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The Effect of a Proposed Training Program Using Plyometric Training on Explosive Power and Blocking Skill in U17 Volleyball Players

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Abstract

The Object of the study aims to identify the effect of a proposed training program utilizing plyometric training on developing explosive power and blocking skill in U17 volleyball players. For this purpose, we used an experimental design with two groups (a control group and an experimental group). The sample consisted of (14) players, with (07) players in each group, affiliated with the Chlef Wilaya Volleyball League for the 2024/2025 sports season. The experimental group underwent plyometric training, while the control group followed conventional training. One of the most significant findings was the success of the proposed training program using plyometric training in developing both blocking skill and explosive power in U17 volleyball players.

1. Introduction

Sports training is a vital and pivotal field within sports science. It prepares individuals physically, skillfully, intellectually, and psychologically to achieve their maximum potential (Salah Saleh Mimar, 2010). In the context of competitive sports, there is a pressing need to develop scientifically sound training programs to ensure optimal performance. Volleyball, specifically, is a team sport that demands a unique combination of high physical and technical abilities to secure victories. This aligns with what Mufti Ibrahim Hammad (2009, p. 68) conveyed from Jürgen Weineck, stating that reaching the highest possible level of physical, technical, tactical, and psychological capabilities necessitates systematic and organized planning of training programs based on scientific principles in modern sports training.

Explosive strength is considered one of the most critical physical attributes in athletic performance, essential for evaluating an athlete's success level and their ability to develop skills (Talha Hossam et al., 2003). In volleyball, explosive strength directly impacts the effectiveness of movements such as jumping for blocking or spiking. Furthermore, the blocking skill constitutes a primary defensive and offensive pillar, requiring complex movement and high response speed to effectively intercept opponent's shots (Hamdi Abdel Moneim, 1986). To achieve excellence in these two attributes, plyometric training has emerged as one of the effective training methods.

Plyometric training aims to increase the explosive power of muscles, based on the principle of concentric contraction immediately following an eccentric contraction of the same muscle group, thereby improving the level of motor performance (Taheri Rabah, 2020). Previous studies, such as the one by Richam Jamal El Din (2018), have shown that plyometric training has a positive and significant impact on developing both explosive strength and blocking skills in volleyball players. Therefore, this study aims to evaluate the effect of a proposed training program, based on plyometric training methods, on developing these two essential attributes in U17 volleyball players.

Based on the preceding discussion, we can formulate the following main research problem:

- What is the extent of the proposed plyometric training program's impact on developing explosive strength and blocking skills in U17 volleyball players?

a) General questions

- ✓ Are there statistically significant differences between the pre-test and post-test results for explosive strength in volleyball players, favoring the post-test, attributable to the proposed plyometric training program?
- ✓ Are there statistically significant differences between the pre-test and post-test results for blocking skills in volleyball players, favoring the post-test, attributable to the proposed plyometric training program?
- ✓ Are there statistically significant differences at the significance level of (0.05) between the mean scores of players in the (post-test - post-test) for the experimental and control groups, favoring the experimental group?

Literature Review

a) Definition of Concepts and Terms:

1. **Plyometric Training:** Both Abu El-Ela Abdel Fattah (1997) and Frank Dick (1980) agree that plyometric practices reflect the significant ability of the neuromuscular system to overcome resistance and body weight with rapid contractile power. This power is characterized by the synchronization and coordination of the stretch-shortening cycle of muscular action resulting from the stretch reflex. This leads to the activation of many additional motor units, followed by a powerful and rapid concentric contraction that achieves maximum propulsion of the body's center of gravity in different directions and more effective execution of movements (Adel Abdel Hamid Al-Fadi, 2016, p. 10).
2. **Blocking Skill:** This is a complex movement performed by one, two, or three players together in the front court, facing or near the net, by jumping upwards and extending one or both arms to intercept the ball sent by the opposing team towards the upper edge of the net (Hamdi Abdel Moneim, 1986).
3. **Explosive Strength:** It is defined as the player's ability to utilize maximum neuromuscular force to overcome external resistances that require high degrees of performance speed and muscle contraction. It is also described as the player's ability to overcome resistances that demand significant degrees of performance speed and muscle contraction (Talha Hossam et al., 2003).

b) Previous and Similar Studies :

1. **Recham Jamal El Din (2018)** "The Effect of Repetitive Plyometric Training on Developing Explosive Strength and Blocking Skills in Female Youth Volleyball Players"**:**

This study aimed to investigate the effect of repetitive plyometric training on developing explosive strength and blocking skills in female youth volleyball players. The results showed statistically significant differences between the pre- and post-measurements in the applied skill tests, favoring the post-measurement. Among the recommendations provided were the necessity of selecting appropriate exercises to develop both explosive strength and blocking skills simultaneously, meaning using exercises that align with the motor pathways of the skill, and attempting to link different training methods in training programs (Richam Jamal El Din, 2018).

