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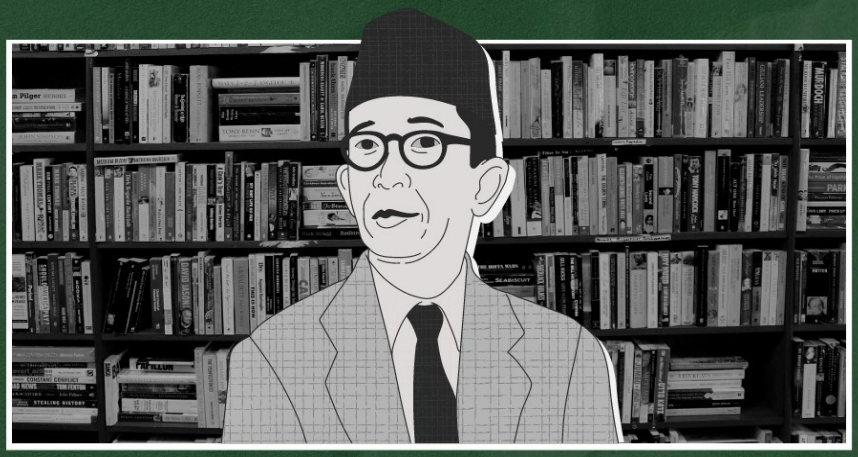

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The Effect of Proposed Exercises on Some Biokinematic Variables and Shooting Performance in Basketball for Female Students

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Abstract

General Background: Basketball shooting requires technical precision and coordinated movement, with performance associated with biokinematic variables such as joint angles, movement velocity, and ball release characteristics. Specific **Background:** Female students demonstrated variations in shooting performance, including movement coordination weaknesses, low accuracy, and differences in selected biomechanical parameters, while conventional training did not sufficiently address these components. **Knowledge Gap:** The study identifies a need for scientifically designed basketball shooting exercises that integrate biomechanical analysis with technical training for female students. **Aims:** This study designs and assesses proposed exercises targeting selected biokinematic variables and shooting performance in female students. **Results:** The six-week training program, conducted through two instructional sessions per week, produced changes in selected biokinematic variables and shooting performance. The experimental group demonstrated better results for several examined factors, while statistically significant differences were reported for selected pre-test and post-test measures. The exercises also supported more coordinated movement phases and greater shooting accuracy. **Novelty:** The study integrates biomechanical analysis of shooting movement with specifically designed exercises addressing technical execution and selected biokinematic variables. **Implications:** The findings provide scientific support for incorporating biomechanically based exercises into basketball teaching and training programs for female students and for considering movement analysis when developing shooting drills.

Highlights:

- Selected biokinematic measures changed following the training program.
- Shooting accuracy increased through improved movement quality.
- Movement phases became more harmoniously coordinated during shooting.

Keywords: Proposed Exercises, Biomechanics, Basketball Shooting.

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Introduction

Basketball is a popular team ball sport which demands a lot of technique and physical fitness. The success of women players relies upon their ability to perform the basic skills with high levels of precision and effectiveness across a variety of gaming scenarios. Among those talents, shooting is believed to be the most essential one because shooting directly affects offensive performance and the possibility of winning. The Kinetic aspects of technique are influenced by many of the Biokinematic factors which can be thought of as optimal biomechanics and translates into executing better quality skill [1].

In view of the relevance of using up-to-date training techniques in teaching sports skills, the present study is intended to examine the impact of a set of recommended training method on selected biokinematic parameters of the basketball shooting skill in the case of female students. This is achieved by tailoring a trainingprogram that comprises sports activity-based movements that consider the technical features of the shooting skill, serving to enhance movement and shooting performance [2].

The new aspects of the present study are the application of biomechanical analysis to identify the determinants of the technical performance of the shooting skill, to identify the basketballthrowing strengths and weaknesses of female students, and to formulate skill enhancementthrowing exercises based on scientific principles that will facilitate skill enhancement and thus improved basketball performance [3]. The aim of this research is also to assess the validity of these exercises in improving the shooting skills of female students, and in positively affecting some selected biokinematic parameters.The results may contribute in future to enhance better and more scientific training of players.

