapes
7. Whistle

2.4. Steps for designing and standardizing the test

2.4.1. Test design
The researchers designed a proposed test to measure defensive movement speed endurance within half of a basketball court, in accordance with the technical and legal performance requirements of the game. The test was presented to experts and specialists[1]* in basketball and various sports sciences to evaluate and provide feedback regarding the following points:

1. Whether the test accurately measures defensive movement speed endurance.
2. The ease of performing the test.
3. The test's cost-effectiveness in terms of tools and time required for administration.
4. The suitability of the test for the research sample and their capabilities.

After gathering feedback and conducting the pilot experiment, the test was finalized in its current form.

2.4.2. Description of the final test

Test Name: Defensive Movement Speed Endurance.

Purpose of the Test: To measure defensive movement speed endurance within half of a basketball court.

Equipment Used: Measuring tape – cones – colored adhesive tapes – stopwatch – whistle.

Test Performance Procedure:
Four cones are placed within the first half of the basketball court. The first cone on the right side is positioned 3 meters away from the midline and 2 meters from the sideline. The second cone on the same side is placed 6 meters away from the midline and 2 meters from the sideline. On the left side, the third and fourth cones are positioned using the same measurements as those on the right side. A colored adhesive tape is placed parallel to the midline, connecting the first cone on the right with the third cone on the left. Another tape is positioned between the second cone on the right and the fourth cone on the left. The starting point is located at the midpoint of the baseline on the half of the court without cones, and the finish line is at the midpoint of the baseline of the half-court where the cones are located.

Test Execution Method:
Four cones are placed within the first half of the basketball court. The first cone is positioned 3 meters away from the center line and 2 meters from the right sideline. The second cone, on the same side, is placed 6 meters from the center line and 2 meters from the right sideline. Similarly, on the left side, the third and fourth cones are placed at the same distances as those on the right side. A colored adhesive tape is placed parallel to the center line, connecting the first cone on the right with the third cone on the left.

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[1] *The expert panel included:
- Prof. Dr. Mustafa Abdul Rahman Mohammed, Specialist in Basketball Testing and Measurement, College of Physical Education and Sports Sciences – University of Basrah.
- Prof. Dr. Haider Abdul Razaq, Specialist in Basketball Training, College of Physical Education and Sports Sciences – University of Basrah.
- Assist. Prof. Dr. Zuhair Salem Abdul Razaq, Specialist in Basketball Training, Department of Student Activities – University of Basrah.
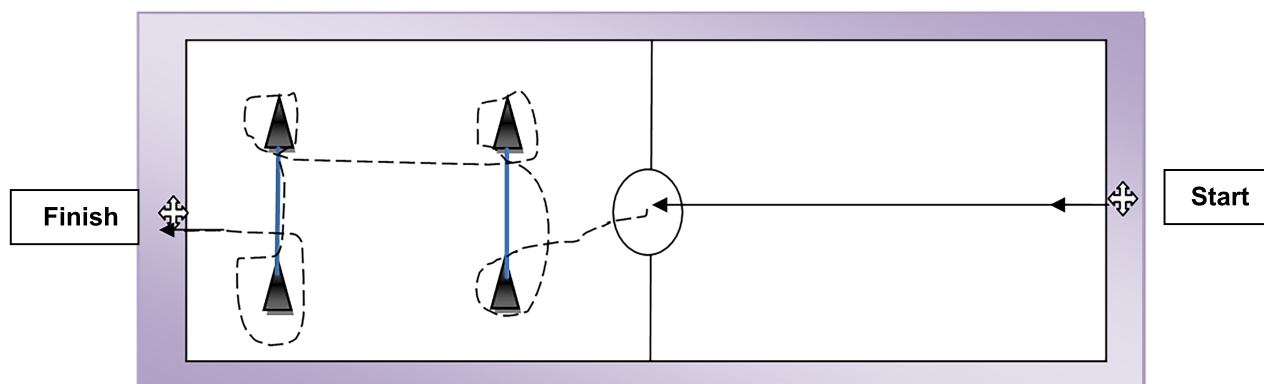
Fig. 1. Illustration of the defensive movement speed endurance test within half a basketball court.

