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The Effect of a Proposed Plyometric Training Program on Improving Explosive Power and Long Jump Performance in the U18 Category.

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Abstract

This study aimed to evaluate the effect of a proposed training program using plyometric training on improving explosive power and long jump performance levels among U18 athletes. The field study was conducted in the Wilaya Athletics League clubs at the level of Chlef province, where the study sample was purposively selected from the original study population, consisting of 10 U18 long jump athletes, representing 62.5% of the research population after excluding (06) athletes. The sample was randomly divided into two groups: an experimental group and a control group, with 5 athletes in each group.

In the overall field study, it was necessary to rely on a specific methodology in addition to identifying a suitable tool for data collection that serves the study topic. It was relied on an experimental method to suit the nature of the study. The data collection tool was embodied in the physical tests performed, i.e., the post-tests of the experiment. After data processing, results analysis, and discussion, it was concluded that the experimental group, which underwent the training program using plyometric training, showed a positive effect in developing and improving explosive power and long jump performance levels among U18 athletes.

Keywords: Plyometric training, explosive power, long jump.

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1-1-Introduction and Research Problem:

Athletics encompasses a diverse range of competitions, including track events like walking and running, and field events such as throwing, jumping, and vaulting. Athletics is considered a fundamental sport in many countries, contributing significantly to individual physical, mental, and scientific well-being. It is an ancient sport and is often referred to as the "Queen of Olympic Sports."

From a physical perspective, athletics combines strength, speed, and endurance, which are essential components of overall physical fitness. To excel in athletics, athletes must possess these qualities to varying degrees. This can only be achieved through consistent daily training while also considering other physical factors.

Evaluating physical abilities during the physical preparation phase allows coaches to assess the progress of the training program and the effectiveness of the training load. This is crucial for both coaches and athletes, as it guides the athlete towards achieving the necessary physical fitness level for their specialization.

Plyometric training is an effective method for many athletic disciplines that require high-level performance. It involves combining maximum muscle force with maximum movement speed to achieve high levels of power output. This is particularly important when developing explosive leg power.

Furthermore, athletics competitions offer objective measures of performance, as athletes are evaluated against established standards. This self-assessment is a key advantage compared to other sports where subjective judgments by officials can sometimes influence the outcome, such as in wrestling, boxing, and football (Hridi, 1998, p. 12). Therefore, implementing effective training programs is crucial for achieving optimal results in athletics, especially in long jump.

This problem has dominated the Algerian sports scene and clubs due to the absence of a standardized assessment of physical abilities during training for runners, overlooking age-appropriate progression, and the random application of modern training methods, principles, and methodologies without proper adherence. There has also been a lack of regulation in training loads aimed at enhancing athlete performance. This necessitates a practical reassessment of training planning in athletics to align with international standards. Those involved in this field must focus on providing the necessary infrastructure and support to give athletes a new impetus and improve their performance in this specialization. Hence, the following general question arises: Does the proposed plyometric training program improve explosive power and long jump performance in the 18U category?

1-2-Research Questions:

1-Does plyometric training affect the development of explosive power in the 18U category?

2-Does plyometric training improve long jump performance in the 18U category?

3-Are there statistically significant differences between the experimental and control groups in the post-test?

1-3-Hypotheses:

1-3-1-General Hypothesis:

There are statistically significant differences between the pre-test and post-test in terms of explosive power and long jump performance in the 18U category, favoring the post-test.

1-3-2-Partial Hypotheses:

1-There are statistically significant differences in the vertical jump test between the pre-test and post-test for the experimental group, favoring the post-test in 18U players.

2-There are statistically significant differences in the long jump test between the pre-test and post-test for the experimental group, favoring the post-test in 18U players.

3-There are statistically significant differences between the experimental and control groups in the post-test, favoring the experimental group.

1-4-Research Objectives:

1-To determine the effect of plyometric training on improving explosive power in 18U athletes.

2-To determine the effect of plyometric training on improving long jump performance in 18U athletes.

Absolutely! Here's the English translation of the provided text:

1-5-Definition of Terms:

Training Program: A training program is defined as "an activity that involves formulating a program name, selecting program elements including its objectives, content, methods, techniques used, and choosing trainers and trainees" (Qasim Jameel, 1999, p. 100).

