

APPLICATION AND PRACTICAL RELEVANCE OF VERTICAL FORCE-VELOCITY PROFILING FOR OPTIMIZING PERFORMANCE IN TEAM SPORTS: A SYSTEMATIC REVIEW

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Abstract Vertical force–velocity (F–V) profiling is widely used to assess athletes' neuromuscular capabilities; however, its transfer to sport-specific performance and the effectiveness of individualized interventions remain debated. This systematic review examined the application and efficacy of vertical F–V profiling for optimizing explosive actions such as sprinting, jumping, and change-of-direction performance in team-sport athletes.

Following PRISMA guidelines, a systematic search was conducted across Scopus, Web of Science, and SpringerLink for studies published between January 2020 and December 2025. Thirteen studies met the inclusion criteria (team-sport athletes aged ≥17 years, vertical F–V assessment through loaded jumps, and sport-related performance outcomes) and were included in the qualitative synthesis.

The results indicate that maximum power (P_{max}) is strongly associated with jump performance, whereas its relationship with sprint ability appears more variable and may be influenced by sex and biomechanical specificity. Individualized interventions targeting F–V imbalance generally improved P_{max} and jump performance, but transfer to sprinting was limited and inconsistent across studies. Methodological heterogeneity, particularly in test standardization and the distinction between vertical and horizontal force production, was a key factor affecting outcomes.

Overall, vertical F–V profiling appears useful for optimizing jump performance but shows limited predictive value for sprinting and change-of-direction tasks due to vector specificity. Future research should integrate horizontal profiling and longer intervention periods to better address team-sport demands.

Key words: force–velocity profile; neuromuscular performance; vertical jump; individualized training; team sports

Introduction

In modern team sports, the ability to generate explosive power is a key determinant of athletic performance (Türkarslan & Deliceoglu, 2024). Decisive actions such as sprinting, jumping, and changing direction depend on the neuromuscular system's ability to generate high levels of force and movement velocity in a short time frame (Morin & Samozino, 2016). In this context, characterizing the force–velocity (F–V) profile has become a fundamental approach in sports science (Samozino et al., 2008). This approach provides a framework for assessing athletes' individual mechanical qualities and for prescribing targeted training interventions (Samozino et al., 2012). The vertical F–V profile is particularly valuable in practice for talent identification, monitoring neuromuscular development, and guiding individualized training strategies in team-sport athletes. Analysis of the F–V profile, as measured through loaded jump tests, quantifies the linear relationship between force and velocity (Garcia-Ramos et al., 2019). This approach enables the identification of key variables such as theoretical maximal force (F_0), theoretical maximal velocity (V_0), and maximal power (P_{max}) (Morin et al., 2019). This analysis has also been considered useful for identifying mechanical imbalances and guiding individualized training interventions in athletic populations (Bobbert et al., 2023).

Notwithstanding the burgeoning interest in F–V profiling, there are still significant gaps in the literature. Numerous studies have explored the relationship between the F–V profile and vertical jump performance (Baena-Raya et al., 2022; Ramirez-Campillo et al., 2015), but the transfer of these findings to sprint performance and field-based actions remains less clear, and conclusions are often contradictory (Ettema, 2024). For instance, a robust correlation between vertical F–V profile variables and sprint speed has been demonstrated in certain studies (Jiménez-Reyes et al., 2018), while other research has been unable to substantiate this association or to demonstrate adequate external validity (Lindberg et al., 2021; Wolte et al., 2024). Furthermore, the effectiveness of individualized training protocols based on the F–V profile to correct specific deficits (strength deficit vs. velocity deficit) has not yet been firmly established, particularly for specific populations such as female athletes or young talents in various disciplines (Solberg et al., 2025). To date, there has been a paucity of critical and integrative syntheses of the results of these studies, which could clarify the conditions of application, optimal methodologies, and limitations of this approach.

The primary aim of this systematic review was to evaluate the relevance and practical application of the vertical force–velocity profile and its key variables (F_0 , V_0 , P_{max} , F–V slope, FV_{imb} , and DSI) in explaining and optimizing explosive performance in team sports, including sprinting, jumping, and change-of-direction tasks. A secondary aim was to compare the methodologies and measurement tools used across studies and to identify the most effective

individualized training strategies derived from vertical F–V profiling. It was hypothesized that individualized training based on the vertical F–V profile would improve key neuromuscular qualities (F_0 , V_0 , and P_{max}) and selected explosive performance outcomes in team-sport athletes. It was also hypothesized that the relationship between vertical F–V variables and athletic performance would be influenced by biomechanical task specificity.

