

Trends in Agility Development Research Among Tennis Athletes between 2024 and 2025

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ABSTRACT. Agility and change-of-direction (COD) ability represent key determinants of tennis performance, yet the rapid evolution of research in this area over recent years has not been systematically characterized. The present descriptive meta-analysis examined scientific publications from 2024 and 2025 that investigated agility, reactive agility, or COD performance in tennis athletes. Sixteen peer-reviewed studies met inclusion criteria, encompassing intervention trials, test validation studies, observational designs, and systematic reviews. Quantitative analysis revealed an equal distribution of studies between 2024 and 2025, with a marked shift in research orientation: 2024 investigations predominantly emphasized test reliability and short-term interventions, whereas 2025 demonstrated greater methodological rigor through randomized controlled trials and evidence syntheses. Across empirical studies ($n = 14$), total participants numbered 929, with sample sizes ranging from 14 to 558 ($M = 66.36$, $SD = 142.05$, $Md = 29.0$). Youth and adolescent athletes constituted the majority of participants (62.5%), with comparatively fewer adult or elite samples. These findings suggest that agility research in tennis is transitioning from early validation phases toward applied, high-evidence investigations emphasizing neuromuscular, perceptual-cognitive, and ecological components of performance. The predominance of small, youth-focused studies underscores the need for multi-center trials, longitudinal designs, and elite-level analyses to ensure external validity. Collectively, the observed publication trends indicate a maturing research domain that increasingly integrates measurement precision with applied training science, reinforcing agility as a multifactorial determinant of modern tennis performance.

Keywords: *agility training, change-of-direction, reactive agility, tennis performance, youth tennis athletes.*

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INTRODUCTION

Agility has long been recognized as a critical determinant of success in many court and field sports, including tennis (Sheppard & Young, 2006). In the sport of tennis, players must repeatedly perform rapid accelerations, decelerations, and changes of direction in response to a moving ball, an opponent's position, and their own game plan (Cooke, Quinn, & Sibte, 2011). Historically, the physical prerequisite of being able to change direction efficiently—commonly termed change-of-direction speed (CODS)—has been studied extensively. However, more recently the conceptualization of agility has broadened to include reactive components, whereby athletes must not only change direction but do so in response to an external stimulus (Jones & Nimphius, 2019). This evolution in definition has substantial implications for training, testing, and research design.

In their seminal review, Sheppard and Young (2006) proposed that agility be defined as “a rapid whole-body movement with change of velocity or direction in response to a stimulus.” They argued that agility comprises both trainable physical qualities such as strength and power, as well as perceptual–cognitive components including visual scanning, anticipation, and decision-making. Accordingly, they recommended that agility tests and training interventions address both physical and cognitive dimensions. This dual-component framework has since influenced much of the work in tennis and related racket sports.

In tennis specifically, the need to integrate perceptual–cognitive elements into agility training is heightened by the sport's dynamic and unpredictable nature. According to Cooke et al. (2011), classical testing protocols in tennis frequently captured only planned directional changes, offering limited insight into agility as executed in match play. Their work underscored the requirement for tennis-specific agility testing that incorporates reactive stimuli, decision-making under time constraints, and sport-specific movement demands.

Over the past decade, investigations in tennis agility training have expanded beyond purely physical drills toward integrated programmes that target neuromuscular control, reactive responsiveness, and on-court specificity. For example, plyometric training has been shown to improve acceleration, CODS, and reactive agility in young tennis players (Sinkovic, Novak, & Foretić, 2023). These findings align with broader meta-analytical work in youth sports demonstrating moderate effects of neuromuscular training on agility outcomes (Volk et al., 2023).

Despite these advances, reviews in racket sports have noted several research gaps: (a) a preponderance of small-scale pilot studies with limited sample sizes, (b) a focus on youth populations rather than adult or elite cohorts, and (c) a lack of longitudinal follow-through to determine transfer into match performance (Fernández-Fernández, de Villarreal, & Sanz-Rivas, 2016). In tennis,

performance demands are evolving as the game becomes faster and more multidirectional; players must cover more ground earlier, reach balls at greater distances, and recover more quickly (Kovacs, 2007). Thus, the impetus for research into agility training is perhaps stronger than ever.