Another colored tape connects the second cone on the right with the fourth cone on the left. The starting point is located at the midpoint of the baseline in the half of the court without cones, and the finish line is the midpoint of the baseline in the half of the court containing the cones.

Test Performance Procedure:

The player begins by sprinting straight forward at full speed upon hearing the whistle. Upon reaching the centre of the court, the player pivots and performs a backward defensive run toward the first cone. Upon reaching it, the player circles around the cone using a defensive movement, then continues moving along the coloured tape line toward the third cone. After circling around the third cone with the same defensive movement, the player sprints toward the second cone, circles around it, and then proceeds along the coloured tape line toward the fourth cone, circling around it as well. Finally, the player sprints toward the finish line. The task is repeated a second time, starting from the initial starting point without stopping. The time is recorded at the completion of the second attempt, as illustrated in Fig. 1.

Notes:

1. The participant must perform a proper warm-up before attempting the test.
2. The participant is allowed to perform a number of trial attempts for practice purposes before the official test.

Scoring:

- The time is measured from the initial whistle at the starting point until the completion of the second repetition at the finish point.

2.4.3. Exploratory experiment

The researchers conducted the exploratory experiment on August 3, 2024, involving a sample of 20 basketball players aged 10–12 years. The experiment was repeated one week later, on August 10, 2024, using the same sample under identical conditions. The purpose of the experiment was to accomplish the following:

1. To determine the suitability of the test for the research sample.
2. To identify the appropriate amount of time required to conduct the test.
3. To recognize any potential difficulties that might be encountered by the researcher and the assisting staff.
4. To determine the necessary tools for conducting the test.
5. To establish the scientific foundations of the test.

2.4.4. Scientific foundations of the test
2.4.4.1 Test validity

Farahat (2005) defines test validity as "the degree to which a test accurately measures what it is intended to measure or the extent to which it is suitable for measuring the construct it was designed to assess" (p. 111).

Accordingly, in addition to establishing face validity through expert review, discriminative validity was also assessed by comparing the results of two distinct age groups: 20 basketball players aged 10–12 and 20 players aged 14–16. These differences are presented in Table 2.

2.4.4.1 Test reliability

Test reliability was determined using the test-retest method. The initial administration of the test was conducted on August 3, 2024, for players aged 10–12 years. The same test was repeated on August 10, 2024,

Table 2. Illustrates the discriminatory validity of the test.

		Players Aged 10–12 Years		Players Aged 14–16 Years			
Test	Unit of Measurement	M	SD	M	SD	T-Value	Significance Level
Defensive Movement Speed Endurance	Seconds	45.42	0.895	41.74	0.845	13.049	Significant

The t-value at 38 degrees of freedom and a significance level of 0.05 = is 2.024.

Table 3. Illustration of test reliability using the test-retest method.

		First Test		Second Test			
Test	Unit of Measurement	M	SD	M	SD	Reliability Coefficient	Significance Level
Defensive Movement Speed Endurance	Seconds	45.42	0.895	45.33	0.945	0.914	Significant

The critical value of the correlation coefficient (r) at a degree of freedom of 8 and a significance level of 0.05 is 0.549.

under identical conditions as the initial administration, as shown in Table 3.

2.4.4.3 Objectivity of the Test

Since the test includes a fixed correction key that prevents any manipulation and allows for straightforward evaluation by the scorer, it is considered objective. Furthermore, the test is also deemed objective due to its reliability. As Majeed (1989) stated, "The higher the reliability coefficient, the higher the objectivity coefficient, and vice versa" (p. 9).

2.5. Test administration

The test was administered to the construction sample, which consisted of 80 basketball players aged 10–12 years from the specialized school in Basra. Based on this group, the norms and standard levels for the test were established, as shown in Tables 4 and 5. The implementation period spanned from Sunday, September 14, 2024, to Tuesday, September 16, 2024.

