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Systematic review of sprint training on acceleration and maximum speed in soccer players

Vega Soniawan^{*)}, Ikhwanul Arifan

Coaching Department, Faculty of Sport Science, Universitas Negeri Padang, Padang, West Sumatra, Indonesia

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ABSTRACT

In soccer, acceleration and top sprint speed are the basis for game-changing moves. However, the rapid introduction of various training methods has fragmented the evidence, complicating decision-making for practitioners. This systematic review synthesized controlled training research to identify which sprint-related interventions improve acceleration and top sprint speed in soccer players, and which programme features lead to the greatest improvements. The study adhered to PRISMA 2020 guidelines. A Boolean search of Scopus (20 December 2025; 2021–2025) yielded 1,105 records. After removing 15 duplicates and screening, 18 controlled intervention studies met the eligibility criteria (association football sample, sprint-oriented training, and a recorded acceleration or maximum-speed outcome). Screening was conducted by a single reviewer, and no inter-rater reliability coefficient was computed, which is acknowledged as a limitation. The MMAT (2018) was used for quality appraisal. Due to substantial heterogeneity in interventions, comparators, and outcome definitions, a narrative thematic synthesis was performed instead of meta-analysis. The two main findings were: first, resisted sprint techniques consistently improved short-distance acceleration, particularly when external load was individualized for maximum horizontal power; however, effect sizes varied across studies and were not pooled. Second, volume-matched modalities often produced similar changes, suggesting that compliance and specificity may be more important than any single method. Biological maturation also moderated adaptations. This review integrates dose-response principles for speed development and highlights the need for maturity-stratified trials that directly report maximal-velocity outcomes.



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Corresponding Author:

Vega Soniawan,
Coaching Department, Faculty of Sport Science, Universitas Negeri Padang
Email: vegasoniawan@fik.unp.ac.id

Introduction

Ahead of time, systems controlled by human decision-makers are constantly challenged by external forces that are highly dynamic and often difficult to foresee or quantify. As a result, decision-makers are naturally inclined to heavily rely on feedback mechanisms when adapting to changes (or new information). A typical example of such a system is a football team live in a stadium during a match where players' behavior is determined by constantly evolving environmental conditions and decisions of other players. In fact, more detailed tactical and technical behaviors of players in context heavily depend on dynamic decision-making and environmental constraints changes are used as a key element to continuously adapt behavior (e.g., passing to a teammate only when he is moving towards space, which dynamically changes as defenders position/speed changes) (Araujo et

al., 2006). Nevertheless, a plethora of other functions of the game (e.g., balance of play, physical performance transformations) are heavily impacted by various external factors (coaches, strategies, facilities, personnel, etc.) greatly affecting the success of the team (Araujo et al., 2006).

Researchers studying these phenomena argue that two highly-related aspects-velocity production and deceleration of the player at the highest effort level-are the mechanical and neuromuscular foundation for any soccer sprint (Zhang et al., 2022; Bishop et al., 2021). Acceleration intensity, however, dictates much of the internal and external load, and even minor improvements in acceleration can significantly alter a player's ability to create and close space (Beato & Drust, 2021). Furthermore, the ability to orient force horizontally and the tolerance to repeated decelerations are mechanics that should help soccer coaches and sport scientists plan more effective training (Zhang et al., 2022; Bishop et al., 2021).

Studies have shown the biomechanical foundation of sprinting in men's soccer. Using sprint force-velocity profiling, players' individual mechanical characteristics have been described, seasonal changes have been tracked, and players have been differentiated by sex and competition level (Jimenez-Reyes et al., 2022; Devismes et al., 2021). A horizontal force production deficit has been suggested not only as a risk factor that can be changed but also as a performance limit (Edouard et al., 2021). In addition, youth maturation-related differences in force-velocity profile have been reported (Fernández-Galván et al., 2022). Both retrospective and methodological studies have extended the use of these tools to female players and to in-situ acceleration-speed profiling, thereby enhancing the ecological validity of assessment (Vescovi & Jovanović, 2021; Alonso-Callejo et al., 2024). This descriptive evidence helps understand...

Nowadays, improvements in methods and technology for training prescription and monitoring have changed the way we approach training. Global positioning and inertial systems not only quantify acceleration and high-speed running during training and competition but also enable load management that is sensitive to contextual factors such as match location, opponent, and outcome (Teixeira et al., 2021; Díez et al., 2021). Physical attributes-performance relationships have been charted for adult and women's cohorts (Gonçalves et al., 2021), and match loads have been associated with neuromuscular fatigue and intermittent-running capacity (Marqués-Jiménez et al., 2022). Such advances have pushed the focus away from generic conditioning to targeted speed development on an individual basis. At the same time, they have increased the number of potential training methods-resisted and assisted sprinting, plyometrics, heavy and complex resistance training, sprint-agility drills, and working on different surfaces-without a clear agreement on their effectiveness.

A first gap concerns the youth and developmental context. Adaptations to speed-oriented training appear to be moderated by biological maturation, yet maturity status is inconsistently reported and rarely used to stratify effects (Nobari et al., 2021; Carranza-García et al., 2024). Studies that have examined maturation directly report divergent responses across pre-, mid-, and post-peak-height-velocity groups for sprint and agility outcomes (Sellami et al., 2024; García-Ceberino et al., 2024), and training-load tolerance itself varies with maturity (Fernández-Jávega et al., 2025). Because a large share of applied speed research is conducted in academy settings, the failure to account for maturation limits the transferability of pooled conclusions.

