Modern Sport

Volume 25
Issue 3 *Special Issue of the Fourth International Scientific Conference, Titled: "Applications of Entrepreneurship and Knowledge Parks: Horizons for Excellence in Sports Sciences"*

Article 3

7-3-2026

Muscular Capacities of Arms and Legs and Biokinematic Variables in the Preparatory Phase and Their Relationship to Basketball Shooting Accuracy

Intisar Kadhim Abdul Kareem
College of Physical Education and Sports Sciences for Women, University of Baghdad,
intisar@copew.uobaghdad.edu.iq

Zubaidah Salah Hadi
College of Physical Education and Sports Sciences for Women, University of Baghdad,
zubaida.s@copew.uobaghdad.edu.iq

Recommended Citation

Kareem, Intisar Kadhim Abdul and Hadi, Zubaidah Salah (2026) "Muscular Capacities of Arms and Legs and Biokinematic Variables in the Preparatory Phase and Their Relationship to Basketball Shooting Accuracy," *Modern Sport*: Vol. 25: Iss. 3, Article 3.
DOI: https://doi.org/10.54702/2708-3454.2125

MODERN SPORT 2026;25:265–274

SPECIAL ISSUE ARTICLE

Muscular Capacities of Arms and Legs and Biokinematic Variables in the Preparatory Phase and Their Relationship to Basketball Shooting Accuracy

Intisar Kadhim Abdul Kareem, Zubaidah Salah Hadi *

College of Physical Education and Sports Sciences for Women, University of Baghdad

Abstract

As basketball has evolved and the intensity of competition has increased, it has become essential to explore the determinants of shooting accuracy by using scientifically rigorous methodology that is consistent with the demands of the athletic event and its central role in determining the result of matches. The aim of the research was to identify the muscular capacities of the arms and legs and selected biokinematic variables in the preparatory phase of actual performance among the research sample, as well as the accuracy of set shooting and layup shooting in basketball. The descriptive method was employed on a purposively selected sample consisting of (10) third-year female students from the College of Physical Education and Sports Sciences for Women. The results showed that the arithmetic mean of the muscular capacity of the arms was 6.340, with a standard deviation of 0.550. The mean score for set shooting accuracy was 4.60, with a standard deviation of 1.647. The correlation coefficient was 0.550, indicating a moderate positive association between arm muscular capacity and shooting accuracy. This finding underscores the importance of physical capacity in improving basketball performance. The researchers proposed several recommendations, including: The necessity of focusing on developing the muscular strength of the arms and legs within practical basketball lessons through exercises appropriate to the level of third-year female students. Emphasizing the incorporation of simplified biomechanical analysis in teaching and training by guiding students toward correct joint positions during the performance of shooting skills.

Keywords: Muscular capacity, Biokinematic variables, Basketball shooting accuracy, Layup and set shooting

1. Introduction

Taking into consideration the development of basketball and the increasing intensity of the competition, it is necessary to explore the factors of shooting accuracy with the help of the scientific framework that is related to the requirements of the sport and the decisive role of the outcomes in the matches. Typically, this kind of inquiry would provide evidence-based and practical recommendations To provide effective guidance to the female students, hence improving individual and team performance. The shooting, in all its forms, is considered to be one of the primary skills in basketball and the decisive element to win the game. The achievement of this skill depends on uniting the physical abilities of the arms and legs with definite biokinematic features. Therefore, the valuation of both coach and player of the effect of arm and leg abilities and biokinematic variables in the preparatory period enables the promotion of efficiency in performance.

There is a great deal of empirical evidence that supports the idea of improving the accuracy of shooting, which requires a focus on physical abilities and the study of biokinematic characteristics (França et al., 2022). The physical capacity of the arms and legs in the basketball shooting skill plays a significant role, with varying contributions depending on the type of skill and the method of its execution. The muscular strength of the arms in set shooting plays a

Received 2 February 2026; revised 10 March 2026; accepted 27 March 2026.
Available online 3 July 2026

* Corresponding author.
E-mail addresses: intisar@copew.uobaghdad.edu.iq (I. K. A. Kareem), zubaida.s@copew.uobaghdad.edu.iq (Z. S. Hadi).

https://doi.org/10.54702/2708-3454.2125

fundamental role in performance accuracy, as it controls the propulsion of the ball and its precise direction toward the basket. The legs contribute by providing a base of support and body stability during shooting, in order to avoid any imbalance that may affect accuracy. In layup shooting, the legs provide Female student with the necessary force for take-off, achieving elevation, and maintaining the correct performance rhythm toward the basket, while the arms contribute to guiding and controlling the ball during the jump. Some studies emphasize that integrated training of the arms and legs improves shooting accuracy (Shamim, 2020).

