International Journal of Business, Management & Economics
e-ISSN: 2746-1351
Vol. 7, No. 4, November 2026

Evidence-Informed Management of Futsal Conditioning Programs: A Systematic Review of High-Intensity Interval Training and Player Performance

Rangga Ahmad Suryanegara[1], Aan Komariah[2] Nugraha Suharto[3]

[123]Universitas Pendidikan Indonesia, Indonesia
Correspondence Author: suryanegara17@upi.edu

Article Information:
Received: October 23, 2026; Accepted: November 22, 2026; Published: November 23, 2026

Abstract

Background: Futsal clubs, academies and school programmes must decide which conditioning programmes merit scarce training time, yet futsal-specific evidence on high-intensity interval training (HIIT) has not been systematically synthesised. Objective: To synthesize evidence on the effectiveness of HIIT on aerobic capacity and repeated sprint ability (RSA) in futsal players and to derive implications for the evidence-informed management of conditioning programs. Methods: This systematic review followed PRISMA 2020. We identified records from a Scopus AI report (n = 71; 19 October 2026) and supplementary searches of journal websites and repositories (n = 16; 20 October 2026), including national journals whose Scopus indexing was not verified. Experimental, quasi-experimental or pre–post studies of HIIT lasting at least 4 weeks in futsal players, reporting aerobic capacity and/or RSA outcomes, were included. The synthesis was narrative and was complemented by a robustness check restricted to studies with a comparator. Results: Eleven studies (237 participants; 2012–2026; six from the Scopus AI list and five from web searching) met the criteria. All reported improved aerobic outcomes in the HIIT groups; relative VO_2max change ranged from 1.8% to 11.3% in six studies. Of five studies with a comparator receiving regular training or no HIIT, two favored HIIT, two (in competitive players) found no between-group difference, and one reported within-group results only. RSA was assessed in five studies; improvements were observed, but none exceeded regular futsal training. Methodological quality was low to moderate (3 RCTs, 5 non-randomized comparative studies, 3 single-group studies). Conclusion: HIIT appears to improve aerobic capacity in futsal players, but its advantage over regular training depends on players' training status. Managers should match program choice to player level, build comparison data into each conditioning block, and treat RSA benefits as unproven.

Keywords: HIIT, Futsal, Aerobic Capacity, Repeated Sprint Ability, Systematic Review

JEL Codes: Z20, L83, M53

1. Introduction

Futsal is a high-intensity intermittent sport played on a small pitch involving frequent acceleration, deceleration and changes of direction (Naser et al., 2017; Spyrou et al., 2020).

Published by:

Arins et al. (2015) summarised that decisive moments in a match are preceded by sprints of 10–30 m (2–4 seconds) and that professional players spend approximately 5–12 per cent of match time running at speeds exceeding 15 km/h. These demands make aerobic capacity—which supports recovery between actions—and RSA, namely the ability to repeat sprints with brief recovery periods, crucial fitness components for futsal players.

Conditioning is also a management problem. In futsal clubs, academies and school programs, coaches and sport managers allocate limited training time, staff, testing equipment and squad rotation to conditioning. Choosing between HIIT formats (running-based, skill-based or game-based), or between adding HIIT and relying on regular futsal training, is therefore a resource-allocation decision whose quality depends on the strength of the evidence behind it. In this article, 'evidence-informed management' means decisions about program selection, dosage, monitoring and expected return that are explicitly tied to the best available evidence and to its limits.

High-intensity interval training (HIIT) is a series of high-intensity exercise repetitions interspersed with recovery periods; outcomes depend on the intensity, interval duration, recovery duration and type, number of repetitions, and training modality (Buchheit & Laursen, 2013). In a trained population, 4 × 4-minute aerobic intervals at 90–95 per cent of maximum heart rate have been shown to increase VO_2max to a greater extent than moderate-intensity exercise (Helgerud et al., 2007), whilst repeated sprint training in footballers resulted in an increase in RSA not observed with aerobic intervals (Ferrari Bravo et al., 2008). These findings originate from football or the general population. Futsal differs in terms of pitch size, frequency of changes of direction and player rotations; therefore, direct extrapolation needs to be tested.

Evidence on HIIT in futsal is scattered across small-scale trials, many of which have been published in local Indonesian-language journals, and has not yet been mapped using explicit selection criteria. An initial map generated by Scopus AI contained 71 references, but only a small proportion involved futsal players; the remainder came from football, handball, tennis and the general population.

Previous syntheses have addressed neighbouring populations. A systematic review of HIIT in female team sports included 13 studies (230 participants) and reported that HIIT improved VO_2max in five studies and RSA in three; its authors noted that earlier HIIT reviews in team sports had concentrated on male soccer players or young athletes (Stankovic et al., 2023). A meta-analysis comparing small-sided games (SSG) with running-based HIIT on soccer players' RSA pooled only four studies and found no significant difference between the two approaches and no significant within-group RSA effect (Clemente et al., 2021). In futsal itself, the principal review of aerobic training is narrative (Arins et al., 2015), and no systematic review restricted to futsal players was identified in the searches reported here. A systematic review restricted to futsal players is therefore required so that training recommendations are not based on extrapolation from other sports.

This review addresses four questions: (1) does HIIT improve the aerobic capacity of futsal players; (2) does HIIT improve the RSA of futsal players; (3) how do protocol variables (intensity, duration, frequency, modality) relate to the magnitude of the reported responses; and (4) what do the findings imply for the evidence-informed management of futsal conditioning programmes.

Published by:

2. Research Method

2.1 Design and reporting

This systematic review was conducted and reported in accordance with PRISMA 2020 (Page et al., 2021). PRISMA-based systematic reviews have also been used in management research to consolidate dispersed evidence into a transparent basis for strategic decisions (Wijaya et al., 2024). The protocol was not registered with PROSPERO or any other repository. The synthesis was conducted narratively due to the wide variety of protocols, outcomes and measurement tools.