A second gap is methodological and definitional. Interventions are frequently volume-matched only loosely, control conditions vary from ordinary soccer training to no-training, and outcomes conflate acceleration, maximal velocity, curvilinear sprinting, and change of direction. Repeated-sprint and multidirectional-speed constructs are often reported without isolating maximum-velocity capacity (Riboli et al., 2022; Selmi et al., 2024). This heterogeneity makes it difficult to determine whether observed gains reflect the training modality, the loading scheme, the total dose, or simply the specificity of the assessment-precisely the questions practitioners need answered.

These gaps justify a focused systematic review conducted now. The recent five-year window has produced a dense cluster of controlled trials using contemporary tools and loading strategies, creating both the opportunity and the necessity to consolidate evidence before divergent practice becomes entrenched. Following established guidance for systematic reviews (Tranfield et al., 2003) and the PRISMA 2020 reporting standard (Page et al., 2021), this review restricts inclusion to controlled training studies in association football that measure acceleration or maximum sprint speed, thereby isolating the trainability question from the broader descriptive literature. The review is guided by three research questions.

RQ1. What types of sprint-oriented training interventions have been implemented to improve acceleration and maximum sprint speed in soccer players?

RQ2. How effective are these interventions in improving acceleration and maximum sprint speed across different age groups, sexes, and competitive levels?

RQ3. Which training characteristics-modality, external load, duration, frequency, and volume-are associated with the greatest improvements in acceleration and maximum sprint speed?

By answering these questions, the review contributes an integrated, dose-sensitive account of speed development in soccer that distinguishes modality effects from loading and specificity effects, situates findings within the maturation literature, and offers a structured agenda for trials capable of resolving the outstanding uncertainties.

Method

A systematic literature review design was adopted because the research questions require an exhaustive, reproducible, and bias-minimised aggregation of primary intervention evidence rather than a narrative overview (Tranfield et al., 2003; Liberati et al., 2009). The review was designed, conducted, and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (Page et al., 2021), which structures the identification, screening, eligibility, and inclusion phases and standardises transparent reporting of study flow.

Before the search string was built, the research questions were broken down using the PICO framework to make sure that the key search concepts would be systematically identified. Population (P): association-football (soccer) players of any age, sex, or competitive level. Intervention/Interest (I): sprint-oriented training interventions, including resisted and assisted sprinting, plyometric, strength, complex, and speed-agility methods. Comparison (C): an alternative training modality, a control or usual-training condition, or a within-group pre-post comparison where no separate comparator was used. Outcome (O): acceleration and/or maximum sprint speed, operationalized as sprint split times, linear velocity, or force-velocity-derived maximal-velocity indices. Each component was turned into a set of synonyms and the sets were combined using Boolean operators.

Boolean search string.

(TITLE-ABS-KEY (soccer OR football*)) AND (TITLE-ABS-KEY (sprint* OR "resisted sprint*" OR plyometric* OR "speed training" OR "strength training" OR "complex training")) AND (TITLE-ABS-KEY (accelerat* OR "sprint speed" OR "maximal velocity" OR "running speed" OR "linear speed")) AND (TITLE-ABS-KEY (train* OR intervention OR program* OR protocol))

Truncation (the asterisk wildcard) was used in order to include morphological variants-for instance, football* will retrieve "football" and "footballer(s)," accelerat* will get "acceleration" and "accelerate," and train* will find "train," "training," and "trained." The TITLE-ABS-KEY field code narrowed matching to just titles, abstracts, and keywords, which is the standard Scopus scope for topical relevance while excluding incidental full-text mentions. Limiters were set for document type (article), language (English), and publication year (2021–2025); the five-year window was chosen to reflect current loading strategies and monitoring technology, and the article limitation to prioritize peer-reviewed primary studies. The string was piloted iteratively: an initial version without the fourth ("training") concept returned an unmanageable volume of descriptive match-demand records, so the training concept was added to raise precision toward intervention studies.

For the search, the only database we used was Scopus. We selected it based on its comprehensive multidisciplinary coverage of sport-science journals and its capability to export structured metadata. The actual date of running the search was 20 January 2026. No additional databases were searched; the choice to rely on a single comprehensive index is an acknowledged limitation.

Table 1. Inclusion and exclusion criteria

Criterion	Inclusion	Exclusion
Population	Association-football (soccer) players, any age, sex, or level	Non-soccer sports; mixed-sport samples without soccer-specific data
Intervention	A defined sprint-oriented training programme (resisted/assisted sprint, plyometric, strength, complex, or speed-agility)	No structured training intervention (observational, load-monitoring, or purely descriptive designs)
Outcome	A measured acceleration and/or maximum sprint-speed outcome (split times, linear velocity, maximal-velocity indices)	No acceleration or maximal-speed outcome reported

Criterion	Inclusion	Exclusion
Design	Controlled or comparative trial with pre–post assessment	Cross-sectional, correlational, or single-session designs without training
Language	English	Non-English
Document type	Peer-reviewed article	Conference paper, book chapter, editorial, review, protocol
Publication period	2021–2025	Before 2021
Accessibility	Full text available	Full text unavailable

Selection took place in three phases. First, records downloaded from Scopus were deduplicated. Second, titles and abstracts were screened against the eligibility criteria (Table 1) to remove records that were clearly off-topic, non-interventional, or outside the target population. Third, records that were not eliminated in this step were further evaluated for definitive eligibility based on the full-text report, and reasons for exclusion were logged by category (Figure 1). Screening was performed by a single reviewer using a predefined criteria sheet; no dual independent screening was conducted, and no inter-rater reliability coefficient (Cohen's kappa) was calculated. This is acknowledged as a limitation. Ambiguous records were reviewed again with a view to the abstract and, if still necessary, the full report before the final decision was reached. Grey literature was not searched; only peer-reviewed articles indexed in Scopus were considered. The complete eligibility criteria, including study design, language, date range, and document type, are presented in Table 1. Methodological quality was assessed using the Mixed Methods Appraisal Tool (MMAT 2018), with a threshold of at least 60% of quality criteria met for inclusion in the main synthesis; studies with lower scores were retained for sensitivity analysis as recommended by MMAT developers. The PRISMA 2020 flow diagram (Figure 1) reports exact numbers at each filtering stage, and the study-flow figures reported in Sections 4 and 5.1 are numerically consistent with that diagram and with the Abstract.