The results of some studies have shown that biomechanical analysis of sports skills provides vital information for the development of training methods and the improvement of performance accuracy (Amaro et al., 2025). The importance of this research lies in revealing the role played by the muscular capacity of the arms and legs, as well as selected biokinematic variables in the preparatory phase of actual performance, in determining the accuracy of set and layup shooting in basketball. The preparatory phase represents a part of the motor sequence of the skill that has an effective and significant influence on the success of skill performance, as it includes physical and motor preparation that enables Female student to execute the shot at the required level and contributes to achieving the optimal trajectory of the arm, knees, and trunk, thereby directly affecting the accuracy of ball release.

In addition, the importance of the research emerges from the urgent need to understand the biokinematic variables associated with this phase, such as joint angles and arm trajectory, as they constitute the scientific basis upon which coaches rely in developing training programs and correcting technical errors that appear during practical application. The justifications for this research stem from the scarcity of local studies that have addressed the integration between muscular capacities and biokinematic variables in analyzing the preparatory phase of shooting, despite their importance in improving the level of skill performance among female students. Furthermore, field observation indicates a considerable variation in shooting accuracy among them despite receiving similar training, which highlights the necessity of in-depth study of the variables affecting this vital skill. Moreover, this research contributes to providing scientific indicators that can be utilized in identifying the variables most closely associated with shooting accuracy, thereby strengthening the applied dimension of movement sciences and biokinematics and supporting the orientation of coaches and instructors toward the use of motion analysis as a foundation for performance development. Hence, the justifications and significance of this research arise as a scientific step that contributes to filling a gap and providing a qualitative addition to research related to the development of fundamental skills in basketball.

The research problem lies in the low level of performance demonstrated by many female students in these two skills, which require mastery through the integration of physical capacities (of the arms and legs) and biokinematic factors, particularly in the preparatory phase that constitutes a foundation for developing both physical and skill performance. Through field observation, the researchers noted that despite the increasing attention and efforts exerted during lessons by the subject instructors, there remains a clear weakness in the accuracy of set shooting and layup shooting among many third-year female students, which negatively affects performance. The researchers attribute this to the limited number of studies concerned with analyzing the physical capacities of the arms and legs in conjunction with biokinematic variables in the preparatory phase and linking these aspects together.

Accordingly, the research problem can be defined and formulated through the following questions:

1. What is the effect of the physical capacities of the arms and legs on the accuracy of set shooting and layup shooting?
2. What is the effect of biokinematic variables in the preparatory phase on the accuracy of set shooting and layup shooting?

Hence, the need arose to study this problem scientifically in order to determine the role of the investigated variables in shooting accuracy in basketball, with the aim of providing practical solutions based on precise analytical data. Such findings would contribute to establishing a scientific framework for both the instructor and the student, facilitating the understanding of the role of physical capacities and biokinematic variables in shooting accuracy and their reflection on the development and enhancement of students' performance levels.

Research Aim: The research aims to identify:

1. The muscular capacities of the arms and legs and selected biokinematic variables in the preparatory phase of actual performance among the research sample.
2. A study of set shooting and layup shooting accuracy among the research sample.
3. The relationship between the muscular capacities of the arms and legs and selected biokinematic variables in the preparatory phase of actual performance and the accuracy of set shooting and layup shooting.

Research Hypotheses:

1. There is no statistically significant correlation between the muscular capacity of the arms and legs and the accuracy of set shooting and layup shooting in basketball among third-year female students.
2. There is no statistically significant correlation between selected biokinematic variables in the preparatory phase of actual performance and the accuracy of set shooting and layup shooting in basketball among third-year female students.

