

The Effect of a Training Program on Strength Development for Volleyball Among Students of the Institute of Sciences and Techniques of Physical and Sports Activities, Abdelhamid Mehri Constantine2

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Received: 21/03/2026 ; Accepted: 26/07/2026 ; Published: 21/08/2026

Abstract:

This study investigates the impact of plyometric training on explosive strength in volleyball players among STAPS students at Constantine-2 University. A total of 30 students were randomly assigned to two equal groups of 15 each. The control group followed a traditional training regimen, while the experimental group underwent plyometric training twice a week for one hour per session over a period of 12 weeks. The analysis revealed a minor but significant difference in results for the control group across the three tests ($\alpha=0.05$). In contrast, the experimental group demonstrated significant improvements in all three tests ($\alpha=0.05$). The findings suggest that plyometric training is beneficial for enhancing physical qualities and improving volleyball performance in STAPS students.

Keywords: Training program; strength; volleyball

Introduction

Volleyball is a highly competitive sport characterized by its fast-paced and dynamic motor performance, requiring players to respond quickly to constantly changing match conditions. With direct competition between two teams and frequent, intense shifts in the game, players face considerable psychological pressure that affects both skill execution and tactical decision-making, ultimately influencing the game's outcome. Success in such an environment demands exceptional physical attributes. Consequently, coaches must strategically plan to develop and enhance these physical qualities, in addition to focusing on psychological, technical, and tactical preparation, to achieve victory.

This prompted the formulation of the primary research question for this study:

- How effective is the training program in improving the muscular strength of students at the Institute of Science and Technology of Physical and Sports Activities in volleyball?

To explore this, we addressed the following questions:

- Do the exercises enhance the muscular strength of the upper limbs of the institute's students?
- Do the exercises improve the muscular strength of the lower limbs of the institute's students?
- Are plyometric training sessions more effective than traditional training sessions?

1- Research Hypotheses:

- **First Hypothesis:** Statistically significant differences exist between the pre- and post-tests in the control group, with the post-test results favoring improvements in volleyball-related physical aspects.
- **Second Hypothesis:** Statistically significant differences exist between the pre- and post-tests in the experimental group, with the post-test results showing improvements in volleyball-related physical aspects.
- **Third Hypothesis:** Statistically significant differences exist between the post-test results of the control and experimental groups, favoring the experimental group in terms of physical development related to volleyball performance.

2- Research Objectives:

1. To determine the impact of plyometric training sessions on the physical development of volleyball players among first-year students at the Institute of Science and Technology of Physical and Sports Activities, Abdelhamid Mehri University of Constantine 2.
2. To identify which training approach—plyometric or traditional—has a greater impact on improving the physical fitness of volleyball players among first-year students.

3- Importance of the Research:

The significance of this research revolves around two main points:

1. Encouraging professors at institutes of physical education and sports sciences to adopt modern training methods, particularly those incorporating plyometric exercises, for physical conditioning.
2. Gaining insight into the nature and application of plyometric training and its effectiveness in developing the physical abilities required for volleyball.

- **Plyometric Exercises:**

Plyometric exercises focus on lengthening the muscle from a contracted state and then rapidly contracting it again, producing powerful movements in a short time (Wahba, 2015). Holly and Frank (1989) and Franks (1997) describe these exercises as those that allow the muscle to generate maximum force in the shortest time. This technique increases explosive power as a quick response to muscle elongation, drawing on the biological principle that a muscle generates more force when stretched before contracting (Al-Qatami et al., 2006).

Plyometric exercises aim to develop muscular elasticity through reflex action and are widely used to improve explosive power and the relationship between maximum and explosive strength (Goe, 1991; Della, 2013). Jumping, bounding, and other high-intensity movements are commonly employed in plyometric training (Luxbacher, 1994; Davis, 1994).

