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The Effect of Resistance Training with Assisted Means According to Some Biomechanical Indicators on Developing the Accuracy of Smash Hit in Volleyball for Youth

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Abstract

The importance of this research lies in providing resistance training with assisted means for the technical performance, according to some biomechanical indicators, and its impact on the accuracy of the smash hit skill in volleyball, especially for the youth sample, who represent the basic pillar of the game, to ensure their learning of a technical performance based on a scientific basis, for this important skill and achieving more points and its impact on the result. The problem of the research was identified through following up on the developments in volleyball in general and the development of the smash hit skill in particular at the global and Arab levels, and its impact on determining the outcome of the match. The researchers observed that the technical level of this skill does not match the development and that there is a weakness and great fluctuation among young players in the level of accuracy of performance, which the researchers attribute to the lack of attention to improving the physical aspect according to the mechanical principles and rules, which is one of the most important problems facing those responsible for the training process. The objectives of the research were to prepare resistance training with assisted means according to some biomechanical variables to correct the accuracy of the smash hit in volleyball, to identify the statistical differences between the pre- and post-tests among some biomechanical variables to correct the accuracy of the smash hit in volleyball, and to identify the statistical differences between the pre- and post-tests for the accuracy of the smash hit in volleyball.The researchers used the experimental method with a one-group design, which is suitable for the problem to be researched, to complete the research process. The researchers identified the research population intentionally, who are the youth players (from the Volleyball Specialized Center in Dhi Qar Governorate, Shatra District), numbering (16) players, and the research sample was chosen, numbering (8) players, who represent (50%) of the original population. One of the most important conclusions is that the resistance training prepared by the researchers contributed to the development of some biomechanical variables for the smash hit.

Keywords: Resistance Training Biomechanical Variables Spike Skill Accuracy Volleyball Youth Players Technical Performance

Introduction

The remarkable progress and development the world is currently witnessing remains a primary reason for the unprecedented advancements in all areas of life, including sports(David J. Smith, 2003; Lee & Kim, 2016). We now see that this progress and development in sports has been based on scientific principles and theories(Andika et al., 2024; Hinkin, 1995; Steenbok & Walter Gaboinewe, 2024). Through this, some countries have been able to bring athletes to levels and limits that were unattainable in the recent past. The development we are witnessing today is nothing but the result of the creativity of human minds, from coaches and experts to scientists and professors. This development also included the use of many devices and methods. Modern scientific tools help improve motor performance, thus contributing to assessing the success of the training process and serving as an indicator of the athlete's progress(Birrer & Morgan, 2010; Jayanthi et al., 2022; Ojeda-Aravena et al., 2023).

Resistance training is a type of exercise that uses resistance bands or elastic straps to provide resistance during movement(Hughes et al., 2018; Vealey, 2024). Movement helps strengthen muscles and improve flexibility. Among the benefits of resistance training is muscle strengthening, which helps build and strengthen muscles throughout the body, as well as improving flexibility, enhancing body flexibility, and improving range of motion. To build movement on solid foundations that the player understands, it is necessary to utilize biomechanics(El-Rajab et al., 2025; Yan et al., 2023). This science has the highest degree of connection with other sciences, most notably sports training, as it explains the causes of movement and its strengths and weaknesses. The role of modern technologies in measurement is also undeniable. Monitoring the development accompanying each development process.

The smash is an offensive skill that plays a clear and effective role in deciding points in games; therefore, those working in this field strive to improve players' proficiency in performing it, thus raising the overall leve(Eriek Satya Haprabu et al., 2025; Junior, 2019)l. The team's technical performance is enhanced through a variety of offensive skills, including powerful spikes from different areas of the court. This facilitates deceiving the opposing team's defense, such as the block and defensive line, thus enabling easy scoring. To achieve this, training exercises tailored to the development of the tea are essential. The players have different weaknesses, so the researcher resorted to using resistance training exercises(McGill et al., 2014; Micheo et al., 2012).

Hence, the importance of this research lies in providing resistance training exercises with aids to technical performance, according to some biomechanical indicators, and their effect on the accuracy of the volleyball spike skill, especially on a sample of young people who represent the main pillar of the game. To ensure they learn a scientifically based technical approach to this important skill, leading to higher scores and impacting the final result.