Research Problem

Shooting is a basic skill in basketball and is required for the offense to be effective. The mastery of this skill demands an exact integration of the technical and biomechanical properties of the movement. Shement observed practical sessions of female students at the College of Physical Education and Sport Studies where she found pronounced variations in shooting performance. These included poor movement fluency, low throw accuracy, and anomalies in a number of biomechanical parameters related to performance such as joint angles, movement velocity, and ball release height, all of which are known to challenge throwing effectiveness.According to the research, a fundamental cause for the inefficiencies is the use of conventional training techniques that overlook some of the biomechanical components affecting technical performance. Consequently, there is a need to develop proposed exercises based on scientific principles of human movement to improve selected biokinematic variables associated with shooting performance, thereby enhancing the skill level of female students.

Accordingly, the research problem is to determine the extent to which the proposed exercises influence the development of selected biokinematic variables and improve shooting accuracy in basketball among female students, thereby contributing to enhanced technical performance and achieving better educational outcomes**.**

Research Objectives

The objectives of this study are to:

1. Design proposed exercises to develop selected biokinematic variables and improve basketball shooting skills among female students.
2. Identify the effect of the proposed exercises on selected biokinematic variables associated with basketball shooting skills among female students.
3. Determine the effect of the proposed exercises on improving the accuracy of basketball shooting performance among female students.

Research Hypothesis

It is hypothesized that the proposed exercises will have a positive effect on selected biokinematic variables and basketball shooting performance among female students .

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Scope of the Research

1. Human Scope The research participants consisted of 18 third-year female students from the College of Physical Education and Sport Sciences, University of Kufa.
2. Time Scope The study was conducted from November 25, 2025, to March 1, 2026.
3. Place Scope The study was carried out in the Basketball Hall, College of Physical Education and Sport Sciences, University of Kufa.

Research Methodology and Field Procedures

A. Research Method

To achieve the objectives of the study, the researcher adopted the research method most appropriate for addressing the research problem. A research method is defined as the systematic approach used to discover scientific facts through a set of general principles that guide the research process toward obtaining valid and reliable results [4].

The researcher employed the experimental method, as it was considered the most appropriate for the nature of the research problem. The study utilized an equivalent-groups design with pre-test and post-test measurements.

B. Research Population and Sample

The research population consisted of 18 third-year female students enrolled in the College of Physical Education and Sport Sciences, University of Kufa.

The research sample was selected randomly by lottery from the research population and consisted of 9 female students, representing 50% of the total population. This percentage is considered adequate to ensure that the sample provides a valid and representative reflection of the research population [5].

1. Homogeneity of the Research Sample

Before implementing the field procedures of the study, and in order to control the variables that might affect the accuracy of the research findings, the researcher examined the homogeneity of the research sample with respect to anthropometric and morphological characteristics [6]. These characteristics included body height, body weight, training age, and leg length, as presented in Table (1).

Table 1. Homogeneity of the Research Sample in the Variables of Body Height, Body Mass, Age, and Leg Lengths

Measures	Unit of Measurement	Mean Min	SD Max	Median	Skewness Coefficient
Height	**cm**	161.2	1.98	160.5	0.35
Body Mass	**kg**	66.4	2.66	66	0.85
Age	**years**	21.8	0.69	21	0.75

Table (1) shows that the values of the skewness coefficient ranged within (±1), indicating that the research sample was homogeneous with respect to these variables. This also confirms that the data were normally distributed, making the sample appropriate for the implementation of the experimental procedures.

C. Research Instruments, Tools, and Means

1. Research Means

a. Observation.
b. Arabic and foreign references and literature.
c. Internet resources.
d. Tests and measurements.

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2. Instruments and Equipment

a. Basketball hall at the College of Physical Education and Sport Sciences, University of Kufa.
b. Two Casio Exilim digital cameras with a recording speed of 120 frames per second (fps)
c. One Dell laptop computer.
d. Two tripods for mounting the cameras.