2.2 Information sources and search strategy

The search drew on two sources, summarised in the PRISMA flow diagram (Figure 1). Source 1 (database): a Scopus AI report generated on 19 October 2026 for the topic 'high-intensity interval training in futsal', framed around effectiveness for RSA and aerobic capacity. Scopus AI is a generative-AI layer over the Scopus database; the 71 references in its report were treated as the database records, and all 71 entered the screening log. Because the output of Scopus AI is not a conventional Boolean search that can be re-run identically, the date, topic and complete reference list are reported here. Source 2 (other methods): supplementary searching of journal websites, institutional repositories, and open-access indexes on 20 October 2026, using nine queries. Core keywords: futsal AND (HIIT OR "high-intensity interval training" OR "interval training" OR "repeated sprint" OR "sprint interval") AND (VO_2max OR aerobic OR "repeated sprint ability" OR "Yo-Yo"), together with their Indonesian equivalents (high-intensity interval training, futsal players, endurance). Only records that mentioned futsal and a form of training entered the screening log; this yielded 16 records, of which seven duplicated Scopus AI records and nine were unique (Figure 1). Because the second source included national journals whose Scopus indexing was not checked, the review does not claim that all included studies were sourced from Scopus: six of the 11 included studies came from the Scopus AI list and five from supplementary searching (Table 5). Web of Science, PubMed and SPORTDiscus were not searched directly (see Limitations).

For replication, the following Scopus advanced-search string is proposed; it was not executed in this review: TITLE-ABS-KEY(futsal AND (hiit OR "high-intensity interval training" OR "interval training" OR "repeated sprint" OR "sprint interval") AND (vo2max OR aerobic OR "repeated sprint ability" OR "yo-yo")) AND PUBYEAR > 2009 AND PUBYEAR < 2027.

2.3 Eligibility criteria

We formulated the criteria using the PICOS framework (Table 1).
Table 1. Inclusion and exclusion criteria

Component	Inclusion	Exclusion
Population	Futsal players (all ages, genders and competition levels)	Players of other sports; mixed population without separate futsal data
Intervention	HIIT for at least 4 weeks: high-intensity intervals with recovery, including shuttle run HIIT, sprint intervals or repeated sprint training, skill-based HIIT, and HIIT with small-sided games (SSG)	Weight training or plyometric training without a HIIT component; single-session acute response; interventions focusing on aids (e.g. masks)
Comparators	Regular exercise, control group, other HIIT protocols, SSG, or pre–post without	—

Published by:

Component	Inclusion	Exclusion
	a comparator	
Outcomes	Aerobic capacity (VO_2max or VO_2peak, either direct or estimated; YYIR1, FIET or T-CAR; threshold speed) and/or RSA	Outcomes limited to agility, strength, power, or non-RSA anaerobic capacity
Design	Experimental, quasi-experimental, or pre–post; journal articles; 2010–2026; English or Indonesian	Correlational or observational; narrative review; single-case study

Source: Authors.

2.4 Data selection and extraction process

Screening was carried out in two stages (title and abstract, followed by eligibility) by a single reviewer with the aid of AI tools, without a second independent reviewer; this is noted as a limitation. Duplicates were removed based on title and DOI. Eligibility was assessed based on the abstract or full bibliographic record, and on the full text where accessible. Data extracted: sample characteristics, study design, HIIT protocol (intensity, duration, frequency, modality), measurement tools, and primary outcomes. Where the original authors did not report the percentage change, this was calculated from the pre- and post-measurement means as (post – pre) / pre × 100.

2.5 Quality assessment and synthesis

Methodological quality was assessed narratively based on randomization, the presence of a comparison group, sample size, and completeness of reporting. Formal risk of bias assessments (RoB 2, ROBINS-I, or PEDro) and evidence certainty assessments (GRADE) were not conducted due to limited access to full-text articles. We synthesized results narratively based on outcomes (aerobic capacity and RSA) and protocol variables; we did not conduct meta-analyses. Because the evidence base was small, a robustness check restricted the synthesis to studies with a comparator that received regular training or no HIIT and examined whether the conclusions changed (Section 3.1.6).

2.6 Variables and outcome indicators

The exposure was HIIT, defined as repeated high-intensity exercise bouts separated by recovery periods, delivered as running-based, skill-based, sprint-based or game-based formats. The outcomes were aerobic capacity and RSA. Because the included studies used different tests, Table 2 defines each variable and lists the indicators used to measure it; effect sizes are reported as the relative change (post – pre) / pre × 100 in the HIIT group.

Table 2. Variables and outcome indicators used in this review

Domain	**Variable**	**Definition**	**Indicators in the included studies**
Exposure	HIIT protocol	Intensity (% of peak speed or maximum heart rate), interval and recovery durations, sets, weekly frequency, programme length and modality	Extracted for each study (Table 3)

Published by:
Training & Research Institute JERAMBA ILMU SUKSES

Domain	Variable	Definition	Indicators in the included studies
Aerobic capacity	Maximal oxygen uptake	Highest rate of oxygen use during maximal exercise (mL/kg/min), measured directly or estimated from a test	20-m shuttle run (Karahan, 2012); Cooper 12-min run (Masjid et al., 2025); Multistage Fitness Test (Ridho & Putra, 2026); submaximal treadmill test (Putra & Ansori, 2025); YYIR1-based index (Nugroho & Kusuma, 2022); incremental treadmill test (Campos et al., 2021; Teixeira et al., 2019)
Aerobic capacity	Intermittent endurance	Performance in an intermittent shuttle test, expressed as distance or peak speed	YYIR1 (Soares-Caldeira et al., 2014); Futsal Intermittent Endurance Test and its peak speed, PSFIET (Campos et al., 2021; Teixeira et al., 2019); Carminatti intermittent shuttle test (Nascimento et al., 2015); intermittent work performance (Gómez et al., 2023)
Aerobic capacity	Threshold speed	Running speed at the second lactate turnpoint	Teixeira et al. (2019)
RSA	RSA indices	Best, mean and worst sprint time, and percentage sprint decrement across a series of short sprints with brief recovery	RSA tests in Soares-Caldeira et al. (2014), Nascimento et al. (2015), Campos et al. (2021) and Teixeira et al. (2019)
Anaerobic (not RSA)	RAST fatigue index	Decline in power across the repeated sprints of the running anaerobic sprint test; indicates anaerobic capacity rather than futsal-specific RSA	Karahan (2012)

Source: Authors.

3. Findings and Discussions

3.1 Results

3.1.1 Study selection

The search identified 87 records (71 from the Scopus AI report and 16 from supplementary web searching). After removing seven duplicates, 80 records were screened. A total of 59 records were excluded at the title and abstract stage: 58 did not involve a futsal population (including one study of Thai professional footballers referenced by Scopus AI in the context of futsal) and one narrative review. We assessed 21 reports for eligibility; 10 were excluded for the reasons outlined in Table 4, leaving 11 studies included (Figure 1). Six of the included studies were identified from the Scopus AI list and five from supplementary web searching (Table 5). Only 13 of the 71 Scopus AI references (18.3 percent) involved futsal players, and 6 (8.5 percent) met all the criteria.

