



Construction and Standardization of a Static Balance Test for Body Muscle Strength during the Preparatory Phase in the Shot Put Event for Female Students of the College of Physical Education and Sport Sciences

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Abstract

The present study aimed to construct and standardize a static balance test for body muscle strength during the preparatory phase of the shot put event for female students of the College of Physical Education and Sport Sciences. The researchers adopted a descriptive research approach using the survey method. The study population consisted of first-year female students from the Colleges of Physical Education and Sport Sciences at the University of Baghdad (Women's College and Al-Jadriya Campus) for the academic year (2024–2025), totaling (203) students. Prior to data collection, (7) students from the Women's College and (10) students from the Al-Jadriya College were excluded due to reasons that did not meet the purposes of the study, including failure in the previous academic year, irregular attendance, and sports injuries. Accordingly, the remaining population comprised (186) students, who represented the construction and standardization sample. After completing the procedural and statistical processes of test construction and standardization, the data were analyzed using the Statistical Package for the Social Sciences (SPSS). The conclusions and recommendations indicated that the static balance test for body muscle strength is valid for its intended purpose of measuring the ability of first-year female students in the College of Physical Education and Sport Sciences to maintain static balance and withstand specific muscle strength from a stationary position during the preparatory phase (initial position) of the shot put. The test demonstrated appropriate scientific bases and measurement coefficients in accordance with accepted measurement and evaluation criteria. It can be used to assess first-year female students through six criterion-referenced normative levels achieved by the test. The study also emphasized the importance of benefiting from the construction and standardization of specialized tests for physical and motor abilities related to the technical performance phases of the shot put, and of adopting such tests in evaluating female students in track and field courses within colleges of physical education and sport sciences. Furthermore, greater attention should be given to training faculty members through continuing education programs on the application of the test and the calculation of its scores.

Keywords: Static Balance, Body Muscle Strength, Preparatory Phase in the Shot Put Event.

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Introduction

Reaching scientific facts requires researchers to set aside personal experience when presenting evidence and proofs that substantiate those facts. Results derived from sports tests constitute one of the fundamental pillars of accuracy and objectivity in providing such evidence. Therefore, it is essential to ensure that tests are appropriate to the specific disciplinary field within Physical Education and Sport Sciences in which they are applied. In other words, sports tests that support the educational process possess a particular specificity, as they are designed to measure the knowledge students possess or the level of their physical abilities. Tests represent an essential component of plans aimed at improving physical and motor performance, and the construction of new tests to measure basic skills in the shot put event has become an urgent necessity that must be addressed throughout the educational process.

It has been indicated that one of the most important contributions of tests for teachers is the ability to monitor learners' evaluation levels as they acquire knowledge through curricula during lessons, identify educational problems, and determine appropriate means to address them (Abdulwahid, 2022, p. 10). Furthermore, the practical performance component is considered the most critical element of skill execution, as it requires speed, accuracy, efficiency, minimal effort, and low cost (Al-Hayek, 2018, p. 144).

Standardized test criteria classify students into measurement categories through which their level of performance on test items can be judged. These normative levels serve as benchmarks for interpreting the numerical scores obtained by students in response to test requirements, in accordance with their capacities for success or failure following interaction with the curriculum within the teaching and learning process (Al-Manizel, 2024, p. 201).

The investigators also claim that to increase performance in any kind of sport or event the internal variables and association factors which are related, contributing, associating with natural behaviour patterns should be analysed. These factors may be many, complex to capture in a single variable and, for this reason it is necessary to focus the attention on the main factors that are ab ovo recognized as having relationship effects on performance. This is the first step in the study of such factors and presents evidence based on the proper selection and use, within a sport arena, of sports tests with the nature of event for which it was designed and its application to a target population. Long-term, the goal is to improve performance by allowing players to attain a high level of skill through an on-going process of refining these interdependent factors that cumulatively shape optimal technical execution.

As physical education classes represent one of the applied fields for sports testing, they seek to achieve educational and instructional objectives and focus on developing learners' various abilities in accordance with individual differences, thereby enabling them to accomplish lesson tasks. This is achieved through the application of selected physical and motor tests to assess and develop their performance levels.

