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Statistical analysis of the digital achievement performance of the deadlift according to body types (muscular, lean, obese)

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Abstract. This research aims to identify the relationship between certain physical variables and performance in the shot put event. It focuses on the most important physical variables such as muscular strength, weight, height, and explosive power that affect performance. It also analyzes the contribution of body characteristics to achieving athletic performance. The study contributes to developing scientific methods for evaluating athletic performance and enhancing the educational process to increase effectiveness in shot put. The study was conducted on first-year female students of the College of Physical Education and Sports Sciences for the academic year 2024–2025. The descriptive analytical method was adopted due to its suitability for the research problem and objectives, as it analyzes phenomena as they exist without researcher intervention, using precise statistical methods. This approach is suitable for analyzing relationships between variables and determining their relative contributions to performance. The study concluded that the mesomorphic body type is the most efficient in shot put performance. Statistically significant differences among the three body types emphasize the importance of body composition in performance. Weight alone is not a sufficient performance indicator unless paired with muscle-mass. The researchers recommend directing mesomorphic-type students toward sports requiring explosive power such as shot put, designing training programs tailored to somatotype, and using body composition evaluation as a tool in athletic selection.

Keywords. shot put, somatotype, body composition, explosive strength, statistical analysis

Introduction

Shot put is one of the most important throwing events in track and field, requiring special skills that combine key physical capabilities essential to most sports. The performance in shot put depends on complex factors such as explosive arm strength, leg power, motor ability, neuromuscular coordination, and anthropometric and biomechanical characteristics. Since athletic achievement is a result of these interacting factors, statistical analysis becomes a precise tool for understanding and interpreting such interactions.

Statistical analysis has become a vital component in modern sports research due to its ability to examine relationships between quantitative variables and offer precise indicators that help improve performance and guide training plans. As noted by Al-Karkhi (2011, p. 175), 'Statistical analysis is the best means of transforming motor phenomena into interpretable and predictable data.' El-Sayed (2014, p. 229) also emphasized that 'linking measurements with performance opens the door for scientifically based training programs.' Hence, statistical

analysis of performance in shot put helps understand the influencing variables and provides quantitative indicators for improvement. Performance in shot put relies on a mix of physical capabilities, where explosive strength of the primary muscles—especially in the upper and lower limbs—is essential for longer throws.

Previous studies show that athletes with higher levels of muscular strength and active body mass tend to achieve better results. Statistical analysis can examine these relationships and determine the relative weight of each variable contributing to performance. The research problem arises from the observed relative development in performance among some first-year students, which remains below the desired level. This raises questions about whether performance improvement considers the real influencing variables.

The research problem can be summarized in the following question: What is the nature of the relationship between certain physical variables and performance in the shot put event, and which variables contribute most to performance? decade. [2]

2. Methodology and Field Procedures

2.1 Research Method

The study relied on the descriptive analytical method due to its suitability for the research problem and objectives. It is used to study phenomena as they exist in reality without any intervention by the researcher and to analyze them quantitatively using appropriate statistical techniques. This method is appropriate for analyzing the relationship between variables and determining their relative contribution to performance. According to Saleh Hassan Abu Mayala (2010, p.135), 'The descriptive analytical method is one of the fundamental methodologies in educational and sports research. It is used to study relationships between variables and to scientifically interpret phenomena using quantitative data.' Abdel Baset Mohammed Hassan (2003, p.89) emphasized that 'The descriptive analytical method enables the understanding of kinetic and sports phenomena through statistical data analysis, allowing the inference of causal or predictive relationships between variables.' Ibrahim Abdo (2001, p.76) added that this method 'is one of the most used in research addressing sports performance and statistical outcome analysis, as it combines accurate observation with scientific data interpretation.'

2.2 Research Population and Sample

Selecting the appropriate sample is a primary step in data collection. Researchers usually define their research population based on the problem being studied.

The research population was purposefully selected and consisted of first-year female students at the College of Physical Education and Sports Sciences, University of Diyala, aged 18–20. The total number of students was 131, with section (Y) comprising 57 students and section (T) 74 students. The final study sample included 100 students after excluding 17 for age-related reasons and 14 for participation in the pilot study.

Table 1: Sample Description

N	class	Number of class	N of sample members	Ratio		
				survey	main	Excluded
1	A	74	43	14	100	17(age/absence)
2	B	57				
Total		131				

2.3 Equipment and Tools

- Laptop computer (HP brand)
- Hand calculator
- Measuring tape
- Weighing scale
- Stopwatch
- Athletics field (shot put arena)
- Shot put implements (8 units)

2.4 Tests Used in the Study

The variables measured were as follows:

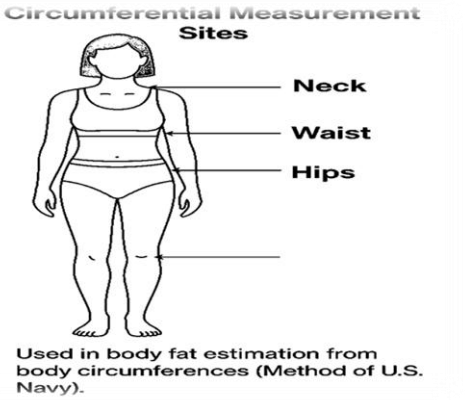
- Height (in meters): measured using a measuring tape
- Weight (in kilograms): measured using a medical electronic scale
- Body fat percentage (%): calculated using the U.S. Navy circumference method, measuring waist, hips, and neck, and applying the following formula:

Body Fat % = [163.205 × log10(waist + hip - neck)] - [97.684 × log10(height in inches)] - 78.387

(Hodgdon & Beckett, 1984, p.14)

Measurement areas used to calculate body fat percentage were illustrated in Figure 1.

