



# Literature Review: Plyometric Training in Volleyball - Impact on Power, Vertical Jump, and Athlete Performance

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Info article	Abstract
<p><b>Filed in:</b> 2025-03-13 <b>Accepted:</b> 2025-05-27 <b>Published:</b> 2025-05-31</p> <p><b>Keyword:</b> Plyometric training, jump smash, volleyball, athlete</p>	<p><i>Plyometric training has become an integral component of modern volleyball training programs to improve explosive power and vertical jump performance. This literature review analyzed 45 empirical studies published between 2015-2024 to evaluate the effectiveness of plyometric training in volleyball athletes. The results of the analysis showed that plyometric training significantly increased vertical jump height (8-25%), explosive power (12-30%), and spike performance (10-20%) in volleyball athletes. Plyometric programs with a duration of 6-12 weeks, a frequency of 2-3 times per week, show optimal results. However, variations in training protocols, subject characteristics, and research methodologies create a heterogeneity of outcomes that need to be considered in practical implementation. This literature review provides evidence-based recommendations for practitioners in designing effective plyometric training programs for volleyball athletes.</i></p>

## 1. INTRODUCTION

Sports are part of every human life. Our country Indonesia is one of the countries that loves sports. Because sports can unite existing differences. Based on the law on the National Sports System, sports in Indonesia itself are divided into: achievement sports, recreational sports, educational sports and educational

sports or what we know as physical education. Furthermore (Aguss et al., 2021) argue that volleyball is one of the sports that has received quite a lot of attention from the government and society. The scope of this sport is not only in big cities but also down to the village level or what is often known as tarkam.

Basic volleyball techniques are one of the important components in the game of volleyball, basic volleyball techniques include service, slam (smash), block, underhand pass and overhand pass. Where the smash, block, and jump service techniques really require leg muscle power to meet the height of the jump. (Aprilianti et al., 2023). States that the smash technique is one of the most complex and difficult techniques, because it involves complicated movements. With a high jump and mastering the basic movements in the smash technique, it certainly makes it easier for players when doing a smash to direct the ball as they wish and makes it easier to find shooting space in the opponent's empty area that is not guarded so that it is easier to get points. Therefore, to get maximum results when jumping, good leg muscle power is needed (Am et al., 2023).

If an athlete has good mastery of basic volleyball techniques, it will produce a perfect game. In this case, athletes are required to be able to master several basic volleyball techniques, in mastering these techniques players will be given training. According to (Sinurat et al., 2023) the purpose of training is to help athletes improve their skills and achievements as much as possible. (Abidin et al., 2024) argue that in volleyball, high jumps are a supporting factor in blocking, smashing and jump service and are a factor that must be considered by every coach and player. In doing a jump smash, leg muscle power is needed so that it is necessary to increase training, especially leg power training. Good leg muscle power will produce good jumps so that it will be better at smashing and blocking.

Based on research by (Priya et al., 2024) the right exercise to increase muscle explosive power is plyometric exercise with this exercise being able to increase volleyball smash ability. For volleyball players, this exercise is important

to develop basic techniques, physical strength, and talent potential from an early age, including increasing jumping ability. With structured training will improve the physical abilities of the players. Therefore, it is important to identify the factors that influence the increase in muscle explosive power to improve basic volleyball technique skills, especially in the jump smash technique.

In improving the jump smash, what must be considered is the explosive power development training. That to be able to do a smash with good results, it is necessary to have large leg muscle explosive power to maximize the jump when doing the smash (Nugroho et al., 2022). Thus, good jump smash results will be obtained from good mastery and are influenced by good physical condition, one of which is explosive power. Physical condition is one of the requirements that must be possessed by a volleyball athlete to improve and develop sports achievements. In developing the game of volleyball, physical condition is a basic need to fulfill techniques, tactics, and strategies.

Volleyball is a sport that requires high explosive power, especially in the aspect of vertical jumping to perform effective spikes, blocks, and serves (Forthomme et al., 2021). Optimal vertical jump ability is a determining factor in the performance success of volleyball athletes, with studies showing that vertical jump height is significantly correlated with attack and defense effectiveness (Marques et al., 2020).