The justification and significance of the present study stem from the absence of a test that measures static balance of body muscle strength during the preparatory phase of the shot put event. Accordingly, the importance of this research lies in constructing and standardizing



such a test and establishing normative scores and levels that are compatible with the abilities and performance levels of female students.

Therefore, the study aims to construct and standardize a static balance test for body muscle strength during the preparatory phase of the shot put event for female students of the College of Physical Education and Sport Sciences.

Methods and Procedures

The researchers adopted the descriptive approach, as it is appropriate for the procedures involved in constructing and standardizing the various measurement tools addressed in the present study. This approach is defined as the study of phenomena as they exist in reality, without researcher intervention that may influence their natural state, using methodologies based on measurement and survey within a specified time frame, and describing these phenomena in an objective, unbiased numerical manner (Al-Saleh, 2024, p. 181).

In line with the specificity of the research problem, the survey method of the descriptive approach was employed. This method is defined as an approach that relies on quantitative and qualitative description to identify the levels of variables by examining phenomena as they are, without any researcher interference that might affect their levels (Al-Shafei, 2024, p. 109).

The researchers adhered to the boundaries of the research problem, which comprised first-year female students from the Colleges of Physical Education and Sport Sciences at the University of Baghdad (Women's College and Al-Jadriya Campus) for the academic year (2024–2025). The total population consisted of (203) female students, distributed as follows: (70) students from the Women's College of Physical Education and Sport Sciences and (133) students from the College of Physical Education and Sport Sciences at the Al-Jadriya Campus. The researchers selected this population for the following reasons:

- The population fully corresponded to the characteristics of the research problem.
- The students belonged to accessible populations, ensuring continuous availability during official academic days and facilitating consistent communication.
- The population was capable of fulfilling the objectives and methodological procedures of the study.
- The cooperation of the two colleges facilitated the completion of the research tasks.

Prior to the sampling procedures, (7) students from the Women's College and (10) students from the Al-Jadriya College were excluded due to reasons that did not meet the objectives of the study, including failure in the previous academic year, irregular attendance, and sports injuries. Accordingly, the remaining population consisted of (186) female students.

To meet the requirements of constructing and standardizing the measurement tools in this study, all remaining (186) students were deliberately selected, representing (91.626%) of the original population. They constituted the total research sample for the construction and standardization processes and were treated as a single comprehensive sample. In addition, an exploratory sample was randomly selected from within this group, consisting of (10) students from both colleges in equal numbers, representing (4.926%) of the population. No statistical analyses were conducted on the data of the exploratory sample, and these students were not excluded from the total sample so as not to affect the research procedures or the specificity of each methodological step.

The researchers conducted a detailed examination of the shared characteristics of the targeted sample used for construction and standardization, comprising (186) female students from both colleges, in order to prepare for effective interaction with them. This was achieved through reviewing relevant theoretical literature and available academic studies addressing their characteristics. Given the nature of the present study, which does not involve external environmental variables outside the college context and applies equally to all participants, this procedure enabled the researchers to design the test in a manner consistent with the students' ability levels and age-related capacities on one hand, and the requirements of the shot put event on the other. The following characteristics were identified:

1. The students were admitted to the two colleges according to the academic grade requirements of the preparatory stage across its various branches, in addition to passing the required physical fitness tests for admission.
2. All students were enrolled in the same academic stage, were female, and ranged in age from (19–21) years.

To avoid assumptions regarding normal distribution based solely on enrollment in the same academic stage, homogeneity of the sample was statistically verified for selected anthropometric variables that might contribute to extreme values in the test under investigation. The results are presented in Table (1).

Table 1. Homogeneity of the Total Research Sample in Selected Anthropometric Variables

Variable (Unit)	N	Mean	Standard Deviation	Skewness	Coefficient of Variation
Total Body Height (cm)	186	163.59	1.45	−0.399	0.886%
Body Weight (kg)	186	62.66	1.698	−0.508	2.71%
Chronological Age (years)	186	19.41	0.565	0.979	2.911%

The values of the skewness coefficient fell within the acceptable range for normal distribution (± 1), and the coefficient of variation was less than (39%), indicating acceptable homogeneity of the sample.