2. **Rouini Ahmed (2020)** "The Effect of Using Ballistic Exercises in Plyometric Training to Develop Lower Limb Explosive Strength in Football Players"**:**

This study aimed to identify the effect of using ballistic exercises during plyometric training on developing lower limb explosive strength in football players. For this purpose, an experimental approach was used on a purposive sample of 24 U19 players from the USM Ain Beida team. The sample was divided into two equal groups: experimental and control. To collect data, the Sargent jump test, and the standing long jump test were used. An 8-week program, with two sessions per week, was applied to develop explosive strength. After collecting and statistically processing the results, it was concluded that there were statistically significant differences at the 0.05 significance level in favor of the experimental group in both tests. Based on this, the study recommended integrating ballistic exercises when training for explosive strength development (Rouini Ahmed, 2020).

3. **Ali Abdel Amir Shaima (2024)** "Lower Limb Explosive Strength and Its Relationship to Jumping Shot Skill in Fourth-Year Female Students in Basketball"**:**

This study aimed to determine the degree of lower limb explosive strength in the research sample and the relationship between lower limb explosive strength and jumping talent in basketball. The researchers reached several conclusions, including that explosive strength is an important factor for learning the jumping shot skill in basketball, and there is a strong positive relationship between lower limb explosive

strength and the jumping shot skill in basketball. The most important recommendations made by the researchers were: the necessity of focusing on the physical fitness of female students and emphasizing muscular strength elements in general and explosive strength in particular, relying on different training methods to develop lower limb explosive strength, and conducting similar studies and research on other physical abilities (Ali Abdel Amir Shaima, 2024).

2. Method and Materials

- **Research Design**

This study adopted an experimental design with two equivalent groups (experimental and control) featuring pre-tests and post-tests, due to its suitability for the nature and problem of the research.

2.1. Participants

- **Study Population**

The research population was defined as players registered in the Chlef Governorate Volleyball Championship for the 2024/2025 sports season. The total number of clubs was (05), comprising (98) players in the U17 category.

- **Study Sample**

The study sample was purposefully selected from the Chlef Volleyball Club (POC), consisting of (14) players. The researchers randomly divided them into two equal groups (experimental and control), with each group comprising (07) players.

2.2. Materials

The teaching materials used in the current study …

2.3. Design and Procedure

- **Delimitations of the Study**

a) Human Scope:

The study was conducted practically on U17 players from the Chlef Volleyball Club (POC).

b) Spatial Scope:

The study took place at the Martyr M'hamed Naciri Multi-Sport Hall in Chlef.

c) Temporal Scope

The study was conducted during the period extending from September to the end of October of the 2024/2025 sports season. The pre-test for the experimental group was conducted on Friday, September 6, 2024, and for the control group on Saturday, September 7, 2024. Subsequently, the plyometric training program was applied to the experimental group from September 12, 2024, until October 26, 2024. The post-tests were then applied consecutively, with the experimental group tested on October 28, 2024, and the control group on October 29, 2024.

d) Physical Tests used in the study:

1. Sargent Vertical Jump Test

The purpose of this test is to measure the muscular power of the legs in vertical jumping (explosive strength of the lower limbs) (Edgar Thill-Raymond Thomas, 2003, p. 196).

2. Specific Test for Measuring Blocking Skill

The purpose of this test is to measure the blocking skill of volleyball players (Marwan Abdel Majid Ibrahim, 1994).

Pilot Study

A pilot study was conducted on a group of (05) players registered with the Chlef Governorate Volleyball League for the 2024/2025 sports season. These players were part of the original study population but outside the research sample.

The objectives of the pilot study were:

-To determine the components of the training load.

-To provide practical training for the researcher and assisting staff, identifying and overcoming potential difficulties related to equipment, tools, and devices during test application.

-To gain initial familiarity with the timing of the tests used in the research and assess the suitability of the field for testing.

Psychometric Properties

Table 1: This table displays the reliability and validity coefficients for the tests used in the study.