A PICO-based search was formulated independently of the quality appraisal. The Mixed Methods Appraisal Tool (MMAT), version 2018 (Hong et al., 2018), was the tool used to assess individual study quality with the rationale that it can handle the diverse quantitative research designs in the literature. First, the study design category was determined (here, either quantitative randomised controlled trials or quantitative non-randomised studies), and then the relevant five-item checklist was used, with Yes (1), Can't tell/Partial (0.5), or No (0) as responses. Studies were included in the analysis if they met at least 60% of quality criteria (≥ 3 out of 5). No study was excluded solely on the basis of quality score in accordance with MMAT developer recommendations; studies with lower scores were taken up in the discussion for sensitivity purposes (Section 5.4). The appraisal was based on the information available in the retrieved records alone; as it was done by a single reviewer, a formal inter-rater coefficient (Cohen's κ) was not computed, and this is considered a limitation.

Table 2. Methodological quality assessment (MMAT 2018)

Author(s), Year	Design category	Q1	Q2	Q3	Q4	Q5	Score / %	Category
Bailey et al., 2025	Quant. RCT	Y	Y	Y	CT	Y	4.5 / 90%	High
Krzysztofik et al., 2025	Quant. RCT	Y	Y	Y	CT	Y	4.5 / 90%	High
Lee et al., 2024	Quant. RCT	Y	Y	Y	CT	Y	4.5 / 90%	High
Jung & Hong, 2024	Quant. RCT (crossover)	Y	Y	Y	CT	Y	4.5 / 90%	High
Liu et al., 2024	Quant. RCT	Y	Y	Y	CT	Y	4.5 / 90%	High
Rey et al., 2024	Quant. RCT	Y	Y	Y	CT	CT	4.0 / 80%	High
Muñoz et al., 2024	Quant. RCT	Y	Y	Y	CT	Y	4.5 / 90%	High
Solleiro-Duran et al., 2025	Quant. RCT	Y	Y	Y	CT	Y	4.5 / 90%	High
Baena-Raya et al., 2025	Quant. RCT	Y	Y	Y	CT	Y	4.5 / 90%	High
Pereira et al., 2023	Quant. RCT	Y	CT	Y	CT	Y	4.0 / 80%	High
Cusano et al., 2025	Quant. RCT	Y	Y	Y	CT	CT	4.0 / 80%	High
Derakhti et al., 2022	Quant. RCT	Y	Y	Y	CT	Y	4.5 / 90%	High

Author(s), Year	Design category	Q1	Q2	Q3	Q4	Q5	Score / %	Category
Chaalali et al., 2022	Quant. RCT (pilot)	Y	CT	Y	CT	Y	4.0 / 80%	High
Krawczyk et al., 2024	Quant. non-randomised	Y	Y	Y	CT	CT	4.0 / 80%	High
Ferrini et al., 2025	Quant. non-randomised	Y	Y	Y	CT	Y	4.5 / 90%	High
Tvrđý et al., 2022	Quant. non-randomised	CT	Y	Y	N	Y	3.5 / 70%	Medium
Vázquez Romero et al., 2024	Quant. non-randomised	Y	Y	Y	CT	CT	4.0 / 80%	High
Castañó-Zambudio et al., 2024	Quant. non-randomised	Y	Y	CT	CT	Y	4.0 / 80%	High

Y = Yes (1.0); CT = Can't tell / Partial (0.5); N = No (0). RCT items: appropriate randomisation, baseline comparability, complete outcome data, assessor blinding, adherence. Non-randomised items: representativeness, appropriate measurements, complete outcome data, control of confounders, intervention delivered as intended. Item 4 (blinding) is often "Can't tell" because assessor blinding is hardly ever reported in field-based training trials.

A standardised extraction sheet was used to record for each included study: authors and year; country or setting where reported; study design; number of participants, sex, age, and level of competition; the training intervention, including type of exercise, external load, session frequency, and programme duration; the acceleration and maximum-speed outcome measures; and main findings, including the direction of the effect and, if reported, the magnitudes of the effect sizes. In order to gain an understanding of the overall research area, the descriptive metadata of the screened literature were summarized, and a keyword co-occurrence mapping was conducted on the author keywords of the records to find dominant thematic clusters. This descriptive step of bibliometric analysis is indirectly related to the synthesis of interventions; it supports the thematic structure presented in Section 5.3; it has not changed the eligibility of the studies. Due to considerable differences expected in interventions, comparators, and ways of defining outcomes, a narrative thematic synthesis approach was followed instead of meta-analysis (Thomas & Harden, 2008). Results were inductively coded with reference to the three research questions, categorized into descriptive themes (intervention modality; effectiveness by population; and dose-response characteristics), and analyzed for similarities, differences, and conditions at the borders across studies.

The reporting was done according to the PRISMA 2020 checklist and the conventions of the flow-diagram (Page et al., 2021). The numbers of the study-flow mentioned in Sections 4 and 5.1 are numerically in agreement with the figure and the summary counts presented in the Abstract.