Materials and Methods

Study Design

This review was conducted following the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement Page et al. (2021).

Eligibility Criteria

The PICO framework was used to define the following review question: “To what extent does the application of a training intervention based on the vertical force–velocity profile improve explosive performance (sprinting, jumping, and change-of-direction performance) in team-sport athletes?” This framework was also used to guide study eligibility.

Table 1. PICO Search Strategy

P	I	C	O
Male and female team-sport athletes. ≥17 years old	Individualized strength training using the vertical force-velocity profile	Comparison between groups (force vs velocity deficits. different performance levels. pre vs post-intervention)	Primary outcomes: Changes in explosive performance metrics (sprint time, jump height, change-of-direction performance). Secondary outcomes: Changes in mechanical variables of the vertical F–V profile (F_0 , V_0 , P_{max}).

Inclusion Criteria

This review included observational studies (cross-sectional and cohort studies), quasi-experimental studies, and experimental studies that met the following criteria: (i) The study implemented a training intervention or assessment protocol based on the evaluation of the vertical force–velocity profile, as determined through the simple field method proposed by Samozino et al., (2008, 2010) or similar loaded jump protocols (e.g., squat jump or countermovement jump performed with varying external loads). Only vertical F–V profiling methods were included to maintain biomechanical specificity relevant to jumping and sprinting tasks. (ii) Participants were healthy and physically active men or women aged 17 years or older, competing in team sports at any level (elite, amateur, or recreational). (iii) The study reported at least one primary outcome related to sport performance, such as sprinting, jumping, or change-of-direction performance. Studies that additionally reported changes in F–V profile mechanical variables (e.g., F_0 , V_0 , P_{max}) were also included.

Exclusion Criteria

Studies were excluded based on the following criteria:

1. Studies focusing on adults with health problems that prevented sports participation (e.g., osteomuscular pathology, recent surgery, or contusion) or clinical populations.

2. Studies that did not utilize a method to assess the vertical force-velocity profile (e.g., studies using only isometric tests or horizontal sprint profiling without a vertical jump component).
3. Studies that only reported changes in F–V mechanical variables without reporting any functional performance outcomes.
4. Validation studies, literature reviews, systematic reviews, brief reviews, meta-analyses, letters to the editor, comments, and conference abstracts.

Information source

Scopus, Web of Science, and SpringerLink were selected for the literature search.

Search Strategy

A systematic search was conducted across Scopus, Web of Science, and SpringerLink to identify studies investigating the vertical force–velocity profile and its relationship with sport-performance outcomes. The initial search was conducted on April 15, 2024, and was subsequently updated in December 2025 to include newly published and early-access studies. The search covered articles published between January 2020 and December 2025.

The search strategy was as follows: (“The search syntax was adapted to the indexing rules of each database. The core search terms were: (“force–velocity profile” OR “force velocity profiling” OR “vertical force–velocity profile” OR “jump force–velocity profile”) AND (“vertical jump” OR “neuromuscular performance” OR sprint OR “change of direction” OR “team sport” OR “team sports”).

In addition, the reference lists of all included studies were manually screened to identify any further relevant articles.

Data Extraction

The data extraction and analysis process was executed in accordance with a rigorous methodology, ensuring consistent and comprehensive interpretation of the results from the included studies. A standardized grid was employed to systematically collect pertinent information, including the first author name, year of publication, study design and sample size (N), the study population (age, sex, and sporting level), the key parameters of the Force-Velocity profile (F_0 , V_0 , P_{max} , and FV slope) as well as any reported associations between F–V variables and sport-performance outcomes.

Risk of Bias Assessment

The methodological quality of the included studies was assessed using the National Heart, Lung, and Blood Institute (NHLBI) Study Quality Assessment Tools. The specific checklist was selected according to each study design: the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies, the Quality Assessment Tool for Controlled Intervention Studies, or the Quality Assessment Tool for Before-After Studies With No Control Group. Two reviewers (S.K. and K.E.M.) independently assessed each study. Disagreements were resolved through discussion and consensus. Items were rated as •Yes, •No, •Cannot determine, •Not reported, or •Not applicable. Overall quality judgments were based on the reviewers’ evaluation of the potential risk of bias rather than solely on a numerical score.

