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DEVELOPING KNEE FLEXOR AND EXTENSOR STRENGTH IN VOLLEYBALL PLAYERS THROUGH TARGETED EXERCISE

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Abstract

This narrative review examines the role of targeted resistance and plyometric exercise in developing lower-limb strength and supporting volleyball performance, with particular attention to the quadriceps and hamstrings. Jumping, spiking, blocking, rapid movement, and controlled landing require coordinated force production across the lower limbs. The review considers the functional roles of the knee extensors and flexors, the application of resistance and eccentric exercise, and the contribution of plyometric training to jumping performance. It also discusses individualized loading, outcome assessment, and exercise safety. Selected systematic reviews and an experimental study provide the basis for the synthesis. The reviewed literature supports the use of plyometric training to improve vertical jump performance, while resistance exercise provides a means of developing force-producing capacity. An illustrative two-session framework is presented to translate these principles into coaching practice. The framework has not been experimentally validated, and the article reports no original participant data. Future controlled studies should evaluate changes in muscle strength, jump performance, and movement technique across different age groups and competitive levels.

Keywords: volleyball; knee flexors; knee extensors; quadriceps; hamstrings; resistance training; eccentric exercise; plyometric training; vertical jump; physical conditioning.

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Introduction

Success in modern volleyball depends on physical preparation as well as technical and tactical proficiency. Players repeatedly jump, change direction, spike, and block. The quality of these actions is closely related to lower-limb strength, rapid force production, coordination, and movement control.

The quadriceps, located in the anterior thigh, are the principal knee extensors. The hamstrings, located in the posterior thigh, contribute to knee flexion, while most hamstring muscles also contribute to hip extension. These groups act within a broader lower-limb system during jumping, landing, and rapid movement; neither group alone accounts for volleyball performance.

Ramirez-Campillo et al. [1] synthesized 14 studies examining the effects of plyometric jump training on vertical jump height in volleyball players. Their findings support improvements in jumping performance. Silva et al. [2] likewise reported potential benefits for jumping and other physical fitness outcomes.

Targeted preparation of the knee flexors and extensors is therefore relevant to volleyball conditioning. The aim of this review is to examine the contribution of selected strength and plyometric exercises to lower-limb development and performance. Its objectives are to explain the functional roles of these muscle groups, describe suitable exercise options, consider their relationship with jumping performance, and formulate practical training recommendations.

Review approach

This article presents a narrative synthesis of selected publications on plyometric training, lower-limb strength, and jumping performance in volleyball. The principal sources are the meta-analysis by Ramirez-Campillo et al. [1], the systematic review by Silva et al. [2], and the intervention study by Voelzke et al. [3].

The synthesis focuses on muscle function, exercise specificity, plyometric training, assessment of jumping performance, and individualized programme design. No new participants were recruited and no original experimental results are presented. A reproducible search strategy, formal study selection process, and risk-of-bias assessment were not available in the source manuscript; this article is therefore a narrative review rather than a systematic review.

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Functional roles of the knee extensors and flexors

Knee extensors

The quadriceps contribute to knee extension during propulsion and to control of knee flexion during landing. Their contribution varies with the movement task and its coordination with actions at the hip and ankle.

Exercise options include squats, half squats, leg presses, lunges, and resisted knee extension. These exercises can be used to develop strength, but they differ in movement pattern and loading demands. Selection should account for age, training experience, technical competence, and any existing injury.

Knee flexors and hip extensors

The hamstrings contribute to knee flexion and, with the exception of the short head of biceps femoris, hip extension. They are involved in acceleration, changes of direction, and control of lower-limb movement during landing.

Potential exercises include lying leg curls, Romanian deadlifts, hip extension exercises, appropriately modified Nordic hamstring exercises, and single-leg strength and balance tasks. These exercises emphasize different functions: leg curls directly load knee flexion, whereas Romanian deadlifts emphasize hip extension with substantial involvement of the posterior thigh muscles.

Developing the flexors and extensors together supports broader lower-limb preparation. However, an exercise list alone cannot establish an athlete's muscle strength balance. Any assessment of flexor-to-extensor strength ratios requires an appropriate measurement method and clearly specified testing conditions.

Evidence on resistance and plyometric training

Resistance exercise develops the ability to produce force against an external load. Plyometric exercise uses rapid eccentric and concentric actions within the stretch-shortening cycle to train force production during explosive movements. In volleyball, combining these approaches may help connect strength development with sport-relevant jumping tasks.

Squats and Romanian deadlifts can contribute to strength development, while vertical jumps and approach jumps provide opportunities to express force rapidly. The combination should be selected according to the athlete's capacity rather than assumed to produce identical adaptations in every player.

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The meta-analysis by Ramirez-Campillo et al. [1] reported a pooled effect size of Cohen's d = 0.82 ($p < 0.001$) for vertical jump height. This is an aggregate result across included studies, not a predicted improvement for an individual athlete. Silva et al. [2] also described potential benefits for vertical and horizontal jumping, strength, and selected agility and speed outcomes. These findings support the use of plyometric exercise, while allowing for differences among training programmes and participants.

Voelzke et al. [3] studied 16 elite volleyball players over five weeks. Importantly, the comparison was between resistance training plus plyometrics and electromyostimulation plus plyometrics, rather than between two conventional resistance-training programmes. Changes differed by performance test and intervention. This small study provides context for combined training but does not validate the exercise framework proposed below or isolate adaptations in the quadriceps and hamstrings.

