



Concept and Implementation of Agility Development in Physical Training

**Vita Tanti Imelda Rumahorbo^{*1}, Cyntia Anggraini², Michael Situmorang³,
Amalia Zahro Siregar⁴, Anof Bernike Bangun⁵, Nanda Aulia Rizki Siregar⁶**
^{1,2,3,4,5,6}Pendidikan Jasmani Kesehatan & Rekreasi, Universitas Negeri Medan, Jalan Wiliam Iskandar ps V,
20221 Kab. Deli Serdang, Sumatera Utara

e-mail: vitatantiimeldarumahorbo@gmail.com, cyntiaanggraini81@gmail.com,
mikelsitumorang805@gmail.com, amaliasiregar445@gmail.com, anofbangun@gmail.com,
aulia.nan35@gmail.com

Abstract

Agility is a multidimensional performance quality that integrates rapid whole-body movement with perceptual information and decision-making. This structured narrative review clarifies the distinction between pre-planned change-of-direction (COD) speed and reactive agility, synthesizes current evidence on training modalities, and translates the evidence into practical program design. Literature published mainly between 2016 and 2026 was identified through PubMed/PubMed Central, Google Scholar, DOAJ, and publisher databases using combinations of agility, change of direction, reactive agility, plyometric training, strength training, and speed-agility-quickness. Peer-reviewed reviews and intervention studies involving athletic populations were prioritized. The evidence indicates that strength training supports force-oriented COD, plyometric and multidirectional training improve braking, reacceleration, and postural control, and sprint or SAQ training supports velocity-oriented COD. Reactive agility requires additional sport-specific stimuli, visual scanning, anticipation, and decision-making. Effective programs are progressive, technically controlled, and integrated with the movement and perceptual demands of the target sport. Agility assessment should therefore pair a standardized COD test with a reactive, sport-representative test rather than treating the constructs as interchangeable.

Keywords: agility; change of direction; reactive agility; plyometric training; strength training; physical conditioning

corresponding author: vitatantiimeldarumahorbo@gmail.com

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A. Introduction

Agility is routinely identified as a critical physical quality in soccer, futsal, basketball, racket sports, combat sports, and other activities that require athletes to decelerate, redirect momentum, and accelerate again. However, the term is often used imprecisely. Pre-planned change-of-direction (COD) speed refers to completing a known movement pattern as quickly as possible, whereas reactive agility requires the athlete to respond to an unpredictable stimulus. These abilities share physical determinants but are not interchangeable (Sheppard & Young, 2006; Young et al., 2015).

The practical problem is that agility programs are frequently reduced to rehearsed ladder patterns, cone drills, or shuttle runs without matching the force, technique, and information-processing demands of competition. A faster pre-planned test may reflect improved braking and reacceleration but does not necessarily demonstrate better anticipation or decision-making. Conversely, adding visual or human stimuli without adequate eccentric strength and movement technique may increase task complexity without improving safe and effective directional movement (Paul et al., 2016).

Recent evidence has expanded beyond a single-method perspective. Meta-analytic findings indicate that strength, plyometric,

sprint, and combined training can all improve COD performance, but their effects depend on whether the task is more force-oriented or velocity-oriented (Falch et al., 2019). Multidirectional plyometrics can improve COD performance and dynamic postural control (Jlilid et al., 2019), while agility-ladder plyometrics and microdosed plyometrics have shown benefits in youth soccer populations (Liu et al., 2024; Padrón-Cabo et al., 2021).

Despite this progress, applied articles often combine COD speed, reactive agility, balance, and general quickness under one label, making it difficult for coaches to select appropriate tests and training content. The state of the art therefore requires a model that links the type of agility task to its dominant determinants, suitable training modalities, and assessment methods. This review addresses that need by synthesizing conceptual definitions, evidence-based interventions, testing considerations, and practical implementation for physical training.

The review aimed to: (1) distinguish agility from pre-planned COD speed; (2) identify the physical, technical, and perceptual-cognitive determinants of agility; (3) synthesize evidence on strength, plyometric, sprint/SAQ, and reactive-stimulus training; and (4) propose practical principles for designing and evaluating progressive agility programs.

B. Methods

This study used a structured narrative literature review rather than a meta-analysis or a PRISMA systematic review. The approach was selected because the objective was to integrate conceptual definitions, training mechanisms, testing methods, and applied recommendations across heterogeneous sports and study designs rather than calculate a pooled intervention effect.

Searches were conducted in PubMed/PubMed Central, Google Scholar, DOAJ, and publisher databases using combinations of the terms agility, change-of-direction speed, reactive agility, plyometric training, resistance training, speed-agility-quickness, visual stimulus, and athlete. Literature published mainly from 2016 to 2026 was prioritized, while influential earlier papers were retained for foundational definitions. Eligible sources were peer-reviewed reviews, meta-analyses, and intervention studies involving

athletic or physically active populations and reporting agility, COD, reactive-agility, balance, sprint, or related outcomes. Non-sport studies, opinion pieces without an evidence base, duplicate records, and sources lacking a clear connection to agility development were excluded.

The analysis followed four stages: identification, relevance screening, eligibility assessment, and narrative synthesis. For each included core study, information was extracted on population, training modality, duration or design, outcome measure, and principal finding. Evidence was then grouped into five analytical categories: conceptual distinction, neuromuscular determinants, training modality, perceptual-cognitive demands, and testing/implementation. Because no pooled effect was calculated, conclusions emphasize convergence, boundary conditions, and practical transfer rather than a single universal percentage improvement.