Published by:

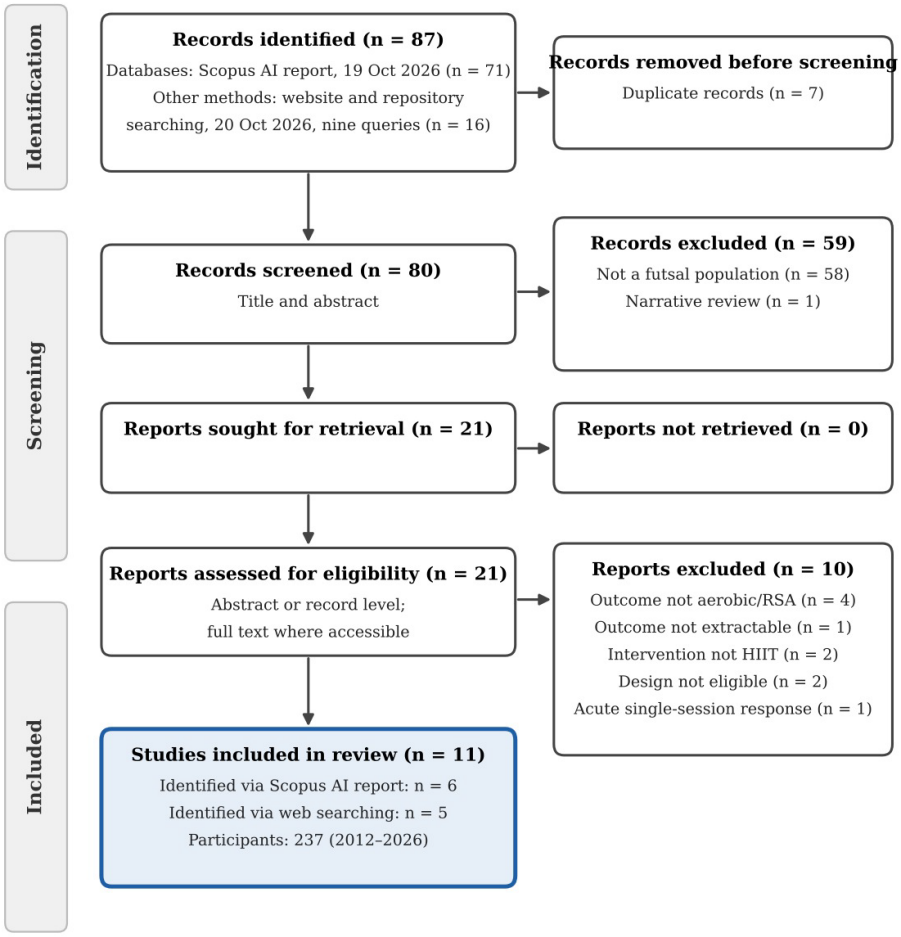

Figure 1. PRISMA 2020 flow diagram of study selection (database: Scopus AI report; other methods: supplementary web searching).

Source: Authors.

3.1.2 Study characteristics

Eleven studies were published between 2012 and 2026, involving a total of 237 participants (median 21; range 11–40). Five studies were conducted in Indonesia. Two studies involved female players (Karahan, 2012; Teixeira et al., 2019), three on male players (Campos et al., 2021; Masjid et al., 2025; Nugroho & Kusuma, 2022), one mixed-gender study (Putra & Ansori, 2025), and five did not specify gender in the sources accessed. Intervention duration: 4 weeks (5 studies), 5 weeks (1), 6 weeks (1), 8 weeks (2), 10 weeks (1), and one study did not specify the duration in the abstract. The reported frequency ranged from 1 to 4 sessions per week. Three studies used a randomized design, five had a control group without details of allocation or an active control, and three were single-group designs (Table 3). Table 5 shows how each included study was identified and what is known about its journal's indexing.

Published by:

Table 3. Characteristics and main outcomes of the included studies (in chronological order)

Study	Sample	Design	HIIT protocol	Duration	Outcomes and primary results
Karahan (2012)	Elite university-league players; HIIT n = 12, physically active control students n = 12	Quasi-experimental controlled	Skill-based maximal-intensity HIIT, 4 days/week	8 weeks	VO_2max (20-m shuttle run) +9.6%; anaerobic capacity average +10.7%; fatigue index RAST improved 22.1% ($p < 0.05$)
Soares-Caldeira et al. (2014)	Professional; n = 13 (additional n = 6; normal n = 7)	RCT	Additional weekly repeated sprint training on top of pre-season training	4 weeks	RSA, YYIR1, jumps, HRV: YYIR1, mean and worst RSA time and sprint decrement improved in both groups (best RSA time unchanged); slightly greater vagal HRV changes in the additional-training group
Nasciment o et al. (2015)	U17; n = 14 (intervention 8; control 6)	Quasi-experimental controlled, competition period	Additional repeated sprint programme, 2×/week	4 weeks	MST 40 m, Carminatti intermittent shuttle test, jump: VHRDP (velocity at the heart-rate deflection point) increased and sprint decrement decreased in both groups; no significant differences between the groups
Teixeira et al. (2019)	Elite female players, Brazilian National Division League; n = 16 (7 vs 9)	Two parallel groups	HIIT shuttle runs 4 sets × 4 minutes, 3-minute rest between sets; 7.5/7.5 seconds (1 change of direction) vs 15/15 seconds (3 changes of direction)	5 weeks	PSFIET and speed at the second lactate turnpoint increased in both protocols; SRIT15×15 gave possibly greater gains in peak treadmill speed (+3.28%) and mean RSA time (+1.17%; 90% CL −0.68 to 3.05) and likely greater gains in running economy (+4.33%)

Published by:

