

## EFFECT OF HIGH INTENSITY INTERVAL TRAINING AND LOW INTENSITY INTERVAL TRAINING IN SPRINTERS- AN EVIDENCED BASED STUDY

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### ABSTRACT

**Background:** Sprint performance relies heavily on speed, power, and muscular endurance. While both High-Intensity Interval Training (HIIT) and Low-Intensity Interval Training (LIIT) are widely implemented in athletic conditioning, their distinct impacts on sprinter performance remain unexplored. HIIT involves short bursts of maximal effort followed by recovery and is employed during intensive training blocks. LIIT consists of longer, moderate- intensity intervals with minimal rest, often used during recovery periods. Study provides evidence regarding HIIT and LIIT for sprinters.

**Objective:** To evaluate the effect of HIIT and LIIT on muscular endurance, strength, speed, and flexibility in trained sprinters.

**Methodology:** A systematic literature review was conducted using databases such as MEDLINE, PubMed, Google Scholar, and The Cochrane Collaboration. Ten studies were initially identified, out of which five met the inclusion criteria and were selected for detailed analysis. The focus was on studies evaluating sprint-specific outcomes following HIIT and LIIT interventions.

**Results:** HIIT interventions demonstrated significant improvements in anaerobic power, sprint speed, and muscular strength. LIIT showed enhancements in aerobic endurance and flexibility. The contrasting mechanisms of protocols support their individual benefits, HIIT as an effective strategy for high-intensity performance gains, and LIIT as a supportive recovery tool promoting sustained conditioning.

**Conclusion:** HIIT and LIIT serve essential and complementary roles for sprinters. HIIT is more effective in boosting anaerobic capabilities and explosive performance, while LIIT supports recovery, flexibility, and endurance. A strategic combination of these training offers a balanced approach to optimizing overall sprint performance.

**Keywords:** High-Intensity Interval Training, Low-Intensity Interval Training, Sprint Performance

### INTRODUCTION

High-Intensity Interval Training (HIIT) and Low-Intensity Interval Training (LIIT) both alternate intense and moderate exercise with rest periods offering unique yet complementary benefits in sprint performance. HIIT, requires explosive demands of sprinting, significantly enhances anaerobic power, muscular strength, and sprint speed. It improves oxygen use in muscles (1), regulates muscle-related gene expression post-injury (2), boosts VO<sub>2</sub>max while reducing body fat (3), and balances fatigue and stress hormones for better sprint

outcomes (4). These effects were due to its ability to stimulate fast energy systems and improve neuromuscular coordination. LIIT focuses on longer, gentler intervals that support recovery, improve joint mobility, increase aerobic endurance and activate antioxidant defenses without causing excessive strain (5). It is particularly helpful during off-peak phases or for athletes in recovery. A balanced, periodized training approach that integrates both HIIT and LIIT not only optimizes performance gains but also reduces injury risk and overtraining. This synergy makes their combined application crucial for peak performance in sprinters.

## METHODOLOGY

Study design was evidence-based study evaluated randomized controlled trials (RCTs) that examined effects of HIIT and LIIT on sprint performance. A systematic search was conducted across established academic databases including PubMed, ResearchGate, and Google Scholar to locate relevant high-quality studies. A comprehensive strategy was applied and keyword like High-Intensity Interval Training, Low-Intensity Interval Training, sprint performance and randomized controlled trials were selected. Boolean operators refined the search and accuracy was improved. To ensure the reliability of the findings, only peer-reviewed, full-text articles published were included. Inclusion Criteria: Studies focused on trained sprinters or athletes subjected to HIIT or LIIT protocols. Studies designed as randomized controlled trials and published in peer-reviewed journals. Studies which have assessed outcomes such as muscular endurance, strength, flexibility, or aerobic/anaerobic performance and studies which had a training duration of at least four weeks and those study includes a direct comparison between HIIT and LIIT interventions were included.