Research Scope:

1. **Human domain:** Third-year female students at the College of Physical Education and Sports Sciences for Women.
2. **Temporal domain:** From 12/10/2025 to 7/11/2025.
3. **Spatial domain:** The indoor hall of the College of Physical Education and Sports Sciences for Women.

2. Methodology and procedures

The research population was identified by the researchers as third-year female students at the College of Physical Education and Sports Sciences for Women, totaling (79) students. The research sample consisted of Section (B), comprising (15) students. Five (5) students were excluded due to non-compliance, resulting in a final sample of (10) students. The sample was selected purposively, representing (18.98%) of the original population.

Table 1. Presents the homogeneity of the sample in terms of height, weight, and age measurements.

Variables	Mean	Standard Deviation	Median	Skewness Coefficient
Height (meter)	170	4.50	170	0.1
Body Mass (kg)	76.80	9.58	75	0.2
Age (year)	22.30	2.58	22	0.4

The results supported the homogeneity of the sample, as the skewness coefficient was between (+1), which implies that it was normally distributed and thus confirms that the research cohort was uniform.

The researchers used Arabic and foreign literature, world information network (Internet), face-to-face interviews, questionnaires on the opinion of experts, data registration and tabulation forms. The tools included a DELL computer, compact discs (CDs), a medicine ball, three basketballs, a height measuring tape, a single whistle, a tripod, and adhesive tape with the width of five centimeters.

To define the research variables, a number of tests were included in the research, such as an upper-limb explosive strength measure, lower-limb explosive strength measure, free-throw accuracy test, and layup accuracy test.

Research procedure steps

Field research procedures

First Test:
Test Name: Two-Handed Overhead Medicine Ball Throw (2 kg) (Allawi & Radwan, 1994).
Purpose of the Test: To measure the explosive strength of the arms.
Required Equipment: A small rope, a 2 kg medicine ball, a chair, and a measuring tape.
Test Procedure: The participant sits on a chair holding the medicine ball with both hands, with the ball positioned in front of the chest and below the chin level. The trunk must remain in contact with the edge of the chair. A rope is placed around the participant's chest and secured firmly from behind to prevent forward trunk movement during the execution of the two-handed throw.
Scoring: The participant is given three consecutive attempts, and the best attempt among the three is recorded. The distance is measured in meters and its fractions.

Second Test:
Test Name: Explosive Strength Test for the Legs (Abd, 2013).
Purpose of the Test: To measure the explosive strength of the legs.
Equipment: A flat surface and a measuring tape.
Performance Description: The participant stands behind the starting line with the feet slightly apart and the arms raised. The arms are swung forward, downward, and backward while the knees are semi-flexed and the trunk is inclined forward. The participant then extends the legs in alignment with the trunk, pushes off the ground with both feet, and jumps forward to the maximum possible distance.
Scoring: The jumping distance is measured from the starting line to the nearest mark left by the participant closest to the starting line, or at the point where the heels first contact the ground. If the participant loses balance and touches the ground with another part of the body, the attempt is considered invalid and must be repeated. Both feet must remain in contact with the ground until the moment of take-off. Two attempts are allowed, and the best attempt is recorded.

Third Test:
Test Name: Shooting from Behind the Free-Throw Line (10 shots) (Majeed, 1989).
Purpose of the Test: To measure free-throw shooting accuracy.

Required Equipment: A basketball court and three (3) official basketballs.
Performance Description: The player stands behind the midpoint of the free-throw line. The player performs two sets, each consisting of five (5) consecutive shots. The player may shoot using any technique deemed appropriate. After completing the first set, the player leaves the shooting position to allow another player to perform the first set, and so on in rotation among the remaining players.
Scoring: One point is awarded for each successful shot that enters the basket.

Fourth Test:
Test Name: Layup Shooting Test (Watban, 2019).
Purpose of the Test: To evaluate the level of layup shooting accuracy.
Equipment Used: A basketball court, a basketball hoop, and one (1) basketball.
Performance Description: Upon hearing the start signal, the player begins by dribbling the ball from a distance of five (5) meters from the backboard. The player then performs two steps followed by the execution of a layup shot.
Test Conditions: The player starts by dribbling the ball from a distance of five (5) meters from the basket. Upon hearing the start signal, the player advances, performs the layup steps, and executes a correct layup attempt while trying to score the ball in the basket.
Number of Attempts: The participant is given five (5) layup attempts.
Scoring:

- One point is awarded when the ball hits the backboard in the area marked with number (1) and does not score.
- Two points are awarded when the ball hits the backboard in the area marked with number (2) and does not score.
- Three points are awarded when the ball touches the rim and does not score.
- Four points are awarded when the ball touches the rim or the small square on the backboard.
- Five points are awarded when the ball enters the rim directly without touching any other part.