Study Characteristics and Main Findings

The initial search yielded a total of 965 records from the selected academic databases: Scopus ($n=37$), Web of Science ($n=640$), and SpringerLink ($n=288$). After the removal of duplicate records ($n=428$), 537 unique records remained. In addition, three records were identified through a targeted search for 2025 early-access articles, resulting in a total of 540 records screened. During the screening process, 283 records were excluded based on title and 227 after abstract review. The remaining 30 reports were assessed for eligibility in full text, of which 17 were excluded for not meeting the inclusion criteria. Ultimately, 13 studies were included in the qualitative synthesis. The complete study selection process is presented in Figure 1.

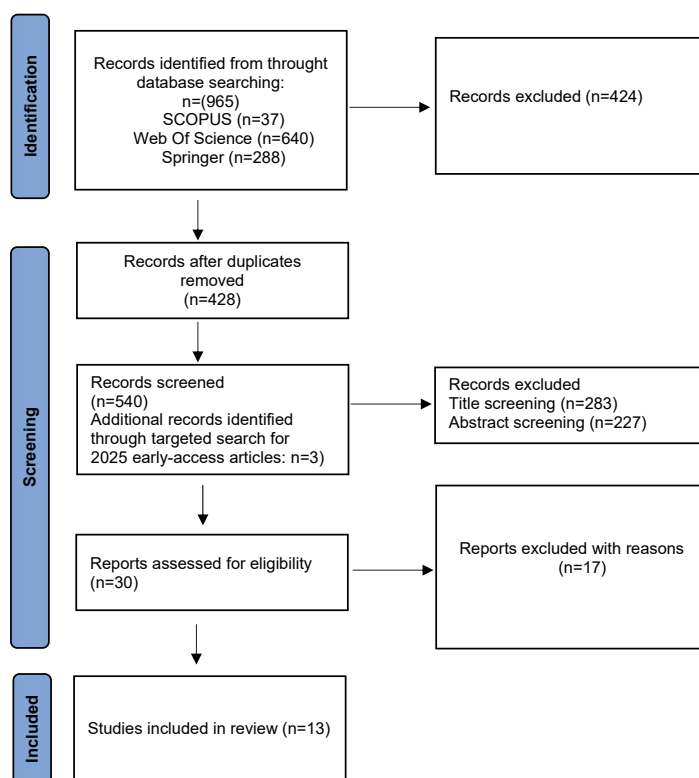


Fig. 1. PRISMA 2020 flow diagram illustrating the study selection process for the systematic review

The included studies were grouped into three main categories according to study design and research purpose: (1) observational studies that described force–velocity (F–V) profiles in specific populations (Conceição et al., 2025; Hicks et al., 2023; Pérez-Ifrán et al., 2024; Qin et al., 2025); (2) correlational studies that assessed associations between F–V profile parameters and specific sport-performance metrics (Manson et al., 2021; Pleša et al., 2021, 2024; Spudić et al., 2024); and (3) experimental studies that evaluated the effects of training interventions on F–V profile parameters and physical performance (Conceição, 2024; Ishihara et al., 2024; Koźlenia et al., 2025; Lindberg et al., 2021; Nishioka & Okada, 2022).

Methodological Quality of Included Studies

The results of the methodological quality assessment are summarized in Table 5. The methodological quality of the included studies varied across study designs. Most studies satisfied several key criteria, including clearly defined research objectives, adequately described populations, appropriate intervention or exposure protocols, and valid outcome measures. However, recurrent methodological limitations included the absence of sample-size justification, limited assessor blinding, insufficient control of potential confounding variables, and incomplete reporting of participant recruitment and retention. These limitations should be considered when interpreting the overall findings of the review.

The following tables summarize the characteristics of the studies included in this systematic review, detailing the programs and outcomes observed.