Plyometric Training: A training method that enables muscles and connective tissues to exhibit rapid force to produce maximum work in horizontal, vertical, and lateral sports movements. Plyometric training is a crucial method used in training to increase the ability to increase speed in performance, sudden changes, and rapid movements during matches, as well as to increase the level of power and explosive force produced and the muscles' ability to contract rapidly (Bompa.T, 2003, p. 58).

Explosive Power: As understood by "Hara," explosive power is defined as the ability of the neuromuscular system to overcome resistance that requires a high degree of contraction. It is important in developing muscle strength and is achieved through explosive force (i.e., muscle contraction) with rapid tension (Qasim Hassan Hussein and Ali Nasif, 1987, p. 320). According to "Wienecke," it is defined as the ability to achieve the greatest increase in force in the shortest possible time. This depends on the contraction of motor units, which consist of fast muscle fibers, their number, and their participation in muscle contraction (J. Wienecke, 1997, p. 228).

Long Jump: Long jump in sports is a competition involving jumping the maximum possible distance from a single leg starting point to a designated landing area. Long jump is considered a track and field event and is characterized by the ability to combine strength and technique. Long jumps are usually performed by athletes using a suitable track with a landing area containing sand or a soft surface to absorb shock. The athlete prepares by starting from a specific point on the track and

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running at high speed to increase momentum, then performs a long jump with precise timing to launch from the landing site.

1-6-Similar Previous Studies:

Study by El Aidani Hakim (2017): This study aimed to demonstrate the importance of plyometric training on muscle strength and the performance of the jump shot in handball. The researchers adopted a single-group design and conducted the study on a sample of 14 U17 handball players from the "Chabab El Qadir " youth team in the Bouira Province League. After implementing plyometric training exercises and collecting pre-test and post-test results for explosive power, speed strength, and jump shot performance, the researchers statistically analyzed the data using mean, standard deviation, Pearson correlation coefficient, and the t-test. The results showed that plyometric training improves explosive power, speed strength, and consequently contributes to the development of jump shot performance. Based on these findings, the researchers recommended that coaches encourage the use of plyometric training due to its significant importance in developing physical and technical aspects. They also emphasized the need to link physical and kinetic abilities with the performance of various skills in handball, and to include plyometric training exercises to develop explosive power and speed strength due to the importance of these abilities in many skills.

Study by Hamish Zakaria (2023): This study aims to determine the effect of plyometric training on lower limb explosive power. The researcher used the experimental method with an equivalent groups design (control and experimental). The study sample consisted of 24 players divided into two groups: a control group of 12 players who followed a traditional program prepared by their coach and an experimental group of 12 players who underwent a plyometric training program. The study sample included players under 19 years of age who participate in the first regional division of central football. The Sargent jump test, known for its high validity and objectivity, was administered. After conducting pre-tests for both groups, the plyometric training program prepared by the researcher was implemented for 6 weeks, with 3 training sessions per week, each lasting 1.5 hours. After completing the training units, post-tests were conducted for both groups. Data analysis involved comparing post-test results, which showed statistically significant differences. The results confirmed that the plyometric training program yielded positive results in the Sargent jump test for players in the group that used the program prepared by the researcher, with significant differences compared to the control group that followed the traditional program. The results of this research are considered beneficial for coaches, physical fitness specialists, and any player seeking to improve lower limb explosive power during the competitive phase through the use of plyometric exercises.

Study by Hussein Ben Zeidan (2018): This research aims to identify the effect of using certain plyometric exercises in improving explosive power and performance in the long jump event for students. The researchers used the experimental method due to its suitability for the nature of the research. The sample consisted of 60 students from the Institute of Physical Education and Sports at the University of Mostaganem (Algeria) during the 2015/2016 academic year. 60 students specializing in athletics were selected and divided into two equal groups. The tests used included the standing broad jump, the standing vertical jump, and the long jump performance test. After statistical analysis of the raw data, the researchers concluded that the use of plyometric exercises in practical lessons led to an improvement in leg explosive power and long jump performance between pre-test

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and post-test in favor of the post-test, in addition to the experimental group outperforming the control group in test results. This indeed confirms the effectiveness of using plyometric exercises during instruction with students, leading to improved performance in the experimental group.

