Journal of Physical Education

Volume 35 – Issue (4) – 2023 Open Access

(E-ISSN: 2707-5729) (P-ISSN: 2073-6452)

https://jcope.uobaghdad.edu.iq

The Relationship Between Torque, Angle, and Javelin Release Velocity for Beginners

Ahlam Sadeq Hussein [1]

DOI: https://doi.org/10.37359/JOPE.V36(2)2024.2193

[1] college of Basic Education

Article history: Received 28/ 2/2011 Accepted 10/ 11/2011 Available online 28/ 12/2024

Abstract:

This study aimed to determine the torque values of the body at the moment of the final throwing position, as well as the velocity and angle of release, and to identify the relationship between these three variables.

The sample consisted of third-year students from the Department of Physical Education and Sports Sciences at the College of Basic Education, University of Mustansiriyah. The mean and standard deviation of the sample's age were (22.6) years (±0.68), weight (70.7) kg (±1.80), and height (173.2) cm (±0.95). The most important procedures for determining the measurements and the specific test of the research included measuring the height and weight of the sample and conducting the tests under study. The most important results showed a correlation coefficient between torque and javelin release velocity for students studying track and field in the javelin throw event. The most important conclusions are that there is a relationship between torque, release angle, and release velocity of the javelin, and the significance level is (0.005).

Keywords: torque, challenge level, jump speed, javelin throw.

[1] college of Basic Education , drahlam1974@gmail.com

Journal of Physical Education

Volume 35 – Issue (4) – 2023 Open Access

(E-ISSN: 2707-5729) (P-ISSN: 2073-6452)

https://jcope.uobaghdad.edu.iq

Introduction

Any advancement in any scientific field requires continuous scientific studies and experiments to establish a scientific and practical foundation upon which humanity can rely to achieve its goals. The javelin throw is one of the track and field events that aims to achieve excellence, success, and victory over opponents. Therefore, those working in this field have strived to achieve the best to demonstrate superiority. This complex event requires specific physical abilities to achieve performance and is linked to specific motor abilities and the degree of integration between them to achieve the desired outcome. The improvement in the athletic level of this event is nothing more than functional and motor adaptations that occur within these internal systems. As a result of these adaptations, the athlete develops skills, and the performance of the skill varies from player to player depending on their physiological, motor, and psychological characteristics, as well as the way they acquire and interpret information.

The goal of high achievement in the javelin throw is to achieve the farthest horizontal distance during performance. One of the most important aspects addressed by scientific research in the field of motor performance is the study of movement and its theories, which rely on many related sciences. Biomechanics, which studies forces and their causes in the execution of movements and the relationship between these components, is one of the most important of these sciences. Based on this, we find that some mechanical variables occupy the greatest common denominator when studying this event from a mechanical perspective. All throwing activities are affected by mechanical principles, including the angle of release, the velocity of release, the height of the release point, and torques, which are a measure of the rotational effect of a force on an object and are calculated from the product of the force vector and its moment arm. Their benefit lies in helping to overcome large resistances with the least possible effort and also helping to achieve high speed or a wide range of motion. In light of this, coaches and athletes must understand these variables.

Previous studies, such as that of Aliah Hussein Dhaham (2011), found a significant positive correlation between torque and javelin release angle in learners. Additionally, a study by Qasim Khalil Ibrahim revealed a significant correlation between hip velocity and release velocity but no significant correlation between the velocity of the drawn bow and release velocity, or between hip velocity and the velocity of the drawn bow. Furthermore, a study by Aws Yusuf Khalfah (2018) concluded that there is a direct positive correlation between the kinetic velocity of the upper and lower limbs in the research sample and javelin throw performance. In a study by Faras Mashar (2015), it was found that there was a statistically significant relationship between the explosive force of the throwing arm muscles, the explosive force of the arm and shoulder muscles, the explosive force of the leg muscles, and the movement speed at the digital level for the javelin throw event.

Given the foregoing, the importance of this study lies in considering the centrifugal force law in designing speed-specific exercises and understanding its impact on the

Journal of Physical Education

Volume 35 – Issue (4) – 2023 Open Access

(E-ISSN: 2707-5729) (P-ISSN: 2073-6452)

https://jcope.uobaghdad.edu.iq

variables of the first arc by applying a realistic training intensity according to the mass of each runner and relying on the radius of curvature and tangential velocity on the curve to create specific exercises for 400m hurdles runners in curves so that the variables of the first arc are in their ideal form.

The significance of the research lies in focusing on a scientific topic by finding the relationship between torque, angle, and javelin release velocity from a biomechanical perspective. This is related to understanding the concepts associated with the performance of this event, enabling those working in the field of sports to find concepts that can be applied to achieve excellence in this event. The researcher hopes that this research will contribute to a serious scientific discussion.