Research Problem

By following the latest developments in volleyball in general and the developments in... The smashing skill, in particular, is highly valued at the global and Arab levels due to its decisive impact on match results. Researchers have observed that the technical level of this skill is not keeping pace with developments, and that there is significant weakness and inconsistency in the accuracy of performance among young players. Researchers attribute this weakness to a lack of Attending to the improvement of the physical aspect according to mechanical principles and rules is one of the most important problems facing those involved in the training process. It is worth noting here that incorrect timing in the power, trajectory, and duration of the smash during its execution leads to the depletion of the hitting player's energy, which affects The performance of the smashing skill naturally depends on the varying timings of the players, the angles of movement, the speed used, and other biomechanical variables that naturally lead to differences in performance from one player to another. Hence, the researchers decided to study this problem by analyzing this The skill and the extraction of its biomechanical variables through which we can diagnose weaknesses and treat them by preparing counter-resistance exercises using aids based on scientific mechanical principles with ideas that focus on the variables of the smash hit in volleyball.

Research Objectives

1. To develop resistance training exercises using assistive devices, based on certain biomechanical variables, to improve the accuracy of the volleyball spike.

2. To identify statistical differences between pre- and post-tests for certain biomechanical variables in improving the accuracy of the volleyball spike.
3. Identifying the statistical differences between pre- and post-tests of the accuracy of the volleyball spike.

Research hypotheses

1. There are statistically significant differences between the pre- and post-tests of some biomechanical variables in developing the accuracy of the volleyball spike.
2. There are statistically significant differences between the pre- and post-tests of spik accuracy in volleyball.

Research Areas

Human Resources

Young players at the specialized volleyball center in Al-Shatra district, Dhi Qar Governorate.

Timeframe: From 10/8/2025 to 24/12/2025.

Location

The Volleyball Specialty Center Hall in Al-Shatra District, Dhi Qar Governorate.

Materials and Methods

Research Population and Sample:

The researchers chose the research community in a purposive manner, and they represent the youth players (of the specialized volleyball center in Dhi Qar Governorate, Al-Shatra District), whose number is (16) players, and (8) players were chosen who represent the original community at a rate of (50%).

Sample Homogeneity:

To verify sample homogeneity, the researchers performed several procedures to control the variables and ensure homogeneity. Statistical methods were then used, including the arithmetic mean, standard deviation, and coefficient of variation for morphological measurements, to determine the actual variation.

Its absence is illustrated in Table (1).

Table 1. shows the homogeneity of the research sample, which displays values less than 30%.

No.	Body Measurements	Unit of Measurement	Mean (X)	SD (s)	Coefficient of Variation
1	Chronological Age	Month	193.00	5.69	2.94%
2	Training Age	Month	33.12	5.06	15.27%
3	Mass	kg	64.00	6.34	9.90%
4	Height	cm	177.00	8.25	4.66%

Methods and tools used

Methods of Information Collection

Arabic and foreign sources, Personal interviews, Testing and measurement.

Tools and Equipment Used

Measuring tape. A Sony video camera (Japanese made) with a frame rate of 300 frames/second. A Sony video camera (Japanese made) with a frame rate of25 frames per second. A Japanese-made whistle. A medical scale. A Japanese-made Casio calculator. A Dell Ci7 laptop (Irish-made).

Six DVDs. A regulation-size volleyball court. Three volleyballs. 1. Casio electronic stopwatch.

Tests and Variables Used in the Research

The smash accuracy test developed by Haider Shamkhi Jabbar (2009) was used to measure the players' ability to direct the ball accurately during a smash. The test was conducted on a standard volleyball court using three volleyballs, adhesive tape to mark the target accuracy zones measuring 1.5 × 1.5 meters, and a measuring tape to ensure the accuracy of the marked areas. In this test, each player was required to perform the smash according to the official rules of volleyball. Every player was given five attempts, and the results were recorded based on the accuracy of the ball placement in the designated target zones.

Registration

1. If the ball lands in square (A), 5 points
2. If the ball lands in square (B), 3 points
3. If the ball lands within the shaded area, 2 points
4. If the ball lands outside the designated area, 0 points
5. Maximum score for the test: 25 points

Biomechanical variables

1. Knee joint angle: This is the angle between the tibia and femur.
2. Shoulder joint angle: This is the angle between the stump and ulna.
3. Elbow joint angle: This is the angle between the ulna and forearm.
4. Maximum height of the hip joint: This is the vertical distance, the straight line descending from the hip joint to the ground.
5. Launch angle: This is the angle between the horizontal line passing through the hip joint at the moment of launch and the line of the player's center of gravity.