Pilot study

The researchers conducted the pilot study on Sunday, 12/10/2025, at 9:00 a.m., on three (3) female students from outside the main research sample (Section A) in the indoor hall of the College of Physical Education and Sports Sciences for Women. During the pilot study, the explosive strength tests for the arms and legs were administered. On the following day, Thursday, 16/10/2025, at 9:00 a.m., the accuracy test for set shooting and the layup shooting accuracy test were conducted. The pilot sample participants were recorded while performing the set shooting and layup shooting skills using a video camera operating at a speed of 120 frames per second. After four days, the tests were repeated under the same conditions.

The objectives of the pilot study were:

- To identify potential obstacles that the researchers might encounter during the implementation of the procedures.
- To assess the extent to which the work team fulfilled its assigned duties.
- To determine the level of understanding and responsiveness of the sample toward the tests.
- To identify the time required to administer each test.

Biokinematic Variables of Set Shooting and Layup Shooting:

These variables were extracted using the motion analysis software *Kinovea*:

- **Wrist Joint Angle:** The angle formed between the line connecting the elbow joint point to the wrist joint point on one side, and the line connecting the palm's anterior point to the wrist joint point of the hand on the other side, as shown in Fig. 1.

Fig. 1. Wrist joint angle during shooting performance.

- **Elbow Joint Angle:** The angle formed between the longitudinal axis of the humerus and the longitudinal axis of the forearm, as shown in Fig. 2.

Fig. 2. Elbow joint angle during shooting performance.

- **Trunk Inclination Angle:** The angle formed between the trunk line (from the shoulder joint point to the hip joint point) and the horizontal line passing through the hip joint point, as shown in Fig. 3.

Fig. 3. Trunk inclination angle during shooting performance.

- **Knee Joint Angle:** The angle calculated by measuring the angle formed between the imaginary line of the thigh and the imaginary line of the leg passing through the knee joint, as shown in Fig. 4.

Fig. 4. Knee joint angle during shooting performance.

- **Height of the Body's Center of Mass:** The vertical distance between the body's center of mass and the ground, as shown in Fig. 5.

Fig. 5. Height of the body's center of mass.

- **Ball Height from the Ground:** The vertical distance between the center of the ball and the ground surface, as shown in Fig. 6.

Fig. 6. Ball height from the ground.

- **Take-off Time in Layup Shooting:** The moment of the player's last foot contact with the ground, measured in seconds, as shown in Fig. 7.

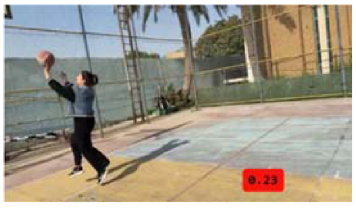

Fig. 7. Take-off time in layup shooting.

Main experiment

The researchers conducted the main experiment on Sunday, 7/12/2025, on ten (10) female students from Section (B) of the third year at the College of Physical Education and Sports Sciences in the indoor hall of the College of Physical Education and Sports Sciences for Women. A video camera operating at a speed of (120) frames per second was used. The camera was positioned at a height of (1.25) meters and at a distance of (3) meters from the midpoint of the test execution area. Prior to the implementation of the test, a detailed explanation was provided by the researchers regarding the procedures.

Statistical analysis

The Statistical Package for the Social Sciences (SPSS) was used to process the results statistically.

3. Results

As shown in Table 2, the means, standard deviations, medians, and skewness coefficients were calculated for the muscular capacity of the arms and legs, selected biomechanical variables, and the accuracy of both set shooting and lay-up shooting in basketball. The relative consistency observed in the values of the means, standard deviations, and skewness coefficients indicates that the research sample possesses a comparable level of physical and skill-related abilities. This homogeneity supports the assumption of a normal distribution among the participants and suggests that these characteristics did not exert any significant influence on the test results for the study sample.