2-1-Population and Sample:

The study population was purposively selected from track and field athletes specializing in the long jump in the Chlef province. The population size was 16 athletes. Ten athletes were randomly selected (62.5%) from the research population after excluding six athletes. These ten athletes were randomly divided into two groups: an experimental group and a control group, with five athletes in each.

2-2-Physical Tests Used:

The researchers used the following measurement tools:

-Vertical jump test (Sargent) - measured in centimeters(cm).

-Long jump test - measured in meters(m).

2-3-Pilot Study:

A pilot study was conducted on a sample of four athletes from the Chlef regional track and field association, selected from the study population. The results of the pilot study were excluded from the main study. The purpose of this pilot study was to determine the suitability of the tests to be used in the main study and to assess the reliability, validity, and objectivity of the tests. The objectives of this pilot study included:

Controlling and determining the necessary tools for conducting the tests.

2-4-Methodology:

An experimental method was adopted in this study. This method involves manipulating one variable to observe its effect on another variable while controlling all other variables. The researcher who designs an experimental study manipulates independent variables and controls other variables to determine the causal relationships between these variables and other variables in the phenomenon. The basic idea of experimental research, in its simplest form, is related to the law of the single variable. If two situations are the same in all respects, and then a specific element is added to one situation but not the other, any change or difference that appears after that between the two situations is attributed to the presence of this added element. Similarly, if two situations are similar and an element is removed from one of them without the other, any change or difference that appears between the two situations is attributed to the absence of this element. The variable that the researcher intentionally manipulates in a specific and organized manner in the experiment is called the independent variable or experimental variable. The type of action or behavior resulting from the independent variable is called the dependent variable. An experiment, in its simplest form, includes at least one independent variable and one dependent variable. The experiment can include more than one independent variable and more than one dependent variable (Mahmoud Kazim Mahmoud Al-Nimri, 2013, pp. 24-25).

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The experimental method is considered an attempt to control all the basic factors affecting the dependent variable(s) in the experiment, except for one factor that the researcher manipulates and changes in a specific way to determine and measure its effect on the dependent variable(s). It is based on the scientific experimental method that reveals the causal relationships between the different variables that interact with the dynamics or forces occurring in the experimental situation (Boudaoud Abdel-Alim and Atta Allah Ahmed, 2009, p. 137).

2-5-Sample:

Five individuals were included in each group: the control group and the experimental group.

Table No. (01): Represents the homogeneity between the experimental group and the control group in the results of anthropometric measurements.

Axes / Measurements	Unit of Measurement	Experimental Group		Control Group		Calculated T	Critical T	Degree of Freedom	Statistical Significance
		C	A	C	A				
Height	(cm)	174.97	6.77	175.96	6.60	0.31	1.86	8	Non-function
Weight	(kg)	66.8	14.51	67.1	12.54	0.10			Non-function
Age	Year	17.15	0.16	17.05	1.19	1.25			Non-function
Training Age	Year	6.5	0.27	6.45	0.18	0.50			Non-function

At a significance level of 0.05 and with degrees of freedom of 2n-2 = 8, the critical t-value is 1.86. Table 1 shows the homogeneity of the research sample in terms of the variables (height, weight, age, training age). There were no significant differences, as the calculated t-values ranged between 0.10 and 1.25. These values are smaller than the critical t-value of 1.86, confirming the homogeneity of the anthropometric measurements between the study samples.

3-Scientific Foundations of Tests (Psychometric Measurements):

Stastical Scale / Test	Reliability Coefficient	Ratify Coefficient
Vertical Jump Test (cm)	0.94	0.97
Long Jump Test (m)	0.82	0.90

Table No. (02): Represents the reliability and validity coefficients of the physical tests used.

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3-1-Reliability and Validity of the Test: As shown in Table 2, the reliability coefficient values were 0.82 and 0.94. To ensure the validity of the test, content validity was used, which is calculated by taking the square root of the reliability coefficient, with the lowest value being 0.90 and the highest value being 0.97. This statistical result confirms the high degree of reliability and validity of the tests used.