To provide support and assistance for faculty members in fulfilling their educational duties, and for the purposes of measurement and evaluation of the static balance test for body muscle strength during the preparatory phase of the shot put event for female students, these considerations constituted the rationale for constructing and standardizing the test. Accordingly, the principle of qualitative analysis was adopted to examine the nature of the movements involved in the execution of this event, specifically during the preparatory phase of the shot put, and the physical and motor abilities embedded within it. This procedure was conducted from Sunday (20/10/2024) to Thursday (24/10/2024), avoiding randomness and improvisation, and eliminating personal judgments in determining the relevant abilities, as follows:

- Consultation with subject-matter instructors in the Colleges of Physical Education and Sport Sciences at the University of Baghdad regarding the nomination of physical and motor abilities to be measured by the static balance test for body muscle strength during the preparatory phase of the shot put event for female students.
- Reviewing numerous available sources and academic studies, particularly those related to static balance and body muscle strength in the preparatory phase of the shot put event for female students, in order to ensure accurate and specialized identification of the relevant abilities.
- Based on the outcomes of the aforementioned procedures, the researchers identified the physical and motor abilities to be measured by the static balance test for body muscle strength during the preparatory phase of the shot put event, and accordingly determined the test name and objectives as follows:
 - **Test name:** Static Balance of Body Muscle Strength during the Preparatory Phase of the Shot Put.
 - **Test objective:** To measure the ability of the tested female student to maintain static balance and withstand specific muscle strength from a stationary position during the preparatory phase (initial position) of the shot put.

Target population: First-year female students in the Colleges of Physical Education and Sport Sciences at the University of Baghdad.

The researchers ensured that the test adhered to conditions guaranteeing the physical and health safety of the students, and that it did not include complex, excessive, or irrelevant movements unrelated to the technical performance of the shot put. The test was designed to closely resemble the actual technical performance, thereby ensuring specificity while maintaining economy in terms of equipment and tools. This allows for practical application during instructional sessions and enables its adoption for measuring and evaluating female students in practical track and field classes at the colleges under study.

Accuracy was emphasized in designing and presenting the initial form of the test in accordance with measurement and evaluation standards in Physical Education Sciences. The test included the following components: test name, test objective, equipment and tools, procedures and conditions, scoring, and unit of measurement.

For the purpose of piloting the test, it was applied in an exploratory trial to a previously identified sample of (10) female students. The researchers conducted this pilot application at the Colleges of Physical Education and Sport Sciences, University of Baghdad (Women's College and Al-Jadriya Campus), on Sunday and Monday (6–7/4/2025), at a rate of (5) students per day. The objectives of this pilot study were to:

- Verify the suitability of the specified equipment and tools.
- Ensure students' familiarity with the equipment and tools and the clarity of instructions.
- Train the assisting research team on application procedures and data recording.
- Identify potential obstacles or procedural errors that might arise during the main study in order to minimize them subsequently.

No noteworthy observations were recorded during the exploratory trial.

The revised version of the test was then applied at the two colleges under study at a rate of (15) female students per day from the construction and standardization sample, totaling (186) students, with the remaining (6) students tested on the final day. This process was carried out over the period from Sunday (13/4/2025) to Monday (28/4/2025). Objectivity was established through inter-rater validity by using two evaluators (Appendix 7), each positioned on one side during test administration. Their scores were statistically analyzed using the Pearson simple correlation coefficient, and objectivity was confirmed through the statistical significance of the correlation coefficient, as shown in Table (2).

The researchers also ensured avoidance of measurement errors resulting from repeated administration of the same test to the same sample. Therefore, the scores recorded by one of the evaluators for the construction and standardization sample (186 students) were adopted, given their objectivity. These scores were then analyzed to determine the difficulty and ease of the test by calculating Pearson skewness coefficients to verify normal distribution across the construction and standardization sample of (186) female students, as presented in Table (2).