4. Discussion of the results

The empirical results of Table 3 show that the muscular capacity of the arms and legs has a statistically significant relationship with the precision of set shooting. This dependence has been explained by the fact that a stable shooting posture is achieved by the production of sufficient, accurately-controlled muscular force that allows the player to track ball position and release point and reduce perturbations caused by involuntary motion or vibration in different parts of the body. In modern literature, muscular strength, especially explosive strength, is the mechanical basis of the implementation of throwing and shooting skills (McCormick et al., 2018).

The findings also indicate that the elbow angle, knee angle, trunk inclination, and height of the centre of mass of the body at the point of release are significantly associated. This observation is consistent with the kinetic-chain theory according to which ideal

Table 2. Descriptive statistics of muscular capacities, biomechanical variables, and shooting accuracy in basketball.

Variables	Mean	Standard Deviation	Median	Skewness Coefficient
Muscular Capacity of the Arms	6.340	0.437	6.1550	0.310
Muscular Capacity of the Legs	1.697	0.274	1.670	0.743
Set Shooting Accuracy	4.60	1.647	4.50	0.620
Wrist Angle	127.21	1.1328	127.230	0.407
Elbow Angle	86.523	4.280	88.595	1.577
Trunk Inclination Angle	70.406	0.490	70.595	1.000
Knee Angle	127.588	1.000	127.620	1.146
Height of the Body's Center of Mass	0.984	0.020	0.99	0.996
Ball Height from the Ground	1.959	0.050	1.980	0.978
Layup Shooting Accuracy	9.90	1.197	9.50	1.204
Wrist Angle	115.390	0.625	115.170	0.622
Elbow Angle	115.510	1.010	115.815	0.860
Trunk Inclination Angle	77.325	1.504	77.540	0.98012
Knee Angle	128.307	0.707	128.450	0.216
Height of the Body's Center of Mass	1.184	0.035	1.170	0.889
Ball Height from the Ground	2.230	0.230	2.140	0.622
Take-off Time	26.700	1.251	27.000	0.280

Table 3. Presents the correlation relationship between the muscular capacity of the arms and legs, selected biomechanical variables, and the accuracy of set and layup shooting in basketball.

Variables	Mean	Standard Deviation	Correlation Coefficient (R)	Sig.	Significance
Set Shooting Accuracy	4.60	1.647	—	—	—
Muscular Capacity of the Arms	6.340	0.437	0.550	0.023	Significant
Muscular Capacity of the Legs	1.697	0.274	0.594	0.070	Significant
Wrist Angle	127.21	1.1328	0.233	0.517	Not Significant
Elbow Angle	86.523	4.280	0.601	0.018	Significant
Trunk Inclination Angle	70.406	0.490	0.591	0.072	Significant
Knee Angle	127.588	1.000	0.442	0.027	Significant
Height of the Body's Center of Mass	0.984	0.020	0.539	0.051	Significant
Ball Height from the Ground	1.959	0.050	0.340	0.337	Not Significant
Layup Shooting Accuracy	9.90	1.197	—	—	—
Muscular Capacity of the Arms	6.340	0.437	0.423	0.224	Not Significant
Muscular Capacity of the Legs	1.697	0.274	0.733	0.061	Significant
Wrist Angle	115.390	0.625	0.603	0.038	Significant
Elbow Angle	115.510	1.010	0.512	0.023	Significant
Trunk Inclination Angle	77.325	1.504	0.407	0.243	Not Significant
Knee Angle	128.307	0.707	0.764	0.041	Significant
Height of the Body's Center of Mass	1.184	0.035	0.641	0.046	Significant
Ball Height from the Ground	2.230	0.230	0.527	0.117	Not Significant
Take-off Time	26.700	1.251	0.764	0.010	Significant

mechanical congruence of joints allows the lower limbs to transmit force to the trunk and shooting arm in the most efficient way, and in the process improve accuracy. Researchers underline that joint-angle control during the preparation and execution stage is a key factor influencing the maximization of accuracy and a reduction in kinetic energy loss (Knudson, 2020).

