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Impact Of High-Intensity Interval Training on Athletic Performance

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Abstract

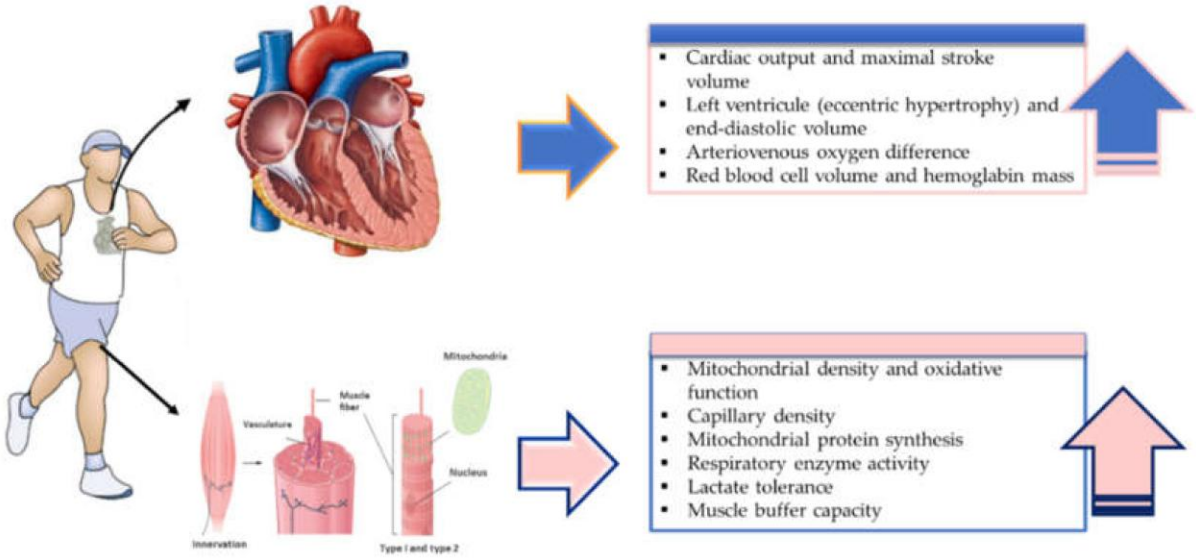
This study examines the impact of high-intensity interval training on athletic performance through a systematic review of contemporary sport science literature published since 2015. The research synthesises empirical findings related to aerobic capacity, anaerobic power, repeated sprint ability, agility, and fatigue resistance among athletic populations. Evidence indicates that HIIT produces significant improvements in maximal oxygen uptake, sprint performance, and multidirectional movement efficiency by eliciting integrated cardiovascular, metabolic, and neuromuscular adaptations. The intermittent structure of HIIT closely replicates the physiological demands of competitive sport, thereby enhancing the transferability of training adaptations to match-play performance. While variability in outcomes exists due to differences in protocol design and athlete characteristics, the overall literature consistently supports the effectiveness of HIIT as a time-efficient conditioning strategy. The study highlights the relevance of appropriately periodised HIIT programmes in optimising performance across endurance- and power-dominant sports within modern high-performance training environments.

Keywords: high-intensity interval training, athletic performance, aerobic capacity, anaerobic power, repeated sprint ability, sport conditioning

Introduction

The concept of high-intensity interval training (HIIT) has gained substantial prominence within contemporary sport and exercise science due to its capacity to elicit significant physiological adaptations within comparatively short training durations. HIIT is broadly defined as repeated bouts of high-intensity exercise interspersed with periods of recovery or low-intensity activity, typically performed at intensities close to or exceeding 80–90 per cent of maximal aerobic capacity. This training modality has increasingly been integrated into

athletic conditioning programmes across a range of sports because it aligns with the intermittent and high-intensity nature of competitive performance. Traditional endurance training methods, while effective, often require large time investments and may not fully replicate the fluctuating intensity demands encountered in competitive sport. Consequently, researchers and practitioners have focused on HIIT as a potentially superior or complementary strategy for enhancing both aerobic and anaerobic performance determinants that underpin athletic success. Empirical investigations since 2015 have consistently examined the effects of HIIT on key performance markers such as maximal oxygen uptake (VO_2max), repeated sprint ability, muscular power, agility, and metabolic efficiency, which collectively contribute to improved sport-specific performance.