Pilot Study

The researchers conducted the pilot study on Tuesday, August 26, 2025, at 9:00 AM in the hall of the Specialized Volleyball Center in Al-Shatra District, Dhi Qar Governorate, on (4) youth and junior players from the community of the Specialized Volleyball Center. The research was conducted from outside the sample to apply the crushing test, and after a period of (7) days the test was repeated with the same procedures in terms of time and place. The purpose of this experiment was to identify the negative aspects and variables that the work would face, as well as to confirm the following:

1. Establishing the scientific basis for the test.
2. Identifying the appropriate tools and equipment for conducting the tests.
3. Determining the suitable time and place for conducting the tests.
4. Ensuring the adequacy of the support staff.
5. Training the support staff on how to administer the tests.
6. Identifying the difficulties and problems that researchers encounter in administering the tests before implementing them in the main experiment.

Scientific Foundations of the Test:

Validity. To determine the validity of the tests, researchers used face validity (arbitrator validity), which means that the test appears valid on its face because its name relates to the function it is intended to measure (Haider Abdul-Razzaq Kadhim Al-Abadi, 2015). The tests were then presented to... A group of experts and specialists agreed on its validity in measuring what it was designed to measure. This procedure is considered valid in tests, as Mustafa Mahmoud et al. (1990) indicate that a test can be considered valid if it is presented to a number of specialists and they judge that it measures what It was designed to measure it efficiently (Mufti Ibrahim, 1998).

Reliability. In order to calculate the reliability coefficient of tests, the principle of a reliable test must be applied. This principle states that a test gives similar or identical results if administered multiple times under identical conditions (Nader

Mahdi Al-Kayoud and Hisham Amer Alian, 2005). This is done under similar conditions, and researchers have used this principle to calculate... The reliability coefficient (test-retest method) with a time interval between the first and second test (7) days, where the first test was conducted on Tuesday, 8/26/2025 at nine in the morning and was repeated on Tuesday, 9/2/2025 at nine in the morning, on the research sample.

Objectivity. The researchers determined the objectivity coefficient for each skill test by calculating the simple correlation coefficient (Pearson correlation coefficient) between the results of the two judges in the first application conducted during the experiment. The exploratory tests showed high correlation coefficients, indicating the objectivity of the tests used in the research, as shown in Table (3).

Table 2. Shows The Reliability And Objectivity Coefficients Of The Tests.

No	*Test*	Reliability Coefficient	Sig	Objectivity Coefficient	Sig
1	Spike	0.999	0.02	0.999	0.01

The correlation coefficient is significant at the 0.05 level.

Field Research Procedures:

Pre-tests for the Research Sample

The researchers conducted pre-tests for the research group before commencing the training program on Thursday, March 2, 2023, at 9:00 AM (in the Martyr Haider Hall Complete proof), and the measurements (height, mass, and age) were identified. Then the researchers and their assistant team conducted tests on the research sample.

Resistance Exercises

The researchers reviewed sources and references on resistance to antagonism in sports training to obtain effective exercises that meet the research requirements. In order for this information to enrich the researchers and enable them to understand and apply it correctly, the researchers undertook the following: Using one of the scientific research tools, namely the personal interview with officially accredited coaches in the Iraqi Central Federation

The exercises were implemented on Sunday, September 14, 2025, and continued until Sunday, November 9, 2025, for a period of eight weeks, with three training sessions per week (Sunday, Tuesday, Thursday).

The following are some clarifications regarding the compound exercises:

1. The training program la two months (eight weeks).
2. There are three training units per week.
3. The program consists of 24 training units.
4. Training days: Sunday, Tuesday, and Friday mornings.
5. Training method used: High-intensity interval training (HIIT).
6. Average intensity per set for each exercise, applying the principle of progressive intensity.
7. Use the 1-3 wave pattern in the intensity between training units.
8. Observe the scientific principles of training and the relationship between the components of the training load (intensity, volume, and r).
9. Training volumes and rest periods between repetitions and between sets were determined through the second exploratory trial, taking into account the coach's opinion.

Post-tests for the research sample:

The post-test was conducted on the research sample on Tuesday, November 1 2025, after the completion of the methodology application period, which lasted (8) weeks. The researchers ensured that the same conditions as the pre-tests were maintained.

Statistical Methods

The researchers used statistical methods to analyze the results and test the research hypotheses using the statistical package (IBM SPSS Statistics 24). These methods include, Arithmetic mean. Standard deviation. Coefficient of variation. Pearson correlation coefficient. T-test for paired samples. Percentage.

