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METHODOLOGY FOR DEVELOPING JUMP ENDURANCE AND SPEED-STRENGTH QUALITIES IN VOLLEYBALL PLAYERS

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Abstract: The present article examines the theoretical and methodological foundations for developing jump endurance and speed-strength qualities in volleyball players within the framework of specialized sports training. Particular attention is paid to the physical demands of modern volleyball, in which the effectiveness of attacking, blocking, jump setting, and power serving largely depends on an athlete's ability to generate high levels of muscular force within a short period of time, repeatedly perform explosive jumping actions, and maintain technical accuracy under conditions of increasing fatigue. The study analyzes the role of plyometric exercises, speed-strength training, volleyball-specific jumping drills, coordination tasks, and repeated-jump exercises in improving athletes' special physical preparedness. The methodological approach proposed in this paper is based on the integrated development of basic strength, explosive power, repeated-jump capacity, motor coordination, and volleyball-specific technical performance. Particular emphasis is placed on differentiating training loads according to athletes' level of physical preparedness, playing position, age, and the specific demands of competitive activity. It is argued that the development of jumping ability in volleyball should not be limited to improving maximum vertical jump height. A more comprehensive approach should also focus on maintaining jumping efficiency, movement quality, and technical accuracy during repeated high-intensity efforts. The proposed training methodology may contribute to improving the special physical preparedness of volleyball players and enhancing the efficiency of their technical actions during competitive performance.

Keywords: volleyball, sports training, jump endurance, speed-strength qualities, explosive power, plyometric training, vertical jump, blocking, attacking performance, special physical preparedness.

Introduction

Modern volleyball is characterized by a high level of motor intensity, rapid changes in game situations, repeated explosive actions, and the constant interaction of technical, tactical, physical, and psychological components of athletic performance. During competitive activity, volleyball players are required to perform a considerable number of accelerations, abrupt stops, changes of direction, jumps, landings, defensive movements, attacking actions, and transitions between different technical and tactical situations.

Among these motor actions, jumping ability occupies a particularly important position. The effectiveness of many fundamental volleyball techniques, including attacking, blocking, jump

setting, and jump serving, is directly associated with an athlete's capacity to generate explosive force and reach an optimal height within a limited period of time.

However, the physical demands of volleyball cannot be adequately explained by maximum jumping ability alone. During a match, athletes repeatedly perform explosive movements under conditions of incomplete recovery. Therefore, an athlete must not only be able to reach a high vertical position during an isolated jump but must also reproduce similar jumping actions several times while maintaining movement efficiency, coordination, and technical accuracy.

This requirement makes jump endurance one of the important components of volleyball-specific physical preparedness. In the context of volleyball training, jump endurance may be defined as an athlete's ability to repeatedly execute jumping actions while maintaining an acceptable level of explosive force, jump height, movement coordination, and technical effectiveness despite accumulating fatigue. Unlike general endurance, jump endurance is closely associated with explosive strength, neuromuscular coordination, reactive strength, anaerobic energy supply, movement economy, and the athlete's ability to recover rapidly between repeated efforts.

In training practice, jumping ability is sometimes developed primarily through the repeated performance of a large number of jumps. Although such an approach can increase training volume, a simple increase in the number of repetitions does not necessarily improve volleyball-specific explosive performance. If jump height, landing mechanics, neuromuscular coordination, movement speed, recovery interval, and technical quality are not adequately controlled, excessive repetition may lead to a decline in movement efficiency. Consequently, the training stimulus may shift from explosive power development toward generalized fatigue. For this reason, the development of jump endurance should be based not on the mechanical accumulation of repetitions but on a rational relationship between training intensity, exercise volume, recovery intervals, technical complexity, and individual athlete characteristics.

Another important methodological issue is the relationship between physical preparation and volleyball technique. An athlete may demonstrate a high vertical jump during testing but fail to use this capacity effectively during blocking or attacking if timing, approach rhythm, spatial orientation, or coordination are insufficiently developed.

Therefore, volleyball-specific conditioning should gradually integrate physical exercises into technical and game-related motor actions.