Table 2. Characterization of vertical force-velocity (F-V) profiles in different athletic populations

Author (Year)	Participants (N, Sex, Age)	Athletic Level	F-V Protocol	F ₀ (N/kg)	V ₀ (m s ⁻¹)	Pmax (W/kg)	F-V slope / FVimb	Key Findings
Hicks et al. (2023)	16-M (8-AT, 8-DF)	Professional (Field Hockey)	CMJ with 3 loads (0%, 25%, 50% BM)	M: 40.16±3.70 F: 34.01±4.60	M: 3.20±0.21 F: 2.79±0.45	M: 32.28±4.31 F: 23.45±3.03	M: -12.52±1.15 F: -12.15±1.64	Significant sex differences. Pmax correlated with jump height (r=0.68 males, r=-0.71 females).
	24.8±7.3 17-F (9-AT, 8-DF) / 22.3±4.2							
Pérez-Ifrán et al. (2024)	10 M (18.9±0.3)	Professional (Rugby)	Loaded SJ (progressive loads)	29.5±5.3	3.81±0.97	27.3±4.4	-8.6±4.0	Pmax strongly correlated with SJ height (r=0.76). High prevalence of velocity deficit in youth players.
Conceição et al. (2025)	38 M (17.1±0.9)	Professional (Soccer)	Loaded CMJ (0, 30, 50, 70% BM)	D1 : 33.58±3.85 D2 : 32.27±3.45 1.08 (p > 0.05)	D1 : 3.18±0.50 D2 : 3.96±1.14 * 2.88 (p > 0.05)	D1 : 26.95±4.17 D2 : 31.54±6.45 * 2.67 (p < 0.05)	D1 : -83.05±20.34 D2 : -62.94±21.28	1st division players had more balanced profiles. Forwards more balanced than midfielders. 76% of players exhibited a force deficit. No differences in jump height.
Qin et al (2025)	SG 10-M/ 22.9±2.1	Professional (resistance-trained)	Loaded SJ (progressive loads)	Stronger group: SJ70: 2.627±296 SJ90: 2.820±261 SJ110: 3.141±501	Stronger group: SJ70: 3.54±0.69 SJ90: 3.33±0.58 SJ110: 3.23±1.31	Stronger group: SJ70: 2.292±318 SJ90: 2.325±330 SJ110: 2.421±653	Stronger group: SJ70: 782±241 SJ90: 883±241 SJ110: 1142±526	Significant between-group differences in F ₀ , V ₀ , and Pmax (p<0.05). Supports F-V profiling for talent identification
	WG 11-M/ 22.9±2.3							
				Weaker group: SJ70: 2.461±308 SJ90: 2.615±308 SJ110: 2.806±557	Weaker group: SJ70: 2.70±0.46 SJ90: 2.75±0.54 SJ110: 2.71±0.62	Weaker group: SJ70: 1.648±303 SJ90: 1.782±325 SJ110: 1.885±396	Weaker group: SJ70: 950±268 SJ90: 1000±310 SJ110: 1125±545	

As summarized in Table 2, observational studies identified several relevant characteristics of force–velocity (F–V) profiles in team-sport athletes. Hicks et al., (2023) reported clear sex-related differences, with male athletes showing higher theoretical force (F_0), theoretical velocity (V_0), and maximal power (Pmax) values than female athletes. Pérez-Ifrán et al., (2024) described a high prevalence of force deficits in under-20 rugby players, emphasizing the importance of individualized mechanical profiling in youth populations. Similarly, Conceição et al., (2025) showed that first-division soccer players presented more balanced F–V profiles than second-division players, suggesting that profile balance may be associated with competitive level.

Table 3. Correlational Studies Relationships between F–V variables and specific performance metrics

Author (Year)	Participants	F–V Variables Measured	Performance Tests	Significant Correlations
Manson et al. (2021)	39 F (24.3±4.7)	F_0 . V_0 . Pmax. FVimb	Sprint (ACC. MSS). CMJ	Pmax ↔ ACC ($r=-0.44$) / CMJ ↔ MSS ($r=-0.67$) / Weaker links between vertical F–V profile and sprint performance in female athletes.
Pleša et al. (2021)	37 M (21.8±3.9)	F_0 . V_0 . Pmax (CMJ)	25m Sprint. T-test. Jump	Pmax ↔ 25m Sprint ($r=-0.93$) / Pmax ↔ T-test ($r=-0.58$) / Sprint-derived F–V metrics were strong predictors of jumping performance.
Pleša et al. (2024)	19 M. 9 F (25.2±3.9)	F_0 . V_0 . Pmax. Slope (SJ & CMJ)	Dynamic Strength Index (DSI)	DSI90 ↔ Pmax ($r=0.550.69$) / DSI30 ↔ V_0 ($r=0.43-0.44$) / DSI proposed as a practical alternative to F–V profiling.
Spudić et al. (2024)	326-M / 17 143-F / 17.4	F_0 . V_0 . Pmax (CMJ)	(CMJ. CoD90 and CoD180) and FvP	No significant correlations were found between the F–V variables from flywheel squats and performance in the CMJ or CoD tests.