Study	Sample	Design	HIIT protocol	Duration	Outcomes and primary results
Campos et al. (2021)	Young men; n = 11 (18.5 ± 1.1 years)	Pre–post, two HIIT models	Shuttle run HIIT at 86% (total work 16 minutes) vs 100% (8 minutes) of peak speed (FIET)	10 weeks	VO_2peak, RSA, HRV, neuromuscular: HIIT86 was more beneficial; the HIIT model explained changes in VO_2peak (R^2 = 0.72); training load and the model explained changes in mean RSA (R^2 = 0.71) and best RSA (R^2 = 0.87)
Nugroho & Kusuma (2022)	Male, ±22 years; n = 26 (13 vs 13)	Two pre–post groups	Futsal-based HIIT vs SSG, 3× per week	4 weeks	Aerobic endurance index based on YYIR1: HIIT 46.29 → 47.10; SSG 46.60 → 47.28 mL/kg/min; no between-group difference
Gómez et al. (2023)	Federation players >18 years; n = 21 (HIIT + Nordic curl 11; HIIT 10)	RCT	25-minute HIIT circuit (8 exercises) ± Nordic curl, 1 session per week	4 weeks	Intermittent exercise performance improved in the HIIT + NC group (p = 0.04) and the HIIT group (p = 0.01)
Fachrezi et al. (2024)	High school futsal players; n = 15	One pre–post group	HIIT (details not available)	6 weeks	VO_2max 48.19 → 49.20 mL/kg/min (+1.01; ±2.1%)
Masjid et al. (2025)	Amateur male, 17.0 ± 1.1 years; n = 32	Controlled experiment	HIIT combined with a game-based approach	Not mentioned in the abstract	12-minute Cooper test: VO_2max +10.44% (HIIT) vs +1.44% (control); distance +8.12% vs +1.11%
Putra & Ansori (2025)	Extracurricular students aged 15–20, boys and girls; n = 40	RCT	HIIT (detailed protocol not accessed)	4 weeks	Estimated VO_2max from submaximal treadmill test: 45.2 → 50.3 mL/kg/min (+11.3%); no significant change in the control group
Ridho & Putra (2026)	Futsal academy athletes; n = 25	One pre–post group	HIIT 2× per week (16 sessions)	8 weeks	Multistage Fitness Test: VO_2max 40.81 ± 5.64 → 44.38 ± 5.74 mL/kg/min (+3.57; 8.7%; r = 0.77); N-Gain 5.9% (ineffective category)

Source: Authors.

Table 4. Reports excluded at the eligibility assessment stage (n = 10)

Study	Reason
Bumrung et al. (2025)	Outcomes limited to agility (CODS and reactive agility)

Published by:

Study	Reason
Teixeira et al. (2018)	Outcomes: lactate, strength, power and 40 m shuttle sprint; no aerobic or RSA outcomes
Fahrudin et al. (2024)	Anaerobic endurance outcomes
Wiranata et al. (2023)	Agility and dribbling performance
Sumpena et al. (2021)	Both groups performed HIIT (with vs without an elevation training mask); no HIIT versus non-HIIT contrast and no extractable aerobic or RSA outcome in the record accessed
Torres-Torrelo et al. (2018)	Weight training and combined exercise interventions, not HIIT
Paz-Franco et al. (2017)	Resistance training frequency interventions
Nunes et al. (2016)	Correlational design
Miloski et al. (2014)	Observational design (internal training load)
Mulazimoglu et al. (2021)	Acute response to a single Tabata session

Source: Authors.

Table 5. Identification route of the included studies and indexing information

Study	**Identified via**	**Journal**	**Indexing information**
Karahan (2012)	Scopus AI list	Biology of Sport	Listed in the Scopus AI reference list
Soares-Caldeira et al. (2014)	Scopus AI list	Journal of Strength and Conditioning Research	Listed in the Scopus AI reference list
Nascimento et al. (2015)	Web searching	Revista Brasileira de Cineantropometria & Desempenho Humano	Not in the Scopus AI list; indexing not verified
Teixeira et al. (2019)	Scopus AI list	Journal of Strength and Conditioning Research	Listed in the Scopus AI reference list
Campos et al. (2021)	Scopus AI list	Frontiers in Psychology	Listed in the Scopus AI reference list
Nugroho & Kusuma (2022)	Web searching	Jurnal Prestasi Olahraga	Not in the Scopus AI list; indexing not verified
Gómez et al. (2023)	Scopus AI list	Medicine	Listed in the Scopus AI reference list
Fachrezi et al. (2024)	Web searching	Jurnal Porkes	Not in the Scopus AI list; indexing not verified
Masjid et al. (2025)	Scopus AI list	Physical Education Theory and Methodology	Listed in the Scopus AI reference list
Putra & Ansori (2025)	Web searching	Journal of Exercise Physiology and Health Sciences	Not in the Scopus AI list; indexing not verified
Ridho & Putra (2026)	Web searching	Active: Journal of Physical Education, Sport, Health and Recreation	Not in the Scopus AI list; indexing not verified

Source: Authors.

3.1.3 Aerobic capacity

All 11 studies reported improvements in aerobic outcomes in the groups undergoing HIIT or repeated sprint training. Six studies provided VO_2max values or percentage changes: Putra and Ansori (2025) +11.3 per cent, Masjid et al. (2025) +10.4 per cent, Karahan (2012) +9.6%, Ridho and Putra (2026) +8.7%, Fachrezi et al. (2024) +2.1%, and Nugroho and Kusuma (2022) +1.8% (Figure 2). Two studies with non-HIIT control groups and detailed data demonstrate the superiority of HIIT: the HIIT group improved by approximately 10–11 per cent, whilst the

Published by:
Training & Research Institute JERAMBA ILMU SUKSES

control group improved by 1.4 per cent (Masjid et al., 2025) or showed no significant change (Putra & Ansori, 2025). Conversely, in competitive players who continued with regular futsal training, the addition of repeated sprint training did not result in any between-group differences over four weeks (Nascimento et al., 2015; Soares-Caldeira et al., 2014). In a comparison of protocols, HIIT and SSG produced similar improvements (Nugroho & Kusuma, 2022), and shuttle run HIIT at 86 per cent of peak FIET speed proved more beneficial than 100 per cent over 10 weeks (Campos et al., 2021). Under low-frequency conditions, one HIIT session per week for four weeks improved intermittent work performance (Gómez et al., 2023).

