Integrating Interval Sprint, Plyometric, and ABC Running Drills for Sprint-Speed Development in Physically Disabled (Tuna Daksa) Para-Athletes: A Narrative Review and Conceptual Framework

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ABSTRACT:

Sprint speed is the principal determinant of para-athletics sprint performance, yet training for physically disabled (tuna daksa) athletes is often adapted ad hoc from programmes designed for non-disabled athletes, and the theoretical basis for integrating multiple speed-training methods in this population remains underdeveloped. This narrative review synthesises evidence on three well-supported speed-training methods interval sprint training, plyometric training, and acceleration balance coordination (ABC) running drills and their mechanistic links to the determinants of sprint speed, and proposes an integrated, disability-specific conceptual framework. Peer-reviewed literature on sprint biomechanics, exercise physiology, para-athletics classification, and each training method was reviewed and organised around the two mechanical determinants of speed (step length and step frequency) and their underlying force, neuromuscular, and coordinative bases. Interval sprint training primarily targets anaerobic capacity and maximal velocity; plyometric training targets the stretch-shortening cycle, rate of force development, and step length; and ABC running drills target coordination, technique, and step frequency. We argue that these methods are complementary rather than redundant, and that their integrated, classification-informed application with dosage and progression adapted to the postural characteristics and functional limitations of tuna daksa athletes provides a coherent basis for speed development. A conceptual framework is presented that links each method to specific determinants and to disability-specific adaptation principles. The framework offers coaches a theoretically grounded structure for programme design and outlines an agenda for controlled, classification-stratified research.

Keywords: para-athletics; sprint speed; interval sprint; plyometric training; ABC running; conceptual framework; physical disability.AIdriven marketing; digital real estate; Bangalore; residential housing; market dynamics.

1. Introduction

Para-sport has grown substantially in visibility and competitiveness, and scientific classification systems together with assistive technology have progressively narrowed the performance gap between disabled and non-disabled athletes (Tweedy & Vanlandewijck, 2011; Burkett, 2010). Nevertheless, athletes with disabilities frequently train under constraints in funding, facilities, and sport-science support (Misener & Darcy, 2014), and disability-specific training methods remain comparatively underdeveloped. In para-athletics sprint events, speed is the dominant determinant of performance, making the development of speed a central concern for coaches of physically disabled (tuna daksa) sprinters.

Biomechanically, running speed is the product of step length and step frequency, which in turn depend on force production, neural recruitment, and limb morphology. Three training methods are each individually well supported for developing these qualities. Interval sprint training enhances anaerobic capacity and maximal running velocity (Boullosa et al., 2022; Koral et al., 2017). Plyometric training exploits the stretch-shortening cycle to increase muscular power and sprint speed (Kons et al., 2023; Xu et al., 2025). Acceleration, balance, and coordination (ABC) running drills improve running technique and coordination (Setyantoko et al., 2019). However, these methods have largely been examined in isolation and in non-disabled populations, and their integrated, disability-specific application to tuna daksa sprinters lacks an explicit theoretical rationale (Asare, 2024; Brand, 2022).

This gap matters because non-adapted training, transferred wholesale from non-disabled programmes, is unlikely to address the specific postural characteristics, functional classifications, and neuromuscular profiles of tuna daksa athletes (Solovjova et al., 2014; Zemková & Zapletalová, 2022). A coherent conceptual account of why and how the three methods should be integrated and adapted for this population would help coaches move from ad hoc practice toward theoretically grounded programme design. Accordingly, this narrative review has two aims: (1) to synthesise the evidence and mechanisms linking interval sprint, plyometric, and ABC running drills to the determinants of sprint speed; and (2) to propose an integrated, disability-specific conceptual framework for sprint-speed development in tuna daksa para-athletes.

2. Review approach

This is a narrative (non-systematic) review intended to synthesise theory and evidence and to derive a conceptual framework. Peer-reviewed journal articles, meta-analyses, and authoritative texts were identified through academic databases (e.g., Scopus, PubMed, and Google Scholar) using combinations of terms such as “sprint speed”, “interval sprint”, “plyometric”, “ABC running”, “para-athletics”, “classification”, and “physical disability”. Sources were selected for relevance to sprint-speed determinants, to the three training methods, or to para-athletics classification and disability-specific training. Evidence was organised around the two mechanical determinants of sprint speed step length and step frequency and integrated into a conceptual framework. As a narrative review, the synthesis is interpretive rather than exhaustive, and no formal quality appraisal or meta-analysis was undertaken.

3. Determinants of sprint speed in para-athletics

3.1 Biomechanical determinants

Sprint velocity is determined by the interaction of step length and step frequency. Step length depends primarily on the magnitude and orientation of ground reaction forces generated during the stance phase, whereas step frequency depends on the rapidity of the stance–

swing cycle and on inter-limb coordination. In tuna daksa athletes, impairment or asymmetry of the limbs can alter both determinants: reduced or asymmetric force production limits step length, while altered coordination and swing mechanics constrain step frequency. Where prostheses are used, energy-return characteristics further shape step mechanics. Any speed-training model for this population must therefore address both force-related and coordinative bases of speed.