Table 3 summarizes correlational studies examining the relationships between F–V variables and sport-performance outcomes. Pleša et al. (2024) reported a substantial association between the dynamic strength index (DSI) and the F–V profile, suggesting that DSI may represent a pragmatic alternative for performance assessment. Manson et al. (2021) and Pleša et al. (2021) reported significant relationships between maximal power (Pmax) and sprint-related performance, although Manson et al. (2021) highlighted weaker associations in female athletes. In contrast, Spudić et al. (2024) found no significant correlations between flywheel-derived F–V variables and jump or change-of-direction performance, highlighting the methodological specificity of assessment tools.

Table 4. Interventional Studies Effects of individualized training based on F–V profil

Author (Year)	Participants	Duration	Intervention Type	Group / Profile Targeted	Key Outcomes
Lindberg et al. (2021)	40 M (20±4)	10 weeks	Individualized training (Force. Optimal. Velocity)	Force-deficient → Balanced → Velocity-deficient	Pmax: +7.8% (Balanced). -2.0% (Velocity). Training towards optimal profile showed greatest power gains.
Nishioka & Okada (2022)	10 M (21.9±1.8)	Acute Protocol	Post-Activation Performance Enhancement (PAPE)	Bilateral Eccentric-Concentric (BEP) vs. Horizontal Resistance (HRP)	Pmax significantly increased in BEP group (p=0.009). highlighting protocol specificity.
Ishihara et al. (2024)	82 M (20.7±1.5)	6 weeks	Deficit-specific training (Force vs. Velocity)	Velocity-deficit: Pmax +4.0% / Force-deficit: Pmax +7.3%	Targeted interventions effectively improved Pmax in the respective deficit groups.
Conceição et al. (2024)	38 M (17.1±0.9)	6 weeks	Individualized training	Correction of F–V imbalance	Significant increase in Pmax from Day 1 to Day 2 (p<0.05) following intervention.
Koźlenia et al. (2025)	25 M (~24 years)	Acute Protocol	PAPE (Force- vs. Velocity-dominant)	PAPE-F (Force) vs. PAPE-V (Velocity)	Pmax increased in PAPE-F group (r=0.63. p=0.03). Supports specific potentiation protocols.

As demonstrated in Table 4, research conducted by Lindberg et al. (2021) and Ishihara (2024) indicates that targeted training programmes are efficacious in correcting F–V imbalances and optimising maximum power (Pmax). These results suggest potential value in training programmes tailored to athletes' specific requirements, though the evidence remains mixed. Furthermore, research on post-activation potentiation (PAPE) protocols, such as that conducted by Nishioka & Okada, (2022) and Koźlenia et al., (2025), reveals that utilising an F–V profile-based approach can also result in substantial performance enhancements.