- **The Concept and Importance of Muscular Strength:**

Muscular strength is defined by Musad Ali Mahmoud (2002) and Mufti Ibrahim Hammad (2001) as the ability of a muscle or group of muscles to overcome external resistance multiple times. Bastawisi Ahmed (1999) describes it as the highest force the neuromuscular system can exert to confront resistance, while Abu Al-Ala Abdel Fattah (1997) views it from a physiological perspective as "the maximum force a muscle can produce." Muscular strength is crucial for both athletic performance and overall physical fitness, contributing to posture, skill execution, and injury prevention (Hassanein and Maani, 1998).

4- Previous Studies: Additional studies and references may be included here to provide context and support for the research background.

1. **First Study (Ayman Muhammad Jaber Al-Assar, 2016):** This study investigated the impact of a proposed plyometric training program on the physical abilities of students in the long jump at Al-Aqsa University. The experimental group showed significant improvements in physical qualities and performance, outperforming the control group that followed traditional training methods.

2. **Second Study (Mahdi Kazem Ali, 2005):** This research explored the effect of using multi-height boxes to enhance strength and speed in long jump performance. Significant differences were found between pre- and post-tests, with the post-tests showing improved strength and jump performance as a result of the experimental training regimen.

Training using the multi-height box method, a form of plyometric training, effectively enhances speed-strength characteristics and improves performance in the long jump more effectively than traditional training methods.

3. **Third Study of Delcore et al. (1998):** The Delcore study aimed to examine the effects of plyometric training using one foot and two feet on vertical jump performance and to compare the effectiveness of both methods. The researchers employed an experimental design with three groups (two experimental and one control), using a sample of 17 female volleyball players. The key findings were:

- Both training methods significantly improved vertical jump performance.
- There were statistically significant differences between the groups, with one-footed training showing superior results compared to two-footed training in the vertical jump.
- Plyometric-based training programs were more effective in enhancing physical characteristics and performance levels than traditional training methods.

5- Practical Aspect of the Study:

1. **Research Methodology:** The experimental method was chosen for this study as it aligned well with the research problem.

2. **Study Sample:** The sample consisted of 30 first-year male and female students from the Institute of Science and Technology of Physical and Sports Activities at Abdelhamid Mehri University, Constantine 2, aged between 19 and 20 years during the academic year 2017/2018.

3. **Research Tools and Data Collection Methods:**

○ **Devices and Tools:** Equipment used in the study included medicine balls, hurdles, plastic rings, cones, rubber bands, measuring tapes, ropes, multi-height boxes, stadium stands, and a volleyball court.

○ **Field Tests:** Based on a review of relevant literature and consultations with sports training experts, the following physical tests were selected to measure key fitness elements in volleyball: vertical jump test, broad jump test, and medicine ball push with both hands.

4. **Homogeneity of the Sample:** Table No. (03) displays the homogeneity among the sample members concerning variables such as age, height, weight, and other physical characteristics.

	Variables	Unit of measurement	Control group	Experimental group	sig	Statistical significance
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			The mean	Standard deviation	The mean	Standard deviation		
	Height	Meter	19.30	1.58	19.20	1.51	0.09	Not significant
	Weight	kg	69	1.12	67	1.12	0.27	Not significant
	Age	The year	19	3.42	19	3.46	0.12	Not significant
	Vertical jump	centimeter	39.46	3.13	39.45	2.82	1.00	Not significant
	Broad jump	Meter	2.04	0.15	2.10	0.24	0.45	Not significant
	Ball push	Meter	3,50	0,13	3.49	0.10	0.94	Not significant

Significance level is (0.05) and degree of freedom is (28)

From Table (02), the probability values (sig) ranged from (0.09, 0.27, 0.12, 1.00, 0.45, 0.94), all of which are greater than the significance level $\alpha = 0.05$. This indicates that there are no statistically significant differences between the experimental and control groups concerning variables such as age, height, weight, and physical attributes in basketball. This suggests that both groups are equivalent, meaning the sample is homogeneous.

6- Areas of Field Study:

- **Spatial Area:** The volleyball court of the institute.
- **Temporal Domain:** [to be completed]

7. Statistical Methods Used:

The test results were recorded and analyzed using SPSS (V20), the Statistical Package for the Social Sciences.