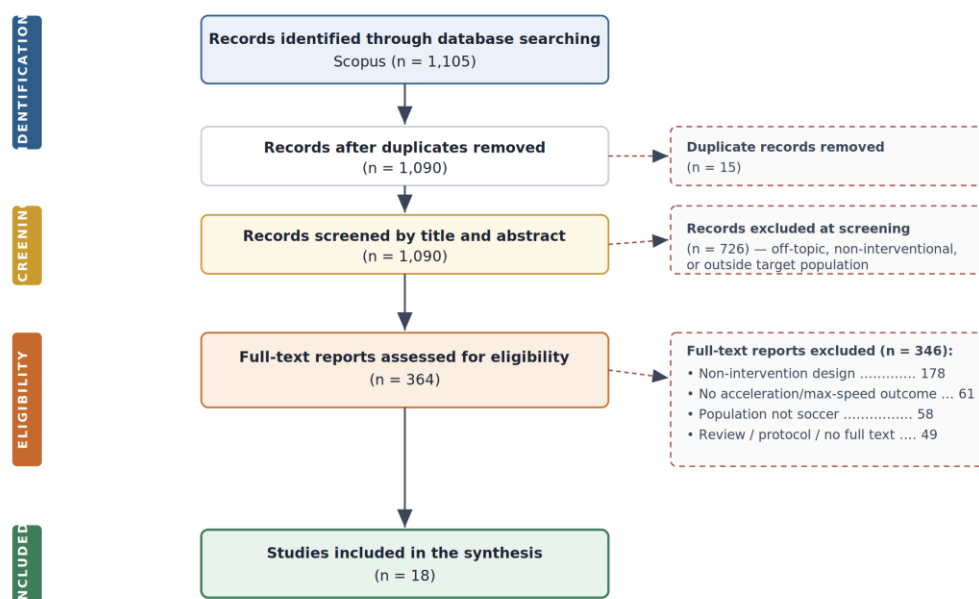


Figure 1. PRISMA 2020 diagram of tracking study identification, screening, eligibility, and inclusion. Diagram structure and reporting conventions adhere to the PRISMA 2020 statement (Page et al., 2021). The figures are from the Scopus metadata export used as the review's base of evidence.

Results and Discussions

A total of 1,105 items were found in Scopus. After duplicates (15) were removed, 1,090 records were left for the title-and-abstract screening. At this stage, 726 items were excluded for being off-topic, non-interventional, or outside the target population. The remaining 364 publications were evaluated for eligibility by reading the full text, and 346 were excluded: 178 did not have a training intervention (i.e., observational, load-monitoring, or descriptive-biomechanical designs), 61 had no acceleration or maximum-speed outcome, 58 were non-soccer or mixed-sport samples without soccer-specific data, and 49 were reviews, protocols, or did not have an accessible full text. Eighteen controlled intervention studies were kept for synthesis. These figures are in agreement with Figure 1 and the Abstract.

The retrieved corpus was recent and growing, increasing from 47 items in 2021 to 104 in 2025 (Figure 2), which means that the scientific attention to speed qualities in soccer is intensifying. The 18 final studies were published during the years 2022–2025 and were mostly present in applied sport-science and strength-and-conditioning journals. The sample sizes ranged from very small pilot cohorts ($n = 14$ – 16) to moderately sized trials (n up to 52), the participants covered youth academy, amateur, semi-professional, senior, and professional players of both sexes, although male youth cohorts were the majority. The country of origin of the study was often not given in the source metadata; when the national setting was mentioned in the paper, it has been noted in Table 3, otherwise marked as "NR."

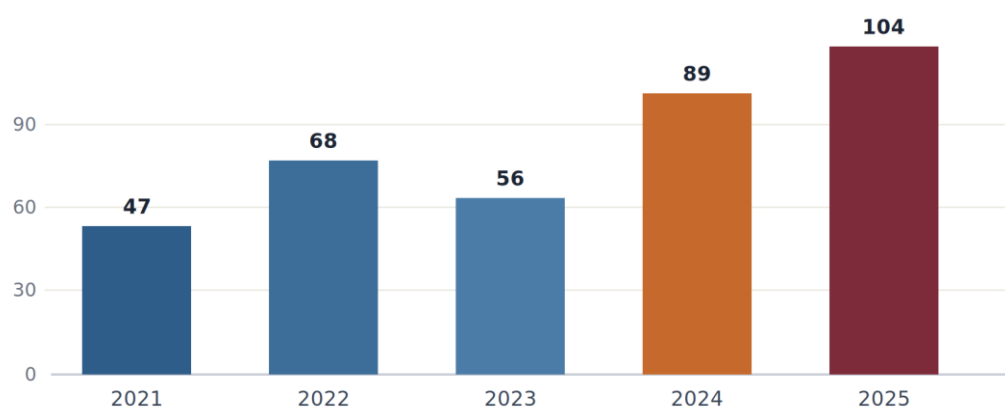


Figure 2. Yearly distribution of the retrieved corpus ($n = 364$ full-text-screened records, 2021–2025) highlighting the rapid growth of research on sprint-related qualities in soccer.



Figure 3. Breakdown of the 18 included studies by primary intervention modality. Among recent controlled-trial evidence, resisted and assisted sprint methods are the most common.



Figure 4. Thematic clustering of the included studies resulting from author-keyword co-occurrence. The size of the bubble reflects the number of studies (k) in each cluster.

