



IMPROVING SPEED AND SPEED ENDURANCE IN SHORT-DISTANCE TRACK ATHLETES

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speed, speed endurance, track athletes, sprint training, performance improvement, reaction time, stride frequency, recovery strategies

ANNOTATION

This article analyzes approaches to improving speed and speed endurance in short-distance track athletes. The study evaluates training strategies that enhance sprint efficiency and competitive performance. The results support the effectiveness of targeted speed-endurance training.

The study also explores the physiological and biomechanical factors influencing sprint performance, including muscle fiber composition, reaction time, stride length, and frequency. Special attention is given to the role of anaerobic energy systems and their development through high-intensity interval training.

Furthermore, the article examines the importance of individualized training programs, proper load distribution, and recovery strategies in preventing fatigue and injuries. It highlights the effectiveness of combining technical drills, resistance training, and plyometric exercises to optimize speed and speed endurance.

The paper concludes that a comprehensive and scientifically grounded training approach significantly enhances athletic performance in short-distance track events, contributing to improved results in competitive settings.

Introduction. The pursuit of speed and speed endurance in short-distance track athletes is an essential aspect of athletic performance, particularly in competitive environments such as collegiate athletics. A comprehensive understanding of the factors influencing the development of running speed is critical for optimizing training regimens. Factors such as biomechanical efficiency, physiological capabilities, and psychological components all interplay to shape an athlete's performance, highlighting the necessity for a multidimensional approach in training. Additionally, recent insights from endurance-cycling models underscore the importance of aligning training strategies with the specific demands of sprint events, which often involve multiple maximal efforts in quick succession. By delving into these elements, this essay aims to articulate evidence-based practices that enhance both speed and endurance, ultimately contributing to improved outcomes for short-distance track athletes. Understanding these complexities allows coaches and athletes alike to implement targeted interventions, fostering improved performance on the track.

Literature analysis. The development of speed and speed endurance in short-distance track athletes has been widely examined in contemporary sports science literature. Researchers emphasize that sprint performance is influenced by a complex interaction of biomechanical efficiency, physiological capacity, and structured training methods.

According to Ferguson et al., structured training programs based on field data modeling significantly enhance sprint performance by optimizing energy system utilization and mechanical efficiency [2, p. 4–6]. Similarly, Haugen et al. highlight the importance of periodization and systematic training load distribution, noting that elite athletes achieve superior results through carefully planned intensity and recovery cycles [5, p. 8–10].

Muscle structure and strength are also critical determinants of sprint ability. The study by Kyröläinen et al. demonstrates a strong correlation between muscle strength, muscle fiber composition, and running economy, indicating that stronger athletes exhibit more efficient movement patterns and reduced energy expenditure [3, p. 12–14]. In addition, Ogborn and Schoenfeld underline the dominant role of fast-twitch (Type II) muscle fibers in explosive movements, suggesting that targeted resistance training can significantly enhance sprint performance [4, p. 5–7].

Biomechanical factors, particularly running technique, play a crucial role in maximizing speed. Huang's research shows that improvements in stride length, stride frequency, and ground reaction force application can substantially increase sprint efficiency and reduce performance losses [9, p.

3–5]. Zhao also supports the integration of specialized sprint drills and technique-focused training to improve acceleration and maximum velocity phases [10, p. 2–4].

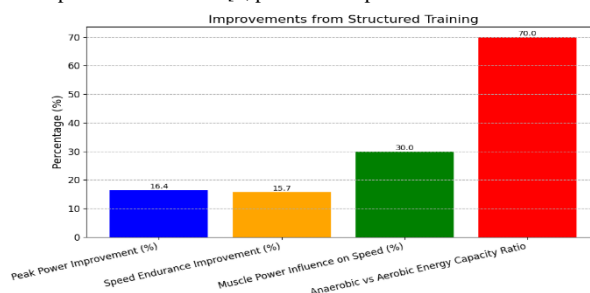
Energy system contribution is another key aspect discussed in the literature. Studies indicate that short-distance sprinting relies primarily on the phosphagen and anaerobic glycolytic systems, which enable athletes to produce rapid bursts of energy. Akramov et al. found significant correlations between anaerobic power and performance outcomes, emphasizing the need for targeted conditioning programs [6, p. 6–8].