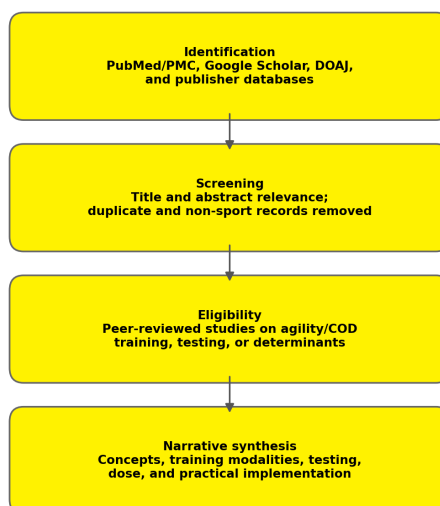


Figure 1. Structured narrative review and synthesis flow.

C. Result and Discussion

The literature consistently differentiates pre-planned COD speed from reactive agility. COD tasks emphasize the ability to brake, reposition the center of mass, apply force in a new direction, and reaccelerate along a known path. Reactive agility adds perception and action selection, meaning that performance depends on the quality and timing of the stimulus as well as the athlete's scanning, anticipation, inhibitory control, and decision-making (Paul et al., 2016; Young et al., 2015).

Training effects are task-specific. Strength training is most relevant when COD performance is limited by braking or propulsive force; plyometric and multidirectional training develop rapid stretch-shortening-cycle function, reacceleration, and dynamic postural

control; sprint and SAQ approaches are useful for velocity-oriented tasks; and combined training can address several determinants simultaneously (Falch et al., 2019). Youth-soccer evidence supports progressive plyometric integration, including multidirectional, agility-ladder, and low-volume microdosing approaches (Jlid et al., 2019; Liu et al., 2024; Padrón-Cabo et al., 2021).

A major implementation implication is that reactive agility should not be trained only through predetermined cones. Once athletes demonstrate adequate deceleration mechanics and directional force capacity, coaches should add external stimuli that reflect the target sport, such as a coach's movement, an opponent, a ball trajectory, or a visual signal. The progression should move from stable technique to time pressure and then to representative

uncertainty while maintaining movement quality and safe joint alignment.

Table 1. Synthesis of representative evidence on agility development.

Study	Design / population	Main contribution
Falch et al. (2019)	Meta-analysis; court/field sports	Strength supports force-oriented COD; plyometrics address force and velocity; sprint training supports velocity-oriented COD.
Jlid et al. (2019)	Intervention; young soccer players	Multidirectional plyometrics improved COD, vertical jump, and dynamic postural control.
Negra et al. (2020)	Comparative training; prepubertal soccer players	Resistance and plyometric training produced time-dependent adaptations relevant to directional movement.
Padrón-Cabo et al. (2021)	Intervention; youth soccer players	Plyometrics combined with an agility ladder improved physical-fitness outcomes including directional movement.
Liu et al. (2024)	Randomized study; youth soccer players	Low-volume microdosed plyometrics improved reactive-strength and acceleration qualities.
Oliver et al. (2024)	Systematic review/meta-analysis; highly trained youth soccer	Strength, plyometric, and combined training improved strength, power, and speed characteristics.

Discussion

The synthesis supports a multidimensional model in which agility emerges from interacting physical, technical, and perceptual-cognitive capacities. Lower-body strength is important because directional changes require athletes to absorb momentum and then produce force within short contact times. The contribution of strength is nevertheless expressed through technique: trunk position, foot placement, braking strategy, and center-of-mass control determine how effectively force is redirected. Therefore, increasing strength without practicing the target movement pattern may produce incomplete transfer.

Plyometric training is valuable because it targets rapid eccentric-concentric actions and the rate of force development required for braking and reacceleration. Its effectiveness is strengthened when drills include lateral and multidirectional vectors rather than vertical jumping alone. Progression should begin with landing control and low-complexity contacts before advancing volume, intensity, direction, and speed. Evidence from young athletes indicates that effective exposure does not always require a large volume; well-timed low-volume sessions can complement sport practice (Liu et al., 2024).

Reactive agility requires a further layer of training. Visual lights can standardize

exposure and timing, while a coach or opponent provides greater sport specificity because the athlete must interpret body movement and contextual cues. Neither option is universally superior: standardized stimuli are useful for monitoring, whereas human or ball-based stimuli better represent competition. Coaches should match the stimulus to the decision the athlete must make and avoid calling a rehearsed sequence a reactive-agility drill.

For implementation, an agility program can follow four linked phases: movement competency, physical capacity, task speed, and reactive transfer. Athletes first learn deceleration and directional mechanics; strength and plyometric work then increase force capacity; timed COD drills develop speed in planned tasks; and sport-specific stimuli introduce uncertainty. Assessment should pair a reliable COD test, such as the 505, T-test, or Illinois test, with a reactive test that documents the stimulus and decision options. This combined approach makes program evaluation more defensible than relying on one generic agility score.

D. Conclusion

Agility development should be understood as the coordinated improvement of directional force production, braking and reacceleration technique, movement speed, and

perceptual-cognitive decision-making. Pre-planned COD speed and reactive agility are related but distinct; consequently, they should not be trained or assessed as if they were the same construct. Strength, multidirectional plyometric, sprint/SAQ, and combined training can improve relevant physical capacities when they are progressive and matched to task demands. Reactive transfer requires external stimuli and representative decisions after adequate movement competency has been established. Practitioners should therefore use a staged program, monitor both planned and reactive performance, and adapt training volume, complexity, and recovery to age, sport, and training history. Future research should directly compare stimulus types, report training dose and movement quality, and use standardized reactive-agility outcomes to improve comparability across studies.

E. Conflict of Interest

The authors declare no conflict of interest.

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