

DEVELOPMENT OF SPEED ENDURANCE IN SHORT-DISTANCE RUNNERS

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Abstract. This article examines methods for developing speed endurance in short-distance runners. The study analyzes training techniques aimed at improving the ability to maintain high-speed performance over sprint distances. The findings highlight effective approaches to enhancing athletic performance.

Keywords. speed endurance, short-distance runners, sprint training, physical conditioning, athletic performance.

I. Introduction

The development of speed endurance in short-distance runners is a critical area of study that intertwines various physiological and psychological factors influencing athletic performance. As competitive events such as the 100m sprint demand not only explosive speed but also the capacity to sustain that speed over the race distance, understanding the underlying principles becomes essential. Research indicates that effective training programs must address biomechanical, physiological, and psychological components, including proper running technique, muscle strength, and athlete motivation, to enhance performance outcomes (Quoc LH, 2024). Moreover, the immense popularity of endurance running among recreational athletes raises questions about optimal training methods that can be translated into effective practices for non-professional runners (Boullosa D et al., 2020). This essay aims to explore these key elements, providing a comprehensive framework for coaches and athletes seeking to improve speed endurance in short-distance running. The insights derived from this analysis will contribute to the design of evidence-based training strategies that prioritize athletic development and performance enhancement.

II. Definition and importance of speed endurance in short-distance running

Speed endurance is defined as the ability of an athlete to maintain a high velocity over a short distance while resisting fatigue. This attribute is crucial in short-distance running events such as the 100 meters, where the limited duration of the race necessitates both explosive speed and the capacity to sustain that speed to achieve optimal performance. The significance of speed endurance is underscored by its multifaceted nature, which encompasses physiological, biomechanical, and psychological elements that collectively influence an athlete's performance. Research highlights the interplay of muscle strength, aerobic and anaerobic energy systems, and

mental preparation as vital components in enhancing speed endurance (Quoc LH, 2024) . Furthermore, tailored training regimens focusing on these factors can lead to substantial improvements in running efficiency and speed, essential for competitive success (Boullosa D et al., 2020) . Thus, understanding and developing speed endurance is paramount for short-distance runners striving to maximize their potential.

III. Overview of factors influencing speed endurance development

The development of speed endurance in short-distance runners is influenced by a myriad of factors that interact in complex ways. Biomechanical aspects, such as running technique, play a crucial role in optimizing performance and reducing injury risk. Additionally, physiological elements, including muscle strength, power, and the efficient utilization of energy systems, directly impact an athlete's ability to sustain high speeds over distances. Psychological factors, such as motivation and mental preparation, are equally significant, as they influence an athlete's training adherence and performance under pressure. Effective training programs, which emphasize periodization and the management of volume and intensity, are essential for maximizing these combined factors ((Quoc LH, 2024)). Furthermore, the unique characteristics of recreational runners necessitate tailored training approaches that address individual needs, ensuring improvements in performance while prioritizing health and injury prevention ((Boullosa D et al., 2020)).

IV. Physiological Foundations of Speed Endurance

The physiological foundations of speed endurance are critical for short-distance runners, as these elements determine their capacity to sustain high-intensity efforts over the course of a race. This endurance involves a complex interplay of anaerobic and aerobic energy systems, muscle strength, and neuromuscular coordination. Specifically, short-distance runners rely predominantly on anaerobic pathways to generate quick bursts of energy, allowing them to reach optimal speeds while minimizing fatigue. The development of running speed is influenced not only by physiological factors but also by biomechanical and psychological elements; thus, tailored training regimens should focus on enhancing muscle power, refining running technique, and fostering athlete motivation. Studies have shown that effective training programs must incorporate concepts such as periodization and injury prevention strategies to support overall performance enhancement (Quoc LH, 2024) . Moreover, synthesizing scientific evidence can help establish best practices that address the unique physiological demands placed on these athletes (Boullosa D et al., 2020) .

V. Role of anaerobic and aerobic energy systems

A comprehensive understanding of the anaerobic and aerobic energy systems is crucial for the development of speed endurance in short-distance runners. The anaerobic system, which predominately fuels activities lasting up to 30 seconds, is critical during high-intensity sprints, allowing athletes to maximize their power output

without the reliance on oxygen. Conversely, the aerobic system plays a significant role during slightly longer efforts, enhancing overall stamina and recovery performance. Successful short-distance training requires a synthesis of both systems; while anaerobic conditioning promotes explosive speed, aerobic capacity supports quicker recovery times between repeated sprints. Engaging in varied training methodologies that emphasize both energy pathways can optimally prepare athletes for competition. Studies indicate that integrating tailored programs focusing on biomechanical and physiological factors can significantly improve running speed, as seen in recent research highlighting the multifaceted influences on performance development in short-distance runners (Quoc LH, 2024) (Boullosa D et al., 2020) .