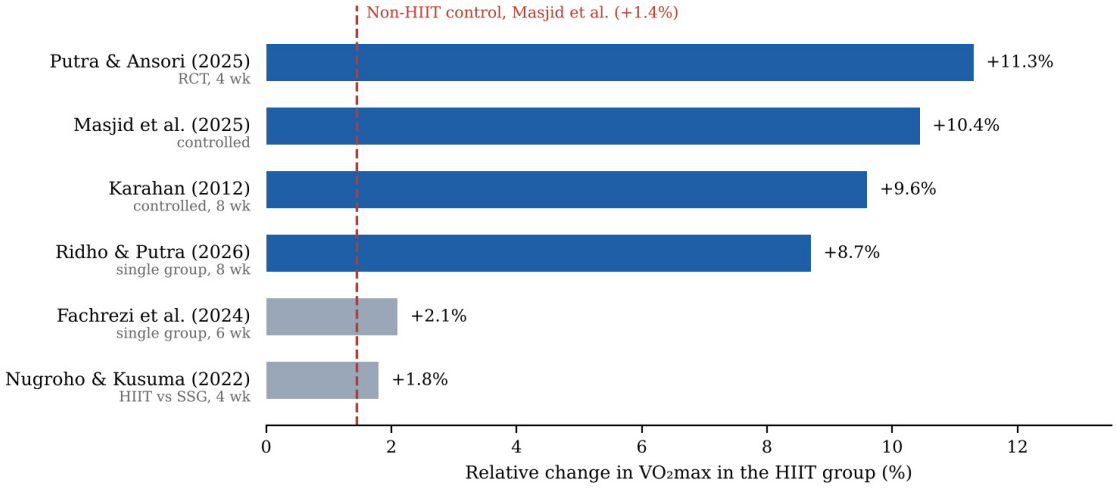

Figure 2. Relative changes in VO_2max in the HIIT group compared with the non-HIIT control group.

Source: Extracted from the included studies (Table 3). Six studies with pre–post values.

3.1.4 Repetitive sprint capacity

Five studies assessed RSA or repeated sprint capacity. Campos et al. (2021) reported that HIIT86 was more beneficial than HIIT100 for both average and peak RSA. Soares-Caldeira et al. (2014) and Nascimento et al. (2015) found improvements in both groups (in Soares-Caldeira et al., best RSA time did not change, whereas mean and worst RSA time and sprint decrement improved), suggesting that additional repeated sprint training does not exceed the benefits of regular training; in Nascimento et al. (2015), sprint decrement decreased in both groups. Karahan (2012) reported a 22.1% improvement in the RAST fatigue index, although the RAST assesses anaerobic capacity rather than futsal RSA. Teixeira et al. (2019) reported that the protocol with three changes of direction (SRIT15×15) produced possibly greater improvement in mean RSA time than the protocol with one (SRIT7.5×7.5; +1.17%, 90% CL −0.68 to 3.05), a difference whose confidence limits include zero; within-group RSA changes were not available in the abstract accessed. Consequently, no studies have demonstrated the superiority of HIIT over regular futsal training for RSA.

3.1.5 Methodological quality

Three randomised controlled trials (Soares-Caldeira et al., 2014; Gómez et al., 2023; Putra & Ansori, 2025), five with controls where the allocation was not specified in the sources accessed or with active controls (Karahan, 2012; Nascimento et al., 2015; Teixeira et al., 2019; Nugroho & Kusuma, 2022; Masjid et al., 2025), and three single-group studies (Campos et al., 2021; Fachrezi et al., 2024; Ridho & Putra, 2026). Eight of the eleven studies had samples of fewer

Published by:

than 30 participants; the majority of aerobic outcomes were estimated from field tests (Cooper, MFT, YYIR1, submaximal treadmill), and only two studies included a non-HIIT control group with detailed data. The certainty of the evidence was rated as low to moderate.

3.1.6 Robustness check

Five studies compared HIIT or repeated sprint training with regular training or no HIIT (Karahan, 2012; Soares-Caldeira et al., 2014; Nascimento et al., 2015; Masjid et al., 2025; Putra & Ansori, 2025). Two reported larger aerobic gains with HIIT (Masjid et al., 2025; Putra & Ansori, 2025), two found no between-group difference in competitive players (Soares-Caldeira et al., 2014; Nascimento et al., 2015), and one reported significant improvements in the training group without between-group results in the abstract (Karahan, 2012). Restricting the synthesis to the three randomised trials leaves one trial favouring HIIT (Putra & Ansori, 2025), one showing no difference from regular training (Soares-Caldeira et al., 2014) and one in which both HIIT variants improved intermittent performance (Gómez et al., 2023). The range of relative VO_2max change (1.8%–11.3%) was unchanged when the two single-group studies reporting VO_2max were removed (Fachrezi et al., 2024; Ridho & Putra, 2026). Within-group improvements in aerobic outcomes were therefore directionally robust across all subsets, whereas superiority over regular training was heterogeneous in every subset and appeared to depend on players' training status.

3.2 Discussion

This review found that the evidence specific to HIIT in futsal players is limited: 11 studies, 237 participants, and most with weak study designs. All studies reported improvements in aerobic outcomes in the HIIT groups, but the magnitude and superiority over regular training varied across studies. The evidence for RSA is even more limited and does not demonstrate any advantage of HIIT.

3.2.1 Aerobic capacity: a measure dependent on training volume and measurement method

The relative increase in VO_2max in the HIIT group ranged from 1.8 per cent to 11.3 per cent. This wide range does not simply correlate with training dose: a four-week study may yield +11.3 per cent (Putra & Ansori, 2025) or +1.8 per cent (Nugroho & Kusuma, 2022), whilst an eight-week study yielded 8.7%–9.6% (Karahan, 2012; Ridho & Putra, 2026). Differences in measurement methods may also play a role, as all studies measuring VO_2max used field test estimates or submaximal treadmill tests, which have greater measurement errors than direct gas analysis. The effects also appear to be greater in amateur players, students and academy athletes than in competitive players who already undergo regular futsal training. In the latter group, additional repeated sprint training did not exceed regular training over a four-week period (Nascimento et al., 2015; Soares-Caldeira et al., 2014). A plausible explanation is the scope for adaptation which was more limited to trained athletes and a small sample size (n = 13–14), meaning that the absence of a difference cannot be interpreted as the absence of an effect. This pattern is consistent with the general principle that the response to aerobic intervals depends on initial fitness status (Helgerud et al., 2007; Buchheit & Laursen, 2013), although these references do not originate from futsal. In female team sports, Stankovic et al. (2023) reported VO_2max improvements in five of 13 included studies and RSA improvements in three, with effect sizes of 0.19–1.08 and 0.32–0.64, respectively; the gains observed here are of a comparable order, although relative percentages and standardised effect sizes cannot be compared directly.