Problem of research

Scientific studies and the continuous observations of the researcher and coaches of athletes during the javelin throw performance have shown that the success of this event depends on certain mechanical variables that many students lack during their performance. These variables include throwing speed and throwing angle, in addition to torque, as torque is related to the final throwing position and the performance level of this event, which is based on the projectile motion law. The success of an athlete in achieving the farthest horizontal distance depends on two main factors: the angle of release and the velocity of release. These two variables are related to other mechanical variables associated with the athlete's high-performance javelin throw. The athlete's adoption of the correct position at the moment of the throw is related to understanding the mechanical requirements of high performance by the athlete adopting the correct angles for support and propulsion, which generates torque as a force opposing gravity.

This force acts as a balancing force that maintains the stability of the body and generates an opposing torque to the acceleration of the body at the moment of the throw. This generated force will have an impact on the angle of release and the velocity of the throw, which has not been previously emphasized, especially when teaching beginners how to throw the javelin.

All of this has created a problem for the researcher in identifying the relationship between torque as an opposing force, which is one of the important factors affecting the angle and velocity of the javelin throw. This is a diagnostic issue that would positively reflect on adopting the correct angles during motor performance and achieving success.

Research Objectives

- To determine the torque values of the body at the moment of the final throwing position and the velocity and angle of release.
- To identify the relationship between these three variables.

Journal of Physical Education

Volume 35 – Issue (4) – 2023 Open Access

(E-ISSN: 2707-5729) (P-ISSN: 2073-6452)

https://jcope.uobaghdad.edu.iq

Research Hypotheses

- There is a statistically significant relationship between torque and javelin throw velocity.
- There is a statistically significant relationship between torque and javelin throw angle.

Research Scope

- Human Subjects: A sample of 26 students from the second stage of the College of Basic Education - University of Mustansiriyah.
- Spatial Setting: The athletics field of the College of Basic Education.
- Temporal Setting: The duration was from March 16, 2020, to May 8, 2020.

Research Methodology and Field Procedures

Research Methodology

The descriptive method with a survey and correlational approach was used as it suits the nature of the research.

Research Sample

In light of the objectives set by the researcher and the nature of the problem, the research population was determined. The research population was selected purposively, and then the sample was selected randomly through a lottery. This method ensured that the objective of the study was achieved. The research population consisted of students of the College of Basic Education - Department of Physical Education, totaling 189. A random sample of 26 students from the third stage, section 2, for the academic year 2019-2022 was selected, representing 14% of the original population. They represent the research population as a true representation for the following reasons:

- Ensuring the availability of the sample
- The inclusion of the javelin throw event in the curriculum
- The availability of a special field
- The ease of having a supporting work team

No.	Variables	Arithmetic mean	Standard deviation	Coefficient skewness
1	Height	173.2	0.95	2.62
2	Weight	70.7	1.80	-1.58
3	Age	22.6	0.68	1.09

Journal of Physical Education

Volume 35 – Issue (4) – 2023 Open Access

(E-ISSN: 2707-5729) (P-ISSN: 2073-6452)

https://jcope.uobaghdad.edu.iq

Data Collection Methods, Tools, and Equipment Used

Data Collection Methods

The following methods were used:

- Literature Review: Both Arabic and foreign sources were consulted.
- Technical Observation: Using technical equipment.
- Personal Interview, Testing, and Measurement.

Research Tools and Equipment Used:

- Measuring tape
- Drawing scale
- Medical scale
- Laser discs
- 6javelins
- Tripod
- Video camera
- Computer
- Dartfish software for motion analysis

Determination of Measurements and Research-Specific Tests:

- Weight measurement using a medical scale.
- Javelin throw test for maximum distance.

Test Execution: Participants threw the javelin for the maximum distance on a flat area of at least 60 meters. Participants were given 3 attempts, and the best attempt was recorded. The camera was mounted on a tripod, positioned vertically above the midpoint of the participant's movement. The researcher ensured that the camera was placed 15 meters away from the throwing area to capture the final movement of the participant's body and the javelin's flight for several meters.

Mechanical Analysis:

After converting the film to a compact disc, the Dartfish software was used on a computer to measure the following variables: javelin movement time, javelin movement distance, javelin release angle, horizontal distance of the body's center of mass from the fulcrum (the vertical line from the body's center of mass to the front foot's support point), approach angle, and push-off angle.

