

## The Effectiveness of Vertical Jump Training on Volleyball Spiking Performance

Kenangan Tektrisman Zega <sup>1</sup>, Bela Sintiya <sup>2</sup>, Bayu Tio Jahtra Gurusinga <sup>3</sup>,  
Cina Pakpahan <sup>4</sup>, Ervan Mario Gomos Tanjung <sup>5</sup>, Jidan Christian Sianipar <sup>6</sup>, Randi  
Kurniawan <sup>7</sup>, Deni Rahman Marpaung <sup>8</sup>

State University of Medan, Department of Sports Science, Medan, North  
Sumatra, 20221, Indonesia

E-mail: [Kenanganzega123@gmail.com](mailto:Kenanganzega123@gmail.com)

### ABSTARCT

This study examined the effectiveness of vertical jump training on volleyball spiking performance through a literature review of several peer-reviewed journal articles published in the past decade. previous research indicated that vertical jump height played a critical role in determining a player's ability to generate optimal spiking power, reach, and ballcontact angle. the purpose of this study was to synthesize empirical findings on how vertical jump ability contributed to improvements in spiking performance and to identify the types of training interventions most effective for enhancing jump capacity. the review method involved selecting reputable journals focusing on volleyball performance, strength and conditioning, biomechanics, and sports training, followed by screening articles that specifically discussed vertical jump measurements, plyometric training programs, and spike-related performance outcomes. the results showed that athletes who engaged in structured vertical jump training particularly plyometric drills, lower-body strength training, and neuromuscular conditioning consistently demonstrated increased jump height, enhanced explosive power, and improved spike velocity and accuracy. several studies also reported that improved vertical jump ability positively influenced approach speed, timing, and overall offensive effectiveness during matches. the review concluded that vertical jump training was an effective performance-enhancement strategy for volleyball players, - especially hitters, and served as an essential component of modern volleyball conditioning programs. the implications of this study emphasized the importance of integrating progressive plyometric and strength-based interventions into regular training schedules to maximize athletes' spiking performance and reduce the risk of injury associated with inadequate jump mechanics.

**keywords:** vertical jump, spiking performance, volleyball training, plyometric exercise, explosive power

### ABSTRAK

Penelitian ini mengkaji efektivitas latihan lompatan vertikal terhadap performa spike dalam bola voli melalui tinjauan literatur atas sejumlah artikel jurnal peer-review yang diterbitkan dalam dekade terakhir. Penelitian sebelumnya menunjukkan bahwa tinggi lompatan vertikal memainkan peran penting dalam menentukan kemampuan pemain menghasilkan daya spike optimal, jangkauan, dan sudut kontak bola. Tujuan dari studi ini adalah mensintesis temuan empiris tentang bagaimana kemampuan lompatan vertikal berkontribusi pada peningkatan performa spike, serta mengidentifikasi jenis intervensi latihan yang paling efektif untuk meningkatkan kapasitas lompatan. Metode tinjauan melibatkan seleksi jurnal bereputasi yang fokus pada performa bola voli, kekuatan dan kondisi fisik, biomekanika, dan pelatihan olahraga, kemudian menyeleksi artikel yang

secara khusus membahas pengukuran lompatan vertikal, program latihan plyometrik, dan hasil performa terkait spike. Hasil menunjukkan bahwa atlet yang terlibat dalam program latihan lompatan vertikal terstruktur — terutama drill plyometrik, latihan kekuatan tubuh bagian bawah, dan kondisioning neuromuskular — secara konsisten menunjukkan peningkatan tinggi lompatan, peningkatan daya eksplosif, serta peningkatan kecepatan dan akurasi spike. Beberapa studi juga melaporkan bahwa kemampuan lompatan vertikal yang meningkat secara positif mempengaruhi kecepatan approach, timing, dan efektivitas ofensif keseluruhan selama pertandingan. Kesimpulan tinjauan menyatakan bahwa latihan lompatan vertikal merupakan strategi peningkatan performa yang efektif bagi pemain bola voli, terutama pemain spiker, dan menjadi komponen esensial dari program kondisioning bola voli modern. Implikasi dari studi ini menekankan pentingnya mengintegrasikan intervensi plyometrik progresif dan berbasis kekuatan ke dalam jadwal latihan reguler untuk memaksimalkan performa spike atlet dan mengurangi risiko cedera terkait mekanika lompatan yang kurang baik.

