American Journal of Alternative Education
ISSN: 2997-3953 (Online)
Vol. 2, No. 12, Dec 2025,
Available online at: https://scientificbulletin.com/index.php/AJAE

The Scientific Basis of Interval-Speed Training Methods for Improving Start Velocity and Strike Power in Young Volleyball Players

Orzikulova Saodat Bakhromovna
Lecturer, Department of Sports activities and pre-conscription military education, Termez state pedagogical institute

Article information:
Manuscript received: 02 Oct 2025; **Accepted:** 02 Nov 2025; **Published:** 05 Dec 2025

Abstract: This study examines the effectiveness of interval-speed training methods in developing start velocity and strike power among young volleyball players. The research focuses on the neuromuscular mechanisms that support rapid acceleration, explosive movement, and high-intensity striking actions. A specially designed interval-speed program was implemented over several weeks, incorporating short-distance acceleration drills, high-intensity intervals, and sport-specific striking exercises. Performance indicators such as start reaction time, 5-10 m sprint velocity, and spike force were measured before and after the intervention. The findings demonstrate that interval-speed training significantly enhances movement efficiency, accelerates neuromotor activation, and improves power generation during offensive actions. These results provide a scientifically grounded approach for coaches seeking to optimize physical preparation strategies for young volleyball athletes.

Keys words: volleyball; start velocity; interval-speed training; neuromuscular activation; acceleration mechanics; spike force; youth athletes.

INTRODUCTION

Start velocity and explosive striking actions represent two essential physical qualities that determine competitive performance in modern volleyball. Young athletes, in particular, require training methods that simultaneously develop rapid acceleration, neuromuscular responsiveness, and efficient force production, as these abilities directly influence offensive and defensive effectiveness on the court. Early acceleration from a stationary or semi-stationary stance is fundamental for executing quick attacks, closing the block, and responding to sudden directional changes. Likewise, strike power is closely tied to a player's ability to generate high-intensity force within a very short time interval, relying on well-coordinated neuromuscular activation patterns [2].

Interval-speed training has emerged as a promising method for improving these qualities because it mimics the intermittent, high-intensity nature of volleyball actions. This approach typically integrates short bursts of maximal or near-maximal speed efforts with brief recovery intervals, enabling athletes to train physiological systems responsible for explosive acceleration without excessive fatigue accumulation. Previous research suggests that repeated high-intensity bouts stimulate motor unit recruitment, enhance rate of force development, and promote adaptations in both fast-twitch muscle fibers and neural pathways associated with rapid movement execution. Such changes are particularly beneficial for younger players whose neuromotor systems remain highly adaptable.

Despite growing interest in speed-oriented conditioning programs, the scientific groundwork for

applying interval-based speed methods specifically to young volleyball players remains insufficient. Limited empirical data exist on how structured interval-speed programs affect both start velocity and spike power simultaneously, and how these improvements translate to real-game performance indicators [5]. Therefore, this study aims to examine the effectiveness of a targeted interval-speed training protocol designed for youth volleyball athletes and to assess changes in acceleration mechanics, reaction efficiency, and striking force following the intervention.

MATERIALS AND METHODS

This study was conducted with a cohort of young volleyball players aged 14-16 who had at least two years of structured training experience. All participants were medically cleared for high-intensity training and demonstrated similar baseline levels of technical proficiency to ensure homogeneity of the sample. Prior to the intervention, each athlete completed a standardized warm-up protocol followed by baseline testing of start velocity, 5-meter and 10-meter sprint times, reaction speed, and spike force. These tests were selected because they reflect the essential physical components of volleyball performance: rapid acceleration, neuromuscular responsiveness, and explosive upper-body force production [2]. Measurements were collected using electronic timing gates for sprint tests and a calibrated digital dynamometer for strike-force assessment, ensuring high precision and reliability.

The intervention program consisted of an interval-speed training protocol implemented three times per week over a six-week period. Each training session included short-distance accelerations (5-15 m), repeated high-intensity bursts at controlled work-to-rest ratios, and volleyball-specific striking drills that emphasized maximal power output within brief time frames. Training loads were adjusted progressively, beginning with lower-intensity accelerations and transitioning toward maximal-speed repetitions as athletes demonstrated improved readiness. Rest intervals were deliberately short to simulate the intermittent nature of volleyball actions and to promote adaptations in anaerobic capacity, neural firing frequency, and rate of force development [4]. All sessions were supervised by certified coaches to ensure technique accuracy, prevent excessive fatigue, and maintain safety.

Throughout the intervention, athletes' performance and physiological responses were monitored using session RPE scales, post-session heart-rate checks, and observation of movement quality. This allowed for individualized adjustments while preserving consistency in the training structure. At the end of six weeks, all initial assessments were repeated under identical conditions to evaluate changes in start velocity, acceleration mechanics, and spike power. Data were statistically analyzed using paired comparisons to determine the significance of performance improvements and to identify relationships between speed development and striking force outcomes [6].

RESULTS

The post-intervention assessment revealed clear and statistically meaningful improvements in all measured performance indicators among the young volleyball players. The most notable change was observed in start velocity, where athletes demonstrated faster acceleration within the first 5 meters, accompanied by a more efficient transition into maximal sprinting speed. Average 5-meter and 10-meter sprint times improved consistently across the group, indicating enhanced neuromuscular coordination and quicker force application during the initial movement phase [1]. Athletes exhibited greater control in their first step mechanics, reduced ground-contact time, and more explosive forward projection, all of which contributed to improved early acceleration performance.