**Exclusion Criteria:** Observational studies, case reports, expert opinions, or non-randomized research were excluded. Included participants with chronic health conditions known to affect athletic performance. Were unavailable in full-text or published in languages other than English.

Had training durations under four weeks or lacked a comparison group. Did not measure physical performance outcomes.

## Quality Assessment

Each selected study was critically assessed using the PEDro scale, a widely accepted tool for evaluating the methodological quality of clinical trials. The PEDro scale considers factors like study design, blinding, allocation, and statistical analysis. Studies scoring eight or above were considered high quality, while a score of seven was categorized as moderate. Any study with a score below seven was excluded from this review.

## General data of included studies

Total Eight studies Six randomized controlled trials met the inclusion criteria and were included in this review. These studies examined trained athletes—primarily sprinters—who underwent structured HIIT or LIIT protocols over training periods ranging from four to eight weeks. Each study aimed to improve performance-related variables such as muscular endurance, strength, flexibility, and both aerobic and anaerobic capacity.

Most of the studies implemented validated assessment tools and structured workout routines. Findings revealed that both HIIT and LIIT can effectively enhance athletic performance. However, HIIT often led to more pronounced improvements in anaerobic power and maximal oxygen uptake, while LIIT was more effective in promoting recovery and building endurance.

## Table of Included Articles

The selected articles were analyzed based on author-year, study design, study population, interventions, duration, outcome measures, results and PEDRO score.

**TABLE 1: SUMMARY OF EVIDENCE-BASED STUDIES ON HIGH-INTENSITY INTERVAL TRAINING (HIIT) AND LOW-INTENSITY INTERVAL TRAINING (LIIT) FOR SPRINTERS**

SR. NO	TITLE	STUDY DESIGN	STUDY POPULATION	INTERVENTION	TREATMENT DURATION	OUTCOME MEASUREMENT	RESULT	PEDRO SCORE
1	Effect of High-Intensity Interval Training Versus Sprint Interval Training on Time-Trial Performance : A Systematic Review and Meta-Analysis (Rosenblat et al., 2020)	Systematic Review and Meta-Analysis	Athletes	HIIT: Repeated bouts of 4min at = 85-95%Max HR, with incomplete recovery. SIT: Repeated bouts of 15-30s all-out" effort (supramaximal), with longer, near-complete recovery	2 weeks (Studies typically range from 4-10 weeks)	Time-Trial (TT) Performance (set distance/time), Maximal Oxygen Consumption VO2max and VO2peak, Maximal Aerobic Power/Velocity (MAP/MAV)	Long-HIIT (work bouts = 4min was superior to SIT for improving TT performance. Both are generally more effective than lower-intensity training for VO2max in athletes	-
2	High-Intensity Interval Training Performed by Young Athletes: A Systematic Review and Meta-Analysis (Tomas-Carus et al., 2018)	Systematic Review and Meta-Analysis	Aerobic & Anaerobic Performance in young athletes	HIIT: 90-95% Peak HR or =90% VO2max SIT: (Supra)maximal interval sprinting	Mean 7.2 weeks (Range: 3-12 weeks). 2-3 sessions per week	Peak Oxygen Uptake (VO2peak), Running Performance, Repeated Sprint Ability (RSA), Jumping Performance	HIIT/SIT/RS T resulted in a higher average increase in VO2peak (7.2%) compared to alternative interventions (4.3%). Improved Repeated Sprint Ability (RSA) and other variables related to anaerobic performance	-
3	Effects of High-Intensity Interval Training vs. Sprint Interval Training on Anthropometric Measures and Cardiorespiratory Fitness in Healthy Young Women	Randomized Clinical Trial (RCT)	Healthy Young Women	HIIT: 8 \times 1min bouts at 85% Wmax with 1min active recovery at 25%Wmax. SIT: 8times 30s bouts at 130% Wmax with 90s active recovery at 25% Wmax	8 weeks	Peak Oxygen Consumption VO2peak, Sum of Skinfolds, Body Mass Index (BMI), Waist Circumference	SIT was more effective than HIIT for reducing the sum of skinfolds, while both significantly improved VOpeak and anthropometric measures compared to baseline	-