Journal of Physical Education

Volume 35 – Issue (4) – 2023 Open Access

(E-ISSN: 2707-5729) (P-ISSN: 2073-6452)
https://jcope.uobaghdad.edu.iq

Pilot Study:

To identify potential obstacles during testing and ensure the objectivity and accuracy of the results, tests were conducted on a random sample representing the original research population. The pilot study was conducted on March 9, 2020, on a random sample of 4 students. The objectives of the pilot study were:

- To assess the suitability of the tests for the participants' level and abilities.
- To ensure the soundness and efficiency of the equipment and tools used.
- To identify difficulties and problems faced by the researcher.
- To determine the best method for conducting the tests.
- To determine the optimal placement of the cameras to achieve the best recording and image of the participants and extract the kinematic variables under study.

Mathematical Processing:

After obtaining the values for the variables, they were mathematically processed to obtain the results of the variables, which are:

1) Torque: Mass multiplied by the horizontal distance from the vertical line from the body's center of mass to the support foot.
2) Javelin velocity: Time taken during the javelin release divided by the launch distance.
3) Javelin release angle: The angle between the line passing through the center of mass of the javelin and the ground.
4) Approach angle and push-off angle: The angle between the line connecting the center of mass and the point of support (the supporting foot) and the horizontal line passing through the center of mass.

Statistical Analysis:

- Mean
- Standard deviation
- Sum
- Pearson correlation coefficient

To achieve the research objectives, the researcher decided to present the results in a tabular form, as this reduces the likelihood of errors in subsequent stages of the research, strengthens the scientific evidence, and lends it credibility. To determine the relationship between torque and release angle, the researcher used Pearson's correlation coefficient. The results are presented in Table 2.

Journal of Physical Education

Volume 35 – Issue (4) – 2023 Open Access

(E-ISSN: 2707-5729) (P-ISSN: 2073-6452)

https://jcope.uobaghdad.edu.iq

Table 2Correlation Coefficient between Torque and Release Angle

Variables	Unit of measurement	Arithmetic mean	Standard deviation	Sum of values	Calculated t value	Confidence level	Error level	Implied Significance
Torque	Net	3822	481	99407	0.593	99.9	0.001	
Angle of release	degree	47,19	3,250	1227				

Table 3 shows that the mean value of torque was 3822 Newton-meters with a standard deviation of 481, and the sum of values was 79940. The mean release angle was 47.19 degrees with a standard deviation of 3.25, and the sum of values was 1227. The Pearson correlation coefficient was 0.593 at a 99.9% confidence level and a significance level of 0.001, indicating a highly significant positive correlation between torque and release angle. This suggests that as torque increases, the release angle also tends to increase.

Table 3 shows the correlation between torque and launch speed.

Variables	Unit of measurement	Arithmetic mean	Standard deviation	Sum of values	Calculated t value	Confidence level	Error level	Implied Significance
Torque	Net	3822	481	99407	.0624	99.9	0.001	
Angle of release	m/th	15,64	1,09	1477009				

Table 3 shows that the mean torque was 3822 with a standard deviation of 481, and the sum of values was 99407. The mean javelin launch speed was 64.5 m/s with a standard deviation of 1.09, and the sum of values was 147009. The Pearson correlation coefficient between torque and javelin launch speed was 0.624 at a 99.9% confidence level and a significance level of 0.001, indicating a highly significant positive correlation between torque and javelin launch speed".

Journal of Physical Education

Volume 35 – Issue (4) – 2023 Open Access

(E-ISSN: 2707-5729) (P-ISSN: 2073-6452)

https://jcope.uobaghdad.edu.iq

Discussion of Results

The study revealed a strong correlation between torque and javelin release angle for track and field students. This relationship was negative, meaning that an increase in torque led to an increase in release angle. This aligns with existing scientific literature, which suggests an optimal release angle for javelin throw,(Kadhim, 2024b) as this activity is governed by projectile motion principles. Therefore, it is essential to maintain an optimal performance angle. The ideal release angle is typically less than 45 degrees. The greater the difference between the launch and landing levels, the closer the angle approaches zero.

The researcher believes that the measured indicator, torque, is the product of body mass and the horizontal distance between the line connecting the body's center of mass and the front foot. An increase in this distance leads to a forward shift of the left foot, causing the body's center of gravity to move forward and generating a significant torque. This reduces muscular balance and stability, hindering the ability to accurately direct the release angle. Qasim Hassan Hussein emphasized that during the javelin throw, the left rear side must be fixed to serve as a pivot point around which the right side rotates. This instability reduced the students' ability to control the release angle correctly.(Kadhim, 2024a)