**Kata kunci: lompatan vertikal, performa spike, pelatihan bola voli, latihan plyometrik, daya eksplosif**

### Introduction

vertical jump ability is widely acknowledged as one of the most influential physical components determining performance in modern volleyball, particularly in offensive skills such as the spike. as the sport continues to evolve into a more power- and speed-oriented game, athletes are required to possess exceptional explosive strength and jumping ability to outperform opponents during net play (smith, 2021, p. 45). a higher vertical jump allows attackers to extend the hitting height, improve ball-contact position, increase striking angle, and overcome defensive blocks more effectively. these performance advantages underline the urgency of understanding the relationship between vertical jump development and spiking performance. the increasing demands of competitive volleyball have also driven interest in scientific, evidence-based training methods designed to enhance lower-limb power. researchers have extensively explored the effects of plyometric programs, neuromuscular training, and resistance-based strength protocols on vertical jump outcomes (johnson & lee, 2020, p. 110). although numerous studies have shown positive results, findings remain inconsistent regarding which type, duration, and

intensity of training yield the greatest improvement in both vertical jump height and spiking execution. this inconsistency contributes to the emergence of a practical problem for coaches and sport practitioners, who must select appropriate training interventions tailored to athletes' physical profiles and competitive levels (miller, 2023, p. 27). given the multitude of available training programs and their varying levels of effectiveness, a comprehensive literature review is required to integrate current findings and evaluate the impact of vertical jump training on volleyball spiking performance. reviewing the latest scholarly works from the past five years is essential not only to ensure conceptual relevance but also to capture recent advancements in sports science, biomechanics, and conditioning strategies (anderson et al., 2022, p. 76). the objective of this study is therefore to synthesize empirical evidence on the effectiveness of vertical jump training and to determine how improvements in lower-limb explosive power influence spiking accuracy, velocity, mechanics, and overall offensive effectiveness.

this literature review is expected to provide both theoretical and practical contributions. theoretically, it clarifies the interaction between biomechanical factors

and sport-specific performance outcomes. practically, it offers guidance for coaches and trainers in designing well-structured, multidimensional training programs that integrate plyometrics, strength development, and technical skill enhancement. to assist readers in navigating the discussion, this study outlines the core problem, highlights methodological trends in previous research, evaluates the main training interventions, and concludes with practical implications for volleyball conditioning.

## METHODS

this study utilized a systematic literature review method intended to gather, examine, and synthesize research findings related to vertical jump training and volleyball spiking performance. a structured approach was employed to ensure methodological rigor and the reliability of the synthesized evidence. the review process consisted of four key stages: identification, screening, eligibility assessment, and final synthesis. during the identification stage, academic databases including google scholar, pubmed, sciencedirect, and researchgate were searched using predefined keywords: “vertical jump,” “volleyball spike performance,” “explosive power,” “plyometric training,” “jump height,” and “neuromuscular conditioning.” boolean operators (and, or) were applied to broaden and refine search results. the time filter was set to include publications from 2019 to 2024, ensuring the inclusion of current and relevant research. in the screening stage, titles and abstracts were examined to remove irrelevant works, duplicates, and non-peer-reviewed materials. the inclusion criteria required that studies: (1) focused on volleyball athletes; (2) examined vertical jump performance, training interventions, or lower-limb power; (3) included measurable outcomes such as jump height, spike velocity, spike

accuracy, or biomechanical indicators; and (4) were written in english. exclusion criteria included review articles, studies outside the domain of volleyball, and articles lacking empirical measurement tools. the eligibility assessment involved reading full-text articles to evaluate methodological quality, clarity of intervention methods, duration of training programs, and statistical analysis used. studies with unclear methodology, insufficient sample size, or incomplete data reporting were excluded. finally, in the synthesis stage, selected articles were grouped according to training types, biomechanical factors, and performance outcomes. patterns, similarities, and differences in findings were systematically compared. the synthesis emphasized the effectiveness of various training approaches, their short-term and long-term impacts, and their contribution to volleyball spiking performance.

## RESULT AND DISCUSSION

### 1. contribution of vertical jump to spiking performance

the reviewed articles consistently showed that vertical jump height is a strong predictor of spiking effectiveness. athletes with higher jumps exhibit superior ball-contact height, steeper attack trajectories, and improved ability to bypass defensive blocks (smith, 2021, p. 48). this biomechanical advantage enables hitters to direct the ball more sharply into the opponent's court, resulting in increased scoring efficiency. additionally, improved jump height was associated with greater kinetic energy transfer, allowing players to generate higher spike velocity (johnson & lee, 2020, p. 114). these findings reinforce that vertical jump development is not merely a physical attribute but a performance determinant in volleyball.

