

# Research on Speed-Endurance Training Methods in Middle and Long-Distance Running

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**Abstract:** Middle- and long-distance running is a crucial event in track and field sports. In middle- and long-distance training, coaches need to tailor effective speed-endurance training methods based on the athletes' individual conditions, enabling them to maintain good endurance during competitions and exhibit sufficient speed at the right moment to surpass their opponents. However, traditional speed-endurance training methods have certain limitations and struggle to improve athletes' speed-endurance levels. Therefore, this paper mainly analyzes the optimization strategies for speed-endurance training methods in middle and long-distance running, providing valuable references.

**Keywords:** Middle and long-distance training; speed; endurance; training methods; optimization strategies.

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## 1. Introduction

As an endurance-based competitive event, middle- and long-distance running demands a higher level of complex qualities in athletes, particularly in terms of both endurance and speed. In competitive practice, participants not only need to master their athletic techniques but also require strong aerobic metabolic capacity and mental resilience to withstand fatigue. Based on this, coaches should thoroughly analyze the energy supply characteristics of middle- and long-distance events, systematically deconstruct the biomechanical mechanisms of speed-endurance training, and precisely grasp key variables such as technical stability and energy distribution efficiency. This approach will help develop a cyclical and personalized scientific training system, achieving a synergistic improvement of endurance and speed abilities.

## 2. The Important Role of Speed-Endurance in Various Phases of Middle- and Long-Distance Races

### 2.1. Start and Acceleration Phase

In the start and acceleration phase of middle- and long-distance races, athletes need to quickly establish a speed advantage and strive to secure a favorable position on the track in the shortest amount of time. This phase requires participants to have highly responsive reflexes and excellent explosive power output, laying the groundwork for maintaining a steady pace in the later stages of the race. Specifically, in middle- and long-distance events on a 400-meter standard track, competitors need to rapidly establish an initial speed in the first 100-200 meters that aligns with their tactical plan, thus gaining track position advantage and setting the necessary conditions for achieving an ideal race result.

### 2.2. Mid-Race Phase

The mid-race phase is the longest segment in the entire middle- and long-distance race. During this phase, athletes need to maintain a certain speed and manage their energy wisely according to their physical condition to conserve strength for the final sprint. The mid-race phase places significant demands on the athlete's speed-endurance, primarily in terms of the ability to run at an appropriate speed

steadily while effectively resisting fatigue. For example, in a 3000m race, athletes should maintain a stable stride length and frequency, fully showcasing their speed-endurance capabilities.

### 2.3. Sprint Phase

Speed-endurance plays a crucial role in the sprint phase of middle- and long-distance races, directly determining the outcome of the competition. In the sprint phase, athletes are usually fatigued, but to achieve a good result, they must increase their speed once again and push themselves to the maximum to reach the finish line. During this process, athletes need a high level of speed-endurance to break through their physical fatigue limits and unleash their full potential. For example, in a 1500m race, the final 100-200 meters of the sprint phase are often the key factors that influence the athlete's final performance, with speed-endurance being a critical element in determining the race outcome.

## 3. Main Factors Affecting Speed-Endurance Training in Middle- and Long-Distance Running

### 3.1. Physical Fitness

In the process of speed-endurance training, an athlete's physical fitness is one of the main factors influencing the training outcome. For example, indicators such as lung capacity, muscle fiber type, and other physical fitness traits play a crucial role in developing an athlete's speed-endurance. Coaches should conduct thorough assessments and analysis of an athlete's physical fitness during speed-endurance training, and create targeted training plans. They should also regulate training intensity and duration to ensure that the training remains within the athlete's physical capacity. Coaches must correctly understand how physical fitness factors impact the effectiveness of speed-endurance training and, based on the athlete's specific physical fitness indicators, introduce diverse training activities to achieve optimal results with less effort.

### 3.2. Training Environment

Athletes' bodies are typically very sensitive to changes in

external conditions, and such changes can cause fluctuations in various physiological parameters. For instance, in middle- and long-distance training, an athlete may be in good physical condition, but if the external temperature suddenly rises, it can lead to faster metabolism and increased water consumption. Therefore, coaches need to acknowledge the impact of the training environment, ensuring that athletes stay hydrated to maintain optimal training conditions. Moreover, selecting a suitable training environment is essential for conducting efficient speed-endurance training, enabling athletes to tap into their potential, push past their physiological limits, and ultimately improve the effectiveness of their speed-endurance training.

### 3.3. Training Methods

Training methods are a core factor affecting the outcome of speed-endurance training. If the coach fails to select appropriate training methods based on the athlete's physical fitness and the specific demands of middle- and long-distance races, it will directly affect the results of the training. Furthermore, relying solely on a single training method can lead to boredom and reduce the athlete's enthusiasm, negatively impacting the overall training effect. Therefore, coaches should incorporate advanced technological tools and equipment, innovate training methods, and encourage athletes to proactively improve their speed-endurance levels.