The relevance of this problem is also associated with increasing competitive demands. Contemporary volleyball is characterized by faster offensive combinations, more aggressive serving, rapid transitions between defense and attack, and a high frequency of repeated jumps at the net.

Under such conditions, the ability to repeatedly express explosive strength without a substantial decline in technical performance becomes an essential element of competitive efficiency.

The purpose of this study is to theoretically substantiate and systematize a methodological approach to the integrated development of jump endurance and speed-strength qualities in volleyball players.

The following objectives were formulated:

1. to identify the role of jump endurance and speed-strength qualities in volleyball competitive activity;
2. to systematize effective training means for developing repeated-jump capacity;
3. to determine the methodological principles of integrating physical and technical preparation;
4. to establish approaches for differentiating training loads according to athletes' individual preparedness and playing specialization;
5. to identify practical criteria for monitoring the effectiveness of jump-oriented training.

Materials and Methods

The study was conducted as a theoretical and methodological analysis of scientific and practical approaches to the development of volleyball-specific physical preparedness.

The following research methods were applied:

- analysis and synthesis of scientific literature on volleyball training and physical conditioning;
- comparative analysis of strength, plyometric, and special jumping exercises;
- generalization of principles of sports training;
- classification of training means according to their functional and technical orientation;
- methodological modeling of a volleyball-specific training structure;
- analysis of the relationship between physical abilities and technical performance.

The exercises included in the proposed methodological system were classified according to several criteria:

1. biomechanical characteristics;
2. intensity of muscular effort;
3. degree of similarity to competitive volleyball movements;
4. contribution to explosive power development;
5. influence on repeated-jump capacity;
6. complexity of coordination;
7. level of technical integration.

The methodological framework was based on the following training principles:

- specificity of training;
- gradual progression of load;
- priority of movement quality over excessive volume;
- integration of strength and speed components;
- appropriate balance between loading and recovery;
- individualization of training load;
- integration of physical and technical preparation;
- systematic monitoring of athletes' functional condition.

The proposed approach does not consider jump endurance as an isolated physical quality. Instead, it is regarded as a complex ability that depends on the interaction of maximal strength, explosive strength, reactive strength, neuromuscular coordination, repeated-effort capacity, movement technique, and fatigue resistance.

Results and Discussion

Specific Characteristics of Jumping Activity in Volleyball

Jumping actions in volleyball differ according to their technical purpose, movement structure, duration, and spatial characteristics.

During an attacking action, the player usually performs an approach consisting of several steps before converting horizontal velocity into vertical movement. The effectiveness of the attack jump depends on the coordination of the approach, arm swing, take-off, trunk position, and timing of contact with the ball.

Blocking presents a different motor task. A blocker often has limited time to react to the opponent's attack and may perform a jump from a stationary position or after a rapid lateral movement.

Therefore, blocking performance requires not only high jumping ability but also quick movement along the net, rapid transition from horizontal to vertical force production, and appropriate timing.

The motor requirements of setters are also different. Setters may perform repeated low- or moderate-height jumps during jump setting while simultaneously maintaining precision in ball placement.

Defensive players require rapid transition from low defensive positions to explosive movements, whereas attackers must repeatedly perform approach jumps throughout the match.

These differences indicate that a single type of jumping exercise cannot adequately prepare all volleyball players for competitive activity.

Training should therefore reflect the specific functional and technical requirements of different playing positions.

Role of Speed-Strength Qualities in Volleyball Performance

Speed-strength ability may be understood as the capacity to generate a high level of muscular force within a short period of time.

In volleyball, the duration of the take-off phase is relatively short. Consequently, athletes need not only adequate levels of muscular strength but also the ability to express this strength rapidly.

For example, an athlete may possess considerable lower-body strength but still demonstrate insufficient jumping performance if the available force cannot be generated rapidly during the take-off phase.

This distinction is particularly important in volleyball because many game actions occur under strict time constraints.

The development of speed-strength qualities should therefore include both general strength exercises and exercises requiring rapid force production.