Also, the same table data show that there is no significant correlation between the height of the ball at the ground contact and the wrist angle. Researchers attribute this finding to the fact that set shooting has lower dependence on final release variables compared to lay-up shooting due to improved motor control and mitigated effects of temporal and dynamic variables (García-Rubio et al., 2013).

The other statistically significant correlations found during the research are between muscular capacity of the legs and accuracy on lay-up shooting. This correlation is supported by the fact that this skill is largely reliant on the explosive strength of the legs to give the required elevation and to attain the maximum point of ball launch. Recent studies also support the fact that offensive efficacy in basketball is directly linked to gains in lower-limb explosive strength especially in close-range and lay-up situations (Ziv & Lidor, 2009).

The results also revealed significant relationships with wrist angle, elbow angle, knee angle, height of

the body's center of mass, and take-off time, indicating that layup shooting is a complex skill requiring a high level of coordination between force production and movement timing. The more appropriate and synchronized the take-off time is with correct joint positioning during movement, the greater the shooting accuracy. Studies have indicated that the wrist joint is the final segment from which the ball is released; the body performs a series of actions such as flexion and extension that are ultimately transferred to the wrist, which then executes the final push of the ball toward the target (Mawlood & Sadiq, 2022). The temporal coordination between take-off and ball release is considered one of the most important determinants of success in layup shooting (Okazaki et al., 2015).

The researchers interpret the absence of a statistically significant relationship between the muscular capacity of the arms and performance accuracy in layup shooting in basketball as being due to the transfer of kinetic momentum during layup shooting according to the principle of the kinetic chain—from the legs to the trunk and then to the shooting arm—thereby reducing the independent effect of arm muscular strength on shooting accuracy. In addition, the members of the research sample performed the skill at speed and in continuous motion toward the target.

Contemporary biomechanical analysis indicates that increasing the muscular strength of the arms does not necessarily lead to improved accuracy; rather, it may sometimes result in increased timing and release-angle errors if not properly synchronized with the rest of the body segments. It is emphasized that the primary force in dynamic shooting skills in handball is generated from the lower limbs, whereas the role of the arms is largely confined to directing and controlling the ball (Wagner et al., 2016). Some specialists further assert that accuracy in layup shooting is more closely associated with motor control factors, as it relies more on movement timing and coordination than on the muscular strength of the arms (Rivilla-García et al., 2011).

The absence of a significant relationship with trunk inclination angle and ball height from the ground is attributed by some specialists to variations in individual performance styles, in addition to the reliance of some female students on compensatory movements during flight to achieve accuracy, which reduces the consistency of the influence of these variables (Hay, 2016).

The researchers also attribute the significant relationship between the muscular capacity of the legs and shooting accuracy to the effective role of explosive strength in improving motor control and ball trajectory. Studies confirm that the integration of muscular strength with proper mechanical joint positioning contributes to enhancing skill performance accuracy (Hassan, 2017; Abdel Fattah, 2018).

In light of the above, the research findings confirm that muscular capacity and biomechanical variables represent interrelated elements that directly influence the accuracy of set and layup shooting in basketball, and that the development of muscular strength in conjunction with the improvement of joint mechanical positioning contributes to enhancing skill performance efficiency. These results are consistent with contemporary trends in sports training that emphasize the integration of physical preparation and motion analysis to achieve optimal performance.

5. Conclusions

According to the interpretation of the findings, the researcher came to the following key conclusions:

1. The findings showed the statistically significant correlation between the muscular capacity of the legs and the accuracy of both set and layup shooting, and a significant correlation between the muscular capacity of the arms and the accuracy of set shooting in the third-year female students.This underscores the critical role of explosive strength in both the upper and lower limbs in enhancing skill performance in shooting techniques.
2. It was found that certain biomechanical variables during the preparatory phase of performance particularly elbow and knee joint angles, trunk inclination angle, and the height of the body's center of mass contribute significantly to determining shooting accuracy. This indicates that precise skill execution depends to a large extent on achieving optimal mechanical positioning of body segments during performance..
3. The absence of a statistically significant correlation between upper-limb muscular power and lay-up shooting accuracy indicates that the primary force production in this skill relies mainly on the lower extremities. This aligns with the principle of the kinetic chain, where momentum is transferred from the legs to the trunk and then to the shooting arm.
4. Some biomechanical variables, such as wrist angle and ball height above the ground, did not demonstrate a statistically significant relationship with set-shot accuracy. This may be attributed to the inherently stable nature of this skill and the relatively limited dynamic influences associated with it, compared to jump shooting.