Table 2. Results of Face Validity, Difficulty and Ease, and Objectivity of the Test

Physical– Motor Test (Shot Put)	Face Validity (Agreement of 15 Experts)	Acceptanc e	Objectivit y Coefficient (Inter- Rater Validity)	Sig.	Acceptanc e	Difficulty and Ease (Normal Distribution)	Acceptanc e
Static Balance of Body Muscle Strength	100%	Accepted	0.986*	0.00 0	Accepted	0.167	Accepted

during the
Preparatory
Phase of
the Shot
Put

✱ The correlation coefficient is statistically significant at $\text{Sig} < 0.05$, with degrees of freedom $(n - 2) = 184$ and a significance level of 0.05.

✱ Normal distribution is considered acceptable in SPSS when the skewness coefficient value falls within ± 1 , indicating a normal (moderate) distribution.

The researchers verified the discriminative power of the test by relying on the scores obtained from administering the test to the construction and standardization sample of (186) female students, following these procedures:

- The test scores were arranged in descending order for the static balance of body muscle strength test during the preparatory phase of the shot put. A longer time indicated better performance and greater ability in this test.
- The method of two symmetrical extreme groups with equal numbers was adopted by multiplying the total number of students in the construction and standardization sample by (27%), yielding (50.22), which was rounded to (50). Accordingly, (50) students were assigned to each of the two extreme groups.
- Differences between the two extreme groups were statistically analyzed using the independent samples t-test, as shown in Table (3).

Table 3. Results of the Discriminative Power of the Test

Test and Unit of Measurement	Extreme Group	N	Mean	Standard Deviation	t-value	Sig.	Significance of Difference	Discrimination Acceptance
Static Balance of Body Muscle Strength during the Preparatory Phase of the Shot Put (s)	Upper	50	8.24	1.205	19.332	0.000	Significant	Accepted
	Lower	50	13.04	1.277				

Acceptance of discriminative power was confirmed by the presence of a statistically significant difference at $\text{Sig} < 0.05$, with a significance level of 0.05 and 98 degrees of freedom.

To verify the reliability of the test, the researchers adopted the test–retest method by administering the test to the construction and standardization sample of (186) female students during the period from Sunday (13/4/2025) to Monday (28/4/2025) as part of the previously described objectivity procedure. The test was then re-administered from Tuesday (6/5/2025) to Wednesday (12/5/2025). The data from both applications were statistically analyzed using the Guttman split-half coefficient (Guttman L.A.), which is considered one of the most appropriate correlation coefficients for estimating the expected reliability of future

administrations. The reliability coefficient reached (0.965*) at a significance level of (0.05) and 184 degrees of freedom.

Reliability is defined as “the consistency of a test in producing the same or very similar scores when it is repeatedly administered to the same examinees” (Al-Ameen, 2022, p. 89).

After completing the methodological steps and statistical analyses, the indicators of the dependability of the final version of the test (Appendix 1) for the shot put event among first-year female students at the two colleges under study can be summarized as follows:

- Low financial cost and no requirement for expensive equipment or tools that are difficult to transport to the shot put sector.
- Ease of score recording due to the clarity of instructions for both examiners and students.
- Absence of exaggerated movements, ensuring the physical and health safety of the students.
- Inclusion of elements of excitement and engagement during practical application, enhancing students' motivation and avoiding forced performance.
- Compliance with scientific foundations and coefficients required for physical and motor tests in Physical Education and Sport Sciences.
- Suitability to the educational environment of the shot put event, given that the test was constructed, applied, and standardized within the two colleges under study.

The researchers also standardized the results of this test by performing the relevant score transformations, which will be presented alongside the results. Furthermore, the data were analyzed using the Statistical Package for the Social Sciences (SPSS), Version 28, to compute the following statistical indicators:

- Percentages.
- Arithmetic mean.
- Standard deviation.
- Skewness coefficient (Pearson).
- Simple correlation coefficient (Pearson).
- Guttman split-half equation (Guttman L.A.).
- Independent samples t-test.
- Standard score (z-score).
- Modified standard score.

Results

Table 4. *Descriptive Statistical Parameters of the Preparatory Phase Test in the Shot Put Event*

Test Name	Number of Students	Unit of Measurement	Mean	Standard Deviation	Skewness
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Static Balance of Body Muscle Strength during the Preparatory Phase of the Shot Put	186	Seconds and fractions	10.50	2.035	0.167
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A normal (moderate) distribution in **SPSS** is assumed when the skewness coefficient value falls within ± 1 .