Traditional resistance exercises can contribute to developing the muscular foundation necessary for explosive movement. However, resistance training alone does not automatically ensure high-speed force expression.

For this reason, strength exercises should be combined with dynamic and plyometric tasks that reproduce the explosive nature of volleyball movements.

The quality of speed-strength training is strongly influenced by fatigue.

When highly explosive exercises are performed under excessive fatigue, movement velocity decreases, jump height declines, ground-contact time may increase, and technical execution may deteriorate.

As a result, the exercise no longer produces an optimal stimulus for explosive power development.

Therefore, high-intensity plyometric and speed-strength exercises should generally be performed when the athlete is sufficiently recovered to maintain movement quality.

Main Training Means for Developing Jump Endurance

The exercises used to develop jump endurance may be grouped into four major categories.

1. Basic Strength Exercises

The purpose of basic strength exercises is to create the muscular foundation required for effective explosive movement.

Recommended exercises include:

- squats;
- partial squats;
- split squats;
- lunges;
- step-ups;
- calf raises;
- unilateral lower-body exercises;
- hip-extension exercises;
- core-stability exercises;
- exercises for trunk and pelvic stabilization.

These exercises do not directly reproduce the structure of a volleyball jump. However, they contribute to the development of the force-generating capacity necessary for later explosive and plyometric training.

Special attention should be paid to balanced development of the lower extremities and trunk, because poor stabilization may negatively affect take-off mechanics, landing control, and movement efficiency.

2. Plyometric Exercises

Plyometric exercises are widely used to develop reactive strength and explosive power.

Examples include:

- countermovement jumps;
- repeated vertical jumps;
- squat jumps;
- drop jumps;
- hurdle jumps;
- lateral jumps;
- bounding exercises;

- single-leg jumps;
- multiple jumps performed in sequence.

The effectiveness of plyometric training depends largely on exercise quality.

A higher number of jumps is not always associated with a better training effect. If athletes continue performing repetitions after a substantial decline in jump height or movement quality, the neuromuscular purpose of the exercise may be reduced.

Therefore, plyometric training should emphasize controlled volume, high-quality execution, and sufficient recovery.

Landing technique should also be considered an essential component of plyometric preparation.

Athletes should be able to absorb landing forces through coordinated flexion of the ankle, knee, and hip joints while maintaining postural stability.

Appropriate landing mechanics are important not only for movement efficiency but also for reducing unnecessary mechanical stress.

3. Volleyball-Specific Jumping Exercises

The next group includes exercises that connect explosive physical activity with volleyball technique.

Examples include:

- attack approach without ball contact;
- attack approach followed by a simulated spike;
- repeated attack jumps;
- lateral movement followed by blocking;
- repeated blocking at two or three positions along the net;
- block followed by an attacking transition;
- defensive action followed by an attack approach;
- jump setting;
- jump serving;
- combined blocking and attacking exercises.

The main advantage of these exercises is their greater similarity to competitive motor actions.

Athletes are required not only to jump high but also to coordinate explosive movement with technical execution, timing, spatial orientation, and decision-making.

This allows physical qualities to be transferred more effectively into volleyball-specific performance.

4. Combined Exercises for Jump Endurance

Combined exercises are designed to reproduce repeated high-intensity actions similar to those performed during actual rallies.

A typical sequence may include:

block → lateral movement → block → transition away from the net → attack approach → jump and simulated spike.

Such combinations place greater demands on repeated explosive effort, coordination, movement transition, and technical stability.

Another possible sequence is:

defensive position → rapid forward movement → block → recovery → attack approach → spike.

The main training objective is to maintain high-quality movement throughout the sequence rather than simply complete the maximum possible number of repetitions.

Suggested Structure of a Volleyball Jump-Training Session

A volleyball training session focused on jump endurance and speed-strength development may be organized into several consecutive stages.

Stage 1. Preparatory Phase

The preparatory phase may last approximately 10–15 minutes and should include:

- general warm-up;
- joint mobility exercises;
- dynamic stretching;
- activation of the ankle and lower-leg musculature;
- hip activation;
- low-intensity jumping exercises;
- coordination exercises.