Table 5. Risk of bias assessment of included studies

Author & Year	Study Type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Quality Rating
Observational Cross-Sectional Studies																
Manson et al. (2021)	Observational	Yes	Yes	NA	Yes	NR	Yes	NA	Yes	Yes	NA	Yes	No	Yes	Yes	9
Pleša et al. (2021)	Observational	Yes	Yes	NA	Yes	NR	Yes	NA	Yes	Yes	NA	Yes	No	Yes	Yes	9
Hicks et al. (2023)	Observational	Yes	Yes	NA	Yes	NR	Yes	NA	Yes	Yes	NA	Yes	No	Yes	Yes	9
Pleša et al. (2024)	Observational	Yes	Yes	NA	Yes	NR	Yes	NA	Yes	Yes	NA	Yes	No	Yes	Yes	9
Pérez-Ifrán et al. (2024)	Observational	Yes	Yes	NA	Yes	NR	Yes	NA	Yes	Yes	NA	Yes	No	Yes	Yes	9
Spudić et al. (2024)	Observational	Yes	Yes	NA	Yes	Yes	Yes	NA	Yes	Yes	NA	Yes	No	Yes	Yes	10
Conceição et al. (2025)	Observational	Yes	Yes	NA	Yes	Yes	Yes	NA	Yes	Yes	NA	Yes	No	Yes	Yes	10
Randomized Controlled Trials (RCT)																
RCT – 3 Parallel Groups																
Lindberg et al. (2021)	RCT – 3 Parallel Groups	Yes	Yes	NR	NR	NR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
RCT – Crossover																
Nishoka & Okada (2022)	RCT – Crossover	Yes	Yes	NR	NR	NR	Yes	Yes	Yes	Yes	Yes	Yes	NR	Yes	Yes	10
RCT – Parallel Groups																
Kozłenia et al. (2025)	RCT – Parallel Groups	Yes	Yes	NR	NR	NR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	11
Non-Randomized Intervention Studies (Quasi-Experimental)																
Intervention – No Control Group																
Ishihara et al. (2024)	Intervention – No Control Group	Yes	NR	NR	NR	NR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10
Quasi-Experimental																
Conceição et al. (2024)	Quasi-Experimental	Yes	Yes	Yes	Yes	NR	Yes	Yes	No	Yes	Yes	Yes	Yes	-	-	11
Quasi-Experimental																
Qin et al. (2025)	Quasi-Experimental	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	-	-	11

Observational, Cohort, and Cross-Sectional Studies: 1. Clear description of the study objective; 2. Study population clearly specified and defined; 3. ≥50% participation rate of eligible individuals; 4. Uniformly applied and specified selection criteria; 5. Sample size justification provided; 6. Exposure measured before the outcome; 7. Sufficient time frame to expect exposure-outcome association; 8. Different levels of exposure examined; 9. Clearly defined, valid, and reliable exposure measure; 10. Exposure assessed more than once over time; 11. Clear definition of outcome measures; 12. Outcome assessors blinded to participants' exposure status; 13. Loss to follow-up after baseline less than 20%; 14. Adjustment for potential confounding variables.

Randomized Controlled Trials (RCTs): 1. Study described as randomized; 2. Adequate randomization method reported; 3. Concealment of treatment allocation; 4. Participants blinded; 5. Outcome assessors blinded to group assignments; 6. Groups similar at baseline; 7. Overall dropout rate <20%; 8. Differential dropout rate between groups <15%; 9. High adherence to assigned protocols; 10. External interventions avoided or similar between groups; 11. Use of reliable measurement tools; 12. Sample size justification provided; 13. Outcomes or subgroups clearly specified; 14. Analysis performed by intention-to-treat.

Quasi-Experimental Studies: 1. Clear description of the study objective; 2. Eligibility criteria clearly specified and defined; 3. Participants representative of the target population; 4. Eligible participants included consistently; 5. Sufficient sample size to ensure adequate statistical power; 6. Clear description of the intervention; 7. Outcome measures clearly defined and reliable; 8. Outcome assessors blinded to participants' status; 9. Overall dropout rate <20%; 10. Appropriate statistical analysis for pre- vs. post-intervention comparisons; 11. Multiple outcome measurements over time; 12. Group-level effects reported in statistical analysis.

Discussion

Force-velocity (F-V) profile analysis has become an integral component of contemporary performance assessment and physical training in team sports such as soccer, rugby, and basketball (Baena-Raya et al., 2022). This discussion is based on the synthesis of 13 studies included in the present systematic review and aims to critically interpret the principal findings regarding the evaluation and practical application of the vertical F-V profile in team-sport athletes.