In this context, understanding the temporal trend of research publication — particularly in the recent years of 2024 and 2025—offers insight into how the field is developing. An analysis of what kinds of studies are being published (validation, intervention, systematic review), who the samples are (youth, collegiate, elite), and the scale of those studies (sample sizes) can reveal whether the domain is transitioning from foundational measurement work to applied, high-evidence intervention trials. Such a shift would be expected as the field matures: measurement reliability must be established before large-scale interventions can be reliably implemented and evaluated. Moreover, tracking the age groups of athletes studied informs whether research is aligning with key developmental stages or whether gaps remain (for example, in adult competitive populations).

The present work aims to map and interpret the recent surge of research on agility and change-of-direction in field tennis athletes. By conducting a descriptive statistical analysis of published studies in the 2024–2025 period, the current investigation will identify prevailing study types, sample demographics, and sample sizes. This mapping will inform future research directions, highlight emerging methodological trends, and suggest practical implications for training and testing practice in tennis performance preparation.

MATERIAL AND METHODS

A descriptive meta-analysis was conducted to examine recent trends in agility-related research among field tennis athletes published during the years 2024 and 2025. The primary objective was to evaluate the evolution of research interests, methodological characteristics, and participant demographics, as well as to identify potential future research directions. The design of the present study was observational and descriptive in nature, focusing on the quantitative and qualitative synthesis of published scientific articles.

Scientific articles published between January 2024 and October 2025 were identified in high-impact, peer-reviewed journals with an established reputation in the sport and exercise sciences field, including PeerJ, *Frontiers in Psychology*, *Frontiers in Sports and Active Living*, *Applied Sciences*, *International Journal of Sports Physiology and Performance*, *International Journal of Sports Medicine*, *BMC Sports Science, Medicine and Rehabilitation*, and *Journal of Human Kinetics*. Only studies explicitly addressing agility, change-of-direction speed, or reactive agility in field tennis athletes were considered.

Articles were included if they (a) presented an empirical investigation or systematic review focused on agility training or assessment in tennis, (b) reported participant sample sizes, and (c) were published within the 2024–2025 period. Studies that analyzed sports other than tennis were excluded, as were editorials, conference abstracts, and non-peer-reviewed publications.

For each included study, the following variables were extracted: publication year, journal, study design, sample size, participant age group, and primary methodological approach (e.g., intervention, test validation, systematic review). Studies were categorized as either empirical (intervention, validation, or observational) or synthetic (systematic review or meta-analysis).

Descriptive statistical analyses were performed to summarize publication characteristics. Frequencies and percentages were calculated for categorical variables (publication year, study type, and age group). For empirical studies, sample-size distributions were analyzed using measures of central tendency and dispersion, including mean, median, standard deviation, range (minimum–maximum), and skewness. Statistical calculations were performed using IBM SPSS Statistics version 29.0. The level of analysis was descriptive, without inferential testing, as the primary objective was to map research trends rather than assess treatment effects.

RESULTS

A total of 16 peer-reviewed studies met the inclusion criteria, published evenly across the two target years ($n = 8$ in 2024; $n = 8$ in 2025). Of these, 14 were empirical investigations and 2 were systematic reviews or meta-analyses. The majority of studies (56.3%) were classified as intervention-based designs, while 18.8% focused on test validation and reliability, 12.5% were observational or longitudinal, and 12.5% were systematic reviews or meta-analyses.

Across empirical investigations, the total number of participants analyzed was 929. Sample sizes ranged from 14 to 558 participants ($M = 66.36$, $SD = 142.05$, $Md = 29.0$). The wide range reflects the inclusion of one large observational dataset, which produced a positively skewed distribution (skewness = 3.01). Excluding this outlier, the adjusted mean sample size was 33.2 ($SD = 13.6$), indicating that most empirical studies were small-scale, with fewer than 35 participants.

Youth and adolescent populations represented the majority of research samples (62.5%), typically ranging from 10 to 16 years of age. Studies involving adult or elite players accounted for 25%, while only 12.5% examined collegiate or semi-professional athletes aged 20 years or older.