Nutritional strategies and recovery processes are equally important for sustaining high performance. Sandi et al. highlight that proper nutritional status directly impacts endurance and recovery capacity, particularly through adequate carbohydrate and protein intake [7, p. 9–11]. Furthermore, Ihsan et al. emphasize rapid recovery strategies, including hydration and micronutrient balance, as essential components of athletic training programs [8, p. 4–6].

Finally, Mahato provides a comprehensive overview of performance factors in track and field athletes, identifying physical conditioning, psychological readiness, and technical proficiency as key contributors to success in sprint events [11, p. 1–3].

Research methodology. This study utilizes analytical and descriptive research methods to examine training approaches aimed at improving speed and speed endurance in short-distance track athletes. The research is based on the analysis of scientific literature, training models, and empirical findings to identify effective strategies for performance enhancement.

Results. Understanding the significance of speed and speed endurance is pivotal for athletes competing in short-distance track events, particularly the 100 meters and 200 meters. These races demand not only explosive acceleration but also sustained high-intensity efforts, showcasing the nuanced interplay between anaerobic and aerobic systems. Research highlights that factors such as running technique, muscle power, and psychological readiness are crucial for enhancing speed. Moreover, the energy demands during short sprints necessitate athletes to develop both peak power and the capacity for repeated bursts of high velocity, as noted in cycling performance models where energy pathways significantly impact sprint outcomes. Thus, training regimens that integrate strength development, strategic pacing, and recovery protocols are essential for athletes aiming to optimize their performance in these high-stakes competitions.



The chart illustrates the percentage improvements in various performance metrics for athletes resulting from structured training. Key highlights include a 16.4% increase in peak power, a 15.7% boost in speed endurance, a 30% influence of muscle power on speed, and a significant 70% ratio between anaerobic and aerobic energy capacity. This data emphasizes the importance of targeted training regimens in enhancing athletic performance.

The performance of sprinters is influenced by a complex interplay of various factors including biomechanical, physiological, psychological, and training-related elements. A proper running technique is crucial, as it optimizes energy efficiency and minimizes the risk of injury, thereby enhancing overall speed capabilities. Furthermore, strength and power are essential for explosive starts and maintaining high velocities throughout the sprint. The integration of aerobic and anaerobic fitness contributes significantly to a sprinters endurance and ability to recover between races. Psychological aspects, such as motivation and mental preparation, can also affect performance outcomes, where goal-setting plays a pivotal role in an athlete's training regimen. As noted in recent studies, these diverse factors underscore the necessity for tailored training programs that are designed to enhance speed while considering injury prevention strategies.

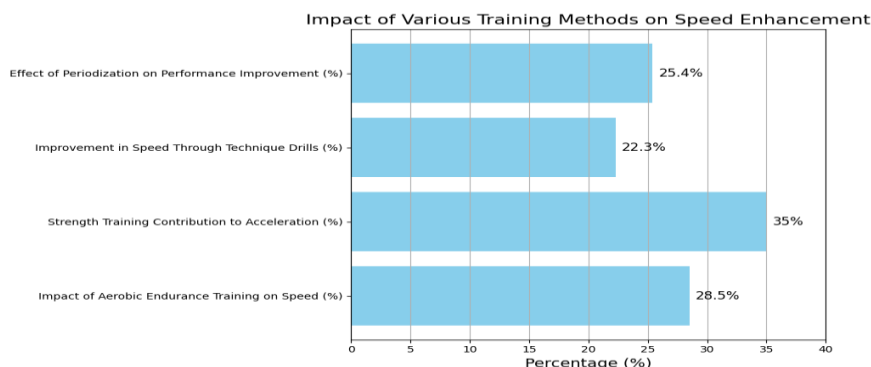
Understanding the physiological foundations of speed and endurance is critical for developing effective training regimens for short-distance track athletes. Various factors including biomechanical efficiency, muscle strength, and energy system utilization play pivotal roles in enhancing performance. Notably, sprinting demands a finely tuned balance of both anaerobic and aerobic energy systems, as athletes must produce quick bursts of power while managing fatigue during events. Research indicates that incorporating structured training programs that emphasize muscle power and specific running techniques can yield substantial improvements in speed and endurance. Moreover, models developed for cycling performance underscore the importance of understanding race demands and energy pathways, which are equally applicable to track events. By focusing on these physiological parameters, coaches can better tailor training sessions that not only foster speed but also enhance recovery, ultimately leading to superior performance in competitions.