The majority of studies conducted on the subject (Conceição, 2024; Hicks et al., 2023; Koźlenia et al., 2025; Manson et al., 2021; Pleša et al., 2024) converge to indicate that the key variables of the vertical F-V profile (theoretical maximum force F_0 , theoretical maximum velocity V_0 , maximum power P_{max} , and slope of the F-V relationship) are relevant indicators of neuromuscular qualities (Samozino et al., 2012). P_{max} has been shown to be a reliable predictor of vertical jump performance (Manson et al., 2021; Pérez-Ifrán et al., 2024). Research has demonstrated a substantial correlation between P_{max} and vertical jump height, thereby validating its role as a reliable metric for evaluating athletic capability (Pérez-Ifrán et al., 2024). These results are consistent with the research of Jiménez-Reyes et al., (2022), which highlights the importance of power as a predictor of explosive performance in various team sports. However, its role becomes more complex when the subject is sprinting (Cross et al., 2017). A significant point of convergence is the pervasive observation of a strength deficit in young athletes (Conceição et al., 2025; Pérez-Ifrán et al., 2024). These findings suggest that more than 75% of young soccer players may present an imbalanced profile oriented toward velocity, with a similarly high prevalence also reported among rugby players.

The evidence regarding training efficacy presents notable inconsistencies. While research by Conceição (2024) and Ishihara (2024) reports improvements following individualized training, it is important to balance these positive findings against contradictory evidence. Lindberg et al., (2021) found no significant advantage of F-V profile-based individualization over non-individualized training, suggesting that the benefits may not be as consistent as sometimes presumed. This discrepancy raises important questions regarding the relative importance of correcting F-V imbalance versus increasing overall power output (Solberg et al., 2025). It is important to note that the duration of the interventions and the population studied could be explanatory factors (Jiménez-Reyes et al., 2014).

In recent research on athletic performance, a recurring question concerns the specificity of F-V profiles in various sports, particularly those involving repetitive actions such as football and rugby. Research has indicated that, in order to enhance performance and mitigate the risk of injury, a training programme that concurrently incorporates vertical (e.g. squats, jumps, plyometric exercises) and horizontal (e.g. sled towing, assisted sprints) exercises is imperative (Falces-Prieto et al., 2021). The findings of this review, which focused exclusively on the vertical profile, indicate a limited transfer to sprinting and change-of-direction performance, consistent with the principle of task- and vector-specificity. This lack of robust transfer is consistent with the principle of specificity and with emerging literature suggesting that horizontal locomotion actions may be better predicted by specific horizontal F-V profiles (Hicks et al., 2023; Pleša et al., 2021). This observation remains speculative within the context of our findings, as the horizontal profile was outside the scope of this systematic review. Therefore, the key conclusion from our analysis is that the vertical F-V profile is a task-specific tool.

Future research should integrate concurrent assessment of vertical and horizontal profiles to clarify their respective contributions to overall sports performance (Jiménez-Reyes et al., 2018). A notable observation from the study by Pleša et al., (2021) is that sprint variables demonstrated a significant predictive capacity for running

jump performance. This particular finding, while intriguing, originates from a single study and warrants replication in broader and more varied athletic populations. It does not overturn the general principle of vector specificity, which is strongly supported by the body of evidence synthesized in this review, but it suggests that the interactions between vertical and horizontal qualities may be complex and merit further investigation. Moreover, the study by Spudić et al., (2024) draws attention to a further significant discrepancy. The findings of this study demonstrate an absence of a substantial correlation between F–V variables derived from a test utilizing an inertial device (flywheel) and performance in vertical jump (CMJ) or change of direction. The lack of correlation observed by Spudić et al., (2024) between flywheel-derived F–V variables and functional performance highlights the methodological specificity of assessment tools. The absence of significant relationships suggests that F–V variables obtained from flywheel squats may not adequately capture the neuromuscular qualities required for jumping and change-of-direction tasks. This finding reinforces the importance of selecting assessment methods that closely match the target performance outcomes.

An important aspect of the present discussion concerns the testing protocols and measurement tools used to derive the vertical F–V profile. Qin et al. (2025) examined squat jumps performed from starting knee angles of 70°, 90°, and 110°. Their findings suggest that standardizing the push-off distance to the value corresponding to a 90° knee angle may reduce variability and improve comparability between participants. The objective of this approach is to reduce variability and enhance the reliability of the simplified method developed by Samozino et al., (2013). Concurrently, the study by Pleša et al., (2024) proposes that the Dynamic Strength Index (DSI) might serve as a valid and safe substitute for the F–V profile in training guidance. However, the study by Conceição et al., (2025) demonstrates that jump height, considered in isolation, is not sufficient to detect F–V imbalances a finding also supported by Bobbert et al., (2023). Indeed, the assessment of these imbalances necessitates a more rigorous approach, particularly through multiple load tests, in order to obtain a comprehensive characterization of physical abilities.