3. Field Procedures

a. Selection of Tests for the Research Variables [7]

The technical performance of the research skills, namely set shooting and jump shooting, was evaluated by three experts and specialists in basketball. The evaluation was conducted using an assessment form prepared by the researcher, with scores ranging from 0 to 10 points.

Each student performed three attempts for each shooting skill, and the best attempt was selected and evaluated by the panel of experts.

b. Selection of the Biokinematic Variables Under Investigation [8]

The biokinematic variables related to the set shot and jump shot in basketball were identified in consultation with the research supervisor and a panel of experts and specialists in biomechanics through personal interviews.

c. Biokinematic Variables [9]

Body Inclination Angle: The angle formed between the trunk line (from the shoulder joint to the hip joint) and the vertical or horizontal reference line. It is measured in degrees.(°)

Step Length: The distance between the rear foot and the point of first ground contact of the front foot. It is measured in centimeters (cm)

Angular Velocity of the Leg: The rate of angular displacement of the leg during a specific period of time. It is measured in degrees per second (°/s)

1) Measurement of the Biokinematic Variables [10]

The biokinematic variables of the two shooting skills (set shot and jump shot) were measured using the Kinovea (Version 0.8.25) motion analysis software. The analysis was based on video recordings of the skills, and the previously identified biokinematic variables were measured accordingly.

2) Assessment of Skill Performance [11]

The technical performance of the research skills (set shot and jump shot) was evaluated by three experts and specialists in basketball. An evaluation form prepared by the researcher was used, with scores ranging from 0 to 10 points.

Each student performed three attempts for each skill, and the best attempt was selected for evaluation by the panel of experts.

d. Pilot Study

The researcher conducted the pilot study on November 27, 2025, using a sample of five female students drawn from the same research population. The purpose of the pilot study was to evaluate the suitability and efficiency of the equipment and instruments used in the tests, identify potential difficulties that might arise during the main experiment, determine appropriate solutions, estimate the time required to conduct the main experiment, assign responsibilities to the assisting research team, and determine the optimal locations for the video cameras.

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D. Main Experiment

1. Pre-test

The pre-test was held in the University of Kufa's College of Physical Education and Sport Sciences' Basketball Hall on December 1, 2025. Basketball experts and specialists evaluated the pre-test results after the researcher performed skill performance tests for the set shot and jump shot.

2. Equivalence of the Research Sample

existResult Before the start of the experimental program, the experimenter compared the technical performance scores of the research groups using the pre-test results to confirm that their skill performance was similar.

3. Main Experimental Procedure (Implementation of the Proposed Exercises)

The investigator was developed a series of suggested exercises from the scientific background of the study and the expertise of the research supervisor in basketball. The exercises were designed to improve the technical execution of the set shot and jump shot and to be at the same level as the skills of the girls.

The proposed training program was implemented over a period of six weeks under the direct supervision of the researcher. The instructional program consisted of two instructional sessions per week, during which the proposed exercises were incorporated into the educational units.

4. Post test

Following the completion of the instructional program, the researcher, with the assistance of the research team, conducted the post-tests on January 18, 2026. The same testing conditions and procedures used during the pre-tests were maintained to ensure consistency and reliability of the results.

D. Statistical Methods

The researcher used the Statistical Package for the Social Sciences (SPSS) to analyze the research data and obtain the statistical results.

Presentation, Analysis, and Discussion of the Results

Table 2. Significance of the Differences Between the Pre-test and Post-test in Technical Performance and Selected Biokinematic Variables for the Experimental and Control Groups in the Set Shot and Jump Shot Skills

Group	No	Variables	Unit of Measurement	Pre-test		Post-test		Calculated t-value	Significance Level Sig.	Level of Significance
				Mean	SD	Mean	SD			
Set Shot	1	Technical Performance	Degree	3.45	0.15	6.35	0.47	17.75	0.00	Sig.
	2	Elbow Angle	Elbow Angle	54.20	0.42	60.90	0.31	43.86	0.00	Sig.
	3	Step Length	(cm)	27.13	0.17	30.12	0.61	33.41	0.00	Sig.
Jump Shot	1	Technical Performance	Degree	3.15	0.74	3.60	0.21	1.71	0.12	Sig.
	2	Elbow Angle	Elbow Angle	55.70	0.67	56.90	0.31	4.81	0.00	Sig.

