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Speed-Strength Training and Its Impact on Developing Speed-Specific Power in the Arms and Legs, and the Performance of the Overhand Serve and Blocking Skills in Volleyball

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Abstract

Study purpose. This study aimed to identify and design speed-strength exercises that develop speed-strength in the arms and legs of the research sample, and to enhance the skill performance of the tennis overhand serve and blocking in volleyball.

Materials and Methods. The researcher employed an experimental design with pre- and post-tests, applying a training program consisting of 24 units over 8 weeks. The sample included 12 first-grade middle school players. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS).

Results. The speed-strength exercises significantly improved arm and leg speed-strength among the participants. Additionally, the exercises had a positive effect on the accuracy of the overhand serve in tennis and blocking skills in volleyball.

Conclusions. Speed-strength exercises are effective for enhancing both physical capabilities and technical performance, particularly for the overhand serve and blocking skills. It is recommended that coaches integrate such exercises into training programs to develop speed-strength as a core component of athletic performance.

Keywords: Speed-Strength, Overhand Serve, Blocking Skills, Volleyball, Training Program.

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Introduction

The advancement in sports, across various disciplines, and the achievement of milestones in athletic competitions do not occur by chance. Instead, they result from continuous scientific research and rigorous effort, elevating sports to the same level as other vital fields (Blerim, Zarko, Visar, Agron, & Egzon, 2018; Erickson & Sherry, 2017; Fadhlani, Hasibuan, & Sembiring, 2022). By following scientific methodologies, significant athletic progress has been achieved, optimizing effort, time, and costs while refining training processes. Among these sports, volleyball stands out with its unique physical and skill-based demands,

distinguishing it from other games. Muscular strength is a fundamental component of skill performance in training and competitions, though its importance varies across sports (Akinbiola & Yekeen, 2022; Hindle, Whitcomb, Briggs, & Hong, 2012; Musálek et al., 2020). Experts in sports training emphasize the significance of speed-strength, as players who possess this attribute can score points through the overhand serve and blocking. Speed-strength plays a crucial role as one of the key components of physical conditioning, influencing ball direction changes during volleyball matches. Athletic excellence depends on enhancing physical, psychological, and motor elements, along with sustaining these attributes through training and competition, in addition to the player's health and physiological characteristics (Cronin, 2005; Forthomme et al., 2018; Spieszny & Zubik, 2018). The overhand serve (tennis serve) and blocking are essential skills in volleyball, as they directly contribute to scoring. These offensive skills create a decisive advantage during matches by disrupting the opponent's defense, thanks to the high-speed ball movement during serves and blocks.

Achieving optimal performance in these skills requires coordinated body movement, where all parts work in harmony to execute the skill effectively. This involves transferring kinetic energy generated from the approach steps during takeoff to maximize jump height while maintaining body control during flight., this research highlights the importance of developing speed-strength through targeted indicators related to these skills. The researcher adopted speed-strength training to enhance physical abilities and improve serving and blocking performance in volleyball.

Materials and methods

Study Participants

Age group and level: First-grade middle school students at Ra'i Al-Islah Primary School in Najaf Al-Ashraf.

Sample size: A purposive sample of 12 students was selected from a total population of 40.
Characteristics: Participants were of relatively similar physical condition. They were selected to undergo pre- and post-assessments related to a specifically designed speed-strength training program.

Study Organization

Methodology:

The researcher used an experimental method with a one-group pre-test and post-test design, deemed appropriate for the nature of the study.

Research Population and Sample

The research population consisted of first-grade middle school students at Ra'I Al-Islah Primary School in Najaf Al-Ashraf, totaling 40 students. A purposive sample of 12 students was selected as the study's participants. Location Scope: School playground.

Equipment Used

a. 10 volleyballs
b. Camera
c. Whistle
d. Stopwatch
e. Adhesive tape
f. Pens/notebook for recording
g. Bench

Tests Used in the Research

First: Speed-Strength Test for the Arms

Test: Maximum number of medicine ball (2 kg) lifts and drops in 10 seconds

Objective: Measure the speed-strength of the dominant arm. Tools: Handball court or flat ground, 2 kg medicine ball, stopwatch, whistle, and recording form. Procedure: Starting position: Supine (lying on the back). The tested player holds the medicine ball (2 kg) and raises it upward by fully extending the dominant arm (throwing arm: right or left). Upon hearing the start whistle, the player performs maximum-speed flexion and extension of the arm for 10 seconds, ending with the final whistle.

Scoring: The recorder counts the number of complete flexion-extension cycles within 10 seconds. Each participant performs the test only once.

Second: Leg Speed-Dominant Power Test Purpose of the test: Measuring speed-dominant power in the legs.