From a physiological perspective, HIIT induces a broad spectrum of central and peripheral adaptations that are highly relevant to athletic development. High-intensity work intervals impose substantial stress on the cardiovascular, neuromuscular, and metabolic systems, thereby stimulating rapid improvements in oxygen delivery, mitochondrial biogenesis, and glycolytic enzyme activity. These responses are particularly important for sports requiring repeated bursts of maximal or near-maximal effort interspersed with brief recovery periods, such as football, hockey, basketball, and middle-distance running. Meta-analytic evidence indicates that HIIT is highly effective in improving VO_2max, a primary determinant of endurance performance, across both trained and untrained populations, with consistent improvements observed irrespective of protocol variations or participant characteristics (Wen et al., 2019; de Mello et al., 2022). Furthermore, the intermittent nature of HIIT closely mirrors competitive sport demands, thereby enhancing movement economy, fatigue

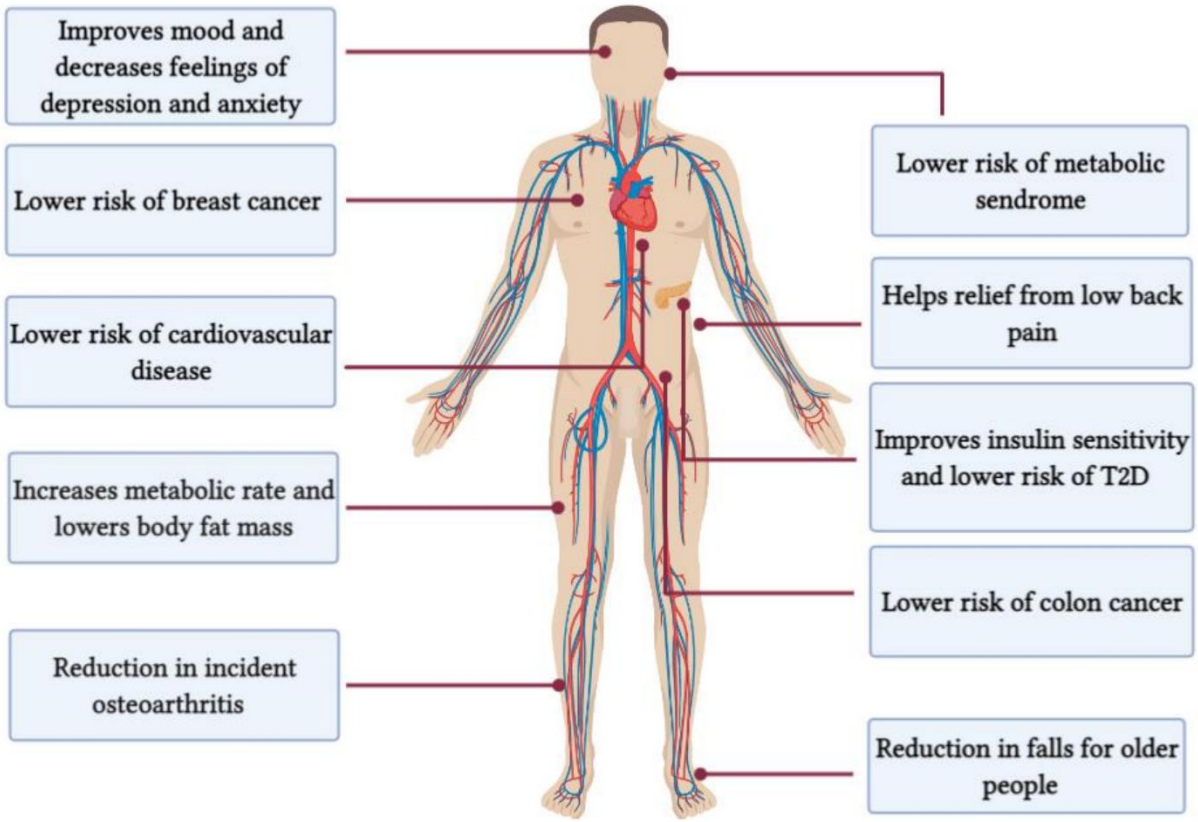
resistance, and energy system interaction, all of which are crucial for sustained high-level performance. The repeated exposure to high workloads within HIIT sessions also facilitates neuromuscular adaptations that can improve power output, sprint performance, and change-of-direction speed, highlighting its relevance not only for endurance athletes but also for those engaged in power- and speed-dominant sports.

In addition to its physiological efficiency, HIIT has attracted scholarly attention because of its practical applicability and versatility within athletic training periodisation. The time-efficient structure of HIIT allows coaches to incorporate high-quality conditioning stimuli without compromising technical and tactical training components, which are essential in competitive sport environments. Contemporary systematic reviews have reported that HIIT can significantly enhance various aspects of physical fitness, including aerobic capacity, muscle strength, agility, and repeated sprint performance, demonstrating its multifaceted impact on athletic capability (Yin et al., 2025; Wiesinger et al., 2024). Moreover, research comparing HIIT with moderate-intensity continuous training (MICT) frequently suggests that HIIT produces equal or greater improvements in cardiorespiratory fitness despite requiring substantially less total training time. This efficiency makes HIIT particularly valuable in elite sport settings where training schedules are densely packed and recovery management is critical. Nevertheless, variability in training protocols, participant characteristics, and sport-specific demands has resulted in heterogeneous findings, necessitating a comprehensive examination of how HIIT influences different dimensions of athletic performance. Therefore, analysing the impact of HIIT on athletic performance is essential for understanding its role in optimising physiological adaptations, improving sport-specific capabilities, and informing evidence-based training programme design within modern competitive sport contexts.