3.2 Functional classification

Para-athletics employs a functional classification system to ensure fair competition; ambulant sprinters compete in standing classes (for example, lower-limb classes T42–T44 and upper-limb classes T45–T47), while athletes competing with prostheses are grouped in dedicated classes (Tweedy & Vanlandewijck, 2011). Classification is not merely an administrative category: it reflects meaningful differences in the biomechanical and physiological demands placed on athletes, and hence in the training loads and movement adaptations that are appropriate. Assistive technology adds a further dimension, as equipment can influence both performance and the mechanics of training (Burkett, 2010). A disability-specific training framework should therefore be classification-informed, matching dosage and drill selection to the athlete's functional class.

3.3 Physiological and neuromuscular bases

Sprint performance relies heavily on the anaerobic energy systems and on the capacity of the nervous system to rapidly recruit type II muscle fibres. Key trainable qualities include maximal velocity, the rate of force development, and the efficiency of the stretch-shortening cycle. In athletes who have previously trained with generic, low-stimulus methods, the potential for neuromuscular adaptation may be substantial, provided the training stimulus is sufficient and appropriately targeted. This adaptive potential is central to the rationale for integrated, progressively loaded speed training in tuna daksa athletes.

4. Evidence for the three training methods

4.1 Interval sprint training

Interval sprint training consists of short, near-maximal sprints interspersed with recovery. Across trials and meta-analyses, such training reliably enhances anaerobic capacity, maximal running velocity, and aerobic power, with the balance of adaptations shifting according to work duration and recovery (Boullosa et al., 2022; Koral et al., 2017). Even brief programmes can improve running performance in trained athletes (Beattie et al., 2014), and high-velocity work has been associated with meaningful gains in maximal running velocity (Haleva et al., 2023; Skoglund et al., 2023). These adaptations map onto the maximal-velocity component of sprinting and, by extension, onto both step length and step frequency at high speeds.

4.2 Plyometric training

Plyometric training uses rapid, powerful movements preceded by a counter-movement to exploit the stretch-shortening cycle, thereby increasing muscular power, jump performance, and sprint speed (Di Lascio et al., 2026; Kons et al., 2023). Combined strength and plyometric work has been linked to improvements in lower-limb stiffness and jump performance (Xu et al., 2025), and integrated plyometric–sprint programmes can enhance physical performance in team-sport athletes (Lin et al., 2025; Zhang et al., 2026). Mechanistically, plyometric training raises the rate of force development and improves the efficiency of the stretch-shortening cycle, which increases ground reaction force during stance and thus supports greater step length and stronger acceleration.

4.3 ABC running drills

Acceleration, balance, and coordination (ABC) running drills are graded movement tasks progressing from simple to complex that refine running technique and coordination. Game-based ABC running has been shown to improve 30-m sprint times in children (Setyantoko et al., 2019), and technique-oriented drills more broadly support running economy and movement efficiency. By improving coordination and the timing of the stance swing cycle, ABC drills chiefly enhance step frequency and the efficiency with which force is transmitted.

4.4 Integrated interventions

A growing body of work indicates that combining sprint-oriented methods can produce additive benefits: integrated sprint and plyometric interventions have been reported to enhance sprint performance (Khan et al., 2026), and systematic reviews of short-distance sprint training support multi-modal programming (Wang et al., 2026). However, such integrated programmes have rarely been designed for, or evaluated in, physically disabled athletes, underscoring the need for a disability-specific conceptual account.

5. Toward an integrated, disability-specific conceptual framework

The three methods are best understood as complementary rather than redundant, because each principally targets a different pathway to the same outcome. Interval sprint training develops the anaerobic and maximal-velocity basis of speed; plyometric training develops the force and stretch-shortening-cycle basis of step length and acceleration; and ABC running drills develop the coordinative basis of step frequency and movement efficiency. Table 1 maps each method to its primary mechanisms, targeted determinants, and disability-specific adaptation considerations, and Figure 1 presents the integrated framework.

Table 1. Mapping of training methods to mechanisms, speed determinants, and disability-specific adaptations

Method	Primary mechanism	Targeted determinant	Adaptation for tuna daksa
Interval sprint	Anaerobic capacity; maximal velocity; fast-fibre recruitment	Maximal velocity (step length and frequency at high speed)	Adjust distance/intensity to functional class; ensure safe acceleration/deceleration space
Plyometric	Stretch-shortening cycle; rate of force development; power	Step length; acceleration	Control ground-contact volume; provide supports; progress from low to high intensity
ABC running	Coordination; running technique; movement efficiency	Step frequency; efficiency	Simplify then progress movement complexity to suit postural/functional limitations

Note. Determinants follow the step-length × step-frequency model of sprint speed.