2.6. Statistical methods

The SPSS software was used to extract the following statistical measures:

- Arithmetic Mean
- Standard Deviation
- Pearson's Simple Correlation Coefficient
- Coefficient of Variation
- Independent Samples t-Test

3. Presentation, analysis, and discussion of results

3.1. Presentation of standard scores and normative levels for the muscular endurance test

After administering the proposed test and analyzing the results, the researchers aimed to achieve the primary objective of the study: establishing standard scores for the test measuring defensive movement speed endurance within half a basketball court. Raw data were obtained, and, in order to meet the research goals, "it is necessary to convert raw scores into standard scores," as stated by Ibrahim (2000, p. 361). These standard scores serve as a means of determining the relative standing of the raw scores, allowing for their transformation and subsequent evaluation. Accordingly, the researchers calculated the standard scores as shown in Table 4.

From Table 4, it is evident that the arithmetic mean for the Defensive Movement Speed Endurance test, as administered to the research sample, reached 45.57, with a standard deviation of 0.886, and a coefficient of variation of 1.944. The highest score recorded was 49.92, while the lowest was 41.307. Based on these values, the researchers confirmed the normal distribution of the sample by calculating the standard error.

Following the extraction of these results, the researchers proceeded to calculate the constant value used later in constructing the modified standard score tables based on the cumulative rank method (see Appendix 1). In this context, the arithmetic mean represents a score of 50 within the standard score table. The constant value refers to the amount that must be either added to or subtracted from the test mean. The adjusted standard score is defined as a score with a mean of 50 and a standard deviation of zero (Naji & Ahmed, 1987).

Based on the above, the researchers conclude that determining the adjusted standard scores earned by the players in the Defensive Movement Speed Endurance test serves as a comparative tool. It allows the raw scores obtained by participants to be evaluated against their corresponding adjusted standard scores (Appendix 1), making it a reference through which player performance can be compared to that of their peers in the specific ability assessed by the test. Furthermore, these scores can also be compared to a normative standard to determine the extent of progress achieved by the players.

Table 4. Means, standard deviations, coefficient of variation, highest score, and lowest score achieved by the sample in the defensive movement speed endurance test.

Test	Unit of Measurement	Mean	Standard Deviation	Standard Error	Coefficient of Variation	Highest Score	Lowest Score
Defensive Movement Speed Endurance	Seconds	45.57	0.886	0.564	1.944	49.92	41.307

Table 5. Normative levels and their corresponding percentages on the normal distribution curve, along with raw scores, adjusted standard scores (using the cumulative rank method), frequencies, and percentages for each level in the defensive movement speed endurance test.

Test	Normative levels and their assigned percentages on the normal distribution curve	Raw Scores	Standard Scores	Frequency	Percentage
Defensive Movement Speed Endurance	Weak	41.307–42.96	1–20	0	0%
	Acceptable	43.047–44.7	21–40	4	5%
	Average	44.787–46.44	41–60	10	12.5%
	Good	46.527–48.18	61–80	60	75%
	Very Good	48.267 and above	81–100	6	7.5%

3.2. Presentation and discussion of levels for the defensive movement speed endurance test

Deriving standard scores represents a critical step in the test standardization process, as raw scores obtained by participants cannot be reliably compared with those of others until they are converted into standard scores.

To establish normative levels—serving as benchmark criteria that represent the intended objective or target to be achieved—the researchers referred to the concept that such levels include scores that indicate essential performance tiers (Abdul & Radwan, 1994).

The researchers employed the normal distribution curve (Gaussian distribution), which is widely used in the field of physical education and sport sciences.

They selected five performance levels for the test. Upon distributing the standard scores across these normative levels, the classification of performance levels was determined, as illustrated in Table 5.

From Table 5, the normative levels, raw scores, and adjusted standard scores—calculated using the cumulative rank method—for the Defensive Movement Speed Endurance test are clearly presented. The data indicate that the players were distributed across all performance levels except the "Weak" level. The distribution percentages were as follows:

The highest concentration was observed at the "Good" level, representing 75% of the total sample, with 60 players falling within this category. The second-highest percentage was at the "Average" level, accounting for 12.5%, or 10 players from the sample. The third percentage was found at the "Very Good" level, comprising 7.5%, or 6 players. The fourth percentage was at the "Acceptable" level, which represented 5%, with 4 players.