Need Of the Study

The need for the present study arises from the increasing prominence of high-intensity interval training within modern athletic conditioning and the continuing debate regarding its precise impact on overall athletic performance. Competitive sport has evolved to require athletes to sustain repeated bouts of high-intensity effort interspersed with brief recovery periods, placing simultaneous demands on aerobic endurance, anaerobic capacity, neuromuscular power, and recovery kinetics. Traditional endurance-based conditioning models, although effective for developing aerobic capacity, do not fully simulate the

intermittent high-intensity nature of most sports, which has led to a growing shift towards HIIT as a more sport-specific training stimulus. However, despite the widespread adoption of HIIT across diverse sporting disciplines, there remains variability in empirical findings concerning its effectiveness in enhancing different dimensions of athletic performance. Some investigations demonstrate substantial improvements in VO_2max, repeated sprint ability, and movement economy, whereas others report more modest gains depending on the athlete's training status, sport specificity, and protocol design (Milanović et al., 2015; Weston et al., 2014). This inconsistency highlights the necessity for a focused examination that synthesises contemporary evidence to clarify the extent to which HIIT contributes to comprehensive performance enhancement in athletic populations.



Another important justification for this study relates to the methodological diversity observed in existing research on HIIT. Studies differ considerably in interval duration, work-to-rest ratios, exercise modalities, and training frequency, which complicates the interpretation and practical application of findings. Such heterogeneity makes it difficult for coaches and sport scientists to determine the most effective HIIT protocols for optimising performance outcomes in specific sports contexts. Furthermore, much of the available literature has traditionally examined isolated physiological parameters rather than assessing the integrated

performance demands faced by athletes during competition. Athletic performance is inherently multifactorial, encompassing endurance, strength, speed, agility, and fatigue resistance, and therefore requires a holistic analytical perspective. By systematically evaluating the cumulative effects of HIIT on these interconnected performance determinants, the study addresses a significant gap in the literature and provides a more ecologically valid understanding of its role in sport performance enhancement (Buchheit & Laursen, 2013; Taylor et al., 2015).

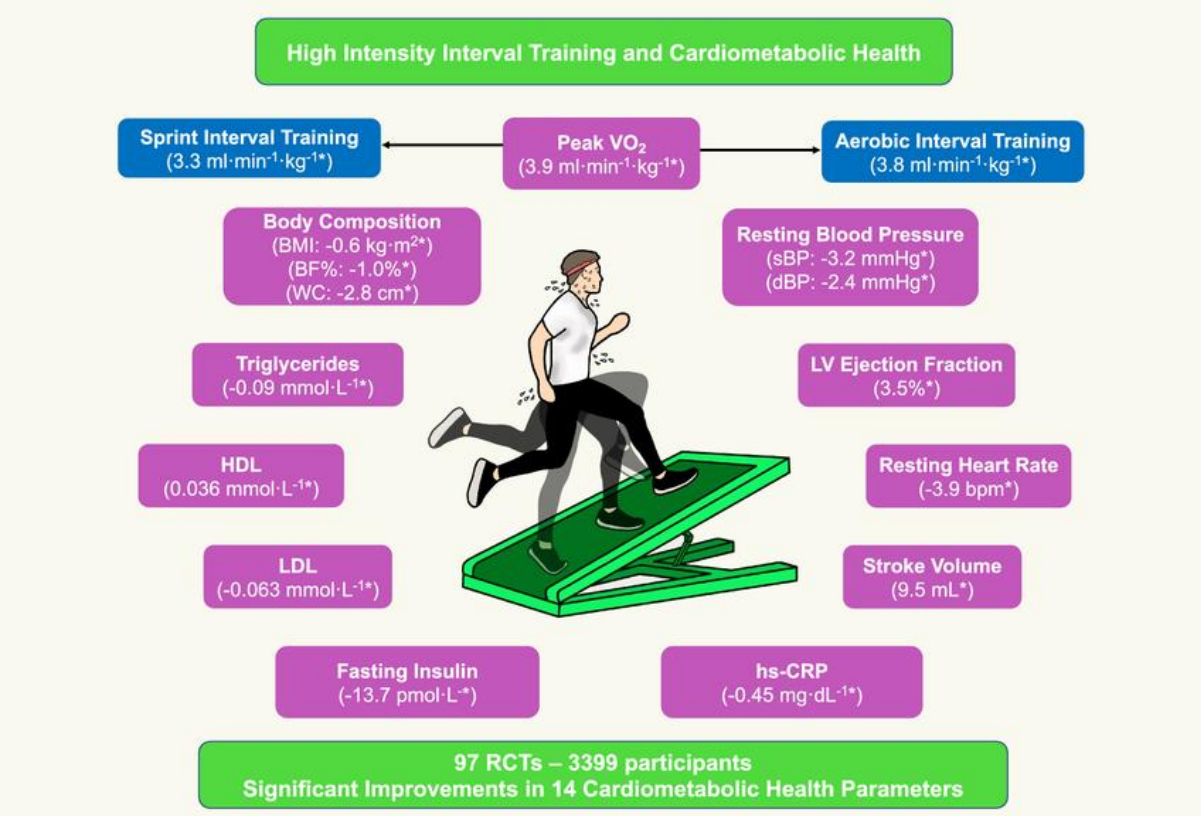
The study is also warranted due to the increasing constraints of time and training load management in elite and sub-elite sport environments. Athletes frequently operate within congested competitive calendars, limiting the feasibility of prolonged conditioning sessions and necessitating time-efficient training strategies that can produce maximal physiological and performance adaptations without excessive fatigue accumulation. HIIT has been widely proposed as an efficient alternative capable of inducing rapid improvements in both aerobic and anaerobic fitness; however, the translation of these physiological adaptations into tangible performance gains across different sporting contexts requires further scholarly clarification (de Mello et al., 2022; Wen et al., 2019). In addition, understanding the performance implications of HIIT contributes to evidence-based periodisation and load monitoring, enabling practitioners to integrate high-intensity stimuli in a manner that optimises adaptation while minimising the risk of overtraining or injury. The present investigation is therefore necessary to provide a comprehensive and contemporary evaluation of the impact of high-intensity interval training on athletic performance, thereby supporting informed decision-making in sport conditioning and performance optimisation.

