

# INPLASY

## The Effects of High-Intensity Interval Training on tennis Players: A Systematic Review and Meta-Analysis

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### ADMINISTRATIVE INFORMATION

**Support** - None.

**Review Stage at time of this submission** - The review has not yet started.

**Conflicts of interest** - None declared.

**INPLASY registration number:** INPLASY2024120120

**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 30 December 2024 and was last updated on 30 December 2024.

### INTRODUCTION

**Review question / Objective** The aim of this study is to assess the effects of high-intensity interval training on tennis players, focusing on aspects of physical fitness and athletic performance.

**Condition being studied** This systematic review focuses on the effects of High-Intensity Interval Training (HIIT) on the physical performance and fitness of tennis players. Tennis is characterized by intermittent bursts of high-intensity activity, including rapid sprints, directional changes, and prolonged matches requiring both anaerobic and aerobic energy systems. HIIT, which alternates short bursts of high-intensity exercise with periods of rest or low-intensity recovery, has been widely recognized as a time-efficient training method for improving cardiovascular fitness, anaerobic capacity, and sport-specific performance. In the context of tennis, optimizing these fitness components is essential for enhancing match

performance, endurance, and recovery. By synthesizing current evidence, this study seeks to provide practical insights into the potential benefits of HIIT as a training strategy for tennis players.

### METHODS

**Participant or population** The subject population for this review is tennis players (well-trained).

**Intervention** The intervention protocol requirements for the studies included in this systematic review are: various high-intensity interval training programs.

**Comparator** The control requirements for the studies included in this systematic review are MICT or no control (regular training or no intervention activity) or comparisons between different HIIT protocols (e.g., short sprints vs. long sprints).

**Study designs to be included** RCTs.

**Eligibility criteria** Studies were identified using the following inclusion criteria: (1) Participants are tennis players with at least 2 years of training experience, including children, adolescents and adults; (2) Studies comparing HIIT with either control (CON) or MICT group, where training intensity thresholds of HIIT and MICT were defined as high ( $\geq 80$ – $85\%$  VO<sub>2</sub>max,  $\geq 85$ – $90\%$  maximal heart rate [HRmax] or  $\geq 90\%$  velocity/power at VO<sub>2</sub>max [ $v/p$ VO<sub>2</sub>max]) and moderate ( $40$ – $65\%$  VO<sub>2</sub>max or  $55$ – $75\%$  HRmax) respectively; (3) Results related to the effects of HIIT on physical fitness (body composition, strength, speed, agility, flexibility, balance, cardiovascular endurance, muscular strength, muscular endurance, and reaction time) and tennis performance (e.g., stroke consistency and depth of stroke) in the study were reported or could be calculated; (4) RCTs. Studies were excluded if they met the following criteria: (1) not published in English; (2) included participants suffering from any kind of acute or chronic diseases; (3) training intensity did not meet the previously defined thresholds; (4) HIIT was combined with other training methods; (5) Can't obtain the original full text.

**Information sources** Web of Science, PubMed, Scopus and EBSCO.

### Main outcome(s)

#### 1. Physical fitness.

##### (1) Aerobic capacity

Measure: VO<sub>2</sub>max/VO<sub>2</sub>peak (maximum oxygen uptake), expressed in mL·kg<sup>-1</sup>·min<sup>-1</sup>.

Timing: Baseline and post-HIIT intervention.

Effect Measure: Mean difference or standardized mean difference (SMD) in VO<sub>2</sub>max values, comparing pre- and post-intervention results.

##### (2) Anaerobic capacity

Measure: Metrics such as Wingate test results, repeated sprint ability (RSA), or peak power output during anaerobic efforts.

Timing: Baseline and post-HIIT intervention.

Effect Measure: Mean difference or SMD in performance metrics.

##### (3) Ability of sprint

Measure: Sprint times (e.g. sprint or shuttle run)

Timing: Baseline and post-HIIT intervention.

Effect Measure: Mean difference or SMD in speed and agility scores.

2. Timing: Baseline and post-HIIT intervention.

Effect Measure: Performance metrics comparing intervention and control groups.

