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Exploration on the Practical Path of Physical Training in the Improvement of Sprint Performance

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Abstract: Sprint events rely on the anaerobic phosphagen system for energy supply and are typical high-intensity competitive sports. An athlete's performance and final results largely depend on their ability to deliver peak power output in specific events. In grassroots track and field training and competition practice, a common phenomenon exists: some athletes exhibit standard technical movements and sufficient daily training loads, yet struggle to achieve significant breakthroughs in event-specific speed. The domestic grassroots track and field training system has clear shortcomings in developing event-specific physical fitness, primarily due to inadequate adaptation of physical training to specific events, fragmented overall training systems, and poor integration between old and new training models. This study employs literature review, logical analysis, and practical training synthesis methods, integrating the energy supply characteristics, force-generation patterns, and dynamic technical features of sprinting, to systematically clarify the complete composition and core training logic of sprint-specific physical fitness. It identifies various common issues in grassroots sprint training and proposes an optimized physical fitness training framework with practical applicability across four dimensions: hierarchical annual periodization, precise enhancement of event-specific abilities, integration of diversified training models, and training monitoring with injury prevention. The research outcomes can further refine the theoretical framework for grassroots sprint physical training and provide solid, feasible practical guidance for cultivating specialized abilities in youth sprint ers and implementing scientific training at the grassroots level.

Keywords: Sprint competition; special physical fitness; training system; Competitive Improvement; practice approach.

1. Introduction

The 100m, 200m, and 400m sprint events place extremely high demands on the instantaneous physical load of athletes, and they are also the competitive events in track and field where the tolerance for movement errors is the lowest. Throughout the entire course of these events, the human body relies on the anaerobic metabolic system for energy supply. They possess the characteristics of short-term output, high-intensity work, and high-power burst. During the competition, athletes basically have no extra space to adjust their physical condition and competitive posture. The training thinking of grassroots track and field coaches in China generally has a fixed problem. Most training work overly relies on technical refinement and the athletes' inherent physical fitness, and regards repeated running practice and action correction as the core training content. Modern track and field sports research has verified that specific physical fitness is the core foundation of a sprint athlete's competitive ability and also the key element for athletes to widen the gap in performance and break through their personal competitive limit [1].

The scientific training level of short-distance running events in China has maintained a steady upward trend. The simplistic training mode that solely relies on increasing training duration and neglects training quality, which was a loose training model, has gradually withdrawn from the grassroots training system. The scientific training concept of integrating physical fitness reserve, technical optimization, and state regulation has been fully popularized in all levels of grassroots training scenarios. The physical condition of athletes runs through the entire technical performance of sprinting, including the starting push-off force, maintaining speed during the middle run, and controlling the posture at the finish line. All technical links require stable and sufficient specific physical fitness as support. Short-distance runners with weak physical fitness reserves are prone to problems such as sluggish starting force, rapid decline in speed during the middle run, and distorted movements in the later run. These problems can cause inconsistent performance on the field and significantly increase the probability of muscle and joint injuries.

The training model for short-distance running and the aerobic endurance training system for middle and long-distance running have essential differences. Short-distance training does not focus on the endurance ability of athletes for long periods of exercise, but rather focuses on cultivating the neural-muscular recruitment efficiency, instantaneous burst ability, and dynamic body control ability of athletes. Most grassroots training teams have insufficient understanding of this core feature of the event, and the effectiveness of the implementation of scientific training concepts shows significant regional and hierarchical differences. Many coaches cannot distinguish between general basic physical fitness and the training focus of short-distance running-specific physical fitness. They directly apply common general strength training content to conduct short-distance running-specific training, resulting in a common phenomenon of excellent basic physical fitness test data but long-term stagnation in specific competitive results. This unreasonable training model will reduce the quality of grassroots short-distance running competitive talents and limit the long-term development of athletes' individual competitive abilities. This article combines the unique movement characteristics of short-distance running events and the actual training situation at the grassroots level to sort out the core shortcomings in training work and build an optimized path for physical fitness training that is suitable for grassroots scenarios [2].

2. The Core Essence and Training Logic of Sprint-specific Physical Fitness

2.1. Core Components of Sprint Specialized Physical Fitness

Many grassroots track and field practitioners have a rather one-sided understanding of sprinting physical fitness, simply classifying it as a combination of basic physical qualities such as strength, speed, and flexibility. Sprinting-specific physical fitness belongs to a complex body ability system that perfectly suits the technical characteristics of sprinting, the anaerobic energy supply mechanism, and the dynamic competitive scenarios on the track. The system contains multiple independent and complementary core physical abilities that jointly determine the upper limit of an athlete's specialized competitive performance.