Results and Discussion

Presentation and Analysis of Speed-Strength Results for Pre- and Post-Tests of the Research Group:

Table 3. Shows The Calculated Means, Standard Deviations, And T-Value For The Speed-Strength Values Of The Arms And Legs In The Pre- And Post-Tests Of The Research Group.

Variable	Pre-Test Mean (X)	Pre-Test SD	Post-Test Mean (X)	Post-Test SD	Calculated t-value	Sig.	Result
Spike Accuracy	14.25	2.60	16.87	1.72	2.37	0.030	Significant
Knee Joint Angle	100.00	3.25	92.70	2.39	5.97	0.000	Significant
Shoulder Joint Angle	117.30	3.69	141.30	1.09	7.96	0.000	Significant
Launch Angle	50.36	1.06	73.88	2.03	6.39	0.000	Significant
Elbow Joint Angle	77.77	92.55	75.82	6.49	3.38	0.001	Significant
Maximum Hip Joint Point Height	122.30	2.30	138.80	4.01	4.263	0.000	Significant

Table (4) shows that all variables and the accuracy of the peaceful aiming had significant differences because the sig value is less than 0.05.

A development occurred in the variables through the players adopting the appropriate and correct position before and during the jump and their effective use of counter-resistance aids. There were one or two methods for developing each variable, which were designed with the main objective of Obtaining a starting angle of (90°) or close to this angle is for the purpose of obtaining a suitable vertical distance for the players by measuring it using a variable at the highest point of the hip.

There is also a second reason related to the direction of the thrust force (or the path of the body's center of gravity). The resultant force produced by bending and stretching will be directed vertically upwards. To obtain a force in the vertical direction we aim for, in order to achieve the primary objective, we must achieve this objective. Therefore, we must set the starting angle to (90°), meaning that all the net force will be applied in the vertical direction except for the force of gravity. This force on the body decreases as the body rises higher. Thus, as a preparatory part in the bending and extending process, the resulting jump lifts the player upwards. As a mechanical objective of this force, it will give us two benefits: raising the center of gravity of the body to the highest possible point. This process will not take place unless the starting angle is (90°) so that we can make the force effective in raising the body utilize its full value and no part of it is lost.

The second is the process of transferring this force from the lower limbs to the upper limbs, which is automatically transferred to the ball, i.e. the process of pushing the ground, which gives additional force in pushing the ball. Therefore, the greater the net force, the greater the results we get from the part of the kinetic transfer to the ball.

If the body moves slightly forward during a jump, the ball will most likely move forward before leaving the player's hand. In this case, the ball will go to the back end due to its forward motion, affecting shooting accuracy. Therefore, the player must strive to perform Vertical movement and narrowing of horizontal movement.

The researchers agree with the opinions of many sports training experts who believe that using plyometric exercises is one of the best ways to develop explosive power and, consequently, improve vertical jumping. (Gregorg, 1986). (Schiffe, Jurgen, 2000). (Bastawisi, Ahmed, 1999).

Therefore, researchers believe that the development in the explosive power of the leg muscles, resulting from the use of antagonistic exercises applied to the sample group in a scientifically sound manner, according to the requirements of distributing the correct training load during the specified time period and taking into account the group's ability to apply the exercises, contributed to Reducing the duration of muscle contraction and increasing the speed of performance results in maximal contraction and the highest muscle strength, represented by a strong and rapid upward thrust. This aligns with what Abu Al-Ala Ahmed and Muhammad Hassan Alawi indicated: "The duration of muscle contraction is inversely proportional to

strength; the shorter the contraction period, the greater the strength." Muscle strength increased (Mufti Ibrahim: 1998). This was also confirmed by Mufti Ibrahim, who stated, "The shorter the period of muscle contraction, the greater the muscle strength and the higher the rate of contraction" (Mufti Ibrahim: 1998). Therefore, researchers believe that, in addition to this, there are other factors that contribute to increased jumping ability, such as angle. The body's initial movement and the improvement observed, as well as the improvement in the knee angle at maximum flexion, all contributed to the development of the vertical jump from a standing position in the research sample

Conclusions

1. The resistance training exercises developed by the researchers have contributed to the development of some biomechanical variables for the smash.
2. The resistance training exercises developed by the researchers have contributed to the development of smash accuracy.
3. The assistive devices contributed to the development of some biomechanical variables and the accuracy of the smash.

Recommendations

1. Adopt opposing resistance exercises in the training programs for the national youth team players.
2. Conduct similar studies with other age groups and different training methods, and observe the results.
3. Use the results of the studied variables to compare them with the results of athletes in other countries.

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