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Review Article

Applying Resisted Sprint Protocols for Acceleration Improvement in Team Sports: Evidence from a Systematic Review

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Abstract

Background. In team sports, decisive actions such as anticipating opponents' scheme executions and realizing game objectives depend on the ability to accelerate rapidly and maintain high speeds, often under external resistance and during changes of direction. Resisted sprint training has been proposed to simulate these conditions and to enhance the sprint-specific neuromuscular qualities required in competitive settings.

Objectives. This study aimed to critically examine, through a systematic approach, the various methodologies of resisted sprinting (sled training, motorized systems) applied in team sports, in order to acquire practical recommendations to optimize acceleration velocity and explosive power.

Materials and methods. A PRISMA-guided literature review was performed on Scopus (2020–2025) using the keywords "resisted sprinting", "sled training" and "sprint with overload". After screening 103 records and assessing 56 full-text articles, 14 studies (13 original research articles and 1 meta-analysis) were included based on language, article type and relevance to the topic.

Results. According to the results obtained, it has been determined that protocols employing sled resistance corresponding to a 50 % velocity decrement or loads of approximately 10–13 % of body mass led to significant improvements in acceleration over 5-30 m, horizontal force production and maximal power output. Profiling tools (e.g., the 1080 Sprint system) proved valid and reliable, while force–velocity profiling revealed load-specific adaptations that support individualized loading based on athlete role, age and sport discipline.

Conclusions. The findings suggest that resisted sprint training is effective in improving acceleration and neuromuscular power in team sports. Optimal outcomes depend on precise load calibration, the use of valid profiling instruments, and personalized programming tailored to the specific needs of athletes and their disciplines.

Keywords: resisted sprinting, sled training, force–velocity profiling, acceleration, team sports.

Introduction

In team sports, athletic performance is the result of a combination of physical capacities, technical skills and tactical elements, which together determine competitive success across different disciplines (Bangsbo, 2015). In particular, in sports such as soccer, basketball, handball and rugby, performance effectiveness depends on athletes' ability to execute specialized technical actions and to sustain high-intensity efforts—characterized by rapid accelerations, changes of direction, repeated sprints and explosive actions such as jumps and tackles (Cusano et al., 2019; D'Elia et al., 2021). Within this context, the capacity to generate high levels of power during performance (Cormie et al., 2011; Cronin & McGuigan, 2011) is a fundamental element in protocols aimed at improving high-intensity, sport-specific movements (Raiola et al., 2025; D'Isanto et al., 2025). The ability to reach high running velocities in short time frames is considered crucial for competitive performance, directly influencing actions such as anticipating opponents, gaining space and finishing plays (Hader et al., 2015). However, sprints in team sports rarely occur under linear, uniform conditions; they frequently involve obstacles, trajectory changes and external resistances that force athletes to make rapid, situational adaptations (Young et al., 2015; Petrakos et al., 2016). In this context, resisted-sprint training has

emerged as a particularly effective methodology for developing specific speed and functional muscular power for sporting gestures, since it simulates actual game conditions (Alcaraz et al., 2018; Sannicandro et al., 2024). Exercises such as resisted runs with towing devices, elastic-band sprints or overloaded sprints have been shown to improve neuromuscular, kinetic and kinematic qualities, fostering increases in explosive strength, maximal power and acceleration capacity (Petrakos et al., 2016; Cross et al., 2018). Numerous studies report that systematic use of resisted-sprint protocols leads to optimal performance adaptations—such as enhancements in maximal speed, step frequency and biomechanical efficiency of technical gestures (Rumpf et al., 2016; Cahill et al., 2020). However, the effectiveness of these methods is strongly conditioned by coaching staff's ability to carefully calibrate load and personalize protocols based on individual athlete characteristics and the specific requirements of the sport (Morin et al., 2017; Altavilla et al., 2023). Despite growing interest in resisted-sprint training, there remains a lack of systematic reviews that critically compare different applications of overload sprinting in team sports—considering parameters such as intensity, duration, equipment and athletes' individual profiles (D'Elia et al., 2023; Raiola et al. 2019; Esposito et al., 2024). The aim of the present review is to critically examine the common and specific aspects of various resisted-sprint training methodologies applied in team sports, in order to provide practical guidance for optimizing acceleration speed, explosive power and technical effectiveness across different sporting contexts.

Materials and Methods

This study was conducted as a systematic review of the scientific literature, aimed at critically analyzing the common and specific features of resisted-sprint training methodologies in team sports to identify practical recommendations for optimizing physical performance. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework was followed, with inclusion criteria defined a priori (see Table 1). The primary source was the Scopus database, and the search terms used were "resisted sprinting", "sled training" and "sprint with overload". Inclusion criteria were: original research articles and systematic reviews; publications in English; relevance to the topic; and full-text availability. During screening, duplicate records, studies lacking empirical data and those not pertinent to the research question were excluded.