Sprint-specific explosive power is the core component of the sprinting physical fitness system. It specifically refers to the athlete's lower limb push-off force and the instantaneous power output generated by the active drive of the hip joint. The acceleration efficiency of the athlete during the start phase, the matching quality of the running frequency and stride of the middle and long-distance running, are all directly determined by the level of sprint-specific explosive power. This ability is also the core criterion for distinguishing general basic physical fitness from sprinting-specific competitive physical fitness. Sprint-specific speed endurance is a basic ability that sprinters must possess. It relies on the continuous energy supply of the human anaerobic phosphagen system, and maintains a high-speed running state through high-frequency contractions of the muscles, effectively inhibiting the speed decline of the athlete in the later stage and ensuring the stability and continuity of the running posture and action rhythm throughout the race [3].

Core stability and dynamic control ability are the main weak points in grassroots sprint physical training. The core muscle groups of the human body perform the function of a central hub for transmitting the body's strength, which can fix the athlete's posture during running, balance the body's center of gravity, and reduce ineffective energy consumption. Insufficient core strength will directly lead to various problems such as body shaking during running, body center of gravity deviation, and decreased force efficiency. Dynamic flexibility and joint mobility mainly act on the three major lower limb core joints of the hip, knee, and ankle. Good muscle extensibility and joint range of motion can broaden the running swing amplitude of the athlete, optimize the overall running posture, effectively buffer the body impact force during landing, reduce the probability of muscle strain and joint sprain, and ensure the stability of long-term systematic training for the athlete [4].

2.2. The Underlying Logic of Short-Distance Running Physical Training

Short-distance running training has highly specific attributes for the sport. General and universal fitness training programs cannot meet the needs of short-distance running training. All training contents for short-distance running must conform to the technical force-attaching rules specific to the sport. There is no aerobic energy-supply dominant stage throughout the entire short-distance running movement. The conventional aerobic endurance qualities have limited effect on the improvement of the athlete's specialized competitive ability. The anaerobic power reserve, rapid neural activation, and elastic force regeneration are the core contents of short-distance running fitness training. Short-distance running is a periodic explosive sport. Rapid pushing and stretching, active hip swinging, and high-frequency limb swinging are the core movement patterns of the sport. Heavy-weight static strength training can only be used as an auxiliary training content. The rapid strength, reaction strength, and the core development direction of training work should be focused on the rapid strength and reaction strength under the specific movement trajectory, and the coordination of specialized technical training, physical recovery and adjustment, and psychological state regulation can achieve the efficient transformation of fitness reserves into competitive advantages on the field [5].

3. The Existing Problems in The Current Practice of Sprinting Physical Training

3.1. The training has cognitive biases and lacks sufficient specificity and adaptability.

The main reason why the quality of grassroots sprint training cannot be improved lies in the widespread training cognitive bias in the industry. Most coaches adhere to the traditional training model and equate sprint-specific physical training with general strength training for the public. Heavy weight squats, deadlifts, and other static strength training occupy the majority of the time for grassroots physical training. Such training can enhance the absolute strength values of athletes, but it is completely unsuitable for the specific characteristics of sprinting, which involves frequent movements, rapid force application, and instantaneous burst. Long-term single implementation of static strength training will cause athletes' muscles to become stiff, their movement rates to decline, and their force application and coordination to become stuck, resulting in a training deadlock where athletes have sufficient strength reserves but cannot break through in terms of the specific speed [6]. Some training teams randomly add aerobic endurance training content and blindly increase training loads, which disrupts the cultivation system of anaerobic specific physical ability for sprinting, causing double waste of training time and training resources.

3.2. The training content is monotonous and rigid, and the systematic construction is weak.

The content structure of basic sprint physical training is generally rather simple and fixed. The daily training mainly focuses on basic lower body strength exercises, jump training on the spot, and other routine items. Specialized core training contents such as core dynamic stability ability, joint dynamic flexibility ability, and neural rapid regulation ability have long been absent in basic training. Most basic training adopts a unified standardized template and does not design stratified and personalized training plans based on the athlete's age group, sports level, and individual weaknesses. Young athletes participating in high-intensity strength training too early will affect normal physical development and also develop incorrect movement patterns. High-level athletes lacking high-order functional specialized training are prone to falling into a long-term development bottleneck in their competitive ability. The overly high proportion of static training and insufficient dynamic specialized training, excessive mechanical repetitive training, and insufficient innovative specialized training in the fixed model seriously restrict the comprehensive improvement of athletes' specialized physical fitness and overall competitive ability [7].

3.3. The planning is fragmented and the load regulation lacks scientificity.

A well-structured annual training plan is the fundamental condition for the steady and progressive growth of an athlete's physical fitness. However, most grassroots training teams in China have not established a standardized annual training system. The training boundaries for the preparation period, competition period, and adjustment/recovery period are unclear. The training contents are overlapping and repetitive, and there is no unified standard for the load ratio. The overall training arrangement is carried out based on the subjective experience of the coach, without scientific data as support. During the preparation stage, a large amount of high-intensity training is accumulated, which can lead to athletes' pre-competition physical exhaustion and the continuous accumulation of physical fatigue. During the competition stage, random addition of strength training loads will disrupt the athlete's long-term established specialized speed rhythm and optimal competitive state. The absence of professional recovery training in the recovery stage will cause the degradation of muscle elasticity and the continuous aggravation of chronic sports injuries. The fragmented training arrangement disrupts the normal growth pattern of physical over-recovery, resulting in a significant decline in overall training quality and a significant increase in the risk of sports injuries for athletes [8].

3.4. Lack of training monitoring, low efficiency in converting physical abilities

The grassroots sprint training generally lacks a standardized and data-based professional training monitoring system. Coaches are unable to accurately assess the athletes' real-time physical condition, fatigue level, and skill deficiencies. The training arrangements are obviously lacking in rationality. Grassroots training has not established a regular review mechanism, and a large number of inefficient and ineffective training contents have been repeatedly carried out for a long time. Physical training and specialized technical training are in an isolated and disconnected state. The basic physical qualities such as strength and jumping ability accumulated by the athletes cannot be integrated with the specialized technical movements such as starting, acceleration, and sprinting. There is a common problem of excellent physical fitness but stagnant performance in specialized competitions. The imperfect injury prevention and physical recovery system will cause the athlete's physical strain to accumulate continuously, frequent disruptions to the normal training rhythm, and the overall efficiency of converting physical reserves into competitive ability remains at a low level for a long time [9].

4. The Scientific Practice Path of Sprinting Competitive Physical Training

4.1. Establish a phased and hierarchical system to adapt to the annual competitive rhythm

Basic sprint training requires the proactive update of traditional training concepts, re-examining the core value of specific physical training, breaking away from the conventional framework of general physical fitness training, and clearly defining the core attributes of sprint physical training in serving specific competitive events. The training process needs to abandon the training orientation that solely pursues muscle dimensions and absolute strength values, focusing on the cultivation of practical capabilities such as rapid force application, instantaneous burst, and dynamic posture regulation, so that all training content can be in line with the energy supply mechanism and specific running rhythm of the sprint event.

Training personnel need to clearly distinguish the training positions of basic physical fitness and specific physical fitness. Basic physical fitness ensures the basic movement functions of athletes, while specific physical fitness determines the upper limit of an athlete's specific competitive performance. Athletes at different levels need to be matched with differentiated training content. For beginners, the focus is on strengthening basic physical qualities such as strength, flexibility, and coordination. For advanced and high-level athletes, the proportion of general physical fitness training can be reduced, and they can focus on polishing the core practical abilities such as specific burst force, stable speed in the later stage, and running posture control. The training evaluation system needs to be optimized simultaneously, and no longer taking training load and training total volume as the sole evaluation criteria. The quality of movement completion, the accuracy of force application, and the specific adaptation effect are the core indicators for measuring training effectiveness [10].

The training team can establish a hierarchical training cycle model based on the overall rhythm of the annual competition. The annual training is divided into three core stages: preparation and accumulation, pre-competition training, and post-competition adjustment. Each stage is clearly defined with specific training priorities and load ratios based on the competition schedule. Through phased systematic training, the core goals of physical fitness reserve, specialized strengthening, and state regulation are achieved, adapting to the practical competitive rhythm of the annual competition.

During the winter training period, there are fewer competition arrangements, making it a crucial cycle for athletes to reserve physical fitness and fill capacity gaps. This stage adopts a medium-load and sufficient-total training mode, combining static strength training and dynamic flexibility training to strengthen the athletes' basic strength, improve muscle stiffness issues, and expand joint movement range. The core task of this stage focuses on filling capacity gaps and strengthening the foundation, strictly controlling the overall proportion of high-intensity explosive training, avoiding the accumulation of fatigue in the early stage of training, and reserving sufficient physical space for subsequent specialized strengthening training [11].

During the competition period, the training structure needs to be adjusted specifically. The core goals are placed on strengthening specialized abilities and regulating competitive states. The content of specialized training focusing on rapid strength, instantaneous burst, and speed endurance is significantly increased, while the frequency of large-weight static strength training is reduced. Trainees can improve the speed and strength response of the athletes through specialized training such as weighted sprints, slope running, and jump squats. Adopting a scientific load mode of high intensity, few sets, and multiple intervals, they can maintain a stable running rhythm and optimal competitive state.

The post-competition adjustment and recovery period is a key link of the annual training cycle. Long-term high-intensity preparation training can cause both physical and neural fatigue in athletes. This stage mainly completes tasks such as physical function repair, fatigue relief, and re-establishing competitive states. The frequency of high-intensity specialized training is significantly reduced, with recovery training mainly consisting of stretching relaxation, fascia relaxation, and mild body activation. This helps to repair minor muscle strains and eliminate metabolic accumulation in the body. The retention of a small amount of basic physical training can maintain the athlete's physical activity and achieve a smooth transition between the old and new training cycles.

4.2. Integrate diverse training methods and enrich the content of specialized training

The integration and application of traditional strength training and modern functional training can enrich the training carriers for specific sports and make up for the inherent shortcomings of a single training mode. Basic training needs to optimize the structure of traditional strength training and establish a hierarchical load training system. Low-load training enhances the flexibility of muscle contractions, medium-load training optimizes the actual conversion efficiency of strength, and high-load training consolidates the foundation of athletes' absolute strength. The hierarchical training model can promote the steady conversion of basic strength into the essential explosive ability required for sprinting events.

The strengthening of functional-specific training can effectively make up for the shortcomings of traditional training. During the training process, it replaces the single static core training with dynamic core exercises, adds dynamic core practice content, adapts to the dynamic changes of the trunk during running, and improves the efficiency of power transmission throughout the body. The addition of super-long jump training can shorten the duration of ground support for athletes, optimize the coordination mode of step frequency and stride length. Combined with dynamic flexibility training, it can improve the problem of joint movement restriction in athletes, correct the stiff running posture and insufficient kicking and swinging movements, and other common technical deficiencies [12].

Neural regulation ability directly determines the on-field performance of sprint athletes. The performance gap in short-distance running events is mostly within the millisecond range. The neural response speed and muscle reaction ability of athletes are the key to winning on the field. The training system can intersperse training contents such as reaction start, short-distance acceleration, and directional running to enhance the high-frequency contraction ability and response sensitivity of the neuromuscular system. The flexible combination of various training contents can precisely fill the practical shortcomings of athletes, improve the specialized ability system, and comprehensively enhance the overall competitive level [13].

4.3. Improve the monitoring and prevention mechanism and enhance the efficiency of specialized transformation.

Training teams need to establish a comprehensive training monitoring system that combines both subjective and objective data. By recording objective data such as running rhythm, exercise load, and physical condition, and combining it with the subjective fatigue feedback from athletes, they can comprehensively assess the physical condition and dynamically adjust the training content and load to avoid overtraining and insufficient training. Regular specialized physical fitness assessments can precisely identify the individual ability weaknesses of athletes, and based on the assessment results, customize personalized training plans, effectively enhancing the targeted and precise nature of training work [14].

The deep integration of physical training and specialized technical training can break the connection barriers between the two types of training content. Weighted sprinting and slope running training can be combined with starting technique correction to be carried out simultaneously, and elastic jumping training can be coordinated with mid-run kicking and swinging techniques to be advanced simultaneously. The results of physical training can directly be transformed into specialized speed advantages and technical advantages, completely solving the common problem of the separation of physical fitness and specialized performance in grassroots training [15].

Recovery training and injury prevention are important components of the regular training system. The stretching and relaxation, muscle relaxation and other recovery work after training can quickly relieve exercise fatigue and reduce the accumulation of metabolic substances. Problems such as ankle strain, posterior thigh pull, and lumbar fatigue that frequently occur in sprinting events are sports injuries. The training team needs to conduct regular strengthening training for weak muscle groups, reducing the probability of injury from the physical fitness level, and ensuring the continuity and stability of training work.

5. Conclusion

The breakthrough in the competitive level of sprinters is inseparable from the continuous optimization and meticulous refinement of their specific physical abilities. This article systematically reviews the core components and training logic of sprint-specific physical fitness, summarizes the core issues in the four dimensions of cognition, content, cycle, and monitoring in grassroots training, and builds a multi-dimensional and implementable training optimization path for specific physical fitness. The traditional training model that is simplistic and homogeneous cannot meet the development needs of modern high-level sprint competitions. Training work that is tailored to the specific characteristics of anaerobic burst and high-frequency exertion, combined with specific techniques, energy supply patterns, and competition rhythms, can achieve an efficient transformation of physical fitness into core competitive abilities.

Modern sprint training generally presents a trend of refinement, dataization, and personalization. The scientific standards for specific physical fitness training have always been on the rise. Grassroots training needs to break away from fixed training thinking, rely on scientific data to customize exclusive training plans, promote the deep integration of multi-dimensional training contents such as physical fitness, technique, psychology, and recovery, continuously improve the grassroots specific physical fitness training system, and provide solid theoretical and practical support for the cultivation of domestic sprinting competitive talents and the overall improvement of the industry's competitive level.

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