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OPTIMIZATION MODEL FOR THE COMBINATION OF STRENGTH AND SPEED IN GRECO-ROMAN WRESTLING

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Abstract: Greco-Roman wrestling is a highly demanding combat sport in which success depends on the effective integration of maximal strength, explosive power, reaction speed, technical precision, and tactical decision-making. Although strength and speed are traditionally trained as separate performance components, their competitive value in Greco-Roman wrestling emerges primarily through their coordinated interaction during gripping, lifting, throwing, countering, and transitional actions. The present study develops an optimization model for the combined development of strength and speed in Greco-Roman wrestlers and proposes a training framework aimed at improving sport-specific performance. The article is based on a structured analysis of wrestling demands, principles of neuromuscular adaptation, and periodized training design. The proposed model integrates maximal strength, explosive strength, speed-strength, reaction speed, and movement efficiency into a unified preparation system. The model is organized around three interdependent blocks: diagnostic assessment, individualized training prescription, and performance correction. Special attention is given to exercise selection, load distribution, recovery control, and the transfer of general physical preparation to wrestling-specific motor actions.

Keywords: Greco-Roman wrestling, strength-speed abilities, explosive power, neuromuscular adaptation, optimization model, wrestling performance, training methodology, sport-specific conditioning

Introduction

Modern Greco-Roman wrestling is characterized by high-intensity intermittent efforts, repeated explosive exchanges, short-duration maximal actions, and continuous neuromuscular tension. In contemporary competition, a wrestler's success depends not only on technical and tactical preparedness but also on the ability to express high levels of force within minimal time under unstable and resistant conditions. Such demands make the relationship between strength and speed one of the most decisive components of wrestling performance.

In Greco-Roman wrestling, the athlete operates under unique biomechanical and tactical constraints. Since attacks below the waist are prohibited, wrestlers must rely heavily on upper-body control, trunk stability, gripping dominance, rotational force, and explosive lifting actions. Therefore, the quality of sport performance is directly influenced by the athlete's ability to combine maximal and explosive strength with reaction speed, coordination, and technical timing. Pure strength without speed may reduce mobility and delay attack execution, while speed without adequate force may limit the effectiveness of throws, lifts, and control actions. For this reason, the optimization of strength-speed interaction remains a central problem in the theory and methodology of wrestling training.

The growing intensity of international wrestling competition has increased the need for evidence-based models that integrate physical and technical preparation. Traditional approaches often separate strength development from speed training, which may lead to insufficient transfer to actual match performance. In contrast, current sport science emphasizes integrated neuromuscular training, individualized load management, and the principle of specificity. For

Greco-Roman wrestling, this means that strength and speed must be developed not as isolated qualities but as interacting capacities that support technical-tactical effectiveness in specific combat situations.

Literature Review and Theoretical Background

Strength and speed are among the most studied motor qualities in sports science, yet their interaction remains especially important in sports that require explosive execution under opponent resistance. In wrestling, the concept of strength-speed ability is not limited to classical power output. Rather, it involves the athlete's capacity to produce effective force rapidly in technically constrained and tactically variable situations. This makes wrestling a particularly complex domain for studying the optimization of motor qualities.

From a physiological perspective, strength-speed performance depends on neuromuscular recruitment patterns, motor unit synchronization, rate of force development, tendon stiffness, muscle fiber composition, and intermuscular coordination. Maximal strength provides the foundation for force application, while explosive strength determines how rapidly this force can be expressed. Speed in wrestling, however, is not merely linear or cyclic speed; it includes reaction speed, movement initiation, transition speed, and the temporal precision of technical actions. Therefore, the relationship between strength and speed in wrestling should be understood as a functional system rather than a simple sum of separate abilities.

A number of sport scientists have argued that maximal strength is an important predictor of explosive performance, especially when combined with sport-specific movement training. However, excessive emphasis on hypertrophy-oriented or non-specific strength work may reduce mobility, interfere with technical precision, and produce fatigue that negatively affects movement velocity. This problem is particularly relevant in wrestling, where athletes must maintain speed, balance, flexibility, and tactical responsiveness across multiple bouts. Consequently, the optimization of strength and speed requires careful balancing of load orientation, volume, intensity, and recovery.

In combat sports, the transfer of general physical training to competitive performance depends heavily on specificity. Exercises that improve force production but do not match the kinetic chain, movement direction, or temporal structure of wrestling may have limited competitive value. On the other hand, sport-specific strength exercises, resisted technical drills, partner-based explosive tasks, and reaction-oriented combat situations are more likely to enhance the functional integration of strength and speed. This supports the principle that training effectiveness increases when physical preparation is directly linked to competitive actions.

Methods

Research Design

This study is based on a methodological and conceptual design aimed at constructing an optimization model for the integrated development of strength and speed in Greco-Roman wrestlers. The model synthesizes principles from sports training theory, wrestling pedagogy, neuromuscular adaptation, and performance diagnostics. The research design combines theoretical analysis, structural modeling, and applied methodological interpretation.