Table 3. Summary of included studies

Title (full)	Author(s), Year	Country / setting	Design	Sample & level	Intervention (modality, dose)	Key findings
Four Weeks of Power Optimized Sprint Training Improves Sprint Performance in Adolescent Soccer Players	Derakhti et al., 2022	NR	RCT	n = 24 male, ~15.7 y (RST/UST/control)	4 wk; heavy resisted vs unresisted 20-m sprints, 2×/wk, load maximising horizontal power	Heavy resisted sprint improved all distances (ES 0.76–1.41), largest over short distances (6–8%); unresisted and control did not change; gains linked to greater maximal horizontal force.
Effectiveness of short vs. long-distance sprint training on sprinting and agility performance in young soccer players	Rey et al., 2024	NR	RCT	n = 18 male, U19	6 wk; short- vs long-distance sprint, volume-matched, 2×/wk	Both groups improved 5–40 m sprint and agility with no between-group difference; long-distance yielded slightly larger percentage gains.
Microdosing Plyometric Training Enhances Jumping Performance, Reactive Strength Index, and Acceleration among Youth Soccer Players: A Randomized Controlled Study Design	Liu et al., 2024	NR	RCT	n = 52 male, U17	8 wk; microdosed vs regular plyometric vs control	Both plyometric groups improved 10-m acceleration, jumps, and reactive strength vs control, with no micro- vs regular difference; lower, more frequent volume was

Title (full)	Author(s), Year	Country / setting	Design	Sample & level	Intervention (modality, dose)	Key findings
Resisted sprint training with partner towing improves explosive force and sprint performance in young soccer players – A pilot study	Chaalali et al., 2022	NR	RCT (pilot)	n = 16 elite male, ~16.6 y	6 wk; partner-towing resisted vs non-resisted sprint, 2×/wk	equally effective. Resisted (towing) reduced 0–5, 0–10, and 0–30 m times and raised stride frequency and explosive force; non-resisted improved only 0–30 m and stride length. Combined groups outperformed plyometric-only for change of direction and jumping; straight-line gains were limited, showing specificity of the combined content. Adaptations were trajectory-specific: linear training improved linear sprint and force–velocity indices; curvilinear improved curve-sprint and COD. Both loads improved 10–30 m linear and curve sprint; only very-heavy loading improved change of direction; control did not change. Curve-sprint and COD improved similarly on both surfaces; linear acceleration and velocity (0–10, 10–17 m) improved only on sand, supporting sand as a practical overload surface. The device group significantly improved acceleration
Effects of combined plyometric, strength, speed and change of direction training on youth male soccer players on physical performance: A randomised controlled trial	Muñoz et al., 2024	NR	RCT	n = 30 youth male	6 wk; plyometric vs combined (PL+speed+COD±strength) replacing warm-up, 2×/wk, 20 min	
Effects of linear versus curvilinear sprint training on multidirectional speed in young soccer players: a randomized parallel-group trial	Solleiro-Duran et al., 2025	NR	RCT	n = 19 male, U16	6 wk (11 sessions); linear vs curvilinear sprint, volume-matched	
Effects of Light Versus Very Heavy Resisted Sprint Training on Multidirectional Speed in Semi-professional Soccer Players	Baena-Raya et al., 2025	NR	RCT	n = 38 male, U19 (control/light/very heavy)	8 wk; resisted sprint at 25% vs 75% velocity loss + control	
Sand and grass surfaces are equally effective in promoting positive adaptations in the sprint performance of elite young soccer players	Pereira et al., 2023	NR	RCT	n = 15 elite male, U20	8 wk (12 sessions); sprint-jump programme on sand vs grass	
The impact of the new technological tool Sprint Resister on the	Cusano et al., 2025	Italy (setting)	RCT	n = 20 male, ~18 y (device vs conventional)	8 wk; resistance-enhanced sprint drills using the Sprint Resister device	

Title (full)	Author(s), Year	Country / setting	Design	Sample & level	Intervention (modality, dose)	Key findings
training of young footballers: an 8-week experimental study						and top speed, with roughly a 15% overall performance advantage over conventional training.
Effects of Vertical and Horizontal Strength Exercises on Sprint Performance and Sprint Mechanical Outputs in Amateur Soccer Players	Krawczyk et al., 2024	NR	Non-randomised controlled	n = 20 amateur male (EG/CG)	6 wk; combined vertical + horizontal strength exercises	Sprint improved at 0–10, 0–15, and 0–20 m and in maximal ratio of force vs control; most other mechanical variables were unchanged, indicating gains beyond 5 m. SAQ improved acceleration, maximum sprint speed, and COD; controls improved only 10-m sprint, showing SAQ adds value beyond general football training. Rest interval did not alter sprint or mechanical outputs; horizontal resistance appeared to buffer fatigue-related compensations, so short rests preserved initial-acceleration mechanics.
SAQ training on sprint, change-of-direction speed, and agility in U-20 female football players	Lee et al., 2024	NR	RCT	n = 19 female, U20 (SAQ/control)	8 wk; speed-agility-quickness (SAQ) training	Sprint (10, 30 m) improved in Pre- and Mid-PHV; Post-PHV improved COD and hamstring strength but declined in sprint-identical programme, maturity-dependent adaptation.
Effects of Short-Rest Interval Time on Resisted Sprint Performance and Sprint Mechanical Variables in Elite Youth Soccer Players	Jung & Hong, 2024	NR	RCT (crossover)	n = 15 elite male, U19	Acute; resisted 20-m sprints with 2-min vs 40-s rest at 30% velocity-loss load	RSA indices and 10- and 20-m acceleration improved after the RSA block, having worsened
Effects of Maturation Status on Physical Performance Adaptations Following a Combined 7-Week Strength and Power Training Program in Elite Male Youth Soccer Players	Ferrini et al., 2025	NR	Non-randomised (maturity groups)	n = 35 elite male youth (Pre/Mid/Post-PHV)	7 wk; combined strength + power, 2×/wk	
Effectiveness of repeated sprint ability (RSA) development in youth soccer players	Tvrđý et al., 2022	Slovakia	Non-randomised (control-then-experimental)	n = 14 elite male, U19	6 wk; repeated 20-m sprint RSA programme	