	(Naves et al., 2018)							
4	Effects of High-Intensity Interval vs. Sprint Interval Training on Performance and Muscle Oxygenation in Sprint Kayakers (Fiorenza et al., 2019)	Randomized Comparative Trial	13 Sprint Kayakers	HIIT (4×4 min) vs. SIT (4×30 sec)	3 weeks, 9 sessions	Performance in time trials, Muscle Oxygenation (NIRS)	No significant difference in performance; both groups improved muscle oxygenation	7/11
5	Effects of Long and Sprint High-Intensity Interval Training on Body Mass Composition, Aerobic Capacity, and Biochemical Markers of Metabolic Syndrome and Liver Damage in Physical Activity Practitioners Adults	Randomized Clinical Trial	38 male adult physical activity practitioners (Army soldiers, military music band), aged 30–55 years (mean 42.75 ± 8.26)	- HILIT: Running sprints >1 minute at intensities between the second ventilatory threshold and VO <sub>2max</sub> . - SIT: Running sprints <1 minute at intensities above VO <sub>2max</sub> . Both groups performed sessions equalized by Banister's TRIMP formula, including warm-up, neuro-muscular core exercises, and interval running on athletics	12 week	- Body composition (DXA: fat mass, lean mass, BMI, VAT, GLU, Albumin, Direct Bilirubin, running distance, and VO <sub>2max</sub> ). - Aerobic capacity (cardiac stress test: VO <sub>2max</sub> , distance run) - Biochemical markers: triglycerides (TRIG), HDL-C, glucose (GLU), liver function markers (Albumin, Bilirubin, AST, ALT, GGT) - Blood pressure (SBP, DBP)	- HILIT group: Significant improvements in fat mass, lean mass, BMI, VAT, GLU, Albumin, Direct Bilirubin, running distance, and VO <sub>2max</sub> . - SIT group: Significant improvements in VAT, GLU, Albumin, Direct Bilirubin, GGT, and running distance. - Intergroup comparison showed SIT had a significant advantage in blood pressure reduction. - Overall, both	7/11

				track or football field			HILIT and SIT improved body composition, aerobic capacity, metabolic syndrome markers, and liver health, with HILIT showing better results.	
6	Effects of 8-Week Medium- and High-Intensity Interval Training on Blood Fatigue, Inflammatory, and Stress Markers in Male Sprinters (Du HY and Sim et al )	Randomized Controlled Trial	20 male high school sprinters from Tangshan city,	Three 60-minute interval training sessions per week (Monday, Wednesday, Friday), including warm-up, interval training, and cool-down; Intensity defined by 85–95% HRR (High) and 75–85% HRR (Medium)	8 weeks (24 sessions total)	Blood levels of LDH, CK, CRP, IL-6, cortisol, ACTH; 100-m sprint time measured twice, best recorded time used	Both groups showed decreased LDH, CK, CRP, IL-6, ACTH levels; cortisol increased; no significant intergroup differences; interval training positively affected blood markers and 100-m sprint performance	7/11
7	Effects of low and high intensity interval training exercises on VO <sub>2max</sub> and components of neuromuscular and vascular system in male volunteers	RCTs	36 healthy physically inactive males	HIIT (%HRmax= 85–90%) and LIIT (%HRmax= 57–64%) for 2x/week, 4 weeks; 20s work:20s rest x 8 exercises x 3 cycles	4 weeks	BDNF, TrkB, VEGF-A, PGC-1 $\alpha$ , and Irisin levels measured at baseline, post-acute, and post-4-week training	Both HIIT and LIIT increased neurotrophic and angiogenic biomarkers significantly; HIIT showed greater increase than LIIT	6/11
8	Effect of High- and Low-Intensity Interval Training on Myostatin Gene Expression Levels in		18 male Wistar rats, 10 weeks old, with induced myocardial infarction	- HIIT: 90–85% VO <sub>2max</sub> , 30-min treadmill jogging sessions, each interval: 4 min		Myostatin gene expression in slow-twitch (ST) and fast-twitch (FT) muscles, measured by molecular techniques	- LIIT significantly decreased myostatin expression in both ST and FT muscles (P = 0.002 and P = 0.016) -	7/11