7.1 Presentation, Analysis, and Discussion of Results: here are the analysis of each hypothesis

7.1.1 Presentation and Analysis of the First Hypothesis Results:

Table No. (04) presents the significance of the differences between the pre- and post-measurements for the control group regarding the physical aspects of volleyball.

Variables	Unit of measurement	Pre-test		Post-test		T-test	Sig	Statistical significance
		Mean	SD	Mean	SD			
Vertical Jump	centimeter	39.46	3.13	43.13	3.73	6.04	0.00	Positive (+)significance
Broad Jump	Meter	2.04	0.15	2.14	0.10	5.33	0.00	(+)significance
Ball Push	Meter	3.50	0.13	3.58	0.11	4.41	0.00	(+)significance

- Tabular (T) value = (1.79) at a significance level of (0.05) and a degree of freedom (14)

1. From observing Table (04), it is evident that the mean and standard deviation values for the vertical jump and broad jump tests in the post-measurement are higher than those in the pre-measurements. Additionally, the calculated T-value is greater than the tabulated T-value, and the probability value (sig) is 0.00, which is less than the significance level. This indicates that there are statistically

significant differences between the pre- and post-measurements in this test, though the effect is minimal.

2. Similarly, the mean and standard deviation values for the medicine ball push test (using both hands) in the post-measurement are higher than those in the pre-measurements.

7.1.2 Presentation and Analysis of the Second Hypothesis Results:

Table No. (05) demonstrates the significance of the differences between the pre- and post-measurements for the experimental group using plyometric exercises, focusing on the physical aspects of volleyball.

Variables	Unit of measurement	Pre-test		Post-test		T-test	Sig	Statistical significance
		Mean	SD	Mean	SD			
Vertical Jump	centimeter	39.45	2.82	50.61	4.17	11.36	0.00	Positive (+)significance
Broad Jump	Meter	2.10	0.24	2.70	0.70	1.01	0.00	(+)significance
Ball Push	Meter	3.49	0.10	4.08	0.06	23.12	0.00	(+)significance

Tabular (T) value = (1.79) at a significance level of (0.05) and a degree of freedom (14)

From our observation of Table (05), it is clear that all the arithmetic mean values in the post-tests related to the physical aspect were higher than those in the pre-tests. The probability value (sig) for the vertical jump test (Sargent's test) was 0.00, as was the probability value for the broad jump test (0.00). All probability values in the physical tests were less than the significance level $\alpha = 0.05$. The tabulated T-value (1.79) is significant at the 0.05 level, and the calculated T-value was statistically significant in all physical tests, as it exceeded the tabulated T-value. This indicates statistically significant differences between the pre- and post-measurements, favoring the post-tests.

Similarly, the probability value (sig) for the medicine ball push test was 0.00, which is also below the significance level $\alpha = 0.05$. The tabulated T-value (1.79) is significant at the 0.05 level, and the calculated T-value in the medicine ball push test was greater than the tabulated value, confirming statistically significant differences between the pre- and post-tests in all tests for the experimental group, favoring the post-test results.

7.1.3 Presentation and Analysis of the Results of the Third Hypothesis:

Table No. (06) presents the significance of the differences between the post-measurements of the control and experimental groups regarding the physical aspect of volleyball performance.

Variables	Unit of measurement	Control Group		Experimental Group		T-test	Sig	Statistical significance
		Mean	SD	Mean	SD			
Vertical Jump	centimeter	43,13	3,73	50,61	4.17	7.25	0.00	Positive (+)significance

Broad Jump	Meter	2,14	0,10	2.70	0.70	4.71	0.00	(+)significance
Ball Push	Meter	3,58	0,11	4.08	0.06	6.48	0.00	(+)significance

Tabular T value = (2.07) at a significance level of (0.05) and a degree of freedom (28)

Analysis of Table (06):

Upon reviewing Table (06), it is evident that the arithmetic mean values of the physical aspect tests in the post-tests for the experimental group are higher than those for the control group. The tabulated T-value (2.07) is significant at a 0.05 level, and the calculated T-value is statistically significant across all tests, as it exceeds the tabulated value. The probability values (sig) in the physical tests, such as the Sargent vertical jump test (0.00), broad jump test (0.00), and the medicine ball push test, are all less than the significance level $\alpha = 0.05$. This indicates statistically significant differences between the two post-measurements, favoring the experimental group.