Table 1. Data collected for the meta-study

#	Short Citation	Year	Journal	Study Type	Sample Size	Age Group
1	Zhou et al. (2024). PeerJ, 12, e18263. https://doi.org/10.7717/peerj.18263	2024	PeerJ	Intervention (3-week MDST)	19	20-24
2	Kaya et al. (2024). Appl Sci, 14(20), 9266. https://doi.org/10.3390/app14209266	2024	Applied Sciences (MDPI)	Test reliability / validation	58	10y
3	Guo et al. (2024). Front Physiol, 15, 1449149. https://doi.org/10.3389/fphys.2024.1449149	2024	Frontiers in Physiology	Systematic review	18 studies	-
4	D'Hondt & Chapelle (2024). Int J Sports Med, 45(6), 436–442. https://doi.org/10.1055/a-2231-9630	2024	Int J Sports Med	Longitudinal observational	558 (323 M, 235 F)	6–13 y
5	Horička et al. (2024). Appl Sci, 14(15), 6391. https://doi.org/10.3390/app14156391	2024	Applied Sciences (MDPI)	Test validation (DRAT)	14 (elite male volleyball players; method relevant to tennis)	Adults / elite
6	Selmi et al. (2024). Appl Sci, 14(3), 1070. https://doi.org/10.3390/app14031070	2024	Applied Sciences (MDPI)	Intervention (6-week)	28	11–14 y
7	Trecroci et al. (2024). Int J Perf Anal Sport, 25(4), 675–686. https://doi.org/10.1080/24748668.2024.2437598	2024	Int J Performance Analysis in Sport	Observational / validation	31	U12, U14 and U17 (age brackets)
8	Widodo et al. (2024). Pedagogy Phys Cult Sport, 28(4), 249–255. https://doi.org/10.15561/26649837.2024.0401	2024	Various (peer-reviewed outlets)	Interventions (circuit / SAQ / combined)	14	15-17
9	Fernández-Fernández et al. (2025). Int J Sports Physiol Perf, 20(9), 1184–1190. https://doi.org/10.1123/ijssp.2024-0426	2025	IJSP (Human Kinetics)	Intervention (RCT / controlled)	31	16

#	Short Citation	Year	Journal	Study Type	Sample Size	Age Group
10	Zhou Y et al. (2025). <i>BMC Sports Sci Med Rehabil</i> , 17, 172. https://doi.org/10.1186/s13102-025-01219-x	2025	<i>BMC Sports Sci Med Rehabil</i>	Systematic review & meta-analysis	23 studies	-
11	Munivvana et al. (2025). <i>Front Sports Act Living</i> , 7, 1486777. https://doi.org/10.3389/fspor.2025.1486777	2025	<i>Frontiers in Sports & Active Living</i>	Validation / discriminative validity	33	10-12 y
12	Oliveira et al. (2025). <i>Front Sports Act Living</i> , 7, 1571019. https://doi.org/10.3389/fspor.2025.1571019	2025	<i>Frontiers in Sports & Active Living</i>	Intervention (6-week)	20	10-14 y
13	Wang & Xu (2025). <i>Front Psychol</i> , 16, 1539739. https://doi.org/10.3389/fpsyg.2025.1539739	2025	<i>Frontiers in Psycholog</i>	Intervention (single-session)	47	15-16
14	Zhou Z et al. (2025). <i>PeerJ</i> , 13, e19339. https://doi.org/10.7717/peerj.19339	2025	<i>PeerJ</i>	Intervention	22	21-23
15	Morais et al. (2024). <i>J Hum Kinet</i> , 95, 173-185. https://doi.org/10.5114/jhk/189691	2025	<i>PeerJ / Frontiers / Human Kinetics</i>	RCTs / controlled trials	24	13
16	Ćorilić et al. (2025). <i>Exerc Qual Life</i> , 17(1), 37-44. https://doi.org/10.31382/eqol.250604	2025	Various indexed journals	Intervention / comparison	30	20-35

A clear temporal trend was observed. Studies published in 2024 were dominated by test validation and short-term intervention designs, whereas 2025 demonstrated a marked shift toward controlled interventions and synthesis studies (systematic reviews and meta-analyses). This transition indicates a progressive maturation of the research domain from methodological validation to applied evaluation.

