Biomechanical, anthropometric, and physical indications as an indicator of the free throw achievement in women's basketball

Instructor : Rahma Mohamed Aly ElNour
Department of Sports Training and Movement Sciences - Faculty of Physical Education for Girls - Alexandria University

Prof. Dr Sozan Salah Eldin Shaaban Tantawy
Full-time Professor of Biomechanics Emeritus- Department of Sports Training and movement Science - Faculty of Physical Education for Girls - Alexandria University

Prof. Dr. Sanaa Abas Ebrahim Hussien
Full-time Professor of Sports Training (Basketball) Emeritus - Department of Sports Training and Movement Sciences - Faculty of Physical Education for Girls - Alexandria University

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Introduction

Women's basketball is a team sport that gained initial prominence in the United States through collegiate competitions and later expanded globally. It is governed internationally by the International Basketball Federation (FIBA), which has organized the Women's World Basketball Championship

Since 1953. This championship was rebranded as the FIBA Women's Basketball World Cup following the 2014 edition. Several professional leagues and international tournaments contribute to the global growth of women's basketball. Among these, the Women's National Basketball Association (WNBA) in North America stands out as a premier professional league. Internationally, the FIBA Women's Basketball World Cup and the Women's Olympic Basketball Tournament feature elite national teams competing at the highest level, with qualification based on performance in continental championships.

At the collegiate level, the NCAA Women's Basketball Championship holds significant popularity, showcasing top-tier teams such as the University of Connecticut (UConn). This season marks a historic moment, as Egyptian player Jana El Alfy, a former player of Egypt's national team and Al Ahly club, joins the team for the first time in its history.

In Europe, the Euro League Women serves as the leading competition for elite clubs, while in Africa, the AfroBasket Women represents the premier continental tournament. Organized biennially by FIBA's African division, AfroBasket Women not only determines the best teams in Africa but also Serves as a qualifier for the FIBA Women's Basketball World Cup and the Women's Olympic Basketball Tournament. The

development and organization of women’s basketball on national and international levels demonstrate its growing significance as a global sport. Through structured competitions and the continuous interest inclusion of talented players, the Egypt women’s basketball continues to elevate its status in the global sporting community.

So, the free throw is considered one of the fundamental shooting skills in basketball for players of all ages and genders. It is distinct from other types of shots, such as two-point and three-point shots, as it is executed individually without defensive interference and must be performed within five seconds. According to the 2022 International Basketball Rules, the free throw is defined as "a chance granted to a player to score one point without defensive opposition, executed from behind the free-throw line.

And the analysis of technical performance in basketball skills is a critical factor in enhancing player performance and achieving optimal results. The free throw, as one of these essential elements, requires scientific analysis to refine its execution and improve players' accuracy rates. The free throw is a unique skill that demands a tailored preparation technique for each player. It relies on automatic and repetitive motion, consistently performed with a specific rhythm and appropriate speed, ensuring improved efficiency and success rates.

This study explores the relationship between biomechanical, anthropometric, and physical indicators and their impact on predicting free throw performance in women’s basketball. It focuses on identifying the key factors influencing technical performance during various phases of the free throw, the objectives of it include:

- Identifying the main biomechanical indicators during the preparatory phase (moment of maximum knee flexion).
- Determining the critical biomechanical factors during the main phase (moment of final contact with the ball).
- Analyzing biomechanical indicators in the follow-through phase (moment of ball release).
- Examining ball release parameters as distinctive predictors of free throw performance.
- Investigating the anthropometric and physical indicators that contribute to enhanced technical performance.

The study employed a descriptive survey method, targeting: Egypt’s national team women basketball players, Data collection was conducted from February 1, 2023, to November 15, 2023, including biomechanical analysis of free throw execution, anthropometric measurements, and physical performance tests

The findings revealed statistically significant correlations between specific biomechanical indicators and the technical performance of the free throw across all phases. These correlations were categorized based on the preparatory, main, and final phases, as well as the skill as a whole, Figure (1), and Key Findings: 1. Preparatory Phase: A positive correlation was observed between the angle of the left wrist joint and the technical performance level at the moment of "ball release.2. Main Phase: Negative correlations were observed between the technical performance level and the angle of the right ankle joint, the angle of the Left hip joint. The lateral potential energy of the body's center of gravity3. Final Phase: A positive correlation was observed between the angle of the right wrist joint (throwing arm) and the technical performance level.4. Skill as a Whole: Positive correlations were observed between the technical performance level and Vertical velocity of the body's center of gravity Resultant velocity of the body's center of gravity, Angle of the left wrist joint. Vertical kinetic energy of the body's center of gravity.