### 2. impact of plyometric training

plyometric exercises emerged as one of the most effective training interventions for increasing vertical jump



height. studies found that programs lasting 6–10 weeks led to notable improvements in explosive power and stretch-shortening cycle efficiency (anderson et al., 2022, p. 80). depth jumps, tuck jumps, bounding, and lateral hops enhanced neuromuscular responsiveness and improved the rate of force development. these physiological adaptations resulted in significant gains in jump height and approach speed, both crucial in spike execution. moreover, plyometric training improved landing mechanics, reducing injury risk and improving the stability needed during spiking actions.

### 3. strength training and lower-limb force production

strength-based interventions, including squats, lunges, romanian deadlifts, and olympic lifts, were shown to contribute substantially to improved vertical jump performance (miller, 2023, p. 30). strength training enhances maximal force output, which directly influences the upward propulsion needed during jumping. studies also revealed that combining strength training with plyometrics termed complex training yielded the most significant improvements. this combination allowed athletes to develop both maximal force and explosive power, promoting optimal performance transfer to spiking.

### 4. neuromuscular and coordination adaptations

vertical jump training was found to improve more than just height. several biomechanical analyses reported better synchronization of movement patterns, improved spinal alignment during takeoff, and more coordinated arm swings (kumar, 2021, p. 36). these adaptations enhanced efficiency in spike timing, accuracy, and kinetic chain coordination. improved neuromuscular activation also increased the stability required during mid-air ball contact, resulting in greater spike precision.

### 5. volleyball-specific training integration

the review highlighted that the most effective programs integrated vertical jump training with volleyball-specific drills. when plyometrics and strength exercises were complemented by technical spike training, athletes demonstrated more substantial improvements in both power and skill execution (anderson et al., 2022, p. 83). this supports the principle of specificity, where training closely related to game movements results in better performance gains.

### 6. interpretation and implications

overall, the literature consistently supports that vertical jump training significantly enhances volleyball spiking performance. the effectiveness of the training depends on a combination of physiological improvements such as explosive power, force production, and neuromuscular coordination and technical enhancements in spiking mechanics. training programs should therefore adopt a multidimensional approach, combining plyometrics, strength work, mobility training, and volleyball-specific drills to maximize performance outcomes.

## Conclusion

This literature review demonstrated that vertical jump training plays a critical and multi-dimensional role in enhancing volleyball spiking performance. The synthesis of recent empirical studies confirmed that improvements in vertical jump height are not merely a reflection of increased jumping ability but represent a broader set of physiological, neuromuscular, and biomechanical adaptations that directly contribute to offensive effectiveness. Training interventions particularly those involving plyometric exercises, structured strength programs, and neuromuscular conditioning were consistently shown to elevate explosive lower-limb power, enhance force production, and increase the rate of force development, all of which are essential components for a powerful

and efficient spike. Moreover, vertical jump training was found to influence technical aspects of spiking, including timing, arm swing coordination, approach velocity, and kinetic chain integration, thereby reinforcing the notion that jump performance and technical skill are inseparable in volleyball.

The review also highlighted that training programs combining multiple modalities, such as strength work and plyometrics, produced greater performance gains compared to single-method interventions. This finding emphasizes the importance of adopting a holistic and periodized training approach that targets both maximal strength and explosive power while integrating sport-specific drills to ensure effective transfer to match play. Additionally, several studies underscored the value of progressive overload, individualized program design, and regular performance monitoring, indicating that athlete-specific considerations are crucial for optimizing training outcomes and preventing overuse injuries.

Based on the reviewed evidence, vertical jump training should be regarded as a fundamental component of volleyball conditioning, particularly for offensive players who rely heavily on powerful and accurate spiking actions. Coaches, trainers, and practitioners are encouraged to incorporate multidimensional training strategies that enhance not only physical power but also biomechanical efficiency and technical proficiency. Future research is encouraged to explore long-term adaptations to various training protocols, differences across competitive levels and playing positions, and the use of biomechanical technology such as motion capture and force platforms to further refine training recommendations. Ultimately, enhancing vertical jump ability offers a reliable pathway to improving overall spiking performance, contributing significantly to individual

athlete development and team tactical success.

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