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3	**Step Length**	(cm)	**21.13**	**0.17**	**29.12**	**0.62**	**31.45**	**0.00**	**Sig.**

Degrees of Freedom: (8) The differences are statistically significant at the significance level of $p \leq 0.05$.

Discussion of the Results

Based on the presentation and analysis of the paired-samples t-test results shown in Table (2), which illustrates the pre-test and post-test results for selected biokinematic variables and basketball shooting accuracy among female students, statistically significant differences were found in favor of the post-test for both the experimental and control groups. However, in most of the factors examined, the experimental group showed better improvement [12].

The efficiency of the suggested exercises, which were created in accordance with scientific principles and took into account the biomechanical needs of basketball shooting skills, is credited by the researcher with the improvement attained by the experimental group [13]. These exercises helped students develop better movement patterns, improve neuromuscular coordination, gain more control over various movement phases, and receive ongoing feedback that allowed them to fix technical mistakes while performing. Consequently, this improved the skill's biokinematic components and had a positive effect on shooting accuracy [14].

Moreover, the investigator is of the opinion that the suggested workout was focused on accuracy and quality of movement execution instead of quantity processing. Using practice conditions that simulated real basketball games, the students improved their coordination of body parts and developed more fluid movement patterns when shooting. Therefore, the post-test showed significant differences [15].

Due to the normal teaching routine of the instructor of the course, the control group, however, also demonstrated improvement in some variables.A great amount of execution enhancement was derived from the shooting ability repetition and continual training featured in this program. However, because it lacked particular workouts intended to target the biokinematic variables directly impacting shot accuracy, this increase was not as noticeable as that of the experimental group [15].

According to the researcher, shot performance was directly improved by altering the biokinematic factors. Biomechanical elements that contribute to a more effective movement pattern while shooting include proper management of body and limb joint angles, movement time, execution speed, and body balance. This improves shooting accuracy and lowers technical errors [16].

The results shown in Table (2) demonstrate that improving shooting performance depends not only on practice volume but also on the caliber of the workouts and how well they fit the biomechanical aspects of the talent. The proposed exercises achieved this by synchronizing the execution of movements, providing immediate correction of technical errors, and integrating technical and physical aspects with the biomechanical requirements of a basketball shot [17].

Consequently, the researcher concludes that the proposed training methods enhanced some biomechanical parameters and the shooting accuracy of female students. Compared to the traditional teaching method, these drills demonstrated usefulness to develop technical skills, as shown by the statistically significant differences in favor of the post-test.

Conclusions

1. The proposed training have positively changed in some biokinematic variables related to female students' basketball shooting capabilities, which resulted in an increment in the quality of the technical performance in.
2. The proposed exercises contributed to increased accuracy of shots, through improving on the movement quality and biomechanical efficiency of skills execution.
3. The exercises-based experimental group, who perform the proposed routines, achieved statistically better results for certain bio-kinematic variables and post-test shooting performance compared to the control group.

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4. The phases of movement were more harmoniously coordinated when the exercises were designed to match the technical demands of basketball shooting in a manner that resulted in better execution of skills.
5. The proposed activities proved to be effective in improving female students' technical basketball shooting skills than the traditional mode of teaching..

Recommendations

1. The exercises that were recommended may be used in basketball teaching and training programs to help develop biokinematic variables and enhance shooting performance in female students.
2. More emphasis should be given to analysis of biokinematic factors while instructing and drilling basketball shooting techniques because these factors are critical to optimal technical performance and minimizing errors of motion.
3. To enhance the quality of shooting skill performance, training drills that simulate actual game situations must be employed.
4. It is the recommendation that researchers replicate the study with a larger age group and examine additional basketball skills such as passing, dribbling, and layup shooting.
5. It is suggested that further investigations consider other biokinematic variables and their association with physical and technical performances for the better coaching and training in basketball..

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