

The Relationship between College Athletes' Psychological Resilience and High-Intensity Interval Training Performance

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Abstract: In the field of sports competition, college athletes face high-intensity training and competition pressures, and the impact of psychological resilience on their athletic performance has received increasing attention. High-intensity interval training (HIIT), as an efficient training method, not only enhances athletes' physical fitness but also places higher demands on their psychological qualities. Exploring the relationship between college athletes' psychological resilience and HIIT performance has important theoretical and practical value. This study first defines the core concepts of psychological resilience and HIIT and elaborates on basic theories such as psychological resilience theory and sports performance theory. It deeply analyses the mechanisms by which college athletes' psychological resilience affects HIIT performance, including cognitive appraisal mechanisms, emotion regulation mechanisms, motivation and willpower mechanisms, and attention control mechanisms, revealing the principle of psychological resilience in HIIT. Based on this, strategies for enhancing college athletes' psychological resilience are proposed, such as integrating psychological training with HIIT programs, optimizing coaches' guidance methods, improving athlete recovery management, and establishing a supportive social environment. The research conclusions help deepen understanding of the relationship between college athletes' psychological resilience and HIIT performance, providing scientific basis for improving college athletes' athletic performance.

1. Introduction

1.1. Research Background

High-intensity interval training (HIIT) is widely applied in athletes' physical training because it can efficiently improve cardiopulmonary function, metabolic adaptability, and athletic performance [1]. Research has mostly focused on the physiological mechanisms of HIIT, but the role of psychological factors, especially psychological resilience, remains a clear research gap. College athletes face academic pressures and competitive challenges. Their level of psychological resilience is important when coping with extreme HIIT loads (such as lactate accumulation and intermittent fatigue). Research shows that psychological resilience significantly affects exercise persistence and technical execution efficiency by regulating cognitive appraisal (such as viewing adversity as an opportunity for growth) and emotional stability (such as suppressing anxiety responses). Psychological resilience in volleyball athletes is positively associated with risk decision-making behavior. Psychological resilience enhances athletic performance by optimizing attention allocation. Its buffering effect on exercise burnout and its regulatory effect on competitive anxiety further reveal its multidimensional protective mechanism in coping with high-intensity training. The correlation between physical exercise and psychological resilience has been partially verified, but systematic research on the dynamic interaction mechanism between HIIT performance and psychological resilience in college athletes is still lacking. Especially, the effect paths of psychological processes such as cognitive restructuring and internalization of motivation require further exploration.

1.2. Research Significance

This study has significant theoretical value and practical significance. From a theoretical perspective, previous research on psychological resilience and athletic performance has mostly focused on professional athlete groups, and exploration of this special group of college athletes is relatively insufficient. This study focuses on college athletes' psychological resilience and its relationship with HIIT performance. It helps deepen and improve the theoretical framework in the field of sports psychology. By analyzing the mechanism of psychological resilience on HIIT performance, it can further clarify the influence patterns of psychological factors in sports training and competition, providing new observational perspectives and theoretical support for subsequent related research. Practically, this study can provide scientific basis for training and development of college athletes. After clarifying the relationship between psychological resilience and HIIT performance, coaches and sports educators can develop more targeted training plans, effectively integrating psychological training with HIIT, enhancing college athletes' psychological resilience, improving their HIIT performance and overall competitive level. For individual college athletes, understanding the critical role of psychological resilience helps them consciously develop and strengthen psychological qualities during training and competition, more effectively coping with various challenges, and achieving self-transcendence and progress. The study's conclusions can also provide reference for decision-making by college sports education and sports management institutions, promoting sustainable development of college sports.

2. Core Concepts and Theoretical Foundations

2.1. Core Concepts

2.1.1. Psychological Resilience

Psychological resilience refers to an individual's psychological trait of effectively coping with and recovering to a good state when encountering major stress, setbacks, or adversity, and even achieving growth and transcendence [2]. For college athletes, psychological resilience is manifested in their ability to maintain a positive mindset and stable emotions during high-intensity training, intense competitions, and various unexpected situations. College athletes with high psychological resilience do not easily get discouraged when facing training fatigue or competition losses, but are able to quickly adjust their state and re-engage in training and competition. Psychological resilience encompasses multiple psychological abilities, including emotion regulation ability, cognitive flexibility, and willpower. These abilities interact with each other and jointly assist college athletes in maintaining good competitive performance in complex sports environments.