Scope of the research

The scope of the present research encompasses a comprehensive examination of the impact of high-intensity interval training on multiple dimensions of athletic performance across varied sporting contexts. The study is delimited to analysing how HIIT influences key performance determinants, including aerobic capacity, anaerobic power, speed, agility, repeated sprint ability, and fatigue resistance, which collectively underpin competitive athletic success. By focusing on these interconnected components, the research seeks to evaluate HIIT not merely as a conditioning method but as an integrative training stimulus capable of enhancing overall sport-specific performance. The investigation considers both

individual and team sport settings where intermittent high-intensity efforts predominate, thereby ensuring that the analysis reflects the physiological and biomechanical realities of contemporary athletic competition. Such a multidimensional perspective allows for a nuanced understanding of how HIIT contributes to performance development beyond isolated physiological adaptations.

The research further extends to examining the differential effects of HIIT across athletes with varying training statuses, including trained, elite, and developmental populations. Differences in baseline fitness, adaptation potential, and sport-specific demands can influence the magnitude and nature of training responses, making it essential to contextualise the impact of HIIT within distinct athletic cohorts. Additionally, the study considers variations in HIIT protocol design, such as interval duration, intensity level, recovery modality, and session frequency, to understand how these variables mediate performance outcomes. This approach acknowledges that HIIT is not a uniform training method but rather a flexible framework that can be manipulated to target specific physiological systems and performance goals. Contemporary research has demonstrated that protocol characteristics significantly affect improvements in VO_2max, metabolic efficiency, and neuromuscular performance, underscoring the importance of evaluating these moderating factors within the research scope (Milanović et al., 2015; Wen et al., 2019).



Another important aspect within the scope involves the examination of both short-term and medium-term training adaptations resulting from HIIT interventions. By analysing studies that implement structured HIIT programmes over defined training periods, the research captures the progression of physiological and performance responses over time rather than relying solely on acute exercise effects. This temporal perspective is essential for understanding how repeated exposure to high-intensity intervals contributes to sustained improvements in athletic capability and competition readiness. Furthermore, the scope incorporates comparisons between HIIT and traditional conditioning approaches, particularly moderate-intensity continuous training, to contextualise its relative effectiveness in enhancing performance metrics within time-constrained training environments (Taylor et al., 2015; de Mello et al., 2022).

While the research provides a broad analytical framework, it remains focused on performance-related outcomes and does not extensively address clinical rehabilitation populations or non-athletic cohorts. The emphasis is placed on empirical evidence derived from sport science and exercise physiology studies published from 2015 onwards, ensuring that the findings reflect contemporary training practices and scientific advancements. By concentrating on recent scholarly literature, the study aims to present an up-to-date synthesis

of knowledge regarding the role of high-intensity interval training in shaping athletic performance across diverse sporting disciplines and competitive levels.