For the purpose of establishing test norms (physical–motor) for the preparatory phase of the shot put event, the raw scores of each tested student were arranged in ascending order. These raw scores were then converted into z-scores, which were subsequently transformed into modified standard scores using the equation ($z\text{-score} \times 10 + 50$). This procedure was applied to obtain the modified standard scores used for criterion-referenced evaluation of the test. To derive standardized norms for the preparatory phase physical–motor test in the shot put event, the scores were classified to extract normative levels by determining the frequency of students' scores within six categories bounded by ± 3 on the normal number line. These categories represent both z-scores and modified standard (final) scores distributed across both sides of zero on the Gaussian (normal) curve, as shown in Table (5).

Table 5. *Derived Norms for the Preparatory Phase Test in the Shot Put Event*

Z-Score Category (Gaussian Curve)	Modified Standard Score Range	Normative Evaluation Level	Frequency	Percentage
–2 and below	29 and below	Very Poor	8	4.301%
–1.99 to –1.00	30 – 39	Poor	7	3.763%
–0.99 to 0.00	40 – 49	Acceptable	84	45.161%
0.01 to 1.00	50 – 59	Average	62	33.333%
1.01 to 2.00	60 – 69	Good	19	10.215%
2.01 and above	70 and above	Very Good	6	3.226%
Total			186	100%

Discussion

The results presented in Table (4) indicate that the scores of first-year female students from the two colleges under study, who constituted the main construction and standardization sample, were normally distributed in this test. The researchers attribute these findings to the soundness of the procedures followed in constructing the static balance test for body muscle strength during the preparatory phase of the shot put, as well as to the statistical treatments used to verify the acceptance of its foundations and coefficients, which met the scientific criteria adopted in Physical Education and Sport Sciences. In addition, the test was appropriate for the target sample, as evidenced by the indices of difficulty and ease, which were normally distributed.

Furthermore, the results of transforming raw scores into standard and modified standard scores showed that the z-scores were distributed around the mean ($M = 0$) with a

standard deviation ($SD = \pm 1$) on the normal number line. This confirms that the scores were distributed within the limits of the normal (Gaussian) curve, which allowed for proper standardization through the derivation of criterion-referenced normative evaluation levels for the female students who undertook the test. These findings also indicate that each student's performance can be evaluated by comparing her score with those of her peers.

A review of the derived norms shown in Table (5) demonstrates that the distribution of score categories across the six levels was consistent with a normal distribution. The researchers attribute this balanced distribution to the fact that the measurement was conducted during the second academic semester, after the students had received both theoretical and practical instruction in the shot put event.

Standardization is defined as the process of precisely determining the conditions of test administration so that a single method is used in application, scoring, and interpretation. This entails controlling all variables that may influence test results, thereby ensuring that differences among individuals can be attributed to their own characteristics rather than to external variables (Al-Obaidi, 2011, p. 251). In this regard, normative levels are of particular importance for classification and comparison among students' test results and may even extend to selection processes aimed at identifying talent (Hoshiyar, 2017, p. 26).

The researchers also attribute the validity of the standardization of the static balance test for body muscle strength during the preparatory phase of the shot put, across its six normative levels, to the careful attention paid to the precision of procedural steps in constructing the test. These steps considered the students' age, gender, and physical and health safety, and ensured that the test did not include complex, excessive, or irrelevant movements unrelated to the technical performance of the shot put. Emphasis was placed on the principle of specificity, such that the test incorporated a variety of static balance movements involving body muscle strength that characterize the preparatory phase of the shot put, thereby closely matching the technical performance requirements of the event.

Practical specificity and the appropriateness of test items are among the most important foundations upon which test developers rely when formulating test items. This specificity should be prioritized during test construction, as it plays a crucial role in determining the purpose for which the test is developed, and may even precede the importance of defining objectives (Shouq, 2019, p. 7).