Published by:

3.2.2 Initiation, recovery and movement specificity

Campos et al. (2021) reported that shuttle run HIIT at 86 percent of the FIET peak speed was more beneficial than 100 percent for aerobic, RSA and neuromuscular parameters over a 10-week period. Interpretation requires caution: the total work for the 86 percent protocol was 16 minutes, twice that of the 100 percent protocol (8 minutes); consequently, the effect of intensity cannot be separated from the volume of work, and the design was a pre–post study without a control group involving 11 players. Teixeira et al. (2019) demonstrated that a protocol involving three changes of direction per repetition (15/15 seconds) was superior to one change of direction (7.5/7.5 seconds) in elite female players, with the same total work volume (4 sets × 4 minutes). These findings support the notion that movement specificity—namely, repeated acceleration and deceleration—is relevant in designing futsal HIIT, but they stem from a single study involving 16 participants. Both studies originated from the same research group, thus limiting the independence of the evidence.

3.2.3 Repetitive sprinting ability

The included studies do not strongly support the claim that HIIT improves futsal RSA. Of the two studies comparing protocols, one reported a benefit of the 86% protocol but lacked a control group (Campos et al., 2021) and the other found only a possible, statistically inconclusive advantage of the protocol with more changes of direction (Teixeira et al., 2019), whilst two studies using regular exercise as a comparison found equivalent improvements. These results are similar to a meta-analysis of football players, which found no significant effect on RSA from either running-based HIIT or SSG combined (Clemente et al., 2021). In football, only the group receiving specific repeated sprint stimuli improved their average RSA time, whereas the group undergoing 4 × 4-minute aerobic intervals did not (Ferrari Bravo et al., 2008). If this pattern holds true in futsal, specific repeated sprint stimuli may be more relevant for RSA than aerobic intervals, but this hypothesis has not yet been tested in futsal. The female team-sport review similarly found RSA improvements in only three of its 13 studies (Stankovic et al., 2023).

3.2.4 Game-based HIIT

HIIT combined with a game-based approach increased VO_2max by 10.44% in amateur players, compared with 1.44% in the control group (Masjid et al., 2025). HIIT based on futsal techniques and SSG produced similar improvements with no differences between groups (Nugroho & Kusuma, 2022). The similarity of SSG and HIIT is consistent with the football meta-analysis that found no significant difference between SSG-based and HIIT-based interventions on RSA (Clemente et al., 2021), although that analysis concerned RSA rather than aerobic outcomes and pooled only four studies. If the physiological effects are equivalent, practical considerations such as technical-tactical demands and player involvement may form the basis for selection.

3.2.5 Practical and managerial implications

Current evidence supports the use of tried-and-tested protocols, rather than a single approach. The protocols reported include 4 sets × 4 minutes of shuttle run intervals with a 3-minute rest between sets over five weeks (Teixeira et al., 2019), shuttle run HIIT at 86 per cent of peak FIET speed over 10 weeks (Campos et al., 2021), and game- or skill-based HIIT for 4–8 weeks at a frequency of 1–4 sessions per week (Karahan, 2012; Masjid et al., 2025; Gómez et al., 2023). In amateur players and schoolchildren, HIIT appears to be beneficial for aerobic

Published by:

capacity. In competitive players, coaches should not expect significant additional benefits from a single short block of HIIT on top of regular futsal training, and should monitor training load.

From a management perspective, the evidence supports three decisions. First, programme selection should be segmented by player level: in amateur, school and academy players the reviewed studies consistently show aerobic gains from HIIT, whereas in competitive players who already train regularly the added value of a short HIIT or repeated-sprint block over regular futsal training was not demonstrated (Nascimento et al., 2015; Soares-Caldeira et al., 2014). Second, program evaluation should be built into delivery: the weakest studies lacked controls, relied on field-test estimates of VO_2max and had small samples, so clubs and academies can improve the decision value of their own data by testing before and after each block with the same protocol, including a comparison group where feasible, and by recording absolute and relative change. Third, the opportunity cost of training time matters: game-based formats produced aerobic gains similar to HIIT (Nugroho & Kusuma, 2022), a HIIT–game-based combination improved aerobic outcomes relative to a control group (Masjid et al., 2025), and a single weekly HIIT session improved intermittent performance in one randomised trial (Gómez et al., 2023), so managers with limited training time have tested options that do not require separate conditioning sessions. These points are decision aids, not prescriptions: they rest on small studies, mostly estimated VO_2max and short follow-up, and should be revisited as stronger evidence appears.

3.2.6 Comparison with Scopus AI-based synthesis

The Scopus AI summary, which served as the starting point for this review, reported a 6–14.5 percent increase in VO_2max and a 7–10 percent reduction in sprint time in futsal. These figures cannot be replicated from futsal-specific studies: the observed range is 1.8–11.3 percent, and no futsal study has demonstrated the superiority of RSA over regular training. The discrepancy reflects including evidence from non-futsal sports namely football, handball, tennis, and the general population in a single synthesis. Only 13 of the 71 references (18.3 percent) involved futsal players, and 6 (8.5 percent) met all the criteria. One study of professional Thai footballers was cited as evidence for futsal. Methodological lesson: AI-generated summaries need to be re-screened against the population and outcomes before being used as the basis for recommendations.

3.2.7 Limitations

The review rests on 11 studies published between 2012 and 2026. This small number mainly reflects the narrowness of the question: restricting the evidence to futsal players removed 58 of the 71 Scopus AI records. Syntheses in neighboring areas are also small (Stankovic et al., 2023, included 13 studies with 230 participants; Clemente et al., 2021, pooled four studies), and a small evidence base limits the precision of conclusions rather than their validity, provided the methods are transparent. For that reason, every screening decision is reported (Figure 1, Table 4), no pooled estimate is offered, the robustness check in Section 3.1.6 examines whether conclusions depend on study design, and the certainty of the evidence is rated low to moderate. The conclusions should nevertheless be read as provisional.

Firstly, the search was based on Scopus AI and targeted web searches, rather than structured searches across multiple databases; relevant futsal studies may have been overlooked (for example, SSG-based futsal training studies such as Amani-Shalamzari et al., 2019, were not captured by this strategy), and some reports in Indonesian that appeared could not be verified and were therefore excluded from the analysis. Secondly, screening was carried out by a single

Published by:

reviewer with the aid of AI, without a second reviewer. Thirdly, eligibility was assessed based on abstracts or bibliographic records for the majority of studies, rather than full-text articles. Fourthly, the risk of formal bias and the certainty of the evidence were not assessed. Fifthly, the protocols were not registered. Sixth, heterogeneity in protocols and measurement tools precludes meta-analysis. Seventh, small sample sizes and estimates of VO_2max from field tests limit confidence in effect sizes. Eighth, five of the 11 included studies came from supplementary web searching rather than the Scopus AI list, and the Scopus indexing of their journals was not verified (Table 5); a later, non-systematic check also suggested that further Indonesian-language reports of HIIT in futsal players exist that this search did not capture, so the evidence base summarised here should be regarded as incomplete.