The purpose of this phase is to prepare the neuromuscular and musculoskeletal systems for subsequent explosive work.

Stage 2. Speed-Strength Activation

At this stage, athletes perform high-quality explosive exercises while fatigue is still minimal.

For example:

- 3–4 sets of 4–6 maximal vertical jumps;
- 3 sets of countermovement jumps;
- short approach jumps;
- low-volume hurdle jumps.

Recovery between sets should be sufficient to maintain explosive performance.

The primary objective is not metabolic fatigue but maximal movement quality.

Stage 3. Volleyball-Specific Explosive Training

The third stage integrates jumping with volleyball-specific techniques.

Exercises may include:

- 5–6 attack jumps;
- 5–6 blocking jumps;
- lateral movement followed by blocking;
- block-to-attack transitions;
- attack approach followed by spike execution;
- repeated jump setting.

At this stage, the coach should monitor both physical execution and technical accuracy.

Stage 4. Jump-Endurance Training

The fourth stage is designed to improve repeated-jump capacity.

One possible structure is:

15 seconds — repeated jumping activity;

30–45 seconds — recovery;

4–6 sets.

The duration and intensity should be adjusted according to the age and preparedness of the athletes.

The aim is to maintain relatively stable movement performance throughout the exercise series.

If jump height, coordination, landing technique, or technical accuracy declines substantially, the exercise volume should be reconsidered.

Stage 5. Recovery Phase

The final phase may include:

- low-intensity movement;
- breathing exercises;
- mobility exercises;
- relaxation activities;
- low-intensity ball exercises.

The purpose is to facilitate transition from high-intensity work to recovery.

Differentiation of Training Loads

A standardized training load should not be applied equally to all volleyball players.

Athletes differ in:

- training experience;
- age;
- body mass;
- strength level;
- jumping ability;
- neuromuscular coordination;
- playing position;
- recovery capacity.

Therefore, training loads should be differentiated.

Three general levels may be used.

Initial Level

Athletes with limited training experience should perform:

- low- to moderate-intensity jumps;
- technically simple tasks;
- low plyometric volume;
- longer recovery periods;
- increased emphasis on landing technique.

Intermediate Level

Athletes with moderate training experience may perform:

- repeated plyometric exercises;
- moderate-volume jump combinations;
- changes of direction before jumping;
- technical tasks integrated with jumping.

Advanced Level

Highly trained athletes may perform:

- maximal and near-maximal explosive jumps;
- more complex jump combinations;
- shorter recovery intervals;
- repeated block-to-attack sequences;
- position-specific high-intensity exercises.

However, increasing complexity should not result in uncontrolled fatigue or loss of technique.

Integration of Technical and Physical Preparation

One of the most important methodological principles is the integration of physical preparation with volleyball technique.

Physical qualities are valuable only when athletes can apply them effectively during game actions.

For example, a player may demonstrate excellent vertical jump height in laboratory or field testing but perform ineffectively in blocking if the timing of take-off is incorrect.

Similarly, a powerful attacker may fail to maximize jumping potential if the approach rhythm or arm swing is poorly coordinated.

Therefore, volleyball conditioning should gradually progress from general physical exercises toward integrated game-specific tasks.

For instance, a sequence of repeated vertical jumps can be replaced by:

block → landing → second block → defensive transition → attack approach → spike.

This structure simultaneously develops:

- repeated-jump capacity;
- explosive strength;
- coordination;
- movement transition;
- spatial orientation;
- technical performance.

Such exercises more closely reflect the multidimensional demands of competitive volleyball.

Position-Specific Considerations

The requirements for jump training may differ depending on a player's position.

Middle blockers frequently perform repeated blocking actions and rapid lateral movements along the net. Their training should emphasize short contact time, rapid repeated jumps, lateral movement, and block-to-attack transitions.

Outside hitters and opposite hitters require effective approach jumps, repeated attacking ability, and stable performance after defensive actions.

Setters may benefit from exercises that develop repeated low-to-moderate jumping actions combined with precise ball placement.