Literature Review

High-intensity interval training has been extensively investigated in recent years as a time-efficient and potent training modality for enhancing multiple components of athletic performance. Contemporary literature emphasises that HIIT involves repeated bouts of high-intensity exercise interspersed with active or passive recovery periods, designed to elicit substantial cardiovascular, metabolic, and neuromuscular stress. These physiological stimuli are fundamental for inducing adaptations that support improvements in both aerobic and anaerobic performance capacities. Systematic reviews and meta-analyses conducted since 2015 consistently demonstrate that HIIT produces significant enhancements in maximal oxygen uptake, which is widely recognised as a primary determinant of endurance performance. For instance, a comprehensive meta-analysis reported that HIIT is an effective method for improving VO_2max across healthy and athletic populations, highlighting its efficiency compared with traditional endurance training approaches (Milanović et al., 2015). Subsequent research has reinforced these findings, showing that HIIT protocols can stimulate superior cardiovascular and metabolic adaptations by promoting mitochondrial biogenesis, enhanced oxygen transport, and improved substrate utilisation during high-intensity efforts. These adaptations collectively contribute to improved endurance capacity, which is critical for athletes participating in intermittent and high-intensity sports.

Recent empirical evidence has further expanded the understanding of HIIT by demonstrating its multifaceted impact on performance-related variables beyond aerobic capacity. Studies examining team-sport athletes have shown that HIIT significantly improves repeated sprint ability, Yo-Yo intermittent recovery performance, and overall oxygen consumption metrics, suggesting its effectiveness in enhancing sport-specific endurance and fatigue resistance (Yuan et al., 2024). The intermittent structure of HIIT closely mimics the physiological demands of many competitive sports, thereby facilitating transferability of training adaptations to match-play scenarios. Additionally, meta-analytic findings indicate that HIIT contributes to improvements in agility and speed, which are essential for performance in sports characterised by frequent accelerations, decelerations, and directional changes. Research synthesising multiple experimental trials has reported statistically significant gains

in VO_2max, speed, and agility following HIIT interventions, reinforcing the notion that high-intensity interval stimuli can enhance both aerobic and neuromuscular performance determinants (Qi et al., 2026). Such findings suggest that HIIT functions as a comprehensive conditioning method capable of targeting diverse physiological systems simultaneously, rather than acting solely as an endurance training strategy.

Another key strand of literature has explored the comparative effectiveness of HIIT relative to moderate-intensity continuous training. Several systematic reviews and meta-analyses have concluded that HIIT yields equal or greater improvements in aerobic capacity while requiring substantially less total training time, thereby making it a more efficient conditioning modality for athletes operating within time-constrained training schedules. Evidence from controlled trials suggests that the repeated exposure to near-maximal intensities during HIIT sessions leads to superior central cardiovascular adaptations, including increased stroke volume and cardiac output, compared with continuous endurance training (Rosenblat et al., 2022; Wen et al., 2019). These central adaptations are complemented by peripheral changes such as enhanced muscle oxidative capacity and improved lactate clearance, which enable athletes to sustain high-intensity efforts for longer durations during competition. Consequently, HIIT is increasingly regarded as a training approach that optimises both physiological efficiency and performance outcomes across various sporting disciplines.

In addition to aerobic improvements, the literature highlights the significant role of HIIT in developing anaerobic power and neuromuscular performance. High-intensity intervals impose substantial stress on fast-twitch muscle fibres and glycolytic energy pathways, promoting adaptations that enhance sprinting ability, explosive power, and rapid force production. Meta-analytical research examining elite athletes indicates that HIIT leads to notable improvements in repeated-sprint performance, time-trial outcomes, and peak speed or power, demonstrating its relevance for sports that rely on explosive movements and rapid accelerations (Wiesinger et al., 2024). These findings are supported by sport-specific investigations showing that HIIT enhances change-of-direction ability and linear sprint performance in basketball and similar intermittent sports, indicating that neuromuscular coordination and power output benefit from high-intensity interval stimuli (Cao et al., 2025). The ability to repeatedly generate high power outputs with minimal fatigue is a critical determinant of competitive success, and the literature suggests that HIIT effectively targets these performance attributes through both neural and metabolic adaptations.

The influence of HIIT on sport-specific endurance and performance has also been examined within combat sports and youth athletic populations. Systematic reviews focusing on trained athletes in Olympic combat sports reveal that HIIT significantly enhances both aerobic and anaerobic performance markers, supporting its applicability in sports that involve intermittent bursts of high-intensity actions interspersed with short recovery periods (Yue et al., 2025). Similarly, meta-analytic studies on youth athletes indicate that HIIT outperforms low-intensity endurance training and generic training methods in improving maximal oxygen uptake, continuous endurance, and repeated sprint ability, demonstrating its effectiveness across developmental stages (Matzka et al., 2025). These findings highlight the versatility of HIIT in addressing performance needs across different age groups and competitive levels, although they also emphasise the importance of tailoring protocols to the specific physiological characteristics and maturation status of athletes.