Upon reviewing the performance levels presented above, it is evident that the highest level achieved by the research sample in defensive movement speed is attributable to the players' willingness to exert maximum effort in executing the motor task. This motivation stems from their young age and their desire to demonstrate their capabilities, which contributed to their high performance—particularly within the "Good" level category.

The importance of defensive movement speed endurance is underscored by Yousef and Abdul Razzaq (2016), who state that speed endurance is considered one of the most significant physiological challenges for basketball players, as it helps delay the onset of fatigue for as long as possible. Additionally, it enhances a player's dynamism and mobility due to increased stamina, enabling quicker offensive transitions and effective switching from offense to defense. This allows the player to gain an advantage over the attacking opponent or to delay the attacker until teammates can recover their positions. It also enables players to repeatedly perform rapid sprints, which provides a competitive edge.

Similarly, Iaia and Bangsbo (2010) notes that speed endurance can be viewed from two perspectives: first, the ability to maintain a high movement speed for a duration exceeding 15 seconds; second, the capacity to produce fast movements repeatedly with short rest intervals. The latter interpretation closely aligns with the demands of basketball, where rest often occurs during substitutions.

4. Conclusions and recommendations

4.1. Conclusions

1. The test designed by the researchers has proven effective in measuring the level of defensive movement speed endurance within half-court play for basketball players aged 10–12 years.

2. The research sample was distributed across four ascending performance levels: Acceptable, Average, Good, and Very Good.

3. The highest concentration of players in terms of defensive movement speed endurance for the age group 10–12 years was at the "Good" level.

4.2. Recommendations

1. The current test should be adopted as a reliable tool for assessing defensive movement speed endurance within half-court play for basketball players aged 10–12 years.

2. Emphasis should be placed on the development of defensive movement speed endurance within half-court settings for basketball players in the 10–12 age group, as it is a fundamental and essential component of defensive performance.

Conflicts of interest

None.

We confirm that all tables and figures in this article are ours and written by the researchers themselves.

Author's contributions

All contributions of this study were done by the researchers:

Abdul Hassan Raheema Mashkoor: Designed the research stages, conducted field procedures, and formatted the final manuscript.

Jalal Abdul Zahra Kanaan: Developed the test instruments, analyzed the research findings, and contributed to conclusions and recommendations.

Also with number of experts, Laith Mohammed Hussein in statistics (College of Physical Education and Sports Sciences, University of Basrah).

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Data availability

The data that support the findings of this study are available on request from the corresponding author.

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Appendix 1

Illustrates the standard scores for the defensive movement speed endurance test for individuals aged 10–12 years.

Raw Scores	Standard Scores	Raw Scores	Standard Scores	Raw Scores	Standard Scores	Raw Scores	Standard Scores
41.307	1	43.482	26	45.657	51	47.832	76
41.394	2	43.569	27	45.744	52	47.919	77
41.481	3	43.656	28	45.831	53	48.006	78
41.568	4	43.743	29	45.918	54	48.093	79
41.655	5	43.83	30	46.005	55	48.18	80
41.742	6	43.917	31	46.092	56	48.267	81
41.829	7	44.004	32	46.179	57	48.354	82
41.916	8	44.091	33	46.266	58	48.441	83
42.003	9	44.178	34	46.353	59	48.528	84
42.09	10	44.265	35	46.44	60	48.615	85
42.177	11	44.352	36	46.527	61	48.702	86
42.264	12	44.439	37	46.614	62	48.789	87
42.351	13	44.526	38	46.701	63	48.876	88
42.438	14	44.613	39	46.788	64	48.963	89
42.525	15	44.7	40	46.875	65	49.05	90
42.612	16	44.787	41	46.962	66	49.137	91
42.699	17	44.874	42	47.049	67	49.224	92
42.786	18	44961	43	47.136	68	49.331	93
42.873	19	45.048	44	47.223	69	49.398	94
42.96	20	45.135	45	47.31	70	49.485	95
43.047	21	45.222	46	47.397	71	49.572	96
43.134	22	45.309	47	47.484	72	49.659	97
43.221	23	45.396	48	47.571	73	49.746	98
43.308	24	45.483	49	47.658	74	49.833	99
43.395	25	45.57	50	47.745	75	49.92	100