3-2-Main Experiment: Training sessions were conducted on Friday and Saturday mornings, which are official times for practicing athletics for the research sample, according to the program. A program was prepared that included a set of plyometric exercises to develop explosive power among track and field athletes in the Chlef region. A total of 12 training sessions were proposed, each with its specific objective, starting from January 16, 2022, until February 20, 2022.

4-Presentation and Analysis of the Study Results:

4-1- Presentation and Analysis of the Equivalence between the Experimental Group and the Control Group in the Results of Physical Tests:

Table No. (03): Represents the equivalence between the experimental and control groups based on the pre-test results for all tests used.

Axes / Test	Unit of Measurement	Experimental Group		Control Group		Calculated T	Critical T	Statistical Significance
		C	A	C	A			
Vertical Jump	(cm)	47.6	1.60	48.11	1.55	0.54	1.86	Non-function
Long Jump	(m)	4.71	2.36	4.60	1.54	0.68		Non-function

With a degree of freedom of 2n-2=8 and a significance level of 0.05, the critical t-value is 1.86.

Table 3 shows the equivalence of the study groups in the physical tests used, as the calculated t-value was less than the estimated critical t-value (1.86) at a significance level of 0.05. This indicates that there were no significant differences, confirming the equivalence of the study groups in the physical tests used.

4-2-Presentation and Analysis of the Results of the Vertical Jump Test (Sargent) for the Experimental and Control Groups:

Table No. (04): shows the level of significance of the statistical differences in the vertical jump test between the pre-test and post-test results for the experimental group.

Test	Arithmetic Mean	Standard Deviation	Sample Size	Degree of Freedom	Significance Level	Calculated T	Critical T	Significance of Differences
Pre-test	47.6	1.6	05	04	0.05	11.14	2.13	Statistically Insignificant
Post-test	84.21	0.93						

Source: Prepared by the researcher.

At a significance level of 0.05 and with a degree of freedom of n-1=4, the critical t-value is 2.13.

Table 4 shows the statistical results for the experimental group in the pre-test for the vertical jump test (Sargent test), where the arithmetic mean was 47.6 and the standard deviation was 1.6. For the post-test, the arithmetic mean was 84.21 and the standard deviation was 0.93. The calculated t-value (11.14) was greater than the critical t-value (2.13) at a degree of freedom of 4 and a significance level of 0.05. This indicates that there is a significant difference in favor of the experimental group between the pre-test and post-test for the vertical jump test.

Table No. (05): Shows the level of significance of the statistical differences in the vertical jump test between the pre-test and post-test results for the control group.

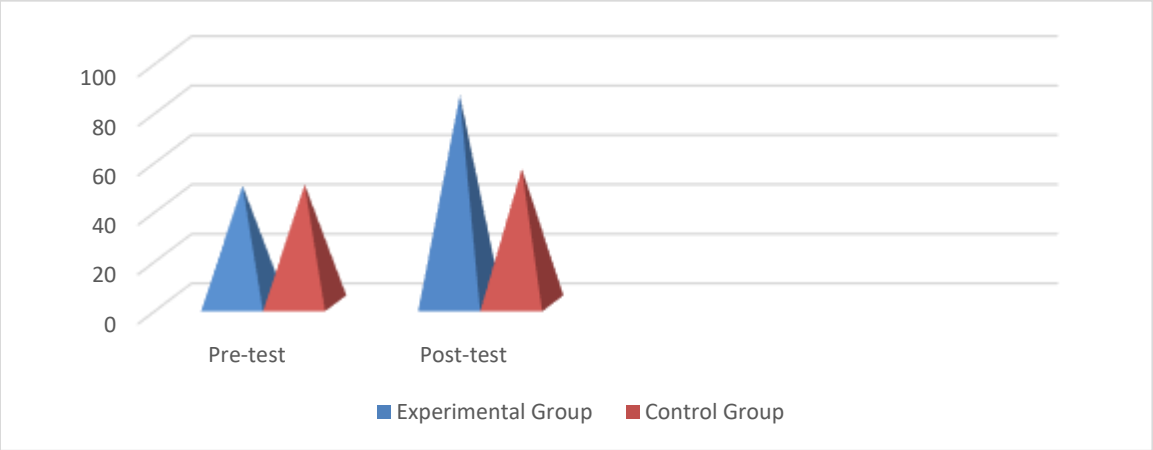
Test	Arithmetic Mean	Standard Deviation	Sample Size	Degree of Freedom	Significance Level	Calculated T	Critical T	Significance of Differences
Pre-test	48.11	1.55	05	04	0.05	0.94	2.13	Statistically Insignificant
Post-test	54.4	0.65						

Source: Prepared by the researcher.