And Resultant kinetic energy of the body's Center of gravity.5.The Relationship between Ball Launch

Indicators and Technical Performance Level Positive Correlation, Figure (2), there is a positive relationship Between the ball maximum height and each of the following the main phase The final phase and The skill as a whole.

Figure (1): Biomechanical Analysis of the Free Throw Skill in Basketball by the Study Sample

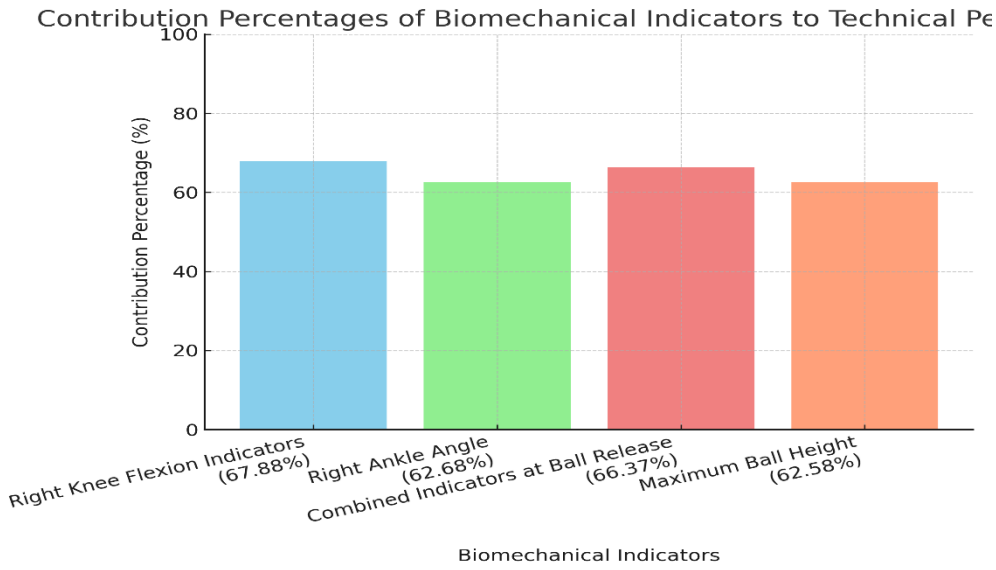
Figure (2): Analysis of Ball Launch Indicators for a Successful Attempt by the Study Sample

he results of the multiple regression analysis of the biomechanical indicators at the moment of (maximum right knee flexion) showed a significant impact on the overall skill performance level, with the contribution percentage of the following variables—right knee joint angle, right hip joint angle, left hip joint angle, vertical impulse of the ball, and resultant impulse of the ball—accounting for (67.88%) of the explained variance in the technical performance level of the skill as a whole.

Regarding the multiple regression analysis at the moment of (end of ball contact), the results revealed that the contribution percentage of the right ankle joint angle variable in explaining the variance in the overall technical performance level of the skill was (62.68%).

In the multiple regression analysis of the biomechanical indicators at the moment of (ball release), the contribution percentage of these indicators, which include the right ankle joint angle, left hip joint angle, and the lateral potential energy of the body's center of gravity, was found to be (66.37%) in explaining the variance in the technical performance level of the skill as a whole.

The study also revealed that the contribution percentage of the maximum ball height indicator in explaining the variance in the overall technical performance level of the skill was (62.58).



Biomechanical Indicators Contribution Chart

The following chart illustrates the contribution percentages of various biomechanical indicators to the overall technical performance level of the skill during free throw execution, shown in different color

The study recommends integrating the predictive equations derived from these findings into training programs to enhance technical performance. Utilizing these models can optimize training processes, refine skills, and improve the overall performance of women's basketball players in competitive settings. Focus on developing motor coordination across all joints involved in the free throw skill. Enhance the kinetic force and resultant velocity of the body's center of gravity. Apply biomechanical principles during training to improve technical performance.

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