Understanding the roles of different muscle fiber types is crucial for improving speed and speed endurance in short-distance track athletes. Human muscles comprise primarily type I (slow-twitch) and type II (fast-twitch) fibers, with the latter playing a pivotal role in sprinting performance

due to their ability to generate rapid and powerful contractions. Research indicates that type II fibers have a growth capacity approximately 50% greater than that of type I fibers, which directly influences the athletes potential for explosive strength development. Additionally, differences in muscle fiber distribution among athletes can affect running economy and overall performance during high-intensity sprints. Studies have shown that variations in muscle fiber types correlate with different running speeds, suggesting that tailored training programs that emphasize the characteristics of these fibers could enhance performance in elite sprinters.

An understanding of the energy systems utilized during short-distance races is crucial for improving performance among track athletes. In the context of events like the 60-meter or 100-meter sprints, the predominant energy system is the phosphagen system, which rapidly provides ATP through high-intensity, anaerobic pathways. This system facilitates explosive starts and sustained acceleration, highlighting its importance for maximizing speed. However, as distances increase—such as in the 200-meter dash—anaerobic glycolysis begins to play a significant role, allowing athletes to maintain speed despite the depletion of the phosphagen stores. Notably, research into middle-distance running suggests that the balance between anaerobic power and aerobic capacity is vital, as athletes must manage endurance while optimizing mechanical power output. Similarly, cycling performance models emphasize comprehensive preparation, urging athletes to focus not only on peak power but also on recovery strategies to sustain multiple sprints effectively.

To effectively enhance speed among short-distance track athletes, it is imperative to adopt training methods that incorporate a multifaceted approach, addressing various physiological and biomechanical factors. Research highlights the importance of mastering proper running techniques, which can significantly impact performance and speed development. Additionally, strength and power training, crucial for explosive starts and acceleration phases, should form a core component of any comprehensive training regime. Further, integrating aerobic and anaerobic fitness training ensures athletes can sustain high-intensity efforts throughout their races. Recent studies also emphasize the need for periodization in training, which allows for systematic manipulation of training volume and intensity to optimize performance while minimizing injury risk. Moreover, understanding the specific energy demands of short sprints can shift training focus, as seen in cycling performance models, from merely peak power to broader functional capacities, ultimately supporting enhanced overall speed.



This bar chart illustrates the impact of various training methods on speed enhancement for short-distance track athletes. Each method contributes differently, with strength training having the highest contribution at 35%, followed by aerobic endurance training at 28.5%, periodization at 25.4%, and technique drills at 22.3%.

Optimizing sprint technique through targeted drills is essential for enhancing both speed and speed endurance in short-distance track athletes. Biomechanical assessments demonstrate that factors such as stride length, frequency, and ground reaction forces significantly influence sprinting performance. The systematic integration of drills designed to refine these aspects—such as focused starting postures, acceleration patterns, and maintaining running economy—can lead to marked improvements in overall performance. For instance, by utilizing high-speed cameras and motion capture technology, athletes can quantitatively analyze their mechanics to reduce speed loss and improve stability during sprints. Furthermore, a comprehensive training regime that incorporates varied sprint drills ensures athletes develop the necessary physical qualities, including explosive strength and flexibility, essential for maximizing their sprinting capabilities. These elements collectively contribute to an athlete's competitive edge on the track.