At a significance level of 0.05 and with a degree of freedom of n-1=4, the critical t-value is 2.13.

Table 5 shows the statistical results for the control group in the pre-test for the vertical jump test (Sargent test), where the arithmetic mean was 48.11 and the standard deviation was 1.55. For the post-test, the arithmetic mean was 54.4 and the standard deviation was 0.65. The calculated t-value (0.94) was less than the critical t-value (2.13) at a degree of freedom of 4 and a significance level of 0.05. This indicates that there is no significant difference in favor of the control group between the pre-test and post-test for the vertical jump test.

Figure 1: Graphical representation of the mean scores in the vertical jump (Sargent) test for both the experimental and control groups.



4-3--Discussion and Interpretation of the Results of the First Hypothesis:

As shown in Tables 4 and 5, the statistical results for the control and experimental groups in the pre-test and post-test of the vertical jump (Sargent test), there is a significant difference between the pre-test and post-test for the experimental group. The researchers attribute this improvement to the plyometric training method applied in the training program for the experimental group, and the absence of differences between the pre-test and post-test for the control group, which relied on the traditional training method.

This study agrees with the results of Hamish Zakaria's study (2023), which aimed to determine the effect of plyometric training on lower limb explosive power. The results showed significant differences in the experimental group in the lower limb explosive power test due to the training method used.

Therefore, the first hypothesis is confirmed, as there is a significant difference in the vertical jump test (Sargent test) between the pre-test and post-test for the experimental group in favor of the post-test in U18 players.

4-4Presentation and Analysis of the Results of the Long Jump Test for the Experimental and Control Groups:

Table No. (06): shows the level of significance of the statistical differences in the long jump test between the pre-test and post-test results for the experimental group.

Test	Arithmetic Mean	Standard Deviation	Sample Size	Degree of Freedom	Significance Level	Calculated T	Critical T	Significance of Differences
Pre-test	4.71	2.36	05	04	0.05	8.15	2.13	Statistically

Post-test	5.46	1.20						Significant

Source: Prepared by the researcher.

At a significance level of 0.05 and with a degree of freedom of n-1=4, the critical t-value is 2.13.

Table 6 shows the statistical results for the experimental group in the pre-test for the long jump test, where the arithmetic mean was 4.71 and the standard deviation was 2.36. For the post-test, the arithmetic mean was 5.46 and the standard deviation was 1.20. The calculated t-value (8.15) was greater than the critical t-value (2.13) at a degree of freedom of 4 and a significance level of 0.05. This indicates that there is a significant difference in favor of the experimental group between the pre-test and post-test for the long jump test.

Table No. (07): Shows the level of significance of the statistical differences in the long jump test between the pre-test and post-test results for the control group.

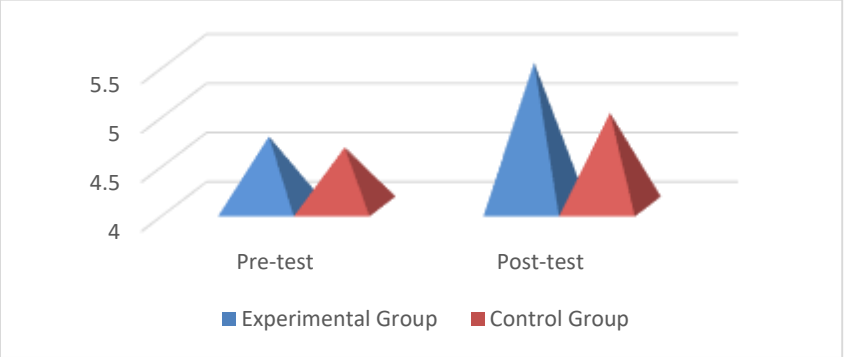
Test	Arithmetic Mean	Standard Deviation	Sample Size	Degree of Freedom	Significance Level	Calculated T	Critical T	Significance of Differences
Pre-test	4.60	1.54	05	04	0.05	1.14	2.13	Statistically Insignificant
Post-test	4.95	2.87						

Source: Prepared by the researcher.