	Muscle Fibers of Rats with Myocardial Infarction		running (85-90% VO <sub>2</sub> max) + 2 min active recovery (50-60% VO <sub>2</sub> max), 3 days/week - LIIT: 50-60% VO <sub>2</sub> max, 30-min treadmill jogging, each interval: 4 min running (55-60% VO <sub>2</sub> max) + 2 min active recovery (45-50% VO <sub>2</sub> max), 3 days/week - Control Group (CG): No training			HIIT significantly decreased myostatin in ST ( $P = 0.011$ ) - HIIT decrease in FT myostatin was higher than CG but not significant ( $P = 0.078$ ) - Myostatin expression values in ST: CG (8.87), HIIT (0.949), LIIT (3.11) - Myostatin expression values in FT: CG (1.22), HIIT (0.975), LIIT (0.975)	
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## RESULTS

### Studies Identified

An initial wide-ranging search identified ten potential studies. After applying the inclusion and exclusion criteria, four studies were excluded for reasons such as lack of full-text availability, failure to meet methodological standards, or misalignment with the study's objectives. Ultimately, five suitable studies were selected for further analysis and quality assessment.

### Quality Assessment Results

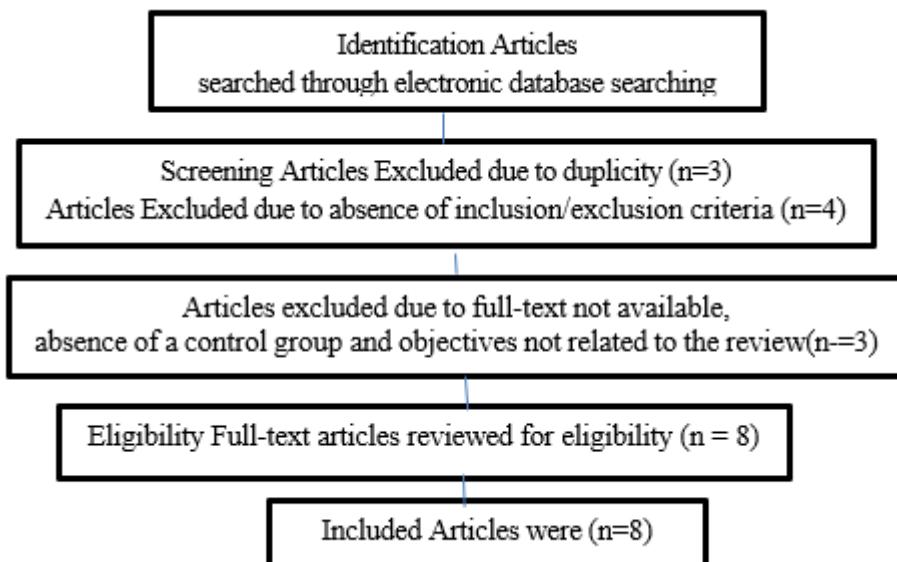
Eight selected studies, three were systematic review and other studies were Randomized controlled trial out of which four scored seven out of eleven on the PEDro scale, indicating strong methodological quality and well-controlled experimental designs. These studies utilized validated measurement tools and clearly defined training protocols. The remaining one studies scored six, reflecting moderate quality. Minor limitations in these studies included inconsistencies in initial participant conditions, absence of blinding, or slightly varying intervention methods.