8. Discussion of the Hypotheses:

- ***First Hypothesis: There are statistically significant differences between the pre- and post-measurements for the control group, favoring the post-test, in the physical aspect of volleyball activity.***

Upon examining the results in Table (04) for the control group, it is clear that the physical tests show a statistically significant difference between the pre- and post-tests. The observed development in the physical abilities of the research sample can be attributed to continuous training and the process of learning and refining skills through repetition and modeling from instructors or peers. This method led to some improvement in the physical aspect; however, it remained insufficient and not at the desired level, indicating a weak impact on performance.

This confirms the first hypothesis, highlighting that the traditional program, which focuses solely on motor skills without integrating plyometric exercises, has limited effectiveness in enhancing the muscular strength of the students in volleyball activity.

- ***Second Hypothesis: There are statistically significant differences between the pre- and post-measurements for the experimental group, favoring the post-measurement in the physical aspect of volleyball activity.***

The results in Table (05) for the experimental group show statistically significant differences in the physical tests. This improvement in muscular strength is attributed to the implementation of plyometric exercises, which effectively enhanced the explosive power of both the upper and lower limbs. The substantial improvement in physical strength can be credited to the correct and consistent application of the selected plyometric exercises.

Thus, the second hypothesis is confirmed, as training with plyometric exercises positively impacts the development of the physical aspects of volleyball performance.

- ***Third Hypothesis: There are statistically significant differences between the post-measurements of both groups, favoring the experimental group in volleyball activity.***

When analyzing the test results in Table (06) for both groups, the post-tests show statistically significant differences, favoring the experimental group. This is due to the effectiveness of the plyometric-based training program, which improved the explosive power of the muscles in the

lower and upper body. The program adhered to proper scientific principles, considering the required intensity and volume for developing explosive power.

This confirms the third hypothesis, demonstrating that the plyometric training program yielded superior results compared to traditional training in enhancing physical performance in volleyball. Providing adequate rest periods between repetitions and sets, along with a progressive increase in load, significantly enhances the effectiveness of plyometric exercises in improving volleyball performance. This improvement is largely due to the enhancement of physical characteristics, particularly strength. Thus, plyometric exercises, being a modern and scientifically-backed training method, play a crucial role in developing strength for volleyball activities. This supports the validity of the third hypothesis, which asserts that plyometric training positively impacts the development of physical aspects in volleyball.

9. Future Recommendations:

1. Develop a comprehensive physical preparation program for students that incorporates plyometric training, due to its benefits across physical, technical, and psychological aspects.
2. Conduct additional research exploring various modern training methods.
3. Organize training programs, scientific forums, and courses for physical education professors to update them on contemporary physical preparation strategies for different age groups and training contexts.
4. Integrate plyometric exercises into training regimens to enhance physical conditioning, facilitate motor skill learning, and improve overall sports performance.

Educators should familiarize themselves with modern training techniques to effectively teach and improve fundamental skills across various sports activities, especially for students in physical education and sports programs.

Conclusion:

Based on the study's objectives, hypotheses, and sample, and following the statistical analysis of the data, the following conclusions were drawn:

1. The plyometric training program positively affects strength improvement in volleyball among the experimental group.
2. Plyometric exercises have demonstrated a superior effect in developing physical attributes compared to traditional methods used by instructors in physical education institutes.
3. Plyometric exercises are among the most effective training methods for enhancing strength in volleyball.
4. The traditional methods employed by many physical education professors, particularly for group sports like volleyball, handball, and basketball, are insufficient for adequately improving students' physical fitness.