Test requirements: Stopwatch, recorder, timing device, measuring tape, whistle. **Test description:** The subject stands behind the starting line. Upon hearing the whistle, they hop on their right leg to the finish line, then turn around and hop back to the starting line on their left leg.

Recording: The time taken to complete the distance is measured to the nearest tenth of a second (Al-Fadhli, 2023).

Third: Tennis Overhead Serve Skill Test (Mahjoub, 2002)

Purpose of the test: Measuring the accuracy of the tennis overhead serve.

Equipment: Four volleyballs, a regulation volleyball court, and a measuring tape are required. Performance Specifications: The subject performs ten consecutive overhead (tennis) serves, attempting to direct the ball into the zone with the highest score.

Conditions: The subject is given two practice attempts. Each subject has ten official attempts. 3. Points are awarded based on where the ball lands in the designated court zones, with the subject receiving the score written inside the zone. If the ball lands on a line, it is counted as landing in the adjacent zone. If it lands on a shared boundary between two zones, the subject is awarded the higher of the two scores. Recording: The subject's score is the sum of points earned across all ten attempts, with amaximum possible score of 50 points.

Fourth: Volleyball Blocking Accuracy Test

Test Name: Blocking Skill Accuracy Test

Purpose of the Test: Measuring the accuracy of volleyball blocking skills.

Equipment Used: A regulation volleyball court, four regulation volleyballs, and colored tape to divide the opposing court Performance Specifications: The subject stands in Position 3 (Center Front), 50 cm from the net, in a ready stance for blocking. The instructor performs a blocking skill from the opposite court, and the subject executes the block upon hearing the signal.

Performance Conditions: Each subject has 5 consecutive attempts, and each block must be properly executed.

Scoring is based on ball landing position:

a. Zone 2: 2 points
b. Zone 3: 3 points
c. Zone 4: 4 points
d. Outside these zones: 0 points.

Recording: The subject's score is the sum of points earned across all five attempts, with a maximum possible score of 15 (Hussein, 2024).

Pilot Study:

Conducted to validate:

a. Readiness of equipment and training tools.
b. Responsiveness of participants to the program.
c. Feasibility and duration of exercises.
d. Competence of the assistant team in carrying out the procedures.

Pre-tests:

Conducted on October 3, 2024, and included the following assessments:

a. Arm speed-strength test (medicine ball throws)
b. Leg speed-strength test (single-leg hops)
c. Tennis-style overhead serve accuracy test
d. Volleyball blocking accuracy test

Post-tests:

Administered on December 9, 2024, under the same conditions as the pre-tests to ensure reliability.

Statistical Analysis

Software used:

The Statistical Package for the Social Sciences (SPSS).

Procedures:

The researcher applied paired-sample t-tests to assess the differences between pre- and post-test results.

Descriptive statistics (means, standard deviations) and significance levels (p-values) were calculated.

The analysis aimed to evaluate the effects of the speed-strength training program on:

a. Arm and leg speed-dominant power.
b. Accuracy of the overhead serve and blocking performance.

Results

Presentation and Discussion of Pre- and Post-Test Results.

Table 1. shows the mean, standard deviation, calculated (t-value), and significance level for pre- and post-test results of speed-dominant power (arms and legs):

Variables	Measurement Unit	Pre-Test		Post-Test		t-value	Significance
Arm Speed-Strength	Count	Mean (M)	SD	Mean (M)	SD		
		9.71	1.27	11.894	1.23	5.87	Significant
Leg Speed-Strength	Seconds	12.146	0.537	14.277	0.368	14.022	Significant

Table 2. Show mean, Standard Deviation, Calculated (t-value), and Significance Level for Pre- and Post-Test Results of the Tennis Overhead Serve and Volleyball Blocking Skills

Variables	Measurement Unit	Pre-Test		Post-Test		t-value	Significance
Tennis Serve Accuracy	Score	Mean (M)	SD	Mean (M)	SD		Significant

Test		17.6	1.39	21.034	1.24	13.16	
Block Skill Test (Volleyball)	Score	3.235	0.76	5.756	0.69	4.412	Significant

From the two tables above, the researcher attributes the development in the variable of speed-strength in the arms and legs, as well as the skills of the overhand serve and blocking in volleyball, to the proper regulation of training load according to the strength exercise method, the careful selection of exercises, and the progressive increase in difficulty and training load. It is observed that jumping exercises had a clear impact on the test results among the members of this group. However, the researcher notes that there was a significant motor workload for this group due to the nature of the high-intensity method used during the exercises. Therefore, the researcher was keen on ensuring correct exercise execution to achieve the desired goals and avoid injuries and errors.