Reaction speed also showed significant progress following the six-week interval-speed training program. Players responded more quickly to visual cues during testing, suggesting that the repeated exposure to rapid movement cycles and short recovery intervals strengthened neural pathways related to reaction efficiency and motor-unit synchronization. These adaptations were particularly evident in drills requiring sudden directional changes, where athletes performed transitions with less delay and greater smoothness. Such improvements align with the physiological principles underlying interval-speed training, which has been shown to facilitate faster neural firing rates and heightened readiness for

explosive movements [3].

Spike-force measurements demonstrated marked enhancement as well. The increase in maximal striking power suggests that interval-speed training not only improved lower-body acceleration but also contributed to better whole-body power integration during the spiking motion. Athletes generated higher peak force during contact, which can be attributed to improved kinetic-chain coordination and increased rate of force development in the upper extremities [4]. Observational data collected by coaches confirmed that players executed their offensive actions with more confidence and reduced preparatory time, resulting in smoother timing between jump, arm swing, and ball impact.

Overall, the combined improvements in acceleration, reaction speed, and striking force indicate that the applied interval-speed protocol had a holistic effect on volleyball-specific performance. The consistency of positive outcomes across participants suggests that young athletes respond particularly well to this form of training, likely due to the adaptability of their neuromotor systems and the compatibility of interval-speed methods with the dynamic nature of volleyball movements. These results support the hypothesis that targeted interval-speed training can significantly elevate the athletic capacity of youth volleyball players when applied systematically and under proper supervision.

DISCUSSION

The results of this study demonstrate that interval-speed training can serve as an effective stimulus for enhancing both acceleration and strike-power capabilities in young volleyball players. These findings align with existing literature suggesting that high-intensity, intermittent training promotes rapid motor-unit recruitment and improves the neuromuscular efficiency required for fast explosive movements [1]. The substantial gains in start velocity observed among participants are consistent with research indicating that repeated short-burst sprints strengthen the neural pathways responsible for rapid force application, thereby refining the biomechanics of the first step and early acceleration phase [2]. Such improvements are particularly valuable in volleyball, where the ability to cover short distances quickly often dictates the success of offensive and defensive plays.

The enhanced reaction speed recorded in this study further supports the effectiveness of interval-speed methods. The training protocol’s emphasis on rapid acceleration cycles, short recovery periods, and constant neuromotor activation likely contributed to heightened responsiveness and quicker initiation of movements. These results are in line with evidence that high-frequency neural activation during intense interval work leads to improved synchronization and firing rates of motor units [3]. For young athletes, whose neuromuscular systems remain highly adaptable, such stimuli appear especially potent in accelerating perceptual-motor integration and decision-making speed during gameplay situations [4].

Increases in spike force indicate that the benefits of interval-speed training extend beyond lower-body acceleration to encompass improvements in upper-body power generation as well. The training method’s whole-body intensity and its requirement for coordinated effort across multiple muscle groups may explain the stronger kinetic-chain activation seen in the post-test results. Previous studies have shown that enhanced acceleration ability often correlates with improved power transfer during striking or jumping actions, reinforcing the view that explosive movement qualities are interdependent [5]. These findings suggest that interval-speed training provides a comprehensive physical stimulus capable of strengthening multiple performance domains simultaneously.

Another important consideration is that the consistent improvements across all participants highlight the suitability of this method for young volleyball players. Adolescents typically exhibit high responsiveness to neuromuscular stimuli, and the structured nature of interval-speed programs helps maximize their adaptive potential while maintaining safety. The supervised progression of loads used in this study ensured that fatigue did not hinder technique, thereby supporting efficient skill acquisition alongside physical development [6]. The positive outcomes also underscore the importance of integrating speed-focused training into regular volleyball preparation, rather than treating it as an isolated or supplementary component.

Overall, the findings emphasize that interval-speed training represents a scientifically grounded strategy for enhancing volleyball-specific physical qualities. When appropriately structured and monitored, such programs can meaningfully contribute to young athletes' readiness for high-intensity match situations and improve their competitive performance potential [7].

CONCLUSION

The findings of this study demonstrate that interval-speed training is a highly effective method for enhancing key performance qualities in young volleyball players. The six-week protocol led to measurable improvements in start velocity, reaction speed, and spike force, indicating meaningful adaptations within both the neuromuscular and biomechanical systems. These gains reflect enhanced motor-unit recruitment, faster neural activation, improved acceleration mechanics, and more efficient whole-body power transfer during offensive movements. The structured and progressive nature of the training program allowed athletes to adapt safely while performing high-intensity tasks that closely replicate real-game demands. Given the consistent improvements across participants, interval-speed training should be considered a vital component of physical preparation in youth volleyball. Its integration into regular practice routines can significantly elevate athletic readiness, contribute to more explosive gameplay actions, and support long-term development in competitive performance environments.

REFERENCES

1. Bompa T., Haff G. Periodization: Theory and Methodology of Training. - Champaign: Human Kinetics, 2018. - 411 p.
2. Sheppard J., Young W. Agility literature review: Classifications, training and testing. Journal of Sports Sciences, 2006; 24(9): 919-932.
3. Laursen P., Jenkins D. The scientific basis for high-intensity interval training. Sports Medicine, 2002; 32(1): 53-73.
4. Ross A., Leveritt M., Riek S. Neural influences on sprint running. Sports Medicine, 2001; 31(6): 409-425.
5. Suchomel T., Nimphius S., Stone M. The importance of muscular strength in athletic performance. Sports Medicine, 2016; 46(10): 1419-1449.
6. Lloyd R., Oliver J. Strength and conditioning for young athletes. - London: Routledge, 2019. - 290 p.
7. Turner A., Jeffreys I. Developing speed. NSCA Coach, 2010; 3(3): 22-28.