## 4. Optimization Strategies for Speed-Endurance Training Methods in Middle- and Long-Distance Running

### 4.1. Optimizing the Training Plan

In the practice of speed-endurance training for middle- and long-distance running, coaches must establish a scientific and differentiated training system. By implementing personalized training plans, coaches can significantly improve the specificity and effectiveness of the training activities. Leveraging advanced sports monitoring technologies, coaches can systematically evaluate an athlete's strength, endurance levels, speed potential, stress tolerance, and mastery of technical skills, forming a multidimensional athletic ability analysis. This dynamic evaluation system, based on big data, not only clearly presents an athlete's individual athletic profile but also provides visual decision-making support for iterating and optimizing training plans over time. For example, by accurately measuring an athlete's anaerobic threshold and maximal oxygen uptake, coaches can build a quantitative model for endurance development. Additionally, using 3D motion capture systems to analyze running posture and biomechanics, coaches can optimize the matching of technical parameters, such as stride frequency and step length.

Coaches should also recognize the individual differences among middle- and long-distance runners and develop highly targeted speed-endurance training plans. For instance, some athletes may have strong endurance but weaknesses in speed. Coaches can incorporate more high-intensity interval training to specifically enhance the athlete's speed. Conversely, some athletes may excel in speed but need to improve their endurance. In such cases, coaches should increase the duration and intensity of the training to improve the athlete's aerobic endurance. Additionally, when optimizing training plans, coaches should consider various influencing factors, including training content, intensity, and volume, to ensure

the plan aligns with the athlete's actual situation and effectively enhances speed-endurance without causing overtraining or injuries.

### 4.2. Optimizing Training Methods

#### 4.2.1. Interval Training Method

In optimizing speed-endurance training methods, coaches can adopt interval training to effectively enhance training outcomes. For example, one coach used fast and slow interval training methods, leading to significant improvements in athletes' speed-endurance levels. Slow interval training involves running at a pace below race speed, followed by brief recovery periods that do not allow complete recovery. By repeating certain segments, this type of interval training strengthens specific aspects of training.

Training protocols could include: 400m  $\times$  4–8 repetitions with a 5-minute rest, heart rate: 180–200 beats/min ;600m  $\times$  8–12 repetitions with a 6-minute rest, blood lactate:  $12\pm 1.15$  mmol/L;800m  $\times$  4–8 repetitions with a 6-minute rest, blood lactate:  $12\pm 1.15$  mmol/L;1000m  $\times$  3–5 repetitions with an 8-minute rest, blood lactate:  $12\pm 1.15$  mmol/L. Coaches should ensure athletes follow the rest intervals strictly and maintain active rest during recovery to optimize their conditioning. By training when athletes have not fully recovered, the body's cardiovascular and respiratory systems are subjected to greater loads, thereby improving their speed-endurance capacity.

#### 4.2.2. Fartlek Training Method

The Fartlek training method is effective in developing cardiovascular and respiratory endurance, improving speed-endurance, and providing an opportunity to regulate athletes' emotions in a natural environment. This method also cultivates willpower and creates a positive training atmosphere. For example, a coach may use road-based Fartlek training, with sessions such as: 1 km fast run + 1 km slow run)  $\times$  5–9 sets with a 20-minute rest, heart rate: 180–200 beats/min ;2 km fast run + 1 km slow run)  $\times$  3–7 sets with a 30-minute rest, blood lactate:  $10.65\pm 2.15$  mmol/L.

In this method, athletes alternate between running at high and low intensities, using varied terrains to develop their speed-endurance. Coaches should carefully choose the terrain, ensure athletes run at maximum speed for certain distances, and then use slow jogging or walking for active recovery before starting the next interval. It is important to note that this method may not precisely calculate running distance, which could slightly affect speed development, so the fast running distance should be controlled to under 2 km.

### 4.3. Optimizing Recovery Training

Recovery training is a critical component of speed-endurance training in middle- and long-distance running, encompassing both physical and psychological recovery. After completing training, coaches should incorporate activities like light jogging and stretching to alleviate muscle tension, improve blood circulation, and facilitate the removal of lactic acid. For example, coaches may ask athletes to do 15 minutes of light jogging followed by stretching the legs, waist, and hips for about 20 seconds, and then provide a full-body massage. Additionally, during the physical recovery process, coaches should emphasize the importance of adequate sleep and proper nutrition to support recovery.

Psychological recovery is equally important. Coaches should observe the athlete's condition and engage in effective communication to identify any psychological issues that may

arise after intense training or competition. Psychological counseling, relaxation exercises, and techniques like meditation can help relieve tension and stress. Meditation, for instance, allows athletes to breathe deeply in a quiet environment, imagine relaxing scenarios, and listen to calming music, which promotes mental recovery.

## 5. Conclusion

The optimization of speed-endurance training methods in middle- and long-distance running is crucial for improving the quality and efficiency of training activities, helping athletes achieve excellent performance. Therefore, coaches should base their approach on practical considerations, tailor training plans to the athlete's needs, innovate training methods,

and strengthen recovery training, in order to enhance athletes' speed-endurance levels in middle- and long-distance races.

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