3.2.8 Research agenda

Future studies should (1) utilize randomized controlled trials with a regular futsal training control group and a sample size calculated a priori, (2) measure VO_2max directly or YYIR1 alongside futsal-specific RSA with changes of direction, (3) distinguish the effects of intensity from those of training volume, (4) involve female, adolescent and elite players, and (5) follow players for more than 10 weeks. Updating this review with a multi-database search (Scopus, Web of Science, PubMed, SPORTDiscus, Garuda) and an independent risk-of-bias assessment will strengthen its conclusions.

4. Conclusion

The futsal-specific evidence supports a narrower claim than the general HIIT literature might suggest. HIIT is associated with aerobic improvement in futsal players, but its advantage over regular futsal training is evident mainly in amateur and school-level players and was not demonstrated for competitive players over four weeks, while any benefit for repeated sprint ability remains unproven. For managers, the practical consequence is to match program choice to player level, to prefer formats that integrate technical-tactical work when physiological effects are equivalent, and to build comparison data into every conditioning block. For researchers, the priorities are randomized trials with regular-training controls, direct or validated aerobic measures, futsal-specific RSA tests with changes of direction, and replication of this review through multi-database searching with independent screening and formal risk-of-bias assessment.

Disclimer

Use of AI. The initial reference list was compiled using Scopus AI, while additional searches, initial filtering, and manuscript drafting were assisted by Claude (Anthropic). The author is responsible for the accuracy of all data, references, and conclusions, and must verify each entry against its original source prior to submission.

References

Amani-Shalamzari, S., Khoshghadam, E., Doniaee, A., Parnow, A., Bayati, M., & Clemente, F. M. (2019). Generic vs. small-sided game training in futsal: Effects on aerobic capacity, anaerobic power and agility. *Physiology & Behavior, 204*, 347–354. https://doi.org/10.1016/j.physbeh.2019.03.017

Arins, F. B., Salvador, P. C. N., Carminatti, L. J., & Guglielmo, L. G. A. (2015). Physiological characteristics, evaluation and prescription of aerobic training in futsal. *Revista*

Published by:

Brasileira de Cineantropometria & Desempenho Humano, 17(6). https://doi.org/10.5007/1980-0037.2015v17n6p753

Buchheit, M., & Laursen, P. B. (2013). High-intensity interval training, solutions to the programming puzzle: Part I: Cardiopulmonary emphasis. *Sports Medicine, 43*(5), 313–338. https://doi.org/10.1007/s40279-013-0029-x

Bumrung, N., Jansupom, C., Rohmansyah, N. A., Khaothin, T., & Hiruntrakul, A. (2025). Acute effects of combined high intensity interval training and step aerobics training on agility in male futsal athletes during the pre-season. *Middle East Journal of Rehabilitation and Health Studies, 12*(3), e158636. https://doi.org/10.5812/mejrh-158636

Campos, F. S., Borszcz, F. K., Flores, L. J. F., Barazetti, L. K., Teixeira, A. S., Hartmann Nunes, R. F., & Guglielmo, L. G. A. (2021). HIIT models in addition to training load and heart rate variability are related with physiological and performance adaptations after 10-weeks of training in young futsal players. *Frontiers in Psychology, 12*, Article 636153. https://doi.org/10.3389/fpsyg.2021.636153

Clemente, F. M., Ramirez-Campillo, R., Afonso, J., Sarmento, H., Rosemann, T., & Knechtle, B. (2021). A meta-analytical comparison of the effects of small-sided games vs. running-based high-intensity interval training on soccer players' repeated-sprint ability. *International Journal of Environmental Research and Public Health, 18*(5), Article 2781. https://doi.org/10.3390/ijerph18052781

Fachrezi, M. F., Irawan, R. J., Widodo, A., & Kafrawi, F. R. (2024). Pengaruh metode latihan high intensity interval training terhadap tingkat kapasitas kerja maksimal (VO2Max) pemain futsal [The effect of the high-intensity interval training method on the level of maximal work capacity (VO2max) of futsal players]. *Jurnal Porkes, 7*(2), 1148–1159. https://doi.org/10.29408/porkes.v7i2.26360

Fahrudin, M. F., Siantoro, G., Kusuma, I. D. M. A. W., Syafii, I., Prianto, D. A., Pramono, B. A., & Fajar, M. K. (2024). Enhancing anaerobic endurance in student futsal players through small-sided games combined with high-intensity interval training. *Physical Education Theory and Methodology, 24*(2), 232–236. https://doi.org/10.17309/tmfv.2024.2.06

Ferrari Bravo, D., Impellizzeri, F. M., Rampinini, E., Castagna, C., Bishop, D., & Wisloff, U. (2008). Sprint vs. interval training in football. *International Journal of Sports Medicine, 29*(8), 668–674. https://doi.org/10.1055/s-2007-989371

Gómez, E. M., Atef, H., Elsayed, S. H., Zakaria, H. M., Navarro, M. P., & Sulé, E. M. (2023). Effects of high-intensity interval training with an eccentric hamstring exercise program in futsal players: A randomized controlled trial. *Medicine, 102*(31), Article e34626. https://doi.org/10.1097/MD.0000000000034626

Helgerud, J., Høydal, K., Wang, E., Karlsen, T., Berg, P., Bjerkaas, M., Simonsen, T., Helgesen, C., Hjorth, N., Bach, R., & Hoff, J. (2007). Aerobic high-intensity intervals improve VO2max more than moderate training. *Medicine & Science in Sports & Exercise, 39*(4), 665–671. https://doi.org/10.1249/mss.0b013e3180304570

Published by:

Karahan, M. (2012). The effect of skill-based maximal intensity interval training on aerobic and anaerobic performance of female futsal players. *Biology of Sport, 29*(3), 223–227. https://doi.org/10.5604/20831862.1003447

Masjid, I., Kusuma, I. D. M. A. W., Suyoko, A., Bulqini, A., Nugraha, A. D., Pranoto, A., Bharlaman, M. B. F., & Nirwansyah, W. T. (2025). Combining high-intensity interval training and game-based approach to enhance aerobic endurance in amateur futsal athletes. *Physical Education Theory and Methodology, 25*(2), 271–276. https://doi.org/10.17309/tmfv.2025.2.07

Miloski, B., Moreira, A., Andrade, F. C., Freitas, V. H., Peçanha, T., Nogueira, R. A., & Bara-Filho, M. (2014). Do physical fitness measures influence internal training load responses in high-level futsal players? *The Journal of Sports Medicine and Physical Fitness, 54*, 588–594.