This review will synthesize evidence on how HIIT protocols improve aerobic and anaerobic capacity, speed, agility, and sport-specific performance in tennis players. Outcomes will be analyzed using

appropriate statistical measures to assess the effect sizes and consistency of results across studies.

**Quality assessment / Risk of bias analysis** The risk of bias in the included studies will be assessed using the ROB 2 (Risk of Bias 2) tool, a widely recognized framework for evaluating the quality of randomized controlled trials. The assessment will be conducted independently by two reviewers, and disagreements will be resolved through discussion or consultation with a third reviewer if needed.

**Strategy of data synthesis** This systematic review will include a meta-analysis to synthesize the effects of different High Intensity Interval Training (HIIT) protocols on tennis players, specifically on physical fitness and tennis performance. The following methods will be used:

#### 1. meta-analysis model

Data will be synthesized using a random effects model to account for potential differences between studies, such as differences in HIIT protocols, participant characteristics (e.g., age, fitness level), and study setting.

Effect sizes will be calculated as standardized mean difference (SMD) and 95% confidence intervals (CI), as differences in measurement tools across studies are expected.

#### 2. Assessment of heterogeneity

Q-test: Cochran's Q-test will be performed to assess whether there is heterogeneity between the studies (the level of statistical significance will be set at  $p < 0.10$ ).

I<sup>2</sup> statistic: The degree of heterogeneity will be quantified using the I<sup>2</sup> statistic, with values of 25%, 50% and 75% interpreted as low, medium and high heterogeneity, respectively.

#### 3. Subgroups

Subgroup analyses will be conducted to explore potential sources of heterogeneity, including differences in HIIT program characteristics (e.g., intensity, duration, work-to-rest ratio), participant age groups, and baseline fitness levels.

#### 4. Software

Data synthesis and statistical analysis will be conducted using Review Manager 5.3 (RevMan 5.3). Forest plots will be used to visualize pooled effect sizes and confidence intervals.

#### 5. Narrative review

For studies that cannot be included in the meta-analysis (e.g., due to incomplete data or significant heterogeneity), a narrative synthesis will be conducted to summarize the findings in a descriptive manner.

### Subgroup analysis

#### 1. Athletic level

Three subgroups of subjects atmosphere developing, national, and international tennis players based on their sport level. This is because athletes of different sport levels may produce different levels of adaptation after HIIT.

Method of analysis: A meta-analysis will be conducted separately for each sport level and the pooled effects will be compared.

#### 2. Type of HIIT

HIIT programs will be grouped according to their design, e.g., SIT and HIIT; and intervention duration, e.g.,  $\leq 6$  weeks vs.  $> 6$  weeks. Different HIIT programs may produce different physiological adaptations in athletes.

Methods of Analysis: Studies within each subgroup will be analyzed individually and pooled results will be compared across subgroups.

#### Program Analysis Methods:

Subgroup analyses will be conducted using random effects models to account for variability between studies. Statistical heterogeneity between subgroups will be assessed using the  $I^2$  statistic.

**Sensitivity analysis** Sensitivity analysis will be conducted to assess the robustness and reliability of the findings in this systematic review and meta-analysis.

#### 1. Study Quality:

Sensitivity analysis will involve excluding studies at high risk of bias, as assessed using the ROB 2 tool. This will help determine whether the overall results are influenced by lower-quality studies.

#### 2. Effect of Outliers:

Studies with extreme effect sizes or results that significantly contribute to statistical heterogeneity (e.g., identified through forest plots or high  $I^2$  values) will be systematically excluded. The impact of removing these studies on the pooled estimates will be assessed.

#### 3. Study Design:

Sensitivity analysis will compare results when including only randomized controlled trials (RCTs) versus including both RCTs and controlled clinical trials (CCTs).

#### 4. Outcome Measures:

Sensitivity analysis will also evaluate the impact of including studies with incomplete or imputed data for key outcomes

The results of the sensitivity analysis will be reported and discussed to ensure the conclusions are robust and not unduly influenced by specific studies, methodological choices, or assumptions.

**Language restriction** English.

**Country(ies) involved** China (South China Normal University).

**Keywords** HIIT; sprint interval training; physical fitness; Endurance Training; Tennis Players.

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