6. Recommendations

1. Emphasizing the development of muscular strength of the arms and legs within practical basketball lessons, using exercises appropriate to the level of third-year female students.
2. Incorporating simplified biomechanical analysis during teaching and training by guiding students toward correct joint positioning while performing shooting skills.
3. Adopting specific exercises to improve layup shooting, as it is among the skills most affected by physical and biomechanical variables.
4. Directing instructors and coaches to consider individual differences among students when teaching shooting skills, particularly in relation to movement timing and take-off time.

Author's declaration

Conflicts of interest

None.

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

Ethical-clearance

This manuscript approved by the Scientific Committee of the College of Physical Education and Sports Sciences for Women, University of Baghdad, Iraq, on (2025/12/01).

Author's contributions

All contributions to this study were carried out by the researchers **Prof. Dr. Intisar Kadhim Abdul Kareem**, who developed the main idea of the study, designed the research, supervised the work, interpreted the results, and participated in writing and finalizing the manuscript, and **Lect. Dr. Zubaidah Salah Hadi**, who participated in conducting the study procedures, collected and organized the data, contributed to interpreting the results, and reviewed the manuscript, with the assistance of a number of experts: **Dr. Intisar Al-Douri** in Statistics and **Asst. Lect. Inam Al-Azzawi** in Translation.

Facilitating the task

This study was supported by the **College of Physical Education and Sports Sciences for Women/University of Baghdad**.

Roles of each researcher in the research

- **First researcher: Prof. Dr. Intisar Kadhim Abdul Kareem** was responsible for the conceptualization of the research idea, study design, literature review, supervision of data collection, interpretation of results, drafting the manuscript, and final revision.
- **Second researcher: Lect. Dr. Zubaidah Salah Hadi** was responsible for assisting in the study design, participating in data collection and experimental procedures, organizing the data, contributing to the interpretation of results, and reviewing the manuscript.

Funding statement

This research received no external funding.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

References

Abd, A. S. (2013). *Applied tests in physical education: Physical, motor, and skill-based*. Baghdad: Al-Nour Office. p. 137.

Abdel Fattah, A. A. (2018). *Sports training: Physiological and mechanical foundations*. Cairo: Dar Al-Fikr Al-Arabi. p. 214.

Allawi, M. H., & Radwan, M. N. (1994). *Motor performance test* (3rd ed.). Cairo: Dar Al-Fikr Al-Arabi. pp. 110–112.

Amaro, C.M., Castro, M.A., Mendes, R., & Peixoto, I. (2025). Influence of jump and ball release parameters on shooting accuracy in basketball under varying constraints. *Journal of Functional Morphology and Kinesiology, 10*(4), 459. DOI: 10.3390/jfmk10040459

França, C., Gouveia, É. R., Coelho-e-Silva, M. J., & Gomes, B. B. (2022). A kinematic analysis of the basketball shot performed with different ball sizes. *Applied Sciences, 12*(13), 6471. DOI: 10.3390/app12136471

García-Rubio, J., Ibáñez, S. J., De Santos, R. M., Leite, N., & Sampaio, J. (2013). Identifying basketball performance indicators in regular season and playoff games. *Journal of Human Kinetics, 36*(1), 161–168. DOI: 10.2478/hukin-2013-0016

Hassan, Q. H. (2017). *Biomechanical analysis in the mathematical field*. Baghdad: Dar Al-Kutub Wal-Watha'iq. p. 150.

Hay, J. G. (2016). *The biomechanics of sports techniques* (5th ed.). New York: Routledge. pp. 80–83.

Knudson, D. (2020). *Fundamentals of biomechanics* (3rd ed.). Cham: Springer. pp. 170–174.

Majeed, R. K. (1989). *Encyclopedia of measurements and tests in physical education and sports*. Basra: Higher Education Press. pp. 366–367.