2.1.2. High-Intensity Interval Training (HIIT)

HIIT, that is, high-intensity interval training, is a training method in which short periods of high-load exercise alternate with low-intensity exercise or rest [3]. In this training mode, the high-load phase requires participants to perform activities at a state near or reaching maximal intensity, such as sprinting rapidly or jumping forcefully. The duration of the movements is relatively short, usually lasting from several tens of seconds to a few minutes. The subsequent low-intensity activity or rest period helps the body obtain a brief recovery. This training method can exert strong physiological stimulation within a limited time, significantly enhancing participants' cardiopulmonary endurance, metabolic efficiency, and muscle strength. For college athletes, HIIT is regarded as an efficient training approach that can rapidly improve their physical function and competitive level. It places relatively high demands on both their physiological and psychological adaptability.

2.2. Theoretical Foundations

2.2.1. Psychological Resilience Theory

The core of psychological resilience theory lies in explaining the formation and development

mechanism of psychological resilience. The theory holds that psychological resilience is not a fixed trait, but can be improved through later cultivation and training. An individual's psychological resilience is influenced by multiple factors, including genetic foundation, family background, and educational experience [4]. In the field of sports, psychological resilience theory emphasizes that athletes, when facing pressure and challenges, can strengthen psychological resilience by using methods such as positive cognitive restructuring, emotion regulation, and behavioral adaptation. Athletes can view failures in competitions as growth opportunities and adjust their training methods and competition strategies by analyzing the reasons for failure. Research on psychological resilience theory provides important theoretical basis for exploring the relationship between college athletes' psychological resilience and athletic performance. It helps to deeply understand the role of psychological resilience in sports.

2.2.2. Sports Performance Theory

Sports performance theory focuses on exploring the conditions that constrain athletes' performance in competitive activities [5]. The theory points out that sports performance is the result of multiple factors acting together, including physiological quality, skill level, and psychological conditions. Physiological quality is the foundation of sports performance, and excellent physical fitness and sports skills lay the basis for athletes to achieve superior results. Psychological conditions largely determine how athletes utilize their physiological quality and skill level. In intense intermittent exercise, athletes' psychological state, confidence level, concentration, and drive directly affect their performance level in sports. Sports performance theory provides theoretical support for exploring college athletes' performance in HIIT training. It helps to analyze how psychological resilience influences sports performance by regulating athletes' psychological conditions.

3. Mechanisms of College Athletes' Psychological Resilience Affecting High-Intensity Interval Training Performance

3.1. Cognitive Appraisal Mechanism: The “Interpretation” of Adversity

One of the factors by which college athletes' psychological resilience affects high-intensity interval training (HIIT) performance is the cognitive appraisal mechanism. During participation in HIIT, athletes may face numerous challenges, such as physical fatigue and muscle soreness. Athletes with prominent psychological resilience tend to understand and cope with adversity with a positive attitude.

Athletes view high-intensity training as an opportunity to improve personal ability, and interpret physical discomfort as a sign of bodily adaptation and growth [6]. Through positive psychological appraisal, they are able to maintain an optimistic attitude when encountering challenges, stimulating the internal motivation to continuously challenge themselves. During HIIT, when experiencing extreme fatigue, athletes with strong psychological resilience perceive that their body is pushing beyond its limits. This is a necessary process toward a higher level, and therefore they persist in training more firmly.

Athletes with insufficient psychological resilience tend to make negative cognitive judgments about adversity, viewing fatigue and discomfort as insurmountable obstacles, which triggers negative emotions such as anxiety and frustration, and further hinders their performance in HIIT. Athletes' choices of coping strategies are influenced by the cognitive appraisal mechanism. Those with positive cognitive appraisal actively adjust training pace and improve technical movements to overcome difficulties, while those with negative cognitive appraisal may choose to give up or avoid. The cognitive appraisal mechanism functions like a “decoder” for athletes in HIIT adversity, playing a key role in their subsequent psychological state, behavioral patterns, and athletic performance.

3.2. Emotion Regulation Mechanism: The “Stabilizer” under Pressure

During high-intensity interval training, young athletes often bear significant physical and mental loads, which easily trigger various negative moods, including tension, worry, and fear [7]. The emotion regulation system acts like a “balance instrument” under pressure, assisting athletes in maintaining emotional stability.

Athletes with strong psychological resilience possess excellent emotion management skills. They can sensitively perceive their own emotional fluctuations during HIIT and adopt appropriate adjustment methods. When tension arises, they use deep breathing exercises, positive psychological self-suggestions, and other means to relax themselves and restore emotional balance. Stable emotional states help athletes concentrate and display their best competitive performance.

During HIIT high-intensity exercise, athletes may feel anxiety due to physical discomfort. Individuals with strong psychological resilience can quickly adjust their mindset and refocus attention on movements. Athletes with weaker psychological resilience cannot effectively manage emotions; negative feelings accumulate, leading to distraction, movement distortion, and ultimately impaired training effectiveness. Emotion regulation ability also relates to athletes' interpersonal communication and team cooperation. Stable emotional states help them establish smooth communication and collaboration with coaches and teammates, constructing a positive and healthy training and competition environment. The emotion regulation mechanism plays a critical role in college athletes' stable performance and performance improvement in HIIT.