Table 1. Inclusion criteria

Web search engines	Scopus
Publishing period	2020-2025
keywords	Resisted sprinting, sled training and sprint with overload
Language	English
Type of article	Original research articles and/or review articles
Full text	Articles matched the purpose and/or topic of the research.

The entire selection process is depicted in the PRISMA flow diagram (Figure 1), which details the number of records identified, screened, excluded, and included in the final review.

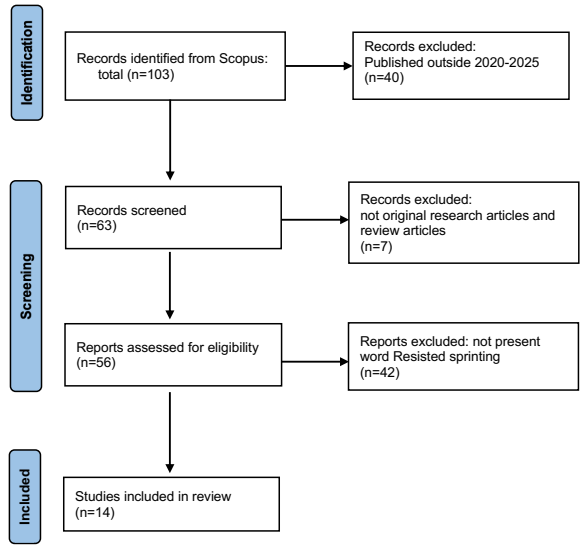

Fig. 1. PRISMA flow diagram illustrating the article selection process.

Results

After conducting the initial search in Scopus, a total of 103 articles were identified. These records were then subjected to additional screening through several phases to yield the 14 studies relevant to our topic. Specifically, 13 experimental studies and 1 systematic review were included. Table 2 summarizes the key characteristics of the included studies, detailing for each: authors, year, topic addressed, methodology employed, and main findings.

Discussion

Optimizing resisted-sprint training requires a clear understanding of in-game demands (Taylor et al., 2017), specifically which actions contribute most to performance and are thus amenable to improvement (Altavilla, 2025). This entails detailed analysis of both training and match loads to obtain quantitative profiles of athletes in team sports such as soccer, basketball, rugby and handball (Bangsbo et al., 2006; Svilar et al., 2018; Parmar et al., 2018; García-Sánchez et al., 2023). Resisted sprints effectively enhance acceleration and neuromuscular power; however, protocol efficacy hinges on precise load determination, the choice of equipment (e.g., Sprint Resister) and meticulous programming (Ceruso et al., 2024). Comparisons between sled towing and weighted-vest sprints reveal similar gains in acceleration, though vest-based loading elicits greater increases in step frequency. Protocols employing sled loads that induce a 50 % velocity decrement or approximately 10–13 % of body mass have demonstrated the greatest effectiveness for improving 5–30 m acceleration, horizontal force production and maximal power (Espasa et al., 2025; Esposito et al., 2024). Profiling instruments, such