Moreover, the researchers attribute the soundness of the standardization results to their reliance on qualitative analysis through consultation with experts to identify the most relevant physical and motor abilities required by the test, according to their relative importance. Measuring these abilities under actual shot put performance conditions enhances ecological validity and ensures specificity. Such an approach enables practical evaluation of students' performance, identification of deficiencies using quantitative indicators, and adjustment or modification of students' activities during lessons. It also allows students sufficient practice time to execute the preparatory phase of the event according to correct performance criteria. Muscle strength, in particular, is one of the most important physical abilities involved in producing movement to meet the demands of the preparatory phase, while balance contributes to stabilizing the body in preparation for executing movements across all phases of the event.

It has been emphasized that the level of development of physical and motor abilities must correspond to the requirements of the motor skill in order to achieve proper performance (Al-Rabadi, 2020, p. 66). Accordingly, practice is considered the most important variable in the learning process of both complex and simple skills (Matnash, 2020, p. 25). The importance of developing muscular strength lies in the ability to exert force in different forms and magnitudes in harmony with movement execution. Strength development is also associated with rapid changes in the rhythm of neural signals, as muscular activity is characterized by a high degree of synchronization between the timing and magnitude of neural impulses (Mar'i, 2018, p. 166). Muscular balance between both sides of the body is regarded as the fundamental basis for good posture, as it helps correct body alignment from its current state toward the ideal posture (Al-Qatt, 2020, p. 28). Sports skills depend on muscular balance in all their components; even when dynamic balance is not clearly apparent, it nevertheless supports posture and prevents falling during skill execution. Therefore, coaches must train balance in its various forms before proceeding to skill development (Al-Yasin, 2019, p. 81).

Continuous and regular practice of skill-based exercises encourages students to explore technical information, thereby forming a knowledge base that enhances achievement. This process activates recall and retrieval mechanisms through sustained cognitive engagement, whereas discontinuity may gradually lead to forgetting (Dunn & Dunn, 2023, p. 4).

Conclusions and Recommendations

- 1.The static balance test for body muscle strength is valid for its intended purpose of measuring the ability of first-year female students in the College of Physical Education and Sport Sciences to maintain static balance and withstand specific muscle strength from a stationary position during the preparatory phase (initial position) of the shot put. The test meets the scientific foundations and coefficients required for accepted measurement and evaluation tools.
- 2.The ability to maintain static balance and withstand specific muscle strength from a stationary position during the preparatory phase of the shot put among first-year female students can be effectively evaluated using this test, which achieved six criterion-referenced normative levels.
- 3.It is essential to emphasize the utilization of constructing and standardizing specialized tests for physical and motor abilities related to the technical performance phases of the shot put, and to adopt such tests in evaluating female students in track and field courses within Colleges of Physical Education and Sport Sciences.
- 4.Greater attention should be devoted to training faculty members in Colleges of Physical Education and Sport Sciences through continuing education programs focused on the application of the test and the calculation of its scores.

Appendix (1): Physical–Motor Test for the Preparatory Phase of the Shot Put Event

Test Name: Static Balance of Body Muscle Strength during the Preparatory Phase of the Shot Put.



Test Objective: To measure the ability of the tested female student to maintain a static balance position and to withstand specific muscle strength from a stationary position during the preparatory phase (initial position) of the shot put.

Equipment and Tools: Electronic stopwatch, flat surface, shot put ball weighing (4) kg, whistle.

Procedures and Conditions:

The tested student stands in the preparatory position for the shot put, either barefoot or wearing appropriate athletic shoes. She raises the thigh of the left leg (or right leg, depending on preference) forward, while the other leg is positioned backward with a slight knee flexion so that the foot points backward. The upper arm is raised at an angle of (90)° relative to the body, with the forearm flexed toward it so that the hand holding the shot is fixed beside the shoulder. The trunk is slightly inclined backward. The tested student must maintain this position for as long as possible without changing her posture, as illustrated in Figure (1).

The tested student must be physically prepared and free from sports injuries.

The test is performed without the use of any assistive aids (e.g., leaning against a wall).

The attempt is performed on a flat, non-slippery surface.

The attempt is invalidated if the tested student loses balance or changes her movement position during measurement.

The tested student is given (3) attempts, with a rest period of two minutes between attempts, and the best attempt is recorded.

Scoring: The duration of static balance is timed from the moment the correct test position is fully stabilized until the moment balance is disturbed or movement occurs during a valid attempt among the three trials.

Unit of Measurement: Seconds and fractions of a second.



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