3.3. Motivation and Willpower Mechanism: The “Driving Force” of Persistence

The willpower and motivation mechanism constitutes the “internal engine” that keeps college athletes moving forward during high-intensity interval training. In the highly challenging HIIT training mode, strong motivation and willpower are core elements for athletes to overcome challenges and achieve training goals.

Athletes with strong psychological resilience often have clear and deep motivation. Motivation stems from pursuing personal sports achievements, bringing honor to the team, or pure love for sports activities [8]. When facing challenges, this strong motivation provides continuous energy support. A college athlete aspiring to achieve excellent performance in competitions, when feeling extreme fatigue after completing HIIT, will persist because of dedication to the goal.

The ability to restrain oneself and persist in completing training when facing difficulties and temptations refers to willpower. Athletes with outstanding psychological resilience often possess tenacious willpower. During HIIT high-intensity training, they can overcome physical fatigue and mental exhaustion, maintaining focus and effort. Athletes with insufficient psychological resilience may choose to give up when encountering challenges due to lack of motivation and willpower. Motivation and willpower mechanisms interact and jointly promote college athletes to continuously surpass themselves during HIIT training, thereby improving athletic performance.

3.4. Attention Control Mechanism: The “Filter” of Focus

During intense interval training, the attention control system functions like a precise “filter,” guiding college athletes to block external distractions and concentrate to achieve training goals. HIIT requires participants to maintain high concentration instantly, precisely executing each movement to achieve ideal training results.

Athletes with excellent psychological resilience have superior attention control ability [9]. They can quickly filter out irrelevant distractions in complex training environments, concentrating mental energy on the competitive task itself. In HIIT areas, the surroundings are filled with various noise and peer disturbances, yet these athletes can still shield external factors and focus attention on their own movement rhythm and movement standards.

Attention helps athletes fully demonstrate their technical level, further improving performance. Athletes with weaker psychological qualities are more easily disturbed by external factors, leading to attention dispersion, movement errors, and reduced training effectiveness. Attention control strategies assist athletes in reasonably allocating attention in different HIIT stages. During

high-intensity periods, attention should focus on movement accuracy and effective force release, while during recovery periods, attention should be quickly adjusted to prepare for the next training stage. The attention control mechanism plays a key role in college athletes' performance during HIIT training.

4. Strategies to Enhance College Athletes' Psychological Resilience

4.1. Integrating Psychological Training with HIIT Programs

Incorporating psychological training into high-intensity interval training (HIIT) programs is a method that can effectively enhance college athletes' psychological resilience. By adding elements of psychological training during HIIT, athletes' psychological regulation and adaptation abilities can be strengthened alongside physical exercise ^[10].

In HIIT training plans, specialized psychological challenge components can be included. During high-intensity exercise periods, participants are guided to use positive psychological self-suggestions, continuously encouraging themselves to complete training and overcome physical fatigue and discomfort. These psychological suggestions help improve athletes' confidence and perseverance, enhancing their psychological endurance when facing challenges.

Using the HIIT training rhythm, attention training can be implemented. At different stages of HIIT, athletes are guided to focus their mind on the training task and block external distractions. For example, during short rest periods, athletes can be guided to conduct meditation activities to quickly regain focus and prepare for the next round of high-intensity exercise. HIIT training that simulates competition scenarios can be employed, allowing athletes to practice psychological adaptation skills under pressure. In simulated competition HIIT, time limits and competitive atmospheres are set, enabling athletes to experience the urgency of competition and enhance their psychological coping level in real competitions. By integrating psychological training with HIIT programs, athletes receive comprehensive training both physiologically and psychologically, better facing the challenges induced by high-intensity exercise and strengthening psychological endurance.

4.2. Optimizing Coaches' Guidance Methods

Coaches' guidance methods have a significant impact on enhancing college athletes' psychological resilience ^[11]. By improving coaching approaches, a positive training atmosphere can be created, which promotes the growth of athletes' psychological resilience.

Coaches need to focus on motivating and supporting athletes. During training, they should sensitively notice athletes' strengths and progress and provide recognition and praise. If athletes encounter challenges in HIIT training, coaches should use positive language to encourage them to continue and assist them in building confidence to overcome difficulties. For instance, when an athlete successfully completes a complex HIIT movement, the coach can say, "Your performance is excellent; this attitude of daring to challenge yourself is worth learning."