Despite the consistently positive outcomes associated with HIIT, the literature also reveals variability in training responses depending on protocol characteristics and athlete populations. Differences in interval duration, work-to-rest ratios, exercise modality, and overall training volume can significantly influence the magnitude of performance improvements. Reviews comparing various interval training methods suggest that while HIIT generally improves VO_2max and endurance performance, certain protocols such as repeated sprint training may produce stronger effects in specific athletic contexts (Yang et al., 2025). This indicates that the effectiveness of HIIT is closely linked to its alignment with sport-specific performance demands and the precise manipulation of training variables. Moreover, some studies report limited or non-significant improvements in variables such as maximal aerobic speed or vertical jump performance, suggesting that HIIT may be more effective for enhancing endurance-related and intermittent performance metrics rather than maximal power outputs in isolation (Yuan et al., 2024). Such findings underscore the importance of considering the specificity principle when integrating HIIT into athletic training programmes.

The literature also addresses the physiological mechanisms underpinning HIIT-induced performance enhancements. High-intensity intervals elicit substantial metabolic stress, leading to increased activation of oxidative enzymes, improved phosphocreatine resynthesis, and enhanced buffering capacity against metabolic acidosis. These adaptations enable athletes to tolerate higher exercise intensities and recover more rapidly between successive bouts of effort. Research synthesising experimental and meta-analytic evidence indicates that

HIIT improves both central and peripheral determinants of endurance performance, including cardiac function, capillary density, and mitochondrial content, thereby enhancing the overall efficiency of the oxygen transport and utilisation system (Yin et al., 2025). Concurrently, neuromuscular adaptations such as improved motor unit recruitment and enhanced muscle fibre contractile properties contribute to gains in sprinting and agility performance, illustrating the integrative nature of HIIT-induced adaptations across multiple physiological domains.

Another important theme in the literature concerns the applicability of HIIT in highly trained and elite athletes. While earlier research primarily focused on untrained or recreationally active individuals, more recent meta-analyses have examined the effects of HIIT in elite athletic populations. Findings indicate that although improvements in VO_2max may be smaller in highly trained athletes due to ceiling effects, HIIT still produces meaningful gains in time-trial performance, repeated-sprint ability, and sport-specific endurance, confirming its value even at advanced levels of training (Wiesinger et al., 2024). These results highlight the potential of HIIT to serve as a performance-enhancing stimulus within periodised training programmes, particularly during phases aimed at improving high-intensity work capacity and competition readiness.

Collectively, the existing body of literature demonstrates that HIIT exerts a significant and multifactorial influence on athletic performance by enhancing aerobic capacity, anaerobic power, neuromuscular function, and fatigue resistance. Nevertheless, the magnitude and nature of these improvements are moderated by factors such as training protocol design, athlete training status, sport specificity, and intervention duration. While strong evidence supports the effectiveness of HIIT as a time-efficient conditioning method, ongoing research continues to explore optimal protocol configurations and the long-term sustainability of performance adaptations. The reviewed studies collectively provide a comprehensive foundation for understanding how high-intensity interval training contributes to performance enhancement across diverse athletic populations and sporting disciplines.

Methodology

The present study adopts a systematic review research design to examine the impact of high-intensity interval training on athletic performance across diverse sporting contexts. This approach enables the synthesis and critical analysis of empirical findings from peer-reviewed

scholarly sources published from 2015 onwards, ensuring that the investigation reflects contemporary developments in sport and exercise science. Relevant studies were identified through electronic academic databases, with a focus on experimental trials, meta-analyses, and systematic reviews that assessed the effects of HIIT interventions on performance-related variables such as aerobic capacity, anaerobic power, speed, agility, and repeated sprint ability. Only studies involving athletic or physically trained populations were included to maintain relevance to competitive sport performance.

The selection process involved screening titles, abstracts, and full texts to ensure methodological rigour and alignment with the research objective. Studies that lacked clear HIIT protocols or did not report measurable performance outcomes were excluded. Data extraction focused on participant characteristics, training duration, interval intensity, and reported performance improvements, enabling comparative evaluation across different interventions. The collected data were then analysed using qualitative synthesis to identify recurring trends, patterns, and divergences in reported findings. This methodological framework provides a comprehensive and structured basis for understanding how HIIT influences multiple dimensions of athletic performance across varied athletic populations and sporting disciplines.

Results and Discussion

The synthesis of recent empirical studies examining the impact of high-intensity interval training on athletic performance reveals consistent improvements across multiple physiological and sport-specific performance domains. A clear trend emerges indicating that HIIT interventions produce significant gains in aerobic capacity, anaerobic power, repeated sprint ability, and agility when compared with traditional training approaches or baseline measurements. These outcomes are particularly evident in sports characterised by intermittent high-intensity efforts, where athletes must sustain repeated bursts of maximal or near-maximal activity interspersed with brief recovery periods. Across the reviewed literature, improvements in maximal oxygen uptake are among the most frequently reported findings, reflecting the substantial cardiovascular stress imposed during high-intensity intervals. Enhanced VO_2max is directly associated with improved endurance performance and delayed onset of fatigue, thereby enabling athletes to maintain higher work rates throughout competition. Such physiological improvements are complemented by enhanced movement

economy and oxygen utilisation efficiency, which collectively contribute to improved sport-specific performance capacity.