Due to significant variation in training approaches, participant characteristics, and outcome measures, a quantitative meta-analysis was not feasible. Instead, a qualitative or descriptive synthesis was employed to interpret the effects of HIIT and LIIT on sprint-related outcomes.

### General Data of the Included Studies

The selected studies also considered different interval training modalities, such as Sprint Interval Training (SIT), HIIT, and LIIT, to assess their impact on athletic performance in sprinters. Training durations varied from three to twelve weeks, with athletes typically training two to three times per week. HIIT sessions included short,

high-intensity sprints performed at 85–90% of VO<sub>2</sub> max, whereas LIIT sessions involved lower-intensity workouts like jogging at 50–60% of VO<sub>2</sub> max. Performance was evaluated through metrics such as sprint speed, muscle oxygen utilization, gene expression, body composition, and biochemical markers. HIIT showed notable improvements in anaerobic capacity and speed, while LIIT contributed to better recovery, endurance, and reduced muscle fatigue. These outcomes underscore the practical value of both training methods for sprinters.



**Figure 1:** Flow diagram illustrating the screening and selection process of articles included in this study.

Studies were excluded when they lacked a control group, had very small sample sizes, or used interventions that were not directly comparable.

## DISCUSSION

This review explores the distinct but interconnected effects of High-Intensity Interval Training (HIIT) and Low-Intensity Interval Training (LIIT) on sprint performance, drawing from a broad range of recent scientific literature. HIIT, characterized by repeated short bursts of high-effort activity, has been consistently shown to elevate anaerobic power, muscular strength, sprint speed, and muscle oxygenation—attributes essential to sprinting performance. It activates fast-energy systems, enhances phosphagen and glycolytic pathways, and supports neuromuscular adaptations that translate directly to sprint efficiency and power output. For instance, HIIT has improved oxygen use in trained sprint kayakers (1), regulated muscle gene expression post-cardiac events (2), and led to positive changes in VO<sub>2max</sub>, body composition, and sprint-specific stress markers (3).

In contrast, LIIT, often underestimated in the sprint training domain, contributes significantly to physiological recovery, aerobic base development, and injury prevention. Through steady-state, moderate-effort sessions, LIIT promotes cardiovascular health, antioxidant activity, and muscular flexibility—all of which are critical for preparing athletes to endure high-intensity workloads without physical or psychological burnout. Studies have confirmed LIIT's role in enhancing antioxidant enzyme function (5), improving aerobic capacity in older and novice populations (8), and supporting joint mobility, fat metabolism, and circulation (6),(9).

Together, these findings reinforce the idea that a periodized program that blends both HIIT and LIIT offers a balanced, strategic approach to peak sprint performance. While HIIT delivers sharp gains in speed, power, and anaerobic fitness, LIIT ensures recovery, sustainability, and long-term athletic resilience. Overreliance on HIIT may lead to overtraining, hormone imbalance, or performance stagnation (23),(25), whereas integrating LIIT helps maintain consistency, prevent oxidative stress, and reduce inflammation (11),(15). This synthesis of evidence encourages coaches and athletes to consider both modalities not as alternatives, but as complementary tools within the broader framework of sprint conditioning. However, varying methodologies,

populations, and intervention durations across the reviewed studies indicate a need for more standardized and sport-specific protocols to optimize training outcomes.

## CONCLUSION

Low-Intensity Interval Training (LIIT) is especially beneficial during the recovery phases of a sprinter's training program. It aids in active recovery, enhances flexibility, and minimizes the risk of injury. On the other hand, High-Intensity Interval Training (HIIT) should be prioritized during high-performance training blocks, such as a two-month phase focused on building sprint speed, strength, and power output. Together, HIIT and LIIT offer a well-rounded and effective training strategy when implemented within a periodized plan. Their complementary nature helps athletes achieve high performance while protecting them from fatigue, burnout, and overtraining.

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