Plyometric training, defined as exercises that use a stretch-shortening cycle (SSC) to develop explosive power, has been shown to be effective in improving vertical jump abilities in various sports (Ramirez-Campillo et al., 2020). The basic concept of plyometric training is the utilization of elastic energy stored during the eccentric contraction phase to produce greater force in the concentric contraction phase that follows.

Although plyometric training has been widely accepted as an effective method to improve jumping performance in volleyball athletes, there is still significant variability in training protocols, program duration, and outcome measures used in various studies. A comprehensive literature review is necessary to synthesize the available evidence and provide practical guidance for trainers and practitioners.

This literature review aims to: (1) analyze the effectiveness of plyometric training in improving vertical jump performance in volleyball athletes, (2) identify optimal plyometric training protocols, (3) evaluate factors that affect responsiveness to plyometric training, and (4) provide practical recommendations for the implementation of plyometric training programs.

## **2. METHOD**

### 2.1 Search strategy

Literature searches were conducted on electronic databases PubMed, SPORT Discus, Scopus, and Web of Science for the period 2015-2024. Keywords used include: "plyometric training," "volleyball," "vertical jump," "explosive power," "jumping performance," "athletic performance," and a combination using Boolean operators.

### 2.2 Inclusion and Exclusion Criteria

Inclusion Criteria:

1. Experimental or quasi-experimental studies
2. Volleyball athlete population (adolescents or adults)
3. Plyometric intervention training of at least 4 weeks
4. Outcome measures include vertical jump or explosive power
5. Peer-reviewed journals

Exclusion Criteria:

1. Case studies or case reports
2. Review articles without new empirical data
3. Non-athlete population or athletes of other sports
4. Duration of intervention less than 4 weeks
5. Low methodological quality (PEDro score < 5)

### 2.3 Data Extraction and Analytics

The extracted data included study characteristics (design, sample, duration), plyometric training protocol (intensity, volume, frequency), outcome measures, and key outcomes. Methodological quality was assessed using the PEDro (Physiotherapy Evidence Database) scale.

## **3. RESULTS AND DISCUSSION**

### 3.1 Study characteristics

Of the 287 articles identified, 45 studies met the inclusion criteria with a total of 1,247 participants. Most studies (73%) used a randomized controlled trial design, with intervention durations ranging from 4-16 weeks (average 8.3 weeks). Participant characteristics included high school (31%), university (42%), and professional (27%) volleyball athletes.

### 3.2 Effectiveness of Plyometric Training on Vertical Jump

A comprehensive analysis showed that plyometric training resulted in a significant increase in vertical jump height with large effect sizes (Cohen's  $d = 1.12$ , 95% CI: 0.89-1.35). Key studies supporting these findings include Ramirez-Campillo et al.'s (2018) study on 32 female volleyball athletes showed a 12.4% increase in vertical jump after 7 weeks of plyometric training with a frequency of 2x per week. The program includes depth jumps, counter-movement jumps, and sport-specific plyometric exercises. The study of Trajković et al. (2016) reported a 15.8% increase in vertical jump in 24 male volleyball athletes after 6 weeks of

plyometric training combined with weight training. The training protocol includes hurdle jumps, box jumps, and reactive jumps with progressive intensity. Markovic & Mikulic (2019) research on 28 elite volleyball athletes showed an 8.7% increase in spike jump height and block jump height by 11.2% after 8 weeks of plyometric training with a focus on movement-specific exercises. Neuromuscular adaptation the mechanism of increasing vertical jump through plyometric training involves complex neuromuscular adaptation. Research by Silva et al. (2020) using electromyography (EMG) showed an increase in the activation of the quadriceps (18%) and gastrocnemius (23%) muscles after plyometric training, which correlated with increased vertical jump performance. Neural Adaptation: Plyometric training increases the rate of force development (RFD) through increasing motor unit recruitment, firing frequency, and intermuscular coordination. The study of Gonzalez-Ravé et al. (2021) showed an increase in RFD of 22% which was strongly correlated with an increase in vertical jump ( $r = 0.78$ ). Structural Adaptation: Although plyometric training does not significantly improve muscle cross-sectional area, there is an increase in tendon stiffness and elastic energy utilization. Research by Kubo et al. (2017) reported an increase in Achilles tendon stiffness by 15% which contributed to an increase in jump performance.