Object and Subject of the Study

The object of the study is the training process of Greco-Roman wrestlers.

The subject of the study is the methodological optimization of the interaction between strength and speed within the system of wrestling-specific preparation.

Research Methods

The following methods were used in the development of the model:

- analysis of scientific and methodological literature on wrestling training, strength development, and speed-strength preparation;

- system-structural analysis of the physical demands of Greco-Roman wrestling;
- modeling of the interrelationship between physical qualities and technical-tactical actions;
- comparative analysis of general and sport-specific training means;
- pedagogical interpretation of training load organization;
- synthesis of diagnostic indicators used in performance monitoring.

Structure of the Optimization Model

The proposed optimization model consists of three closely related blocks:

1. Diagnostic block

This block is aimed at identifying the athlete's initial level of development. It includes indicators of maximal strength, explosive power, speed-strength endurance, reaction speed, movement frequency, grip strength, trunk stability, and the effectiveness of key technical actions. Diagnostic data are used to determine individual strengths, weaknesses, and training priorities.

2. Corrective-developmental block

This block includes the content of the training process. It combines general strength work, explosive power exercises, wrestling-specific speed-strength drills, reaction training, technical-tactical integration, and recovery means. The load is adjusted according to the athlete's age, qualification, weight category, and stage of preparation.

3. Control and feedback block

This block ensures continuous monitoring of adaptation and performance changes. It includes repeated testing, match analysis, coach observation, and correction of exercise dosage and training orientation. The purpose is to ensure that strength gains are translated into faster and more effective wrestling actions.

Methodological Principles of the Model

The model is based on the following principles:

- **specificity**: training means must reflect the biomechanical and tactical structure of Greco-Roman wrestling;
- **individualization**: load and exercise selection must correspond to the wrestler's functional profile;
- **transfer orientation**: physical gains must be expressed in technical and tactical actions;
- **variability**: training stimuli must change to avoid adaptation stagnation;
- **balance between load and recovery**: neuromuscular development requires sufficient restoration;
- **integration**: strength and speed must be trained in coordination with technical execution.

Results

The analysis conducted in this study made it possible to identify the main components of an effective optimization model for combining strength and speed in Greco-Roman wrestling. First, it was established that the success of wrestling performance depends not on the isolated development of maximal force or movement speed, but on their coordinated manifestation in technically meaningful situations. This means that the most relevant performance indicator is the wrestler's ability to produce the required force within the limited time available during attack, defense, lifting, rotation, and transition phases.

The proposed model revealed that strength-speed optimization in Greco-Roman wrestling should be based on four interconnected performance dimensions: force reserve, rate of force development, motor coordination, and technical transfer. Force reserve refers to the athlete's maximal strength potential and determines the upper boundary of force application. Rate of force development reflects how quickly force can be expressed. Motor coordination ensures the efficient sequencing of body segments during explosive techniques. Technical transfer indicates

how well these physical qualities are realized in wrestling-specific actions. A deficiency in any of these components reduces overall competitive effectiveness.

The structural analysis of wrestling actions showed that different technical situations place different demands on the strength-speed system. For instance, par terre lifting techniques require high trunk and upper-body strength combined with explosive extension and rotational power. Standing throws require rapid entry, balance disruption, and coordinated transmission of force through the kinetic chain. Defensive counteractions rely more heavily on reaction speed, grip strength, and positional explosiveness. Therefore, a single undifferentiated training program cannot provide optimal adaptation; the content of strength-speed work must be matched to the athlete's technical profile and tactical specialization.

Conclusion

The study demonstrates that the optimization of strength and speed in Greco-Roman wrestling is a multidimensional pedagogical and physiological task that requires an integrated training approach. Competitive effectiveness is determined not by isolated manifestations of force or movement velocity, but by the wrestler's ability to generate rapid, coordinated, and technically meaningful actions under resistance and fatigue. Therefore, the development of strength-speed qualities must be organized as a unified system closely connected to wrestling-specific motor tasks.

The proposed optimization model includes diagnostic, developmental, and control components and is based on the principles of specificity, individualization, transfer orientation, variability, and adaptive correction. The model shows that maximal strength should serve as a functional foundation, explosive power as a conversion mechanism, and technical-tactical drills as the primary environment for realizing strength-speed potential. Such an approach improves the practical transfer of physical training to match performance.

The article further establishes that the most effective training process is one in which general strength exercises, explosive drills, reaction tasks, and technical combat situations are sequenced logically and monitored continuously. Individual profiling and regular performance control are essential for maintaining balance between strength gains, movement speed, technical quality, and recovery.

In practical terms, the model may be used by wrestling coaches, sport scientists, and university instructors to improve the planning of wrestler preparation.

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