Targeted exercises for lower limb development

Table 1 summarizes exercise options and their intended roles. The descriptions identify training purposes rather than guaranteed performance effects. Volume and intensity should be individualized. During high-intensity jumping, movement quality and adequate recovery between efforts should take priority over accumulating repetitions.

Table 1. Exercises targeting lower-limb strength and movement performance

Exercise	Primary target	Relevance to volleyball
Squat	Hip and knee extensor strength	Developing strength for take-off
Leg press	Lower-limb strength	Developing force-producing capacity
Leg curl	Knee flexor strength	Targeted hamstring conditioning
Romanian deadlift	Hip extension and posterior thigh strength	Conditioning muscles involved in jumping and landing
Forward lunge	Single-leg strength and balance	Developing unilateral support capacity
Vertical jump	Rapid force production	Training jumping actions used in attacking and blocking
Controlled jump and landing	Movement control	Improving landing technique

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Practical training framework

The following framework is an illustrative planning option informed by the reviewed literature and the exercise selection in the source manuscript. The exact combinations, set and repetition ranges, and sequencing have not been tested as a single intervention. They should not be presented as a validated protocol or a universal prescription.

Session 1 Strength development

Squat: 2–3 sets of 6–10 repetitions.

Romanian deadlift: 2–3 sets of 6–10 repetitions.

Leg curl: 2–3 sets of 8–12 repetitions.

Forward lunge: 2 sets of 8 repetitions per leg.

Calf raise: 2–3 sets of 10–15 repetitions.

Session 2 Explosive performance and landing technique

Bilateral vertical jump: 2–3 sets of 4–6 jumps.

Approach jump: 2–3 sets of 3–5 repetitions.

Single-leg balance exercise: 2–3 sets per leg, with task difficulty and duration individualized.

Step-off from a low platform followed by a controlled landing: 2–3 sets of 4–5 repetitions.

Sufficient recovery should separate demanding sessions. The framework does not specify a fixed weekly schedule because placement depends on technical training, match exposure, and the athlete's recovery. External resistance, platform height, and rest intervals must be selected for the individual.

Exercise should be stopped if pain occurs or technique deteriorates. Younger and inexperienced players require appropriate supervision and adjustment of task difficulty. A controlled step-off landing should be distinguished from a reactive drop jump, which requires an immediate rebound and imposes different demands.

Assessing training outcomes

Potential outcome measures include vertical jump height, standing long jump distance, performance in selected strength exercises, jumping and landing technique, and perceived fatigue and recovery. Each measure should be linked to the intended training objective.

If the framework is evaluated experimentally, baseline and post-intervention assessments should use consistent conditions. Where a control group is available, appropriate analyses should compare changes between groups. Reporting should

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include descriptive statistics, variability, confidence intervals, and effect sizes where suitable. These are recommendations for future research rather than results of the present review.

Discussion

The reviewed literature supports the relevance of lower-limb strength and rapid force production to volleyball jumping performance [1–3]. Nevertheless, an increase in strength does not necessarily produce a proportional increase in jump height. Technique, coordination, body mass, training history, and recovery also influence performance.

Preparation should address both anterior and posterior thigh function while recognizing the contribution of other lower-limb muscles. Focusing exclusively on the quadriceps may leave other relevant capacities underdeveloped. Exercise selection should also reflect playing position and individual needs.

Evidence for improved jump performance following plyometric training should not be interpreted as direct proof of isolated knee-flexor or knee-extensor adaptations. Jump height is a whole-body performance outcome and does not independently quantify the strength of either muscle group. Likewise, the proposed framework cannot be assumed to prevent injury, because this outcome has not been established for the framework itself.

The main limitations are the selective narrative design, the small reference base, and the absence of a formal appraisal of evidence quality. The reviewed evidence does not establish an optimal exercise dose for all volleyball players. Although existing studies support plyometric training, the specific programme described here requires independent evaluation. Future work should measure strength, jumping performance, and movement technique together and report participant characteristics and training exposure clearly.

Conclusions

Knee flexors and extensors contribute to jumping, landing, acceleration, and changes of direction within the coordinated lower-limb system. Resistance exercise can develop force-producing capacity, while plyometric training can improve vertical jump performance in volleyball players [1, 2].

Balanced exercise selection, sound technique, and individualized load management are important principles for programme design. The illustrative

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framework in this review offers a practical starting point for planning, but its effectiveness has not been demonstrated experimentally. Controlled studies with standardized baseline and post-intervention testing are needed to evaluate its effects across ages and competitive levels.

References

1. Ramirez-Campillo R, Andrade DC, Nikolaidis PT, Moran J, Clemente FM, Chaabene H, Comfort P. Effects of Plyometric Jump Training on Vertical Jump Height of Volleyball Players: A Systematic Review with Meta-Analysis of Randomized-Controlled Trial. Journal of Sports Science & Medicine. 2020;19(3):489–499. https://pubmed.ncbi.nlm.nih.gov/32874101/
2. Silva AF, Clemente FM, Lima R, Nikolaidis PT, Rosemann T, Knechtle B. The Effect of Plyometric Training in Volleyball Players: A Systematic Review. International Journal of Environmental Research and Public Health. 2019;16(16):2960. https://doi.org/10.3390/ijerph16162960
3. Voelzke M, Stutzig N, Thorhauer HA, Granacher U. Promoting lower extremity strength in elite volleyball players: Effects of two combined training methods. Journal of Science and Medicine in Sport. 2012;15(5):457–462. https://doi.org/10.1016/j.jsams.2012.02.004