Title (full)	Author(s), Year	Country / setting	Design	Sample & level	Intervention (modality, dose)	Key findings
The Effects of Flywheel Training with a Portable Device on Physical Performance in Soccer Players	Vázquez Romero et al., 2024	NR	Non-randomised controlled	n = 33 senior male (EG/CG)	8 wk; portable flywheel multidirectional exercises, low volume	during a preceding non-specific period, demonstrating the need for targeted stimuli. Change of direction and curve-sprint improved vs control at low volume; linear sprint was less affected, positioning flywheel work for multidirectional qualities.
Effect of Six Weeks' Isometric Strength Training Compared to Traditional Strength Training on Gains in Strength, Power, and Speed in Male Academy Soccer Players	Bailey et al., 2025	England	RCT	n = 18 academy male, ~17 y (IST/TST)	6 wk (12 sessions); isometric vs traditional strength	No group×time differences; both improved or maintained strength, jump, and sprint velocity during a congested schedule, making isometric training a viable low-fatigue option.
Enhancing Acceleration Capabilities in Professional Women's Football Players: A Comparative Analysis of Game-Based Versus Resisted Sprint Trainings	Castañó-Zambudio et al., 2024	NR	Non-randomised (longitudinal, mixed models)	n = 26 professional women, ~24 y	Competitive period; game-based vs resisted sprint	Both methods improved acceleration across distances, with the largest gains when high-intensity volume was combined with resisted sprinting; no sprint focus produced no gain.
Effects of 6 weeks of complex training on athletic performance and post-activation performance enhancement effect magnitude in soccer players: a cross-sectional randomized study	Krzysztofik et al., 2025	NR	RCT	n = 24 male (medium vs high intensity)	6 wk; complex training, 2×/wk	High-intensity complex training produced superior 5-m acceleration and 30-m sprint gains and larger drop-jump improvement than medium; both improved linear speed and strength.

NR = not reported in the source metadata. RST = resisted sprint training; UST = unresisted sprint training; PHV = peak height velocity; COD = change of direction; ES = effect size. Titles are reproduced in full from the source records.

Table 4. Classification of included studies by theme and method

Author(s), Year	Design	Age / level	Thematic cluster	Intervention / technology	Primary speed outcome affected
Derakhti et al., 2022	RCT	Youth, ~U16	Resisted / assisted sprint	Heavy resisted sprint (sled/device)	Short-distance acceleration ↑
Rey et al., 2024	RCT	U19	Distance & trajectory specificity	Short vs long sprint distance	5–40 m sprint ↑ (both)
Liu et al., 2024	RCT	U17	Plyometric / jump-based	Micro- vs regular plyometrics	10-m acceleration ↑
Chaalali et al., 2022	RCT (pilot)	Elite youth	Resisted / assisted sprint	Partner-towing resisted sprint	0–5 to 0–30 m acceleration ↑
Muñoz et al., 2024	RCT	Youth	Speed-agility & combined	Combined plyo+strength+speed+COD	COD ↑; linear limited
Solleiro-Duran et al., 2025	RCT	U16	Distance & trajectory specificity	Linear vs curvilinear sprint	Trajectory-specific sprint ↑
Baena-Raya et al., 2025	RCT	U19 semi-pro	Resisted / assisted sprint	Light vs very-heavy resisted sprint	10–30 m linear & curve sprint ↑
Pereira et al., 2023	RCT	U20 elite	Plyometric / jump-based (surface)	Sprint-jump on sand vs grass	0–17 m velocity ↑ (sand)
Cusano et al., 2025	RCT	~18 y	Resisted / assisted sprint	Sprint Resister device	Acceleration & top speed ↑
Krawczyk et al., 2024	Non-randomised	Amateur	Complex & strength-power	Vertical + horizontal strength	0–20 m sprint ↑
Lee et al., 2024	RCT	Female U20	Speed-agility & repeated sprint	SAQ training	Acceleration & max speed ↑
Jung & Hong, 2024	RCT (crossover)	Elite U19	Resisted / assisted sprint	Resisted sprint, rest-interval manipulation	Acceleration mechanics maintained
Ferrini et al., 2025	Non-randomised	Elite youth (PHV)	Complex & strength-power	Combined strength + power	10–30 m sprint ↑ (Pre/Mid-PHV)
Tvrđý et al., 2022	Non-randomised	Elite U19	Speed-agility & repeated sprint	Repeated-sprint (RSA) programme	10–20 m acceleration ↑
Vázquez Romero et al., 2024	Non-randomised	Senior	Complex & strength-power	Portable flywheel	Curve sprint ↑; linear limited
Bailey et al., 2025	RCT	Academy ~17 y	Complex & strength-power	Isometric vs traditional strength	Sprint velocity maintained/↑
Castaño-Zambudio et al., 2024	Non-randomised	Professional women	Resisted / assisted sprint	Game-based vs resisted sprint	Acceleration across distances ↑
Krzysztofik et al., 2025	RCT	Adult male	Complex & strength-power	Complex training (medium vs high)	5-m acceleration & 30-m sprint ↑

↑ = significant improvement reported. Thematic clusters correspond to Figure 4.