VI. Muscle fiber types and their impact on performance

Understanding muscle fiber types is crucial in the development of speed endurance in short-distance runners, as these fibers significantly influence athletic performance. Primarily, muscle fibers are categorized into Type I and Type II; the former, also known as slow-twitch fibers, are better suited for endurance activities due to their resistance to fatigue and energy efficiency. Conversely, Type II fibers, or fast-twitch fibers, excel in explosive movements integral to sprinting. Research indicates that the distribution of these fibers can directly impact running economy and overall speed; for instance, elite middle-distance runners often demonstrate specific muscle structures that enhance running performance through optimal fiber distribution (Kyro H'la inen et al., 2003) . Consequently, tailored training regimens focusing on muscle fiber adaptation, such as high-intensity interval training, can enhance performance through increased power and endurance (Peqini E et al., 2025) . Ultimately, a deeper understanding of these physiological components is essential to optimize training strategies for short-distance runners.

VII. Training Techniques to Enhance Speed Endurance

To enhance speed endurance in short-distance runners, integrating structured training techniques is essential. One effective approach involves periodization, where training cycles are strategically varied to optimize physical adaptations and prevent stagnation. Incorporating interval training—alternating periods of high-intensity sprints with active recovery—can significantly improve both aerobic and anaerobic capacities, crucial for sustaining speed over longer distances. Furthermore, targeting specific physiological markers through tailored high-intensity efforts allows coaches to refine the training process based on individual performance assessments. As highlighted in the literature, a multidisciplinary approach is beneficial, as it addresses various determinants of endurance running performance, ultimately providing runners with a comprehensive methodology for improvement (Bassett & Howley, 2000). Therefore, adapting these training techniques based on ongoing physiological feedback will not only enhance speed endurance effectively but also contribute to overall

performance optimization in a competitive environment (Boullosa D et al., 2020) (James C, 2016) .

VIII. Interval training methods and their effectiveness

The efficacy of interval training methods in enhancing speed endurance for short-distance runners is well-documented, underscoring the significance of tailored training programs. This approach involves alternating periods of high-intensity exertion with recovery intervals, promoting both aerobic and anaerobic capacities essential for sprint performance. The complexities of speed development are accentuated by the multifactorial elements that influence athletic performance, including biomechanical efficiency, muscle power, and psychological readiness, as highlighted in recent research (Quoc LH, 2024) . Furthermore, the challenge faced by recreational runners, who often lack personalized training strategies, can be alleviated through evidence-based interval methods that consider individual physiological responses and goals (Boullosa D et al., 2020) . Thus, implementing structured interval training not only aims to optimize performance gains but also aligns with the broader objectives of injury prevention and overall athletic development in short-distance runners.

IX. Strength and conditioning exercises for short-distance runners

To enhance speed endurance in short-distance runners, a tailored program of strength and conditioning exercises is essential. Such exercises not only build muscle strength and explosive power but also improve running economy, which is crucial during sprints. Incorporating resistance training focused on lower body strength, such as squats and deadlifts, can significantly increase an athlete's ability to generate force quickly. Additionally, core stability exercises play a critical role in maintaining proper form and reducing injury risk. Recent research indicates that the development of running speed is influenced by a complex interaction of various factors including biomechanical and psychological elements, which underscores the importance of a holistic approach to training ((Quoc LH, 2024)). Moreover, evidence suggests that integrating core training exercises not only enhances stability but also positively affects performance metrics essential for short-distance runners ((W Yao, 2022)).

X. Nutritional and Recovery Strategies

In the quest to enhance speed endurance in short-distance runners, nutritional and recovery strategies emerge as crucial elements in performance optimization. A well-structured nutritional plan that emphasizes high carbohydrate intake, depending on an athlete's body weight and training demands, can significantly improve glycogen stores, thereby maximizing energy availability during intense efforts (Fatima F et al., 2024) . Furthermore, the timing of nutrient consumption plays a pivotal role; consuming carbohydrates pre-race and incorporating mid-race fueling can sustain energy levels and stave off fatigue. Additionally, recovery protocols, which include hydration strategies and micronutrient supplementation, can further bolster performance

outcomes. For instance, maintaining electrolyte balance prevents dehydration, while nutrients like iron and vitamin D contribute to improved oxygen transport and recovery time (František Hurt) . Ultimately, these tailored nutritional strategies not only promote enhanced physical performance but also reduce injury risks, underscoring their importance in the holistic development of short-distance runners.