While the exact mechanisms underlying these observations were not directly investigated in the included studies, several theoretical frameworks may help interpret these findings. The disparities between the results obtained in different studies can be attributed to several factors. A thorough examination of the study population illuminates the most salient aspects of this dynamic. As demonstrated in the study by Hicks et al., (2023), responses to a training protocol vary according to performance level (elite vs. amateur), age (youth athletes vs. adults), and gender, highlighting the importance of tailoring vertical F–V interventions to individual characteristics. It is important to note that training protocols vary in terms of duration (between six and ten weeks), volume, and intensity. Seasonal timing may also influence neuromuscular adaptations, as suggested by previous longitudinal studies in team-sport athletes (Hostrup et al., 2019; Jiménez-Reyes et al., 2017). Furthermore, it should be noted that performance tests may vary, which can lead to potentially contradictory results. For instance, an enhancement in CMJ does not necessarily signify progression in sprinting (Ishihara, 2024), thereby reinforcing the relative independence of vertical and horizontal force–velocity (F–V) profiles.

The hypothesis that training specificity is more pronounced for jumping than sprinting finds support in fundamental biomechanical differences between movement vectors. Vertical jumping primarily involves concentric knee extension with minimal horizontal displacement, making it highly responsive to vertical F–V profile optimization. In contrast, sprinting requires efficient force application in a horizontal direction, engaging different muscle groups and neural coordination patterns (Fernández-Galván et al., 2021). This explains why interventions based on vertical

profiling show clearer effects on jump performance compared to sprint outcomes. The scientific literature reports a fundamental distinction between vertical and horizontal F–V profiles (Hicks et al., 2023; Pleša et al., 2021). The research team Pleša et al., (2021) has demonstrated that jumping performance is directly correlated with the vertical profile. Conversely, sprinting and change-of-direction performance are predominantly influenced by horizontal qualities. The findings of this analysis demonstrate that interventions grounded in the vertical F–V profile, encompassing exercises analogous to those employed in the assessment test (bar jumps), provide a more direct application and more unambiguous results.

The findings of this review suggest that F–V profiling shows promise for individualising physical training regimens, particularly for vertical jump performance, though the evidence for its efficacy across all performance domains is not uniform. These findings have clear practical value for coaches and practitioners, offering actionable guidance for optimising training strategies in young and elite athletes. Coaches may consider prioritising the development of maximum strength, given the prevalence of detected strength deficits in young players (Faigenbaum & Myer, 2010), while recognizing that the optimal training approach may vary between individuals. This should encourage the incorporation of heavy strength training (>70% 1RM) into annual planning (Androulakis-Korakakis et al., 2020). Furthermore, it is imperative to personalise training by taking into account the independence of profiles, both vertically and horizontally. Moreover, the assessment of eccentric power can provide a valuable addition to the analysis of essential abilities in deceleration and change of direction manoeuvres.

Limitations and Methodological Considerations

This review synthesizes current evidence on force-velocity profiling, but several limitations must be acknowledged. Although this review primarily targeted studies published between 2020 and 2025, some recently indexed or early-access publications may still have been missed despite the updated search strategy. Second, the focus exclusively on the vertical force-velocity profile, while justified by methodological standardization, means the review cannot fully address the critical interplay between vertical and horizontal force production. Furthermore, the findings must be interpreted considering the methodological characteristics of the included studies. The quality assessment revealed a generally high standard; however, common limitations such as the frequent absence of participant blinding in interventions and occasional lack of sample size justification should be acknowledged. These factors may introduce potential for performance bias and limit the generalizability of some results.

Conclusion

This systematic review shows that the practical usefulness of vertical force–velocity profiling depends largely on the specificity of the motor task being assessed. The synthesized evidence supports its usefulness for optimizing vertical jump performance, an area in which personalised vertical F–V profiling can inform tailored training interventions to systematically enhance power output. However, its application to sprinting and change-of-direction performance remains limited, underscoring the task-specific nature of vertical F–V profiling.

In practice, these results suggest that vertical profiling should be routinely complemented by horizontal assessments to guide training decisions. Future research should integrate these two dimensions through longitudinal studies to validate multidirectional approaches to individualisation, particularly among women and at different levels of competition.

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