Findings for RQ1 - Types of interventions implemented

The included evidence maps onto five thematic clusters (Figure 4). The largest cluster comprised resisted and assisted sprint methods, delivered through sleds, motorised or partner-based towing, and dedicated devices (Derakhti et al., 2022; Chaalali et al., 2022; Baena-Raya et al., 2025; Cusano et al., 2025; Jung & Hong, 2024; Castaño-Zambudio et al., 2024). A second cluster used complex, strength, and strength-power methods, including traditional versus isometric strength, complex contrast training, eccentric flywheel work, and combined strength-power blocks (Krzysztofik et al., 2025; Bailey et al., 2025; Vázquez Romero et al., 2024; Krawczyk et al., 2024; Ferrini et al., 2025). Two smaller clusters manipulated sprint distance and trajectory (Rey et al., 2024; Solleiro-Duran et al., 2025) and jump-based or surface-based stimuli (Liu et al., 2024; Pereira et al., 2023). A final cluster addressed speed-agility and repeated-sprint constructs (Lee et al., 2024; Tvrđý et al., 2022; Muñoz et al., 2024).

Two design features recur across clusters and clarify the modality landscape. First, several trials deliberately individualised the training stimulus-most explicitly by setting resisted-sprint load to maximise horizontal power output or to produce a defined velocity loss (Derakhti et al., 2022; Baena-Raya et al., 2025)-reflecting a shift from fixed percentage loads toward mechanically anchored prescription. Second, many interventions were embedded within, or substituted for, ordinary soccer content (for example, replacing tactical warm-ups), signalling a practical emphasis on time-efficient integration rather than stand-alone conditioning blocks (Muñoz et al., 2024; Liu et al., 2024).

The clustering also reveals what is comparatively scarce. Assisted (overspeed) sprinting, pure maximal-velocity training at distances beyond 30–40 m, and interventions in adult female or professional male cohorts are under-represented relative to youth male academy trials, echoing broader observations that maximal-velocity

capacity is often inferred from short splits rather than measured directly (Alonso-Callejo et al., 2024; Vescovi & Jovanović, 2021).

Findings for RQ2 - Effectiveness across age, sex, and level

Across cohorts, sprint-oriented training reliably improved acceleration, with more variable effects on maximal velocity. In youth male players, resisted sprinting produced the most consistent short-distance gains, whereas volume-matched unresisted or alternative methods frequently produced comparable improvements without clear superiority (Derakhti et al., 2022; Rey et al., 2024; Liu et al., 2024). This pattern-robust acceleration adaptation with equivalence between well-matched modalities-suggests that, once an adequate high-intensity stimulus is present, the specific method matters less than its dose and specificity.

Effectiveness was clearly moderated by maturation. Applying an identical strength–power programme, Ferrini et al. (2025) found sprint improvements concentrated in pre- and mid-PHV players, while post-PHV players improved change of direction and hamstring strength but declined in sprint, indicating that maturity status conditions which quality responds. This convergence with the developmental literature (Fernández-Galván et al., 2022; Sellami et al., 2024) implies that pooled effect estimates that ignore maturation may mask opposing responses and mislead academy prescription (Nobari et al., 2021; García-Ceberino et al., 2024).

Evidence in female and senior/professional cohorts, though thinner, was directionally consistent. SAQ training enhanced acceleration and maximum sprint speed in U-20 women beyond general football training (Lee et al., 2024), and both game-based and resisted sprint methods improved acceleration in professional women, with the greatest gains when high-intensity volume was paired with resisted sprinting (Castaño-Zambudio et al., 2024). In academy men facing congested fixtures, isometric and traditional strength were equally effective at maintaining or improving sprint velocity, highlighting fatigue management as a practical determinant of programme choice (Bailey et al., 2025). Collectively, these findings support trainability of acceleration across sex and level, while underscoring that maximal-velocity outcomes are inconsistently isolated and reported.

Findings for RQ3 - Training characteristics driving improvement

Dose and specificity characteristics were more decisive than modality labels. Regarding external load, heavier resisted-sprint loads amplified acceleration and, in some cases, change-of-direction adaptations: very-heavy loading ($\approx 75\%$ velocity loss) was required to improve COD, whereas both light and heavy loads improved linear and curve sprint (Baena-Raya et al., 2025), and loads individualised to peak horizontal power maximised short-sprint gains (Derakhti et al., 2022). Regarding trajectory and distance specificity, adaptations tracked the trained pattern-linear training favoured linear sprint and curvilinear training favoured curve sprint and COD (Solleiro-Duran et al., 2025)-while short and long sprint distances produced broadly similar improvements when volume was matched (Rey et al., 2024).

Regarding volume and frequency, several trials showed that lower total volume distributed more frequently, or delivered at low absolute volume, was sufficient: microdosed plyometrics matched regular dosing (Liu et al., 2024), portable flywheel work improved multidirectional speed at low volume (Vázquez Romero et al., 2024), and short rest intervals did not degrade resisted-sprint mechanics (Jung & Hong, 2024). Regarding duration, programmes of 4–8 weeks were generally sufficient to elicit meaningful acceleration change (Derakhti et al., 2022; Pereira et al., 2023). Finally, environmental and contrast manipulations-training on sand or using high-intensity complex/PAPE schemes-provided additional overload, with sand improving linear acceleration beyond grass (Pereira et al., 2023) and high-intensity complex training outperforming medium intensity for 5-m acceleration (Krzysztofik et al., 2025). The recurring principle is that horizontally oriented, adequately loaded, and specifically targeted stimuli-not any single named modality-drive the largest gains (Tvrdý et al., 2022).