References

Arabic References:

1. Abu Al-Ela, Ahmed Abdel Fattah. *Sports Training: Physiological Foundations*. Cairo: Dar Al-Fikr Al-Arabi, 1997.
2. Bastawisi, Ahmed. *Foundations and Theories of Sports Training*. Cairo: Dar Al-Fikr Al-Arabi, 1999.

3. Ibrahim, Ali Shabout. "The Effect of Using Complex Training with Low-Intensity Intervals in Rehabilitating Athletes with Lower Extremity Muscle Weakness." *Journal of Physical Education*, Vol. 13, No. 2, 2004.
4. Al-Basti, Amrullah Hamad. *Sports Training: Foundations and Theories*. Alexandria: Education Establishment, 1998.
5. Al-Fattah, Abu Al-Alaa Abd. *Physiology of Sports Training*. Cairo: Dar Al-Fikr Al-Arabi, 2003.
6. Al-Qatami, Hashim Madnan Al-Kilani, and Muhammad. "Developing Explosive Power Through Plyometric Training." *Studies in Educational Sciences*, Vol. 33, No. 2, 2006.
7. Al-Hamad, Amal Muhammad Hassan, et al. "The Effect of Using Plyometric Exercises on Improving Gymnastics Skills for Female Students at Hashemite University." *Taibah University Journal of Educational Sciences*, Vol. 9, No. 2, 2014.
8. Kamal Darwish, Muhammad Subhi Hassanein. *Circular Training*. Cairo: Dar Al-Fikr Al-Arabi.
9. Muhammad Sobhi Hassanin and Ahmad Kasra Maani. *Encyclopedia of Applied Sports Training*. Al-Kitab Center for Publishing, Cairo, 1998.
10. Muhammad Youssef Fahba. *Designing Plyometric Skill Exercises to Improve Kicking and Heading Skills in Young Football Players*. Master's Thesis, Cairo: Helwan University, 2015.
11. Musad Ali Mahmoud, Muhammad Kashk, Amrullah Al-Basti. *Lectures in the Science of Sports Training*. Mansoura: Shajarat Al-Dar Library, 2002.
12. Muftia Ibrahim Muhammad. *Modern Sports Training: Planning, Implementation, and Leadership*. Cairo: Dar Al-Fikr Al-Arabi, 2001.
13. Mahdika Kazem Ali. "The Effect of Using a Multi-Height Box to Develop Strength and Speed for the Long Jump." *Journal of Physical Education*, Vol. 14, No. 2, 2005.

Foreign Language References:

1. Chu, Donald. *Explosive Power Strength: Complex Training for Maximum Results*. California: Human Kinetics, 1998.
2. Field, Robert. *Weight Training*. McGraw-Hill, 1999.
3. Gill, Comett, et Dominique. *La Pliométrie: Méthode de Restitution d'Énergie au Service de la Performance Sportive*. France: Chiron, 2012.
4. Alford, N.S.A. "Round Table by IAAF." *Magazine*, Roma, March 1989.
5. Aountable, N.S.A. "Magazine Room." IAAF, March 1989.
6. Bomba. *Periodization Training for Sport*. Human Kinetics, 1987.
7. Goe, Morten. *Training Distance Runners*. Champaign: Leisure Press, 1991.
8. Davis, Physiology. *Physical Education: The Study of Sport*. 2nd ed. London: Mosby, 1994.
9. Delcore, G., Mathieu, W., Salazar, W., Hernandez, J. "Comparison Between One-Leg and Two-Leg Plyometric Training on Vertical Jump Performance." *Medicine and Science in Sports and Exercise*, No. 5, 1998.
10. Della, Alexandre. *Une Saison de Préparation Physique en Football*. Belgium: Deboeck, 2013.
11. Farentionos, Rade Liffe, et al. *Plyometrics: Explosive Power Training*. Human Kinetics, 1992.
12. Franks, Howly. *Health Fitness in Structure Handbook*. 3rd ed. Human Kinetics, Champaign, 1997.
13. Lambertin, Frederic. *Préparation Physique Intégrée*. Edition Amphora, 2000.