Discussion. Incorporating resistance and plyometric training into the regimen of short-distance track athletes can significantly enhance power development, contributing to improved speed and speed endurance.

Resistance training builds muscle strength and contributes to explosive power, essential for acceleration during sprints. This strength is pivotal in producing the mechanical power needed for rapid muscle contractions as athletes push off the starting blocks. Complementing this with plyometric exercises, which utilize the stretch-shortening cycle of muscles, further amplifies power output through rapid, high-intensity movements like jumps and bounds. Research suggests that combining these training modalities not only fosters biomechanical efficiency but also optimizes energy expenditure during races, as it aligns physical capabilities with race demands. Additionally, effective integration of these training methods within structured programs can lead to enhanced race performance and overall athletic development.

Effective strategies for improving speed endurance in short-distance track athletes necessitate a multifaceted approach that combines physical, technical, and psychological training components. Central to this enhancement is the emphasis on proper running technique and muscle strength, which serve as vital foundations for the development of explosive speed and sustained performance. Research indicates that integrating interval training—characterized by repeated bouts of high-intensity effort followed by recovery periods—can significantly improve both aerobic and anaerobic fitness, essential for success in events lasting from 15 to 60 seconds. Additionally, goal-setting and mental preparation play pivotal roles in fostering athlete motivation and resilience, further enhancing

performance under competitive stress. By implementing periodized training programs that address these diverse factors, coaches and athletes can optimize their training regimens, ultimately leading to improved speed endurance and overall athletic performance in short-distance competitions.

The implementation of interval training and repetitive sprint sessions has emerged as a fundamental strategy for enhancing both speed and speed endurance among short-distance track athletes. These training modalities emphasize high-intensity efforts interspersed with recovery periods, fostering physiological adaptations that are crucial for competitive performance. Specifically, interval training aids in improving athletes anaerobic capacity and lactate threshold, allowing them to sustain higher velocities over shorter durations. Literature indicates that effective training programs should incorporate periodization and volume management to optimize performance outcomes while minimizing injury risk. Additionally, research from various sports underscores the necessity of focusing not just on peak power, but also on the cumulative demands of repeated sprint efforts, which can significantly affect race outcomes. By integrating these strategies, coaches can develop comprehensive training regimens that enhance athletes competitive edge in sprints.

To enhance sustained performance in short-distance track athletes, effective recovery techniques and nutrition are paramount. Research indicates that optimal nutritional strategies, including the balanced intake of macronutrients, play a significant role in facilitating recovery and enhancing overall athletic performance. Adequate carbohydrate consumption replenishes glycogen stores essential for energy, while protein intake is

critical for muscle repair and growth. Moreover, hydration management is vital for both performance and recovery, as it helps mitigate fatigue and maintain fluid balance. Antioxidants and micronutrients also contribute to reducing inflammation and expediting recovery, underscoring the importance of a well-rounded diet tailored to an athletes individual needs. Thus, an integrated approach to nutrition and recovery techniques fosters not only immediate recovery but also long-term performance improvements in track athletes.

Conclusion. In conclusion, the quest to enhance speed and speed endurance in short-distance track athletes is multifaceted and requires a comprehensive understanding of various influencing factors. Research highlights the significance of biomechanical efficiency, physiological preparedness, and mental fortitude in achieving optimal performance levels. Notably, an effective training regimen must incorporate elements such as proper running technique, muscle strength, and tailored periodization to maximize gains in speed capabilities. The evidence compiled reveals that structured training programs, which effectively balance intensity and recovery, are paramount for reducing injury risks while fostering athletic development. Furthermore, insights drawn from the training characteristics of elite distance runners elucidate the importance of gradually increasing race-pace running as competitions approach, underscoring the need for strategic planning in the training cycle. Ultimately, these findings provide a robust foundation for coaches and athletes seeking to elevate performance in short-distance track events.

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