Methodologically, the corpus is dominated by short (4–8 week) controlled trials with small samples; thirteen of eighteen studies were randomised, and five were non-randomised controlled or longitudinal designs (Table 2). Assessor blinding was almost never reported, and several trials lacked a true non-training control, instead comparing two active modalities-an appropriate applied design for equivalence questions but a weak basis for establishing absolute efficacy. In a sensitivity sense, the studies flagged as medium quality (for example, the single-arm control-then-experimental design of Tvrdý et al., 2022) converge with higher-quality trials in showing acceleration trainability, so the review's principal conclusions do not rest on the weaker evidence.

The dominant methods have also evolved. Earlier reliance on fixed-load resisted sprinting has given way to mechanically individualised prescription anchored to horizontal power or velocity loss (Derakhti et al., 2022; Baena-Raya et al., 2025), and outcome assessment has broadened from single split times toward force–velocity and in-situ acceleration–speed profiling (Alonso-Callejo et al., 2024; Jimenez-Reyes et al., 2022). Under-used designs include maturity-stratified randomised trials, adequately powered female cohorts, and interventions that isolate and report true maximal velocity rather than inferring it from ≤ 30 m splits.

Interpretation of findings. The evidence indicates that acceleration is highly trainable in soccer players through diverse sprint-oriented stimuli, and that maximal-velocity qualities respond less consistently and are less consistently measured. The frequent equivalence between volume-matched modalities suggests a threshold model: provided a sufficiently intense, horizontally oriented stimulus is delivered with adequate specificity, the branded modality is secondary to dose and trajectory (Rey et al., 2024; Derakhti et al., 2022).

Theoretical implications. These patterns reinforce a horizontal-force-production framework for soccer speed, in which acceleration gains are mediated by the capacity to orient force effectively at high velocities (Edouard et al., 2021; Zhang et al., 2022). Maturity-dependent divergence in adaptation (Ferrini et al., 2025) extends developmental models by showing that the same stimulus can shift the trained quality across PHV stages, challenging maturation-blind prescription (Fernández-Galván et al., 2022; Carranza-García et al., 2024).

Practical implications. For practitioners, resisted sprinting with individualised load is a defensible default for developing short-distance acceleration, while trajectory-specific and multidirectional methods should be added when curve-sprint and change-of-direction demands are prioritised (Baena-Raya et al., 2025; Solleiro-Duran et al., 2025; Vázquez Romero et al., 2024). Low-volume, high-frequency and low-fatigue options-microdosed plyometrics, isometric strength, short-rest resisted sprints-are attractive during congested schedules (Liu et al., 2024; Bailey et al., 2025; Jung & Hong, 2024). In academy settings, prescription should be stratified by maturity (Ferrini et al., 2025).

Comparison with prior reviews and contradictions. The finding that heavier resisted loads confer additional multidirectional benefit while both light and heavy loads improve linear sprint reconciles apparently conflicting reports about optimal resisted-sprint load by making the outcome-specificity explicit (Baena-Raya et al., 2025). A residual contradiction concerns whether combined and complex methods improve straight-line speed: some combined programmes enhanced change of direction with limited linear transfer (Muñoz et al., 2024; Vázquez Romero et al., 2024), whereas high-intensity complex training improved linear acceleration (Krzysztofik et al., 2025), a divergence plausibly explained by differences in intensity, contrast structure, and sprint content rather than by the "complex" label itself.

Research gaps. Three gaps stand out: (i) scarce, under-powered evidence in adult and professional cohorts, especially women (Castaño-Zambudio et al., 2024; Griffin et al., 2021); (ii) inconsistent isolation and reporting of true maximum sprint speed as distinct from short-split acceleration (Alonso-Callejo et al., 2024); and (iii) limited maturity-stratified randomised designs despite clear moderation effects (Ferrini et al., 2025; Sellami et al., 2024).

Limitations of this review. First, reliance on a single database (Scopus) and English-language, article-only limiters may have omitted eligible evidence. Second, the source metadata lacked affiliation and country fields for most records, precluding a valid geographic analysis. Third, appraisal was conducted by a single reviewer using report-level information, without a formal inter-rater coefficient, and heterogeneity precluded meta-analysis, so synthesis remains narrative.

Future research agenda. Priorities include maturity-stratified randomised trials that report maximal velocity directly using validated profiling; adequately powered trials in professional and female cohorts; and dose-response designs that hold volume constant while varying load, trajectory, and frequency to isolate the drivers identified here (Baena-Raya et al., 2025; Solleiro-Duran et al., 2025).

Summary answers. RQ1: interventions cluster into resisted/assisted sprint, complex/strength-power, distance-trajectory, jump/surface, and speed-agility/repeated-sprint methods. RQ2: acceleration improves reliably across ages, sexes, and levels, but effects are maturity-moderated and maximal-velocity outcomes are inconsistently captured. RQ3: individualised horizontal loading, trajectory specificity, and adequate-often modest-dose drive the largest gains, more than the modality label.

Conclusions

This systematic review of eighteen controlled trials reveals that acceleration in soccer players can consistently be trained using various sprinting techniques, however, the development of sprint speed to maximum is somewhat erratic and seldom documented. Resistance running with a tailored load seems to be a very effective way to enhance acceleration over short distances, although at times volume-matched other approaches also work pretty well, thus suggesting that how much is done, direction of force, and movement pattern are more important than the specific type of exercise. Biological maturity influences the extent and nature of these physical changes, so even if one programme remains the same, it will be the developmental level of the players that determines the kind and number of improvements they will get. The most important aspect of the synthesis is a dose-dependent one that separates the effects of mode from the effects of loading and specificity providing speed developers with a logical framework to

prescribe and set sequences of speed work. The study is limited by sourcing from one database, a narrative synthesis, and an issue of inconsistent reporting of maximal velocity. The most straightforward thing to do from the research perspective in the direction of maturity-stratified random trials that separate and report maximal velocity are the next step.

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