Variables	Sample	Reliability Coefficient	Validity Coefficient	Degrees of Freedom (df 1)	Significance Level
Sargent Test	05	0.942	0.970	04	0.05
Blocking Skill Test		0.845	0.919		

As shown in the table above, the reliability coefficients for all tests were notably high. The lowest obtained value was 0.845, while the highest reached 0.942. Regarding self-validity (or internal validity), the tests also demonstrated a high degree of this characteristic.
To avoid variables that might affect research results and individual differences among players, and to achieve homogeneity between the two study groups:

Table 02: this table represents the homogeneity between the experimental group and the control group in the results of anthropometric measurements. The critical Student's "t" value from the table at a significance level of (0.05) and degrees of freedom (12) was estimated at 2.17.

Axes / Measurements	Unit of Measurement	Experimental Group		Control Group		Calculated t-value (tcalc)	Critical t-value (tcrit)	Degrees of Freedom (df)	Statistical Significance
		S	A	S	A				
Height	cm	175.36	6.77	175.96	6.60	0.31	2.17	12	Not Significant
Weight	kg	69.25	15.51	68.99	12.45	0.10			Not Significant
Age	year	16.38	0.16	16.85	1.19	0.25			Not Significant
Training Age	year	6.5	0.27	6.45	0.18	0.50			Not Significant

Table 02 demonstrates the homogeneity of the research sample members in the variables (height, weight, age, training age), indicating no significant differences. The calculated "t" values ranged between (0.10 and 0.50), and these values are smaller than the critical "t" value of 2.22, which confirms the homogeneity of the anthropometric measurements for both study samples.

Table 03: Equivalence Between Experimental and Control Groups (Pre-Tests)

Table 03 represents the equivalence between the experimental and control groups, based on the researchers' analysis of the pre-test results for all utilized tests.

Axes / Tests	Unit of Measurement	Experimental Group		Control Group		Calculated t-value (tcalc)	Critical t-value (tcrit)	Statistical Significance
		Mean	Standard Deviation	Mean	Standard Deviation			
Sargent Test	Centimeter (cm)	43.02	0.54	42.36	1.25	0.61	2.17	Not Significant
Blocking Skill Test	Frequency	3.25	1.25	3.94	2.87	0.28		Not Significant

Source: Prepared by the researchers at a significance level of 0.05 with a critical t-value of 2.17.

Table 03 (referring to the text's internal consistency, likely meant to be "Table 03" as per the heading) illustrates the equivalence of the two study groups in the physical tests used. The calculated "t" values ranged between (0.28) and (0.61) at a significance level of (0.05). All these values are smaller than the critical "t" value, which was estimated at (2.17), indicating no statistically significant differences. This confirms the high degree of equivalence between the two study groups.

2.4. Statistical Analysis

Data was analyzed using SPSS version 25 (Statistical Package for the Social Sciences) to calculate the following: Mean, Standard Deviation, Pearson Correlation Coefficient, T-test.

3. Results

a. There are statistically significant differences at the significance level (0.05) between the mean scores of volleyball players for explosive strength between the pre-test and post-test, favoring the post-test, attributable to the proposed training program based on plyometric training methods.

1. Presentation and Analysis of Sargent Test Results for Explosive Strength

Table 04: This table shows the level of statistical significance of differences in explosive strength (Sargent test) between the pre-test and post-test results for both the experimental and control groups.

Test	Experimental Group		Control Group		Degrees of Freedom (df)	Significance Level	Calculated t-value (tcalc)	Critical t-value (tcrit)	Significance of Differences
	S	A	S	A					
Pre-test	43.02	0.54	42.36	1.25	06	0.05	7.05	2.44	Statistically Significant
Post-test	49.25	0.23	43.28	0.61			2.35		Not Statistically Significant

Source: Prepared by the researchers at a significance level of 0.05 with a critical t-value of 2.44.

b. There are statistically significant differences at the significance level (0.05) between the mean scores of volleyball players for blocking skills between the pre-test and post-test, favoring the post-test, attributable to the proposed training program based on plyometric training methods.

2. Presentation and Analysis of Blocking Skill Test Results

Table 05: This table illustrates the level of statistical significance of differences in the blocking skill test results between the pre-test and post-test for both the experimental and control groups.

Test	Experimental Group		Control Group		Degrees of Freedom (df)	Significance Level	Calculated t-value (tcalc)	Critical t-value (tcrit)	Significance of Differences
	S	A	S	A					
Pre-test	3.25	1.25	3.94	2.87	06	0.05	5.08	2.44	Statistically Significant
Post-test	7.26	0.71	4.28	1.25			1.67		Not Statistically Significant

Source: Prepared by the researchers at a significance level of 0.05 with a critical t-value of 2.44.

✓ **Comparison Between Experimental and Control Groups (Post-Tests)**

Table 6 reveals that both groups **Table 06:** This table represents the significance of differences between the post-test means for the experimental group and the control group across all utilized tests.