At a significance level of 0.05 and with a degree of freedom of n-1=4, the critical t-value is 2.13.

Table 7 shows the statistical results for the control group in the pre-test for the long jump test, where the arithmetic mean was 4.60 and the standard deviation was 1.54. For the post-test, the arithmetic mean was 4.95 and the standard deviation was 2.87. The calculated t-value (1.14) was less than the critical t-value (2.13) at a degree of freedom of 4 and a significance level of 0.05. This indicates that there is no significant difference in favor of the control group between the pre-test and post-test for the long jump test.

Figure 2: Graphical representation of the mean scores in the long jump test for both the experimental and control groups.



4-5-Discussion and Interpretation of the Results of the Second Hypothesis:

As shown in Tables 6 and 7, the statistical results for the control and experimental groups in the pre-test and post-test for the long jump test, there is a significant difference between the pre-test and post-test for the experimental group. The researchers attribute this improvement to the plyometric training method applied in the training program for the experimental group, and the absence of differences between the pre-test and post-test for the control group.

This study agrees with the results of Hussein Ben Zeidan's study (2018) on the impact of plyometric training on improving explosive power and performance in the long jump. The results showed significant differences in the experimental group in terms of explosive power and long jump performance. Forer M (2003) also indicated that plyometric training develops and enhances strength in a short period of time and ensures high speed. Therefore, the speed applied during the execution of movements remains high, even if the mass of the moving body is large. As seen previously, the use of this process can be observed in a fighter who relies on natural movement.

Therefore, the second hypothesis is confirmed, as there is a significant difference in the long jump test between the pre-test and post-test for the experimental group in favor of the post-test in U18 players.

4-6-Presentation and Analysis of the Results of the Third Hypothesis:

There is a significant difference between the experimental and control groups in the post-test in favor of the experimental group.

Table No. (08): Shows the level of significance of the statistical differences between the experimental and control groups for the post-test of the physical tests used.

Axes / Exams	Unit of Measurement	Experimental Group		Control Group		Calculated T	Critical T	Statistical Significance
		C	A	C	A			
Vertical Jump	(cm)	84.21	0.93	54.4	0.65	3.25	1.86	Function
Long Jump	(m)	5.46	1.20	4.95	2.87	2.68		Function

Source: Prepared by the researcher.

At a significance level of 0.05 and with a degree of freedom of 2n-2=8, the critical t-value is 1.86.

As shown in Table 8, the statistical results for the post-tests of both the experimental and control groups, the calculated t-value for the experimental group in the vertical jump test was 11.14, which is greater than the critical t-value of 1.86. This indicates a significant difference in favor of the experimental group, suggesting that the plyometric training program was effective in improving

vertical jump performance. For the control group in the vertical jump test, the calculated t-value was 0.94, which is less than the critical t-value, indicating no significant difference.

Similarly, for the long jump test, the calculated t-value for the experimental group was 8.15, which is greater than the tabulated t-value, indicating a significant improvement. However, for the control group, the calculated t-value was 1.14, which is less than the tabulated t-value, indicating no significant difference.

These results suggest that the plyometric training program was effective in improving both vertical jump and long jump performance in the experimental group, while the control group did not show significant improvements.

Conclusion:

Numerous scholars and researchers in the field of sports training have written about muscle strength as a fundamental component of overall physical fitness for all athletes and various sports and activities. They all agree that muscle strength, in its various forms such as explosive power, maximum strength, strength endurance, and speed strength, is one of the most important components of physical fitness. It has a direct relationship with developing and improving other physical attributes, particularly in the field of athletics.

In conclusion, track and field events, in general, rely on physical fitness attributes such as strength, speed, endurance, and agility. To ensure an enjoyable experience for spectators watching both international and local competitions, these events are governed by rules and regulations that foster competition and challenge. Unlike other sports, track and field events always reward the best performance, with athletes competing for fractions of seconds or centimeters. To achieve such high performance and set new records in all athletics disciplines, especially jumping events, it is essential to employ modern training methods to improve results.

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