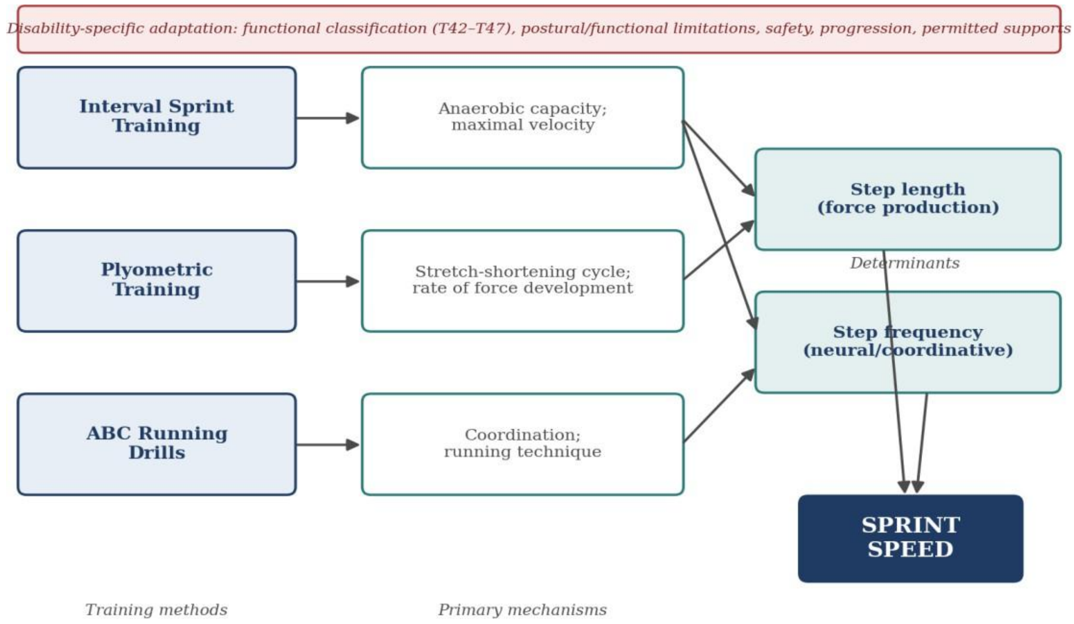

Figure 1. Integrated, disability-specific conceptual framework linking the three training methods, their mechanisms, and the determinants of sprint speed.

5.1 Adaptation principles

Integration alone is insufficient; the framework must be applied through explicit adaptation principles. First, programming should be classification-informed, matching drill selection and load to the athlete's functional class (Tweedy & Vanlandewijck, 2011). Second, movements should be adapted to postural characteristics and functional limitations, with permitted supports used where required. Third, safety should be prioritised, with graded progression from low to high intensity. Fourth, dosage should be specified transparently intensity, volume, repetitions, recovery, frequency, and programme duration so that loading is both sufficient to drive adaptation and appropriate to the athlete. These principles convert the conceptual framework into an actionable programming logic.

6. Practical implications and research agenda

For coaches, the framework offers a structured basis for designing speed-development programmes: rather than selecting a single method, coaches can deliberately combine interval sprint, plyometric, and ABC running work to target complementary determinants, while adapting each to the athlete's classification and functional profile. This is consistent with the broader argument that individualised, evidence-based programming yields more meaningful gains for disabled athletes than generic training (Dehghansai et al., 2017; Jacobs, 2017).

The framework also defines a research agenda. Controlled trials with larger, classification-stratified samples are needed to test the integrated approach against single-method and non-adapted comparators, and to quantify transfer to competition distances. Biomechanical outcome measures (step length, step frequency, ground reaction force) would clarify the mechanisms proposed here. As an initial application, the present authors developed and evaluated an integrated model derived from this logic the IS-PARD model which was rated feasible and improved 30-m sprint speed in tuna daksa para-athletes (Hasan & Nugroho, 2026); the present framework provides the broader theoretical scaffolding within which such models can be understood and extended.

7. Conclusion

Interval sprint, plyometric, and ABC running drills each target a distinct and complementary pathway to sprint speed, yet they have rarely been integrated or adapted explicitly for physically disabled athletes. This review synthesised the evidence and mechanisms linking these methods to the determinants of sprint speed and proposed an integrated, classification-informed conceptual framework for tuna daksa para-athletes. By linking methods to mechanisms, determinants, and disability-specific adaptation principles, the framework provides coaches with a theoretically grounded structure for programme design and researchers with a testable basis for controlled evaluation. Empirical validation across classifications and competition distances is the essential next step.

Declarations

Conflict of interest: The authors declare no conflict of interest.

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