XI. Nutritional requirements to support speed endurance development

Nutritional requirements play a pivotal role in the development of speed endurance in short-distance runners, influencing both performance and recovery. A balanced intake of macronutrients, especially carbohydrates, is essential to fuel high-intensity training sessions and maintain optimal glycogen stores. Research highlights that athletes should aim for a carbohydrate intake of 8-12 g/kg of body weight to enhance endurance capacity and expedite recovery, supporting findings that demonstrate the importance of pre-race carbohydrates for sustained energy levels (Fatima F et al., 2024) . Additionally, adequate hydration and electrolyte balance are critical, preventing dehydration that can impair performance and increase injury risk (Sandi S et al., 2024) . Furthermore, micronutrients like iron and vitamin D are vital for oxygen transport and overall metabolic efficiency. Consequently, tailored nutritional strategies are necessary to meet the individual needs of athletes, fostering enhanced speed endurance and maximizing athletic potential.

XII. Recovery protocols and their role in maintaining performance

The importance of recovery protocols cannot be overstated in the context of maintaining performance for short-distance runners. These protocols play a critical role in optimizing athletic longevity and enhancing overall speed endurance. By effectively managing fatigue and promoting physical repair, recovery strategies—such as active recovery, adequate nutrition, and sleep—facilitate the body’s adaptation to training stressors. Recovery enables athletes to replenish energy stores and repair muscle tissue, which is essential for sustaining high-intensity efforts characteristic of events like the 800 meters. Moreover, recent studies emphasize the synergistic relationship between biomechanical efficiency and endurance capacity, highlighting how recovery interventions can enhance both aspects for improved race performance (Akramov Z O‘tkirvich et al., 2025) . As many recreational runners strive for optimal performance, tailored recovery strategies must be integrated into training regimens to not only enhance physical capabilities but also prevent injuries and ensure sustainable progress (Boullosa D et al., 2020) .

XIII. Conclusion

In conclusion, the development of speed endurance in short-distance runners is a multifaceted process that requires a comprehensive understanding of training principles and methodologies. Effective training regimens must incorporate a balance between intensive speed work and endurance-building activities to optimize overall

performance. As highlighted in recent studies, incorporating race-pace running progressively as competitions approach enhances athletic output, demonstrating that structured periodization not only improves immediate performance but also fosters long-term athletic development (Haugen T et al., 2022) . Furthermore, the lack of consensus around best practices for recreational runners underscores the importance of individualized training plans tailored to specific physiological and psychological needs (Boullosa D et al., 2020) . To achieve peak performance, coaches and athletes alike should focus on integrating scientific evidence with proven training strategies, ensuring that both elite and recreational runners can successfully develop their speed endurance while minimizing injury risks and enhancing overall athletic capabilities.

XIV. Summary of key points on developing speed endurance

To effectively develop speed endurance in short-distance runners, it is crucial to address multiple interrelated factors, including biomechanical efficiency, physiological conditioning, and psychological readiness. Key elements such as proper running technique and muscle power significantly influence an athletes speed capabilities, as identified in extensive research within the sprinting community (Quoc LH, 2024) . Additionally, incorporating tailored training programs that emphasize periodization and balance between intensity and volume can optimize performance while minimizing injury risk. The psychological aspects of training cannot be overlooked, as motivation, goal-setting, and mental preparation contribute to an athletes resilience during high-stress competitions (Boullosa D et al., 2020) . Ultimately, a holistic approach that integrates these factors will ensure comprehensive development of speed endurance, elevating short-distance runners performance to new heights.

XV. Implications for athletes and coaches in training programs

The implications for athletes and coaches in training programs aimed at developing speed endurance in short-distance runners are significant, as the effectiveness of training regimens is closely linked to understanding the multifaceted factors that influence performance. By emphasizing the interplay of biomechanical, physiological, and psychological components, coaches can design tailored training programs that enhance not only speed but also the endurance necessary for optimal sprinting. Specifically, implementing strategies such as periodization and individualized exercise intensity can lead to improved results, aligning with findings from current research, which highlight the importance of these elements in maximizing performance ((Quoc LH, 2024)). Furthermore, the lack of consensus on best practices for recreational athletes underscores the necessity for coaches to utilize evidence-based guidelines, ensuring that training methods account for individual variability in genetic predisposition and training time availability ((Boullosa D et al., 2020)).

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