Axes / Tests	Unit of Measurement	Experimental Group		Control Group		Calculated t-value (tcalc)	Critical t-value (tcrit)	Statistical Significance
		Mean	Standard Deviation	Mean	Standard Deviation			
Sargent Test	Centimeter (cm)	49.25	0.23	43.28	0.61	4.28	2.17	Statistically Significant
Blocking Skill Test	Frequency	7.26	0.71	4.28	1.25	9.25		Statistically Significant

Source: Prepared by the researchers at a significance level of 0.05 with a critical t-value of 2.17.

4. Discussion

✓ Discussion of Table 4: **Explosive Strength (Sargent Test)**

Table 4 presents the statistical results for the experimental group in the pre-test of explosive strength (Sargent test). The mean value was 43.02 with a standard deviation of 0.54. For the post-test, the mean value was 49.25 with a standard deviation of 0.23. The calculated t-value was 7.05, which is greater than the critical t-value of 2.44 at a significant level of 0.05. This indicates statistically significant differences favoring the post-test for the experimental group in the explosive strength (Sargent test) between the pre- and post-test results for U17 volleyball players.

These findings align with the study by Shadi Abdel Razzaq (2019), which concluded that plyometric exercises have an effective impact on the lower limb explosive strength of U19 handball players, and a greater effective impact than conventional exercises in developing lower limb explosive strength. This is further supported by Issam El-Woshahy (1993, p. 128), who emphasized that increasing a volleyball player's explosive strength leads to an increase in the power of muscle groups. This increase requires a type of coordination and harmony between the gained muscular strength in the working muscle groups and the ability to control the ball precisely to achieve the desired outcomes and good performance. Furthermore, it was evident that there were no statistically significant differences favoring the

post-test for the control group in the explosive strength (Sargent test) between the pre- and post-test results for U17 volleyball players.

- ✓ Discussion of Table 5 : **Blocking Skill**

Table 5 presents the statistical results for the experimental group in the pre-test of blocking skill. The mean value was 3.25 with a standard deviation of 1.25. For the post-test, the mean value was 7.26 with a standard deviation of 0.71. The calculated t-value was 5.08, which is greater than the critical t-value of 2.44 at a significant level of 0.05. This indicates statistically significant differences favoring the post-test for the experimental group in blocking skill among U17 volleyball players.

These results are consistent with the study by Recham Jamal El Din (2018), "The Effect of Repetitive Plyometric Training on Developing Explosive Strength and Blocking Skills in Female Youth Volleyball Players," which found that repetitive plyometric training positively affected the development of explosive strength and blocking skills in youth female volleyball players. This is corroborated by Mohamed Ali Ahmed (1999, p. 13), who stated that the success of training programs is measured by the progress an athlete achieves in their practiced activity through skill and physical levels, which depends on the individual's adaptation to the proposed training program. Additionally, it was evident that there were no statistically significant differences favoring the post-test for the control group in blocking skill among U17 volleyball players.

- ✓ **Discussion of Table 6: Comparison Between Experimental and Control Groups (Post-Tests)**

Table 6 reveals that both groups showed improvement in their post-test results. However, the experimental group, which utilized the plyometric training method, demonstrated superior performance. This confirms the third sub-hypothesis, which posited statistically significant differences between the (post-test - post-test) results of the two groups, favoring the experimental group.

The researchers attribute this superiority in the post-tests for the experimental group to the application of the proposed plyometric training program by the researchers. This aligns with Hassan Ali Karim's assertion that plyometric training has a positive and effective role in improving and developing explosive strength. This is further supported by completed studies such as Salman Mahdi Al-Obaidi (2011), who found that plyometric training methods have a significant positive impact on various functional systems of an athlete's body. The positive effect is largely on the muscular

system, followed by a transition to the physiological aspect, where it influences the functional efficiency of the nervous system by increasing the rate of nerve impulse transmission to various working muscle groups, thereby contributing to the development and improvement of explosive strength.

5. Conclusion

In conclusion, this study aimed to address a series of questions focused on revealing the impact of plyometric training on explosive strength and blocking skills in volleyball players, as well as emphasizing the reliance on scientific principles in constructing training programs. Through the discussion and analysis of the results presented, we diligently sought to demonstrate the extent to which plyometric training influences the development of explosive strength and blocking skills in volleyball players.
The findings indicate that the proposed program, utilizing plyometric training methods, achieved significant development in both explosive strength and blocking skills among U17 volleyball players, favoring the post-measurement of the experimental group. Finally, it can be stated that the obtained results open new avenues for future research in this fertile field across various disciplines and different age categories.

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