Regarding the correlation between torque and javelin release speed for track and field students, the study found a strong positive relationship. The researcher suggests that the measured indicator depends on body weight multiplied by the distance between the vertical line from the body's center of gravity to the ground and the foot of support. As torque increases, the horizontal distance between the foot of support and the vertical line from the center of gravity also increases, providing a larger base of support. This acts as a counter-torque to the torque of the trunk and throwing arm, allowing for greater movement of the trunk and arm. As the radius increases while speed remains constant, the tangential velocity also increases.(Kazim et al., 2019) Additionally, the researcher believes that the increase in javelin release speed due to increased torque is caused by an increase in the force of propulsion at the moment of release. Sanab Al-Abidi and others have confirmed this, stating that the mechanical thinking behind the thrower's body position, where the final step is as large as possible, creates a larger base of support to allow for maximum trunk movement from back to front.(Kadhim, 2023) Maintaining balance during rapid movement requires a large base of support to equalize the torques acting on the body. If the final step is short, the thrower cannot complete the full trunk movement, reducing the amount of momentum transferred to the throwing arm and consequently lowering the javelin release speed, as speed is directly proportional to force.

Journal of Physical Education

Volume 35 – Issue (4) – 2023 Open Access

(E-ISSN: 2707-5729) (P-ISSN: 2073-6452)

https://jcope.uobaghdad.edu.iq

Conclusions and Recommendations:

Based on the statistical analysis, the researcher reached the following conclusions:

- There is a relationship between torque, javelin release angle, and javelin release speed.
- There is a negative relationship between torque and javelin release angle.
- There is a positive relationship between torque and javelin release speed.

Recommendations:

- Emphasize increasing the length of the final step for athletes with lighter body masses.
- Emphasize decreasing the length of the final step for athletes with heavier body masses.
- Conduct similar studies.

Journal of Physical Education

Volume 35 – Issue (4) – 2023 Open Access

(E-ISSN: 2707-5729) (P-ISSN: 2073-6452)

https://jcope.uobaghdad.edu.iq

References

Adel Abdul Basir: Biomechanics and the Integration between Theory and Application. (Cairo, Markaz Al-Kitab for Publishing, 1998.

Aliya Hussein Dahham: Relationship between Performance Angles, Torque, and Javelin Throw Launch Variables. Journal of Physical Education Sciences - University of Babylon, Volume 4, Issue 1, 2011.

Aous Yusuf Khalfa: Relationship between the kinetic speed of the upper and lower limbs and some kinematic variables in achieving javelin throw for physical education students, Al-Qadisiyah University, Volume 4, Issue 2, 2018.

Furas Mashar Hussein: A Study of the Relationship between Explosive Strength and Achievement in Javelin Throw Among University of Baghdad Players. Journal of Physical Education, Volume 27, Issue 4 (2015.

Kadhim, M. J. (2023). Examining The Relationship Between Social Classes And The Culture Of Poverty: A Case Study. *International Journal of Social Trends*, *1*(1), 23–27.

Kadhim, M. J. (2024a). Digital Literacy and Its Importance in the Modern Workforce. *International Journal of Social Trends*, *2*(2), 44–50.

Kadhim, M. J. (2024b). Social Networks' Place in Contemporary Political Movements. *International Journal of Social Trends*, *2*(2), 51–59.

Kazim, M. J., Zughair, A. L. A. A., & Shihab, G. M. (2019). The effect of zinc intake on the accumulation of lactic acid after cooper testing among football Premier league referees. *Sciences Journal Of Physical Education*, *12*(5).

Qasim Al-Mandlawi, et al.: Training Foundations for Track and Field Events. (Baghdad, Higher Education Presses, 1990.

Qasim Hassan Hussein: Theoretical and Practical Foundations in Track and Field Events. (Baghdad, Higher Education Press, 1987). Qasim Hassan Hussein: Biomechanical Analysis in Track and Field Events. (Dar Al-Hikma Press - University of Basra, et al., 1991.

Qasim Khalil Ibrahim: Relationship Between Pelvic Speed and Draw Arc Speed and Javelin Launch Speed for Syrian Throwers. Tishreen University Journal for Research and Scientific Studies, Volume 37, Issue 6, 2015.

Rudi Schmittler: Statistical Methods in Physical Education (Translation), Abdul Ali Nasif and Mahmoud Al-Samarai (Baghdad, Dar Al-Hurriya for Printing, 1974.

Saib Attiya Al-Abidi, et al.: Biomechanics and Its Applications. (Dar Al-Kutub for Printing and Publishing, University of Mosul, 1991.

Sarieh Abdul Karim, Wahbi Alwan: Anatomical Analysis and Its Kinetic and Mechanical Applications. (Baghdad, 2007.

Sarieh Abdul Karim: Applications of Biomechanics in Sports Training and Motor Performance. (Baghdad, 2007.