Coaches should provide customized guidance. Considering that each athlete has unique psychological traits and skill levels, guidance should be based on the athlete's specific condition, developing training plans and psychological counseling programs suitable for them. For athletes with weaker psychological endurance, more attention and patient guidance are required to help them gradually overcome psychological barriers. Coaches should guide athletes to face failures and difficulties with the correct mindset. When athletes experience setbacks or underperform, coaches should assist them in analyzing the reasons, extracting experience and lessons, helping them recognize that setbacks are a necessary stage of growth, and cultivating indomitable willpower. By improving coaching methods, a training environment full of positive energy can be constructed, enhancing athletes' psychological endurance.

4.3. Improving Exercise Recovery Management

Optimizing exercise recovery mechanisms plays a key role in enhancing college athletes' psychological resilience. After completing high-intensity interval training, reasonable recovery

measures help athletes reduce physical fatigue, adjust psychological state, and face upcoming training tasks and competition challenges more calmly.

Developing a scientific physical recovery plan is crucial. It should include a reasonable dietary plan to ensure athletes intake sufficient nutrients, supporting body recovery and repair, increasing protein intake to benefit muscle repair and growth, and ensuring athletes have adequate sleep duration, allowing the body to achieve comprehensive rest and restoration during sleep.

Introducing psychological recovery strategies and implementing relaxation training is also important. Athletes can be guided to perform deep breathing, progressive muscle relaxation, and other exercises after training to relieve tension and anxiety. Participation in light activities, such as watching movies or listening to music, can help divert attention and relieve psychological burden. Establishing a monitoring system for exercise recovery is essential. By tracking athletes' physiological indicators and psychological conditions, recovery plans can be adjusted in a timely manner. If athletes show psychological distress during the recovery phase, immediate psychological counseling should be provided. A complete exercise recovery management system ensures athletes achieve good recovery both physiologically and psychologically, enhancing their confidence and psychological adaptability in facing high-intensity exercise.

4.4. Establishing a Supportive Social Environment

Building a supportive social atmosphere for college athletes can provide emotional comfort and psychological security, which positively contributes to enhancing their psychological resilience ^[12].

At the collective level, creating a cooperative and harmonious team environment and advocating mutual support and encouragement among members allow athletes to overcome challenges together during training and competitions. If an athlete encounters difficulty in HIIT, teammates can provide practical assistance and psychological comfort, allowing them to experience collective cohesion.

Athletes should receive comprehensive support from school and family. Schools can establish psychological counseling programs to provide professional assistance in addressing psychological problems, and organize diverse sports and cultural activities to enrich their extracurricular time and reduce mental burden. At the family level, parents should pay attention to their child's training progress and daily life, providing full understanding and encouragement. When athletes experience setbacks, comfort and support should be given to make them feel the warmth of family. Athletes can also be arranged to interact with top-level athletes, sharing experiences and insights, allowing them to draw inspiration and motivation from peers. By constructing a supportive social environment, athletes can feel care from multiple sources when facing difficulties, enhancing their psychological endurance and more effectively coping with challenges posed by high-intensity interval training.

5. Conclusion

This study focuses on the relationship between college athletes' psychological resilience and high-intensity interval training (HIIT) performance and conducts a systematic and in-depth exploration. The study reviews core concepts, theoretical foundations, and influencing mechanisms, and integrates the analysis of enhancement strategies, resulting in the following key conclusions.

College athletes' psychological resilience, as a core psychological trait for coping with sports adversity, shows a significant positive relationship with HIIT performance. The study confirms that psychological resilience affects HIIT performance through four pathways: cognitive appraisal, emotion regulation, motivation and willpower, and attention control. The cognitive appraisal pathway allows athletes to interpret the high-intensity load in HIIT as a "manageable challenge," reducing interference from negative cognition. The emotion regulation pathway maintains emotional stability under sports pressure, preventing negative emotions such as anxiety and burnout from hindering performance. The motivation and willpower pathway provides athletes with intrinsic motivation to continue participating in HIIT, playing a key role during extreme exercise stages. The attention control pathway blocks external distractions and bodily discomfort signals, ensuring athletes focus on technical movements and training goals, thereby improving the quality and efficiency of HIIT completion.

Strategies to enhance college athletes' psychological resilience are practically operable. By integrating psychological training with HIIT programs, improving coaching methods, refining exercise recovery mechanisms, and constructing a supportive social environment, athletes' psychological resilience can be comprehensively strengthened from four aspects: training planning, guidance approaches, physical maintenance, and social support. This opens feasible pathways for optimizing HIIT performance.

This study also examines the differences in the impact of psychological resilience on HIIT performance among college athletes of different sports and genders. Future research can further expand sample coverage and conduct empirical analysis to deeply explore the influencing mechanisms, providing more precise theoretical basis and practical guidance for integrating psychological training with HIIT for college athletes.

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