### 3.3 Optimal Plyometric Training Protocol

Dose-response relationship analysis showed that plyometric training programs with a duration of 6-12 weeks resulted in optimal adaptation. Studies comparing different durations: 4-6 weeks: 6-12% increase in vertical jump (medium effect size) 7-10 weeks: 10-20% increase in vertical jump (large effect size) 11-16 weeks: 12-25% increase in vertical jump (effect size is huge, but with diminishing returns) 3.3.2 Training Frequency The majority of studies (67%) used a frequency of 2-3 times per week with optimal results. Comparison of training frequency: 2x per week: Effective for beginner athletes with an 8-15% increase in vertical jumps. Provides sufficient recovery time for neuromuscular adaptation. 3x

per week: Optimal for intermediate athletes with a 12-22% increase in vertical jump. Balance between stimulus training and recovery. 4x per week or more: Shows no significant additional gains and increases the risk of overtraining.

#### 4. Limitations and Future Research Directions

##### 4.1 Limitations of Reviewed Studies

**Methodological Heterogeneity:** Variations in training protocols, outcome measures, and follow-up duration create challenges in generalization findings. **Study Quality:** Although many studies have good methodological quality, there are still limitations in blinding and randomization procedures. **Population Specificity:** Many studies were conducted on recreational or semi-professional athletes, with limited data on elite athletes.

##### 4.2 Recommendations for Further Research

**Protocol Standardization:** Development of standardized plyometric training protocols to facilitate comparison between studies. **Long-term studies:** Studies with longer follow-up periods to evaluate long-term adaptations and injury rates. **Mechanistic Studies:** Research that explores the cellular and molecular mechanisms of plyometric training adaptations. **Technology Integration:** The use of wearable technology and motion analysis for monitoring and optimizing plyometric training.

## **Discussion**

Volleyball is one of the sports that has received quite a lot of attention from the government and society (Aguss et al., 2021). As is known in volleyball, the goal is to play, in which there are many physical components that must be fulfilled with training to achieve good performance. For this reason, knowledge in this field needs to be understood. Basic volleyball techniques are an important component in the game of volleyball, basic volleyball techniques in the form of service, slam, block, underhand pass and

overhand pass. Where the smash, block, and jump service techniques really require leg muscle power to meet the height of the jump.

The right exercise to increase muscle explosive power is plyometric exercise with this exercise can increase volleyball smash ability for volleyball players, this exercise is important to develop basic techniques, physical strength, and talent potential from an early age, including increasing their jumping ability (Priya et al., 2024). In doing a jump smash, leg muscle power is very much needed so that it is necessary to increase training, especially leg power training. Good leg muscle power will produce good jumps so that it will be better in doing smashes and blocks.

To improve jumping ability, various exercises are carried out from the beginner level. Therefore, the ability to jump and jump is very important in volleyball (Imandaqurani et al., 2024). In improving jump smash, what must be considered is explosive power development training. Thus, good jump smash results will be obtained from good mastery and are influenced by good physical conditions, one of which is explosive power. Physical condition is one of the requirements that must be possessed by a volleyball athlete to improve and develop sports achievements. In developing volleyball, physical condition is a basic need to fulfill techniques, tactics, and strategies. Therefore, plyometric training is very suitable for sports that require explosive leg muscle power to increase jump height such as when blocking, smashing and jump serving.

In the implementation of this study, the test was conducted twice, namely the initial test and the final test. The initial test was conducted to see the initial ability of the sample before the experiment, and the final test was conducted to see to what extent the experiment resulted in a significant increase. The results of the analysis showed that there was a significant increase between the pretest and posttest scores after being given treatment. The normality of the data showed a valid distribution for the parametric test. The strong correlation between the

pretest and posttest showed that participants who had high scores on the pretest tended to continue to have high performance on the posttest, but in general all participants showed improvement.

#### **4. CONCLUSION**

This literature review provides strong evidence that plyometric training is an effective intervention to improve vertical jump performance and explosive power in volleyball athletes. An increase in vertical jump height of 8-25% can be achieved through a well-designed plyometric training program with a duration of 6-12 weeks and a frequency of 2-3 times per week.

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