Mawlood, T. B., & Sadiq, D. M. (2022). The Relation Between Some Bio – Kinematic Variables According to Performance Phases Using 45°Angle Jump Shot Accuracy in Women's National Basketball League. *Journal of Physical Education, 34*(2), 247–256. https://doi.org/10.37359/JOPE.V34(2)2022.1248.

McCormick, B. T., Hannon, J. C., & Newton, M. (2018). The effects of strength and power training on basketball shooting performance. *Journal of Strength and Conditioning Research, 32*(3), 791–801.

Okazaki, V. H. A., Rodacki, A. L. F., & Satern, M. N. (2015). A review on the basketball jump shot. *Sports Biomechanics, 14*(2), 190–205. DOI: 10.1080/14763141.2015.1052541.

Rivilla-García, J., Grande, I., Sampedro, J., & van den Tillaar, R. (2011). Influence of opposition on ball velocity and accuracy in handball throwing. *Journal of Sports Sciences, 36*(11), 1239–1247.

Shamim, P. (2020). Mechanical analysis of basketball shooting: A review study. DOI: https://doi.org/10.22271/kheljournal.2020.v7.i1c.3512.

Wagner, H., Finkenzeller, T., Würth, S., & von Duvillard, S. P. (2016). Individual and team performance in team-handball: A review. *Journal of Sports Science & Medicine*, *15*(1), 1–14.

Watban, K. M. A. (2019). Dynamics of forces in foot areas and their relationship to some biomechanical variables in the accuracy of ladder shooting in youth basketball [Unpublished master's thesis]. Al-Muthanna University, College of Physical Education and Sports Sciences. p. 42.

Ziv, G., & Lidor, R. (2009). Physical characteristics, physiological attributes, and on-court performances of basketball players. *International Journal of Sports Physiology and Performance*, *14*(8), 1019–1026. DOI: 10.2165/00007256-200939070-00003.

القدرات العضلية للذراعين والرجلين والمتغيرات البايوكينماتيكية في المرحلة التحضيرية وعلاقتها بدقة التصويب في كرة السلة

انتصار كاظم عبد الكريم، زبيده صلاح هادي

جامعة بغداد/كلية التربية البدنية وعلوم الرياضة للبنات

ملخص البحث

مع تطور كرة السلة وزيادة المنافسة، أصبح من الضروري البحث في العوامل المؤثرة في دقة التصويب بأسلوب علمي يواكب متطلبات اللعبة ودورها في تحديد نتيجة المباراة، اذ يمكن ان تساهم هذه الخطوة في توفير إرشادات واسس علمية وعملية تستخدم لتوجيه اللاعب بشكل فعال، بما يعزز من أدائهم الفردي والجماعي. وهدف البحث التعرف على القدرات العضلية للذراعين والرجلين وبعض المتغيرات البايوكينماتيكية في المرحلة التحضيرية للأداء الفعلي لدى العينة قيد البحث. ودقة التصويب من الثبات والتصويب السلمي في كرة السلة. وتم استخدام المنهج الوصفي على عينة اختيرت بالطريقة العمدية قوامها (10) طالبات من المرحلة الثالثة لكلية التربية البدنية وعلوم الرياضة للبنات. أظهرت النتائج ان الوسط الحسابي للقدرة العضلية للذراعين (6.340) وانحراف معياري (0.550) أما دقة التصويب من الثبات بلغت قيمة الوسط الحسابي (4.60) وبأنحراف معياري (1.647) وكان قيمة معامل الارتباط (0.550) وهذا يدل على أهمية الصفة البدنية في تحسين الأداء. وخرجت الباحثتان بعدة توصيات منها ضرورة التركيز على تطوير القوة العضلية للذراعين والرجلين ضمن مفردات الدروس العملية لكرة السلة، باستخدام تمارين تتناسب مع مستوى طالبات المرحلة الثالثة.الاهتمام بإدخال التحليل البايوميكانيكي المبسط أثناء التعليم والتدريب، من خلال توجيه الطالبات الى أوضاع المفاصل الصحيحة أثناء أداء مهارات التصويب.

الكلمات المفتاحية: القدرة العضلية، المتغيرات البايوكينماتيكية، دقة التصويب في كرة السلة، التصويب السلمي والتصويب من الثبات.