The analysed studies consistently demonstrate that HIIT enhances both central and peripheral determinants of endurance performance. Central adaptations include increased stroke volume, improved cardiac output, and enhanced oxygen delivery to working muscles, while peripheral adaptations involve increased mitochondrial density, capillary proliferation, and oxidative enzyme activity. These combined responses facilitate improved aerobic metabolism and more efficient energy production during high-intensity exercise. Notably, these adaptations are observed across a range of athlete populations, from youth athletes to elite performers, suggesting that HIIT is effective irrespective of baseline training status. However, the magnitude of improvement tends to be greater in moderately trained athletes compared with elite performers, likely due to the latter approaching physiological ceilings that limit the scope for further enhancement. This observation highlights the importance of training specificity and the principle of diminishing returns in highly trained athletic populations.

In addition to aerobic capacity, the reviewed evidence indicates substantial improvements in anaerobic performance following HIIT interventions. The repeated exposure to maximal or supramaximal intensities stimulates glycolytic enzyme activity and phosphocreatine resynthesis, which are critical for repeated sprint performance and explosive actions. As a result, athletes demonstrate enhanced sprint speed, peak power output, and improved ability to perform high-intensity efforts with reduced fatigue accumulation. These findings are particularly relevant for team sports such as football, basketball, and hockey, where repeated sprint ability is a key determinant of match performance. Improvements in anaerobic capacity are often accompanied by enhanced neuromuscular coordination and motor unit recruitment, which contribute to greater force production and rapid acceleration. Such adaptations underline the comprehensive performance benefits of HIIT, extending beyond endurance to encompass power- and speed-related attributes.

The reviewed literature also provides strong evidence that HIIT positively influences agility and change-of-direction speed, which are essential components of athletic performance in multidirectional sports. The intermittent and high-intensity nature of HIIT sessions requires athletes to repeatedly accelerate, decelerate, and change movement patterns, thereby stimulating neuromuscular adaptations that enhance coordination and reaction speed. Improvements in agility are frequently reported alongside gains in sprint performance,

suggesting that HIIT enhances both linear and multidirectional speed capabilities. These outcomes indicate that HIIT serves as an ecologically valid training stimulus that closely replicates the dynamic demands of competitive sport. Consequently, the transferability of training adaptations from HIIT to actual match-play scenarios appears to be strong, particularly in sports involving rapid transitions between offensive and defensive actions.

Another notable finding from the synthesis of results is the superior time efficiency of HIIT compared with moderate-intensity continuous training. Several experimental studies report comparable or greater improvements in aerobic and anaerobic performance despite significantly lower total training volumes. This efficiency is particularly advantageous for athletes operating within congested training and competition schedules, where maximising physiological adaptation within limited time frames is essential. The ability of HIIT to induce rapid physiological changes is attributed to the high metabolic stress generated during intervals, which activates signalling pathways responsible for mitochondrial biogenesis and oxidative metabolism. This mechanism explains why relatively short HIIT sessions can produce performance gains similar to or exceeding those achieved through longer-duration endurance training.

Despite the generally positive outcomes, variability in performance responses is observed across different HIIT protocols and athlete populations. Differences in interval duration, intensity, recovery type, and total training volume influence the magnitude of adaptation, indicating that protocol design plays a critical role in determining performance outcomes. Shorter, supramaximal intervals tend to favour improvements in anaerobic power and sprint performance, whereas longer intervals performed at near-maximal intensities are more effective for enhancing aerobic endurance. This variability suggests that the effectiveness of HIIT is closely linked to the alignment between training stimulus and sport-specific performance requirements. Therefore, the selection and periodisation of HIIT protocols must be carefully tailored to the physiological demands of each sport and the individual characteristics of athletes.

The following table summarises representative findings from selected empirical studies examining the impact of HIIT on various performance parameters.