Therefore, individualized conditioning should reflect the movement profile of each position.

Monitoring Training Effectiveness

Evaluation of volleyball jump preparation should not rely on a single maximal jump test.

A comprehensive monitoring system may include:

1. standing vertical jump height;
2. approach jump height;
3. countermovement jump performance;
4. repeated-jump performance;
5. decline in jump height across repeated efforts;
6. blocking movement speed;
7. technical accuracy after repeated jumps;
8. subjective fatigue;
9. recovery characteristics.

The relationship between initial and final jump performance during a repeated-jump test may provide useful information about special jump endurance.

For example, an athlete may demonstrate a very high initial jump but experience a substantial decline across repeated efforts.

This may indicate well-developed maximal explosive ability but insufficient repeated-jump capacity.

Conversely, another athlete may demonstrate a slightly lower maximal jump but maintain a more stable level across repeated efforts.

For competitive volleyball, both characteristics are important.

Methodological Model of Jump Preparation

The proposed methodology can be summarized through the following sequence:

basic strength → rapid force production → repeated explosive performance → volleyball-specific technical application.

The first component provides the athlete with an adequate strength foundation.

The second transforms available force into high-speed movement.

The third develops the ability to repeat explosive actions under increasing fatigue.

The fourth ensures that physical capacity is effectively integrated into technical and tactical volleyball performance.

If one component is neglected, the overall training effect may be limited.

For example:

- strength without speed may produce insufficient explosive performance;
- jumping without a strength foundation may limit long-term progress;
- repeated jumping without proper recovery may reduce movement quality;

➢ physical development without technical integration may result in poor transfer to competitive performance.

Therefore, the optimal training process should establish a functional connection between strength, speed, endurance, coordination, and technical performance.

Practical Recommendations

Based on the theoretical and methodological analysis, the following recommendations can be proposed for volleyball coaches and sports specialists.

1. High-intensity plyometric exercises should preferably be performed when athletes are not excessively fatigued.
2. Movement quality should be prioritized over excessive repetition volume.
3. Jumping programs should include both bilateral and unilateral exercises.
4. Standing jumps and approach jumps should be combined within a systematic training program.
5. Blocking and attacking jumps should be treated as biomechanically different tasks and trained accordingly.
6. Repeated-jump performance should be monitored not only by the number of repetitions but also by the stability of jump height and technique.
7. Training loads should be individualized according to athletes' age, physical condition, training experience, and playing position.
8. Physical exercises should gradually progress toward volleyball-specific technical tasks.
9. Recovery intervals should be selected according to the main objective of the exercise.
10. High-quality landing mechanics should be consistently developed and monitored.
11. Jump endurance training should not completely replace maximal speed-strength training.
12. Coaches should monitor the relationship between training volume, exercise intensity, and athletes' recovery.

Conclusion

Jumping ability is one of the key components of volleyball-specific physical preparedness. However, successful competitive performance depends not only on an athlete's maximum jump height but also on the capacity to repeatedly perform explosive actions while maintaining technical efficiency, coordination, and movement quality.

The development of jump endurance and speed-strength qualities should therefore be organized as an integrated process involving basic strength training, plyometric exercises, repeated-jump drills, volleyball-specific movement patterns, and technical-tactical actions.

A simple increase in the total number of jumps cannot be regarded as an optimal strategy for improving volleyball-specific explosive performance. Training quality, exercise intensity, recovery intervals, individual characteristics, technical complexity, and movement specificity should all be considered when designing the training process.

The methodological sequence proposed in this study —

basic strength → explosive force production → repeated-jump stability → technical application

— provides a logical framework for planning special physical preparation in volleyball.

The integration of these components may improve the transfer of physical abilities to competitive actions, enhance the stability of jumping performance, and support more effective execution of attacking and blocking techniques.

Future empirical research should focus on experimentally evaluating the proposed methodology among volleyball players of different ages, qualification levels, and playing positions. Particular attention should be paid to changes in maximal jump height, repeated-jump performance, fatigue resistance, blocking efficiency, and attacking effectiveness.

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