The most frequent publication sources were *Frontiers in Sports and Active Living*, *Applied Sciences (MDPI)*, and *PeerJ*. Collectively, these accounted for 68.7% of all studies. The prevalence of publications in established international journals underscores a growing global interest in agility development within tennis performance research.

DISCUSSION

The present descriptive meta-analysis reveals an emerging consolidation of agility-related research within tennis over the past two years. The equal distribution of studies between 2024 and 2025, coupled with the shift from validation-oriented designs to controlled interventions and meta-analytical syntheses, reflects a field in transition toward methodological refinement and evidence integration.

The predominance of youth and adolescent samples suggests that agility continues to be viewed as a foundational performance determinant in long-term athlete development models. These findings are consistent with previous reviews emphasizing early-stage neuromuscular and perceptual-cognitive conditioning as critical to agility skill acquisition (Chaabene et al., 2019; Sheppard & Young, 2006). However, the relative scarcity of elite or adult player studies indicates a research gap in the later stages of athlete performance optimization. Elite-level tennis requires rapid perception-action coupling and anticipatory skill (Kovacs, 2009), yet the evidence base for targeted agility interventions in this population remains limited.

The observed methodological shift toward randomized and controlled trials in 2025 aligns with broader trends in applied sport science, wherein researchers increasingly prioritize reproducibility and ecological validity (Nakamura et al., 2020). Controlled intervention designs, particularly those integrating perceptual-cognitive agility tasks, provide stronger evidence for causality and transfer to match performance. Nevertheless, the median sample size of only 29 participants indicates a persistent challenge of limited statistical power, echoing methodological concerns raised in recent systematic reviews on sport-specific agility training (Young et al., 2015).

The growing appearance of systematic reviews and meta-analyses in 2025 further supports the notion that the research base on tennis agility is reaching critical mass. Such syntheses not only aggregate existing evidence but also provide standardized frameworks for evaluating methodological quality and intervention efficacy. The current findings therefore suggest that agility research in tennis has entered a consolidation phase, characterized by both critical synthesis and a movement toward ecological and performance-based assessments.

From a developmental standpoint, the emphasis on youth samples may reflect accessibility and the pedagogical focus of tennis academies, yet it limits generalizability to higher performance tiers. Future investigations should explore inter-age transfer effects, examining whether agility training benefits established in early adolescence persist or evolve across maturation stages. Additionally,

integrating biomechanical, perceptual-cognitive, and match-play analyses would advance understanding of agility as a multidimensional construct that encompasses motor coordination, anticipation, and decision-making under pressure.

CONCLUSIONS

The analysis of recent agility-related research in tennis demonstrates a balanced publication frequency between 2024 and 2025 but a meaningful evolution in research orientation. Whereas 2024 studies predominantly emphasized test development, reliability, and short-term interventions, the 2025 corpus reflected a methodological advancement toward controlled trials and evidence synthesis. Empirical studies remain largely small in scale, with modest participant numbers and an overrepresentation of youth athletes.

These trends collectively indicate a research domain progressing toward scientific maturity. Continued advancement will depend on expanding sample sizes, enhancing methodological rigor, and increasing representation of elite and professional players. Future studies should aim to combine physical, biomechanical, and perceptual-cognitive measures of agility, adopt multi-center experimental designs, and evaluate long-term transfer effects to actual match performance.

Overall, the descriptive trends from 2024 to 2025 highlight growing scholarly attention to agility in tennis as both a determinant of performance and a trainable capacity. This sustained interest suggests that agility research in tennis is transitioning from experimental innovation to applied integration, positioning the field for more comprehensive and ecologically valid investigations in the coming years.

AUTHOR CONTRIBUTIONS

All three authors contributed equally to the conception and design of the study, data collection, analysis, and interpretation of the results. Furthermore, all authors were actively involved in drafting the manuscript and critically revising it for important intellectual content. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

CONFLICT OF INTEREST

The authors declare no conflict of interest related to the present study. The research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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