Table 2. Results of the literature review

N.	Authors	Topics	Method	Results
1	Stavridis et al., 2023	Heavy sled sprinting, acceleration, kinematics	Original article	Training with sled resistance corresponding to a 50 % velocity decrement (v_dec) produced significant improvements in 30 m sprint acceleration, horizontal power and step frequency.
2	Espasa et al.,2025	Resisted sprinting, meta-analysis, team sports	Systematic review	A 6–8-week resisted sprint program using loads of ~10–13 % body mass improved performance over 15–30 m. Loads around 13 % BM for 15–20 m and 12.6 % BM for 10–30 m were effective. Higher loads (40 % BM) yielded benefits, but extreme loads (80 % BM) risked compromising sprint technique.
3	Rakovic et al.,2022	Device validation, sprint profiling, horizontal force	Validation Study / Original Article	The motorized "1080 Sprint" device showed high reliability and validity for 0–30 m sprint timing: coefficient of variation 1–2 %, standard error 0.01–0.05 s, ICC 0.86–0.95—making it an accurate, reproducible tool for monitoring resisted sprint performance.
4	Sugisaki et al., 2025	Force–velocity relationship, resisted sprinting, nonlinear profiling	Original Article	Load dependency in horizontal force–velocity (F–V) sprint profiles is driven chiefly by increased horizontal force at very low speeds during resisted sprints, while differences between profiling methods stem from force reductions near maximal velocity.
5	Zabaloy et al., 2025	Force–velocity profiling, youth rugby, individualized training	Cross-Sectional Study / Original Article	Comparative analysis of sprint F–V variables in youth rugby players revealed significant position-specific differences (forwards vs backs). Component relationships support the use of F–V profiling to design targeted resisted-sprint programs in adolescent athletes.
6	Perez et al., 2022	Ice hockey, sprint profiling, unloaded vs loaded methods	Original article	Unloaded and multi-load sprint profiling produced comparable F–V profiles in female ice hockey players (no significant differences in F_0, V_0, P_{max}, $V_{op}t$ or SFV slope). Although correlations were high, loaded methods incurred greater error—suggesting unloaded profiling for general screening and loaded profiling for individualized programming.
7	Cahill et al., 2020	Sled-push training, acceleration, youth athletes	Original article	Sled-push training effectively enhanced horizontal force and initial acceleration in youth athletes without negatively affecting maximal speed—making it a valuable method for developing acceleration-specific neuromuscular adaptations.
8	Zedler et al., 2023	Bobsleigh biomechanics, push phase, acceleration	Original Article (Bio-mechanical analysis)	Biomechanical analysis of the bobsled push phase showed that initial push force and joint angles significantly influence acceleration. Improving push technique and synchronicity can therefore optimize overall bobsled performance.
9	Skujytė et al., 2024	Sprint timing, validity, reliability	Original article	Smart timing systems for sprint measurement demonstrated excellent reliability (ICC > 0.90) and validity against reference devices. Temporal and velocity parameters were reproducible, supporting their use in youth testing and training programs.
10	Cahill et al., 2021	Sled-pull training, force–velocity, youth performance	Original article	Post-sled-pull F–V profiling continued to show consistent benefits for acceleration and maximal power. Resisted training maintained effective neuromuscular adaptations in youth athletes, indicating potential long-term effects when implemented in repeated intervention cycles.
11	Zisi et al., 2022	Sled vs vest, resisted sprinting, step frequency	Original article	Both sled and vest resisted sprints produced similar accelerative gains, but the vest had a greater effect on step frequency. Both methods are useful for specific training purposes, with the vest offering a more evenly distributed and controllable load.
12	Cochrane et al., 2021	Sprint profiling, resisted sprinting, short-term training	Original article	Short-term resisted training in youth athletes elicited improvements in horizontal force and drove F_0 and P_{max} toward greater adaptations. It allows precise programming, with sled training offering specific acceleration advantages over free sprinting.
13	Uthoff et al., 2020	Sled-push, youth athletes, acceleration	Original article	Sled-push training in youth athletes increased initial acceleration without compromising maximal speed. The force–velocity profile improved, highlighting the importance of these adaptations during sport-specific athletic development phases.
14	Cusano et al., 2025	Sprint resisted, youth football, performance enhancement	Original article	The eight-week use of the Sprint Resister device significantly improved acceleration over 5–10 m and maximal speed over 20–30 m in young soccer players, yielding a mean performance increase of 15 % versus the control group and demonstrating its effectiveness as a resisted-training tool.

as the 1080 Sprint system, have shown high validity and reliability, and force–velocity profiling uncovers load-specific adaptations that support individualized loading strategies based on athlete role, age and sport discipline (Ceruso et al. 2019; D'Elia et al. 2021). The Sprint Resister device, used over eight weeks, significantly enhanced acceleration (5–10 m) and maximal speed (20–30 m) in youth soccer players, while sled-pull interventions consistently improved acceleration and maximal power as evidenced by post-training force–velocity profiles. These findings underscore the importance of matching the training tool to the targeted adaptation. Finally, comparative analyses of sprint force–velocity variables across playing positions reveal significant role-dependent differences, reinforcing the need for personalized training prescriptions.

Methodological Limitations

This review was limited to a single database (Scopus), which may have constrained the comprehensiveness of the literature search. Future reviews should consider additional databases and include elite female athletes to broaden the applicability of the findings.