Table 1: Summary of Selected Empirical Findings on HIIT and Athletic Performance

Study (Year)	**Sample Characteristics**	**Duration of HIIT Intervention**	**Key Performance Outcomes**
Milanović et al. (2015)	Trained and untrained athletes	4–12 weeks	Significant improvement in VO_2max and endurance capacity
Wen et al. (2019)	Healthy and athletic populations	6–10 weeks	Enhanced aerobic fitness and metabolic efficiency
Rosenblat et al. (2022)	Endurance-trained athletes	8 weeks	Greater cardiovascular adaptations than continuous training
Yuan et al. (2024)	Team-sport athletes	6–8 weeks	Improved repeated sprint ability and Yo-Yo test performance
Cao et al. (2025)	Competitive basketball players	8 weeks	Increased agility and sprint speed
Matzka et al. (2025)	Youth athletes	6–12 weeks	Improved VO_2max and continuous endurance performance
Wiesinger et al. (2024)	Elite athletes	6–10 weeks	Enhanced time-trial performance and peak power output

The collective interpretation of these findings suggests that HIIT exerts a broad and integrative influence on athletic performance, supporting improvements in both physiological and functional performance indicators. Importantly, the interaction between aerobic and anaerobic adaptations appears to be central to the effectiveness of HIIT. Enhanced aerobic capacity allows athletes to recover more rapidly between high-intensity efforts, while improved anaerobic power enables them to execute explosive actions more effectively. This dual adaptation mechanism is particularly beneficial in sports requiring repeated high-intensity efforts throughout prolonged competition.

Further analysis reveals that the performance benefits of HIIT are strongly linked to improvements in fatigue resistance. Athletes undergoing HIIT programmes demonstrate increased tolerance to metabolic acidosis and improved buffering capacity, enabling sustained high-intensity output with reduced performance decline. This adaptation is especially relevant during the latter stages of competition, where fatigue often determines the outcome of performance. Enhanced fatigue resistance also contributes to improved consistency in technical and tactical execution, as athletes are better able to maintain high levels of physical and cognitive performance under fatigue conditions.

The second table presents a comparative overview of performance variables influenced by HIIT and the direction of observed changes across the reviewed studies.

Table 2: Comparative Impact of HIIT on Key Athletic Performance Variables

Performance Variable	**Direction of Change**	**Observed Effect on Athletic Performance**
Aerobic capacity (VO_2max)	Positive increase	Improved endurance and delayed onset of fatigue
Anaerobic power	Positive increase	Enhanced sprint performance and explosive muscular actions
Repeated sprint ability	Positive increase	Greater ability to sustain high-intensity efforts throughout competition
Agility and change-of-direction speed	Positive increase	Improved multidirectional movement efficiency and reaction capability
Movement economy	Positive increase	Reduced energy expenditure during submaximal efforts
Fatigue resistance	Positive increase	Sustained high-level performance during prolonged competitive activity
Peak power output	Moderate increase	Improved capacity for short-duration maximal efforts

The discussion of these results indicates that HIIT functions as a comprehensive conditioning stimulus capable of enhancing multiple performance domains simultaneously. The convergence of aerobic, anaerobic, and neuromuscular adaptations explains the broad performance improvements observed across different sports and athlete populations.

Nevertheless, the variability in outcomes across studies highlights the importance of individualisation and sport-specific protocol design. Factors such as training status, sport demands, and recovery capacity must be considered when integrating HIIT into athletic training programmes to maximise its effectiveness while minimising the risk of excessive fatigue or overtraining.

Conclusion

The present research demonstrates that high-intensity interval training exerts a substantial and multifaceted influence on athletic performance by simultaneously enhancing aerobic capacity, anaerobic power, neuromuscular efficiency, and fatigue resistance. The synthesis of contemporary empirical evidence indicates that HIIT is an effective and time-efficient conditioning strategy capable of producing meaningful improvements in key performance determinants such as maximal oxygen uptake, repeated sprint ability, agility, and peak power output. These adaptations are particularly relevant for sports characterised by intermittent high-intensity activity patterns, where athletes must repeatedly perform explosive efforts interspersed with short recovery periods. The reviewed findings collectively suggest that the intermittent structure and high physiological demands of HIIT closely replicate the energetic and neuromuscular requirements of competitive sport, thereby promoting strong transferability of training effects to actual performance contexts.

The analysis further reveals that the performance benefits of HIIT are derived from integrated central and peripheral physiological adaptations, including improved cardiac output, enhanced mitochondrial density, increased oxidative enzyme activity, and superior metabolic buffering capacity. These responses enable athletes to sustain higher work rates, recover more rapidly between bouts of effort, and maintain performance consistency during prolonged competition. Moreover, HIIT contributes to neuromuscular enhancements that improve sprint speed, acceleration, and change-of-direction efficiency, highlighting its relevance across both endurance- and power-dominant sports. Although variability in outcomes is evident due to differences in protocol design, athlete training status, and sport specificity, the overall body of literature consistently supports the efficacy of HIIT as a comprehensive performance-enhancing training modality.

In summary, high-intensity interval training represents a scientifically grounded and practically applicable approach to optimising athletic performance across diverse sporting

disciplines. Its capacity to elicit simultaneous improvements in multiple physiological and functional domains, combined with its efficiency within constrained training schedules, underscores its value in modern sport conditioning. The evidence indicates that when appropriately periodised and tailored to sport-specific demands, HIIT can serve as a central component of athletic training programmes aimed at maximising competitive performance and long-term physiological development.

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