Figure (1) (shows the measurement areas for fat percentage extraction)



Shot put performance (measured in meters).

2.5 Pilot Experiment

The pilot experiment is essential in scientific research as it enables the researcher to understand the procedures and anticipate obstacles. It serves as a preliminary trial to identify challenges that may arise during the main experiment. As stated by Al-Shawk and Fathi (2004,

p.89), it is 'a small-scale experiment conducted to identify issues in the implementation of the main study.'

The researchers conducted the pilot experiment on Sunday, 10/4/2025 at 10:00 AM on the athletics field with 14 students from sections Y and T. The aim was to identify potential obstacles, assess the students' understanding of test procedures, estimate the time required, and evaluate the efficiency of the assisting research team.

2.6 Main Experiment

The main experiment was conducted as follows:

- On Sunday, 15/4/2025, the tests were administered to 57 students from section Y. Eight students were excluded due to absence or age.
- On Monday, 16/4/2025, tests were conducted for section T (74 students), with 9 excluded for similar reasons.
- The 14 students involved in the pilot experiment were also excluded from the main experiment.

2.7 Statistical Tools

The Statistical Package for the Social Sciences (SPSS) was used to analyze the data.

3. Presentation, Analysis, and Discussion of the Results:

3-1 Descriptive Variables of the Research Variables:

The sample consisted of (100) female students, divided into three somatotype categories based on morphological evaluation:

Table (1): Sample Distribution by Somatotype

Somatotype	Number of Students	Percentage (%)
Muscular	50 students	50.0%
Ectomorphic (Thin)	35 students	35.0%
Endomorphic (Fat)		
Total	15 students	15.0%
	100 students	100%

Table (2): Means and Standard Deviations of Research Variables by Somatotype

Somatotype	Height (m)	Weight (kg)	Body Fat (%)	Shot Put Performance (m)
Muscular	1.65	64.0	18.5	9.4
Thin	1.62	51.0	15.2	6.6
Fat	1.60	72.0	30.5	7.0

Table (3): ANOVA Test Results

Source	Sum of Squares	Degrees of Freedom	Mean Square	F Value	Sig. Level

Between Groups Within Groups Total	104.7 119.3 224.0	2 97 99	52.35 1.23	42.1	0.000

Table (4): Correlation Coefficients between Weight, Body Fat, and Shot Put Performance

Somatotype	Correlation (Weight vs. Performance)	Correlation (Fat vs. Performance)
Muscular Thin Fat	0.63 0.42 0.20	-0.10 -0.30 -0.38

Table (5): Contribution Ratios in Performance by Somatotype

Somatotype	Mean (m)	Contribution (%)
Muscular Thin Fat Total	9.4 6.5 7.1 32	41.4% 29.1% 29.5% 100%

3-2 Discussion of the Results:

The results showed the superiority of the muscular somatotype in shot put performance with an average of 9.4 meters. This reflects the positive impact of muscle mass in applying the explosive force required for throwing.

The fat group ranked second, possibly due to the additional weight partially contributing to the push, although with lower muscular efficiency compared to the muscular group. The thin group recorded the lowest performance, reflecting a lack of necessary muscular strength for throwing. The researchers believe that a muscular body composition is optimal for performance in activities requiring explosive strength, such as shot put.

Many sources confirm the importance of somatotypes in all sports, where athletes must possess high performance levels, benefiting from the efficient function of working muscles. Developing muscular strength and performance for events requiring physical capabilities is linked to controlling bodily functions, which enhances an athlete's ability to produce muscular force at various levels (Abou El-Ala Abdel Fattah: 1997: 205). Also, directing voluntary movements toward a target requires a high efficiency of the muscular system, and accuracy demands full control over voluntary muscles to direct them toward a specific goal for better performance (Essam Helmy & Mohamed Gaber: 1997: 82).

The muscular somatotype is characterized by a strong build, prominent muscles, and high muscle density, making it the most suitable for strength-based and explosive activities, such as shot put. According to researchers, shot put performance requires high explosive power output and precise motor coordination during its various technical stages (preparation, rotation, push). Carter and Heath stated that the best shot put performance traits are found in individuals with a muscular somatotype rather than other types (Carter & Heath, 1990, p. 145).

Muscular build enhances the ability to apply force at the right moment and direction to achieve optimal performance (Essam Abdel Khaleq, 2001, p. 174).

Bompa and Haff confirmed that athletes with a muscular somatotype achieve better results in throwing competitions compared to their peers from other somatotypes (Bompa & Haff, 2009, p. 211). Abdel Rahman Taha agreed, emphasizing that athletes with muscular builds can integrate strength, motor control, and balance during performance (Abdel Rahman Taha, 1998, p. 112).

Therefore, preferring the muscular somatotype in shot put sport is considered a deliberate choice in selection and training programs (Fleck & Kraemer, 2014, p. 97).

4. Conclusion:

Based on the conclusions reached, the researchers found the following:

- The muscular somatotype is the most efficient in shot put performance.
- The existence of statistically significant differences between the three somatotypes confirms the importance of body composition in shot put.
- Weight alone is not a sufficient indicator of performance unless accompanied by high muscle mass.

The researchers recommend:

- Directing muscular-type students toward activities requiring muscular explosion, such as shot put.
- Designing training programs tailored to body type to enhance performance efficiency.
- Using body type assessment as a tool in athletic selection.

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