Practical Implications

Resisted sprint training with loads that induce approximately a 50 % velocity decrement has been shown to be particularly effective for enhancing initial acceleration over 5–30 m (Stavridis et al., 2023; Espasa et al., 2025). Motorized force–velocity profiling systems enable precise individualization of training loads based on F_0, V_0 and P_{max} parameters, thereby optimizing transfer to sport-specific performance (Rakovic et al., 2022). When selecting between sled towing and weighted-vest protocols, practitioners should align the choice with the primary training objective: sled towing preferentially augments horizontal force production, whereas vest loading increases step frequency without compromising running mechanics (Zisi et al., 2022). It is advisable to implement 1–2 weekly resisted-sprint sessions organized in 4–8-week blocks followed by a taper to consolidate neuromuscular adaptations while preserving free-sprint maximal velocity (Esposito et al.2019; Morin et al., 2017). In youth athletes, moderate-load protocols safely promote gains in acceleration and explosive power while maintaining technique and minimizing injury risk (Cahill et al., 2020). Continuous monitoring via kinematic and kinetic analyses is essential for assessing program efficacy and for making timely technical corrections that enhance competitive transfer (Cross et al., 2018). Moreover, integrating resisted sprints on slight inclines (3–5°) emphasizes horizontal force production and further improves acceleration under gravitational loading (Cross et al., 2016). Incorporating variable-inertia (flywheel) devices in resisted-sprint drills promotes enhanced eccentric loading, yielding greater muscular-strength increases compared with traditional methods (Norrbrand et al., 2010). The use of wearable monitoring systems to capture velocity, acceleration and joint-angle data allows real-time load adjustments, thereby increasing training effectiveness (Luteberget & Spencer, 2017). Tailoring resisted loads according to each athlete's individual force–velocity profile, rather than applying fixed percentages, optimizes neuromuscular adaptations and reduces overload risk (Samozino et al., 2016). Contrast-training sessions that alternate resisted and unresisted sprints exploit post-activation potentiation to boost peak velocity (Turner et al., 2015). Structuring recovery intervals based on physiological or subjective fatigue markers ensures adequate muscle regeneration and prevents performance plateaus (Dupont et al., 2004). Incorporating horizontal plyometric exercises—such as run-up long jumps—reinforces force transmission during the sprint push phase (Spiteri et al., 2013). Finally, a targeted post-training nutrition plan supplying rapidly absorbed proteins and carbohydrates supports neuromuscular recovery and maximizes adaptations to resisted-sprint training (Kerksick et al., 2018).

Conclusions

Resisted sprint training is an effective method for improving acceleration and neuromuscular power. Its success depends on precise load calibration, the deployment of valid profiling instruments and individualized programming tailored to athletes' roles, ages and sport disciplines. In team sports, decisive actions—such as intercepting opponents and finishing plays—rely on the ability to accelerate quickly and sustain high speeds, often under external resistances and during changes of direction. Resisted-sprint protocols replicate many real-game scenarios, making them well suited both to simulate match conditions and to enhance the neuromuscular qualities specific to competitive sprinting. The critical analysis of common and specific aspects across various resisted-sprint methodologies provides actionable guidelines for optimizing acceleration velocity, explosive power and step frequency in diverse sporting contexts.

Conflict of Interest

The author has no conflict of interest.

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Застосування протоколів зі спринту з опором для покращення прискорення в командних видах спорту: Дані систематичного огляду

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 7 с., 2 табл., 1 рис., 50 джерел.

Історія питання. У командних видах спорту вирішальні дії, як-от прогнозування реалізації схем суперників і досягнення цілей гри, залежать від здатності до швидкого прискорення та підтримання високих показників швидкості, що часто відбувається в умовах зовнішнього опору та під час зміни напрямку руху. Для моделювання цих умов та розвитку специфічних для спринту нервово-м'язових якостей, необхідних у змагальних умовах, запропоновано застосування тренувань зі спринту з опором.

Мета дослідження. Мета цього дослідження полягала в критичному вивченні через систематичний підхід різних методологій спринту з опором (тренування із використанням силових саней, моторизовані системи), що застосовуються в командних видах спорту, задля отримання практичних рекомендацій щодо оптимізації швидкості прискорення та вибухової сили.

Матеріали та методи. Відповідно до рекомендацій із пріоритетних елементів звітування для систематичних оглядів та метааналізів (PRISMA) проведено огляд літератури у наукометричній базі даних Scopus (2020–2025) за ключовими словами «спринт з опором», «тренування із використанням силових саней» та «спринт з додатковим навантаженням». Після перегляду 103 записів та аналізу 56 повних текстів статей, залежно від мови, типу статті та релевантності тематиці, було включено 14 досліджень (13 оригінальних наукових статей та 1 метааналіз).

Результати. Згідно з отриманими результатами, встановлено, що застосування протоколів тренувань із використанням силових саней, які відповідають 50 % зниженню швидкості або навантаженням приблизно 10–13 % від маси тіла, сприяло значному поліпшенню показників прискорення на дистанції 5–30 м, створенню горизонтальної сили та максимальної вихідної потужності. Інструменти профілювання (наприклад, система 1080 Sprint) довели свою ефективність і надійність, тоді як профілювання сили та швидкості виявило адаптації до конкретних навантажень, що підтримують індивідуалізоване навантаження з урахуванням функції спортсмена, віку та спортивної дисципліни.

Висновки. Результати дослідження свідчать про ефективність тренувань спринту з опором у покращенні прискорення та нервово-м'язової потужності в командних видах спорту. Оптимальні результати залежать від точного калібрування навантаження, використання надійних інструментів профілювання та індивідуальних програм, розроблених з урахуванням конкретних потреб спортсменів та їхніх дисциплін.

Ключові слова: спринт з опором, тренування із використанням силових саней, профілювання сили та швидкості, прискорення, командні види спорту.

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