Discussion

The researcher also believes that this improvement resulted from the proper regulation of resistances based on scientific principles, which effectively contributed to increasing speed-strength due to muscle adaptation and development. This was achieved through the weights carried by the players during exercises, which enhanced the capacity of both the nervous and muscular systems. This aligns with Sarih Abdul Karim's statement: "Muscle fibers have the ability to produce significant force by changing the type of resistance, thereby increasing the number of active motor units and, consequently, their energy production capacity" (Al-Fadhli, 2023).

The researcher focused on implementing light and moderate weight training, plyometrics, and high-intensity jumps with correct technique at an intensity ranging between (85-90%) using high-intensity interval training (HIIT). This approach yielded positive outcomes in achieving the best level of speed-strength for the arm and leg muscles, confirming the progress of the research sample in this variable .

The strength training program designed by the researcher, based on correct scientific principles and tailored exercise selection, targeted the muscles involved in the two skills (overhand serve and blocking). These exercises were harmonized with the requirements of these skills and proved highly effective in developing arm speed-strength by incorporating elements that enhance both strength and speed key factors in skill improvement and optimal performance (Probo Ismoko & Putro, 2023).

The researcher also agrees with Sarih Abdul Karim Al-Fadhli's assertion that «speed-strength exercises increase muscle force output, meaning greater work production (Work = Force × Distance). This training principle focuses on maximizing speed-strength through peak muscular work output» (Al-Fadhli, 2023). This is evident in the weighted, progressive, and continuous transfer of motion between body segments during skill execution, as emphasized by (Wajih Mahjoub and Ahmed Badri): «Kinetic transfer refers to the balanced, gradual, and uninterrupted movement across body parts during skill performance, generating significant force through joint coordination» (Mahjoub, 2002). Proper kinetic transfer—where motion flows harmoniously from limbs to the core enhances power output, as seen in the overhand serve and blocking jumps in volleyball, where arm swing and leg drive combine to produce a fluid, high-force motion toward the target.

The significant differences in all tests are attributed to the training program's components, which included speed-strength exercises for the legs and arms, as well as precision drills for the overhand serve and blocking. The program incorporated medicine balls, jump runs, hurdle drills, varied box heights, and light-to-moderate weights, blending these within training

units. Note that «the difficulty of exercises combining weights and jumping over hurdles/boxes of varying heights improves performance accuracy». Repeated strength training produced peak explosive power and maximal force in the involved muscles, refining movement patterns through high-speed contractions. «The key training stimulus for explosive strength is performing movements at very high speeds coupled with the necessary force» (Hijah, 2025).

Speed-strength training improved this variable by enabling players to exert greater force during takeoff, overcoming internal resistance. This required leg muscle conditioning through hurdle jumps and single-leg hops to generate rapid, powerful movements, minimizing ground contact time. Jamal Sabri Faraj emphasizes that «volleyball players primarily need speed-strength, requiring high-force, short-duration training, as the sport demands quick and powerful responses simultaneously» a factor that favored the research sample .

The development of arm speed-strength was driven by specialized exercises enhancing the striking speed for the overhand serve (tennis style) and blocking, critical for overpowering opponents' defenses. (Basim, Azez, & Hamid, 2025) notes that «speed-strength exercises are ideal for developing arm speed-strength, enabling players to deliver fast, accurate passes and spikes» (Probo Ismoko & Putro, 2023).

The researcher also attributes these significant results to the sample's use of speed-strength drills, focusing on strength, speed, and agility, with increased repetitions adjusted to intensity. (Razzaq Nema, 2022) confirms that «functional strength training relies on sport-specific exercises or high-repetition resistance drills when competitive conditions are hard to replicate» (Hijah, 2025)

The progress of the research sample was further fueled by motivation, as «learner motivation enhances performance accuracy through clear goals, facilitated learning opportunities, and balanced need fulfillment» (Ali, 2017).

Conclusions

The findings of the training program demonstrated that the integration of speed-strength exercises had a clear and positive impact on the participants' physical and skill performance. Analysis revealed that these exercises significantly enhanced speed-dominant power in the arms, leading to improved execution of explosive upper-body movements. Similarly, the lower extremities showed notable improvements, with increased speed-dominant power in the legs, which contributed to greater efficiency in explosive actions and overall physical performance.

Beyond the physical adaptations, the program also yielded considerable benefits in skill accuracy. Specifically, participants exhibited enhanced precision in performing sport-specific tasks, most notably in the tennis overhead serve and volleyball blocking skills. These outcomes highlight that speed-strength training not only augments physical power but also translates into improved accuracy and effectiveness in technical performance under competitive conditions.

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Conflict of interest

The author declare that they have no conflicts of interest regarding the publication of this paper.

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