Mulazimoglu, O., Boyaci, A., Afyon, Y. A., & Celikbilek, S. (2021). Acute effect of tabata workout on heart rate and blood lactate accumulation of female futsal players. *Acta Medica Mediterranea, 37*(5). https://doi.org/10.19193/0393-6384_2021_5_380

Nascimento, P. C., De Lucas, R. D., Dal Pupo, J., Arins, F. B., Castagna, C., & Guglielmo, L. G. A. (2015). Effects of four weeks of repeated sprint training on physiological indices in futsal players. *Revista Brasileira de Cineantropometria & Desempenho Humano, 17*(1), 91–103. https://doi.org/10.5007/1980-0037.2015v17n1p91

Naser, N., Ali, A., & Macadam, P. (2017). Physical and physiological demands of futsal. *Journal of Exercise Science & Fitness, 15*(2), 76–80. https://doi.org/10.1016/j.jesf.2017.09.001

Nugroho, M. A., & Kusuma, D. A. (2022). Pengaruh latihan high intensity interval training & small sided games terhadap daya tahan aerobik pemain futsal [The effect of high intensity interval training and small-sided games on the aerobic endurance of futsal players]. *Jurnal Prestasi Olahraga, 5*(5), 81–88. https://ejournal.unesa.ac.id/index.php/jurnal-prestasi-olahraga/article/view/47629

Nunes, R. F. H., Buzzachera, C. F., Almeida, F. A. M., Da Silva, J. F., Flores, L. J. F., & Da Silva, S. G. (2016). Relationships between isokinetic muscle strength, measures of aerobic fitness, single sprint performance, and repeated-sprint ability in elite futsal players. *Gazzetta Medica Italiana Archivio per le Scienze Mediche, 175*(5), 205–213.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., . . . Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, Article n71. https://doi.org/10.1136/bmj.n71

Paz-Franco, A., Rey, E., & Barcala-Furelos, R. (2017). Effects of 3 different resistance training frequencies on jump, sprint, and repeated sprint ability performances in professional futsal players. *Journal of Strength and Conditioning Research, 31*(12), 3343–3350. https://doi.org/10.1519/JSC.0000000000001766

Published by:
Training & Research Institute
JERAMBA ILMU SUKSES

Putra, N. A. S., & Ansori, S. (2025). Improving cardiorespiratory and muscular endurance in futsal extracurricular participants the impact of a four week interval training program. *Journal of Exercise Physiology and Health Sciences, 1*(2), 10–16. https://journal.unesa.ac.id/index.php/jephs/article/view/44728

Ridho, M. A., & Putra, R. B. A. (2026). Effect of high-intensity interval training (HIIT) on increasing VO_2max in Pemalang futsal athletes. *Active: Journal of Physical Education, Sport, Health and Recreation, 15*(2). https://doi.org/10.15294/active.v15i2.48805

Soares-Caldeira, L. F., de Souza, E. A., de Freitas, V. H., de Moraes, S. M. F., Leicht, A. S., & Nakamura, F. Y. (2014). Effects of additional repeated sprint training during preseason on performance, heart rate variability, and stress symptoms in futsal players: A randomized controlled trial. *Journal of Strength and Conditioning Research, 28*(10), 2815–2826. https://doi.org/10.1519/JSC.0000000000000461

Spyrou, K., Freitas, T. T., Marín-Cascales, E., & Alcaraz, P. E. (2020). Physical and physiological match-play demands and player characteristics in futsal: A systematic review. *Frontiers in Psychology, 11*, 569897. https://doi.org/10.3389/fpsyg.2020.569897

Stankovic, M., Djordjevic, D., Trajkovic, N., & Milanovic, Z. (2023). Effects of high-intensity interval training (HIIT) on physical performance in female team sports: A systematic review. *Sports Medicine - Open, 9*(1), Article 78. https://doi.org/10.1186/s40798-023-00623-2

Sumpena, A., Sidik, D. Z., & Syahid, A. M. (2021). The using of an elevation training mask: Does it improve the physiological abilities of futsal players? *Malaysian Journal of Medicine and Health Sciences, 17*(Suppl.), 129–134.

Teixeira, A. S., Arins, F. B., De Lucas, R. D., Carminatti, L. J., Dittrich, N., Nakamura, F. Y., & Guglielmo, L. G. A. (2019). Comparative effects of two interval shuttle-run training modes on physiological and performance adaptations in female professional futsal players. *Journal of Strength and Conditioning Research, 33*(5), 1416–1428. https://doi.org/10.1519/JSC.0000000000002186

Teixeira, A. S., Arins, F. B., De Lucas, R. D., Carminatti, L. J., Dittrich, N., Nakamura, F. Y., Loturco, I., & Guglielmo, L. G. A. (2018). Shuttle-run interval training with more directional changes induces superior gains in shuttle sprint performance in female professional futsal players. *Human Movement, 19*(5), 40–51. https://doi.org/10.5114/hm.2018.79623

Torres-Torrelo, J., Rodríguez-Rosell, D., Mora-Custodio, R., Pareja-Blanco, F., Yáñez-García, J. M., & González-Badillo, J. J. (2018). Effects of resistance training and combined training program on repeated sprint ability in futsal players. *International Journal of Sports Medicine, 39*(7), 517–526. https://doi.org/10.1055/a-0596-7497

Wijaya, F., Waspada, I., & Sari, M. (2024). A systematic literature review of investment strategies in perfect capital markets: Insights from the PRISMA framework. International Journal of Entrepreneurship and Sustainability Studies, 4(2), 47–65. https://journals.researchsynergypress.com/index.php/ijeass/article/view/2813

Published by:

Wiranata, F. A., Kusuma, I. D. M. A. W., Phanpheng, Y., Bulqini, A., & Prianto, D. A. (2023). The effect of 6 weeks of combination of three cone exercise using ball and high-intensity interval training on the agility and dribbling ability of student futsal athletes. *Physical Education Theory and Methodology, 23*(5), 686–691. https://doi.org/10.17309/tmfv.2023.5.05

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (http://creativecommons.org/licenses/by/4.0/)

Published by: