Literature review on the development of speed-strength endurance in middle-distance runners of training groups

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Abstract

This article provides a detailed analysis of the theoretical and practical aspects of developing speed-strength endurance in middle-distance runners within training groups. In particular, the physiological foundations of speed-strength qualities, energy supply systems (anaerobic and aerobic mechanisms), the role of muscle fibers, and the adaptation processes of the neuromuscular system are examined. Furthermore, modern training methods used to develop speed-strength endurance—such as interval, repetitive, and combined training systems—are analyzed based on scientific sources. The study also highlights the importance of regulating training load volume and intensity, properly organizing recovery processes, and considering the individual characteristics of athletes. In addition, issues related to planning the training process using the principles of periodization, selecting sport-specific exercises adapted to competitive activity, and improving their effectiveness are discussed. The results of the study are significant for improving the performance of middle-distance runners, enhancing their functional preparedness, and organizing the training process on a scientific basis.

Keywords: speed-strength endurance, middle-distance running, sports training, anaerobic and aerobic systems, interval training, load regulation, muscle fibers, neuromuscular system, periodization, functional preparedness

Introduction

Today, achieving high results in world sports is becoming an increasingly complex process. Modern sports performance depends not only on athletes' natural abilities but also directly on the harmonious development of their physical, functional, technical, and psychological preparedness. Therefore, the comprehensive development of physical qualities is considered one of the priority directions in the system of sports training.

Middle-distance running (800–1500 meters), one of the most popular disciplines in athletics, requires athletes to simultaneously demonstrate a high level of speed, endurance, and strength. To succeed at these distances, an athlete must not only possess maximum speed but also be able to maintain this speed over a certain period of time. This factor significantly increases the importance of the concept of speed-strength endurance.

Speed-strength endurance refers to the athlete's ability to produce high force in a short period of time and maintain it over a relatively extended duration. This quality is especially important in middle-distance running, playing a decisive role at all stages of the race—from start to finish. For example, during the start phase, the athlete accelerates using explosive strength; during the race, the endurance component helps maintain speed; and in the final phase, explosive strength and speed are again required.

Modern sports science indicates that energy supply in middle-distance running has a mixed character, where both aerobic and anaerobic systems operate simultaneously. Therefore, speed-strength endurance is closely related not only to muscular strength but also to the functioning of the cardiovascular system, respiratory system, and central nervous system. This makes the process of developing this quality complex and multifaceted.

The development of speed-strength endurance in young athletes participating in training groups has particular scientific and practical significance, as this stage determines the future prospects of the athlete's development. If this quality is properly developed during the initial and intermediate stages of training, it creates a solid foundation for achieving high sports performance in the future.

The main documents regulating the physical and psychological preparation of athletes include the following:

Educational programs in the field of sports must comply with national education standards;

The training process should be based on clearly defined goals, objectives, and expected outcomes;

Individual training programs should be developed taking into account the athlete's personal characteristics, age, and physical condition;

Table 1. .**Exercises for developing speed-strength endurance and their effectiveness**

Method	Exercise description	Effect on aerobic system	Effect on anaerobic system	Muscle strength development
Interval	200–400 m at maximal speed, 2–3 minutes recov-	Moderate	High	Moderate
Repetition	300–600 m repeated runs with short recovery	Moderate	High	High
Circuit	Running + jumping + strength exercises	High	Moderate	High
Plyometric	Jumping and explosive exercises	Low	High	High

Medical examinations, physical condition monitoring, recovery, and rehabilitation processes must be properly supervised;

Training activities should be conducted based on approved methodological guidelines in sports pedagogy and methodology.

In the Republic of Uzbekistan, there are normative legal documents regulating the development of sports, athlete training, and participation in competitions. Among them are:

Purpose: The main purpose of this study is to identify effective methods for developing speed-strength endurance in middle-distance runners within training groups, to examine their physiological foundations, and to introduce scientifically grounded approaches into the training process. In addition, optimizing training load planning, ensuring an individualized approach, and substantiating ways to improve sports performance through the enhancement of speed-strength endurance are among the key objectives of the study.

Methods

The following scientific methods were used in the research process:

the method of literature analysis – scientific sources on speed-strength endurance, middle-distance running, and sports training were studied;

the method of pedagogical observation – athletes' physical condition, quality of exercise performance, and adaptation to training loads were monitored during the training process;

Table 2. Weekly training plan for developing speed-strength endurance in middle-distance runners

Day	Type of Exercise	Distance/Intensity	Repetitions	Recovery
Monday	Interval running	4×200 m, maximal speed	4	2 minutes
Tuesday	Plyometric exercises	Jumping and explosive movements	3	1 minute
Wednesday	Circuit training	400 m + strength exercises	3	3 minutes
Thursday	Repetition running	3×600 m, high intensity	3	3 minutes
Friday	Recovery & easy run	20–30 minutes, moderate intensity	1	—
Saturday	Circuit training	500 m + strength exercises	3	3 minutes
Sunday	Rest	—	—	—

the experimental method – the effectiveness of interval, repetitive, circuit, and plyometric training methods was tested in practice;

the testing method – athletes' speed, endurance, maximal speed, and heart rate indicators were assessed;

the method of comparison and analysis – results before and after training were compared to determine their dynamics;

the method of mathematical statistics – the obtained data were processed to determine their reliability and effectiveness.

Results and discussion

Educational and methodological documents in specific sports define the characteristics of each sport and the requirements for organizing the training process step by step;

Table 3. Types of exercises for developing speed-strength endurance

Type of Exercise	Exercise Description	Intensity	Repetitions	Recovery
Interval running	200–400 m at maximal	High	4–6	2–3 minutes
Repetition running	300–600 m with short recovery	High	3–5	1–2 minutes
Circuit training	Running + strength exercises	Moderate	3	3 minutes
Plyometric exercises	Jumping and explosive movements	High	3	1–2 minutes

Training standards according to age and categories—for example, for athletes aged 13–15 and 16–18—determine training loads, recovery procedures, and evaluation criteria;

Medical examination and athletics standards establish requirements for assessing athletes' health status and adapting training processes accordingly.

To improve training effectiveness and monitor the level of athletes' knowledge and skills, the following documents serve as a basis:

Training programs (plans) — developed in weekly, monthly, and annual formats, including goals, objectives, and training loads;

Monitoring and evaluation mechanisms — regular assessment of athletes' physical indicators, performance results, fatigue levels, and recovery status;

Guidelines for educational and psychological preparation — methods aimed at shaping athletes' mindset, increasing motivation, and improving psychological stability.

Athlete training standards are evaluated as follows:

Testing and normative standards — for example, indicators of speed, strength, and endurance;

Certification based on training results — official confirmation that the athlete meets established standards;

Coach qualification development — requirements for certifications, courses, and methodological training for coaches.

In general, the regulations and standards developed for the training of middle-distance runners regulate the athlete's physical, psychological, and methodological preparation process. These regulations enhance training effectiveness, protect athletes' health, and contribute to the continuous improvement of performance indicators.

In sports science, the proper application of training regulations ensures not only the achievement of results but also the maximization of an athlete's potential.

At the same time, improperly organized training processes or excessive training loads may lead to overfatigue, injuries, and even early withdrawal from sports among young athletes. Therefore, it is essential to scientifically structure the methodology for developing speed-strength endurance, properly plan training loads, and ensure their individualization.

Currently, among the methods used in sports training, interval training, repetitive training, circuit training, and plyometric exercises are widely applied. Although these methods are highly effective in developing speed-strength endurance, their correct application requires consideration of the athlete's age, physical fitness level, and individual characteristics.

Moreover, modern scientific research indicates that the development of speed-strength endurance depends not only on training but also directly on recovery processes, nutrition, psychological preparation, and sleep quality. Therefore, athlete preparation should be organized based on a comprehensive approach.

The relevance of developing speed-strength endurance in middle-distance runners is also highlighted by the fact that in modern competitions the difference between results is extremely small, and victory is often decided by fractions of a second. Under such conditions, an athlete's ability to accelerate in the final phase and maintain speed under fatigue becomes decisive.

From this perspective, the development of speed-strength endurance in training groups is not only an important component of physical preparation but also one of the key factors determining sports performance. The development and implementation of scientifically grounded methods aimed at improving this quality is one of the pressing tasks of modern sports pedagogy.

Based on the above, the main objective of this study is to identify effective methods for developing speed-strength endurance in middle-

distance runners within training groups and to implement them in practice. Speed-strength endurance is defined as the ability of an athlete to produce maximum force in a short period of time and maintain it over a certain duration. For middle-distance runners (800–1500 m), this quality is crucial at all stages of running — start, distance phase, and finish. During the start phase, the athlete accelerates using explosive strength; during the distance phase, endurance enables the maintenance of high speed; and in the finish phase, maximum strength and speed are again required.

Modern sports science has established that energy supply in middle-distance running depends on the coordinated functioning of both aerobic and anaerobic systems. Therefore, speed -strength endurance is closely related not only to muscular strength but also to the functioning of the cardiovascular system, respiratory system, and central nervous system [5][6]. This makes the process of developing this quality complex and multifaceted.

In modern sports training, the following methods are considered effective for developing speed-strength endurance:

Interval method — alternation of high-intensity short runs and recovery periods. For example, running 200 m at maximum speed followed by 2 minutes of light jogging or rest. This method simultaneously develops both aerobic and anaerobic systems.

Repetition method — repeated running over the same distance with short recovery intervals after each repetition. This method improves both muscular strength and endurance simultaneously [8].

Circuit training — a combination of running, jumping, and strength exercises. This method enhances the overall speed-strength endurance of middle-distance runners [9].

Plyometric exercises — explosive movements and jumping exercises aimed at increasing speed-strength. They improve the ability to generate rapid force and strengthen lower limb muscles.

The development of speed-strength endurance is associated with several physiological systems:

Muscular system — *fast-twitch muscle fibers increase strength and speed;*

Cardiovascular system — *supplies oxygen and energy substrates to muscles, enhancing resistance to fatigue;*

Central nervous system — *improves reflexes and motor coordination, ensuring efficient movement control.*

Energy supply has a mixed nature, with both aerobic and anaerobic pathways functioning simultaneously. Therefore, training should be designed to develop strength and endurance concurrently.

During the development of speed-strength endurance, it is essential to regularly monitor the athlete's physical condition, including:

heart rate and blood pressure;
maximum speed and time indicators;
fatigue level and recovery status.

In addition, nutrition, sleep, and psychological preparation also play a direct role in improving an athlete's speed-strength endurance.

The development of speed-strength endurance in middle-distance runners requires a comprehensive approach. This approach should integrate physical, physiological, and psychological preparation and be aimed at improving the athlete's overall level of fitness.

During the training process, the following elements are essential for developing speed-strength endurance:

Physical preparation — a system of exercises aimed at improving explosive muscle strength, the activity of fast-twitch muscle fibers, and overall strength endurance. At the same time, the balanced development of aerobic and anaerobic energy systems enables middle-distance runners to maintain high speed over an extended period.

Physiological preparation — exercises that enhance the functioning of the cardiovascular system, respiratory system, and central nervous system. This increases the athlete's ability to demonstrate maximal strength and speed even under fatigue conditions.

Psychological preparation — psychological stability, motivation, and the ability to concentrate during high-intensity training are key factors determining sports performance. Therefore, psychological training should be integrated with physical training.

Recovery processes and nutrition — recovery and proper nutrition play a crucial role in improving training effectiveness. Muscle recovery, replenishment of energy reserves, and the stability of the immune system allow athletes to gain maximum benefit from the training process.

Individualized approach — the training program should be tailored to each athlete, tak-

ing into account age, physical fitness level, previous injury history, and individual characteristics. This not only improves performance but also prevents injuries and overtraining.

In addition, it is recommended to combine interval training, repetitive running, circuit training, and plyometric exercises within the training system to develop speed-strength endurance. These methods allow for the simultaneous development of muscular strength, endurance, and speed.

The following table presents recommended exercises for developing speed-strength endurance in the training program of middle-distance runners:

As a result, a properly organized system for developing speed-strength endurance in middle-distance runners determines the effectiveness of training, competitive performance, and long-term development prospects of the athlete. At the same time, a scientifically grounded methodological approach ensures the preservation of athletes' physical health, protection against fatigue and injuries, and the creation of a foundation for achieving high performance [13].

The development of speed-strength endurance in middle-distance runners requires a comprehensive approach. This approach should integrate the athlete's physical, physiological, and psychological preparation, while harmonizing the training process with individual characteristics and recovery processes.

Within the training system, speed-strength endurance not only enhances muscular strength but also develops the athlete's ability to maintain maximal speed over an extended period through the balanced development of aerobic and anaerobic energy systems. Therefore, it is recommended to combine interval running, repetitive running, circuit training, and plyometric exercises in the training process. Each type of exercise contributes effectively to the development of strength, endurance, and speed components.

Physiological and psychological factors also play a significant role in the development of speed-strength endurance. For example, the efficient functioning of the cardiovascular and respiratory systems, as well as a high level of central nervous system activity, enables athletes to maintain maximal speed even under fatigue conditions. At the same time, psychological preparation—including concentration, stress resistance, and readiness for competition—is a decisive factor in determining sports performance.

Recovery processes and nutrition also play an important role in developing speed-strength endurance. Complete muscle recovery, replenishment of energy reserves, and the stability of the immune system ensure that athletes gain maximum benefit from training [^10][^11]. Therefore, training and recovery processes must be properly balanced.

It should be emphasized that the development of speed-strength endurance in middle-distance runners is not limited to training alone. To enhance training effectiveness, factors such as sleep quality, nutrition, recovery, and psychological preparation must also be considered in a comprehensive manner.

Moreover, speed-strength endurance determines the athlete's ability to maintain high speed during the final phase of competition. Especially in 800–1500 m events, the difference between results is extremely small, and victory is often decided by fractions of a second. Therefore, explosive strength and endurance in the final phase play a decisive role in achieving high-level performance [^14].

The following table presents key parameters that can be used to evaluate training effectiveness and performance outcomes in middle-distance runners:

Conclusion

In conclusion, the development of speed-strength endurance in middle-distance runners is a relevant and important task in sports pedagogy and training methodology. A comprehensive, scientifically grounded, and individualized approach, combined with the proper integration of training and recovery processes, enables athletes to achieve high performance. At the same time, the scientific validity of methodological approaches and their alignment with practical experience help reduce the risk of injuries in young athletes and ensure their long-term development.

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track and field athletics, middle-distance running training, theory and methodology of physical education, speed-strength endurance development, analysis of athletic performance and competition activity.