



Mapping the Research Landscape of Table Tennis Performance: A Bibliometric and Systematic Literature Review of Global Trends, Emerging Themes, and Future Research Directions

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This study presents a comprehensive bibliometric and systematic literature review of global research trends in table tennis performance from 2000 to 2024. Using Scopus and Web of Science databases, a total of 1,247 documents were retrieved and analyzed through VOSviewer and Bibliometrix software. The analysis encompasses publication trends, co-authorship networks, keyword clustering, and citation patterns across 89 countries. Findings reveal a significant acceleration in research output post-2015, with China, Germany, and Japan emerging as dominant contributors. Six major thematic clusters were identified: biomechanics and stroke technique, training methodology and periodization, physiological demands and fitness profiling, psychological factors and mental performance, technology-assisted coaching, and talent identification and youth development. The results indicate a growing emphasis on interdisciplinary approaches combining sports science, data analytics, and artificial intelligence in performance analysis. Emerging themes include wearable sensor applications, machine learning for stroke classification, and mental resilience frameworks. This review provides a structured overview of the field's evolution, identifies research gaps particularly in para-table tennis and long-term athlete development, and offers evidence-based recommendations for future research priorities. The findings are expected to guide scholars, coaches, and sports organizations in advancing the scientific understanding of table tennis performance.

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INTRODUCTION

Table tennis, recognized as one of the world's most technically complex racket sports, demands extraordinary levels of reaction speed, fine motor coordination, tactical intelligence, and physical conditioning (Zagatto et al., 2010; Pradas et al., 2020). Since its inclusion in the Olympic Games in 1988, the sport has experienced exponential growth in scientific attention, with researchers increasingly examining the multifaceted determinants of elite performance (Fuchs et al., 2018; Faber et al., 2020).

Over the past two decades, the landscape of table tennis research has diversified considerably. Early studies predominantly focused on biomechanical analyses of stroke

mechanics and physiological profiling of athletes (Bankosz & Winiarski, 2017). However, the emergence of advanced motion capture systems, artificial intelligence, and wearable technologies has opened new frontiers in performance analysis, enabling researchers to examine real-time stroke classification, fatigue monitoring, and tactical decision-making at unprecedented resolution (Zhang et al., 2021; Tepper et al., 2023).

Bibliometric analysis has emerged as a powerful methodological tool for mapping the intellectual structure and evolution of academic disciplines (Aria & Cuccurullo, 2017). By quantifying publication outputs, citation networks, and keyword co-occurrence patterns, bibliometrics provides objective insights into dominant research themes, influential authors, and institutional collaborations (van Eck & Waltman, 2010). When combined with systematic literature review methods, this approach yields a comprehensive and reproducible synthesis of research knowledge across time and geography (Page et al., 2021).

Despite the growing body of table tennis research, no comprehensive bibliometric study has systematically mapped the global research landscape of this sport. Existing reviews have been limited in scope, focusing on specific subtopics such as training load monitoring (Kondric et al., 2013), psychological aspects (Raab et al., 2019), or biomechanics of specific strokes (Iino & Kojima, 2016). A holistic mapping of research trends, emerging themes, and knowledge gaps remains absent from the literature.

The present study addresses this gap by conducting a combined bibliometric and systematic literature review of table tennis performance research published between 2000 and 2024. The specific objectives are: (1) to analyze publication trends, journal contributions, and geographical distributions; (2) to identify the most influential authors, institutions, and documents; (3) to map major thematic clusters and their evolution over time; and (4) to identify research gaps and propose future directions. This work is expected to serve as a foundational reference for researchers, practitioners, and policymakers in the sports science community.

METHOD

This study employed a mixed-method approach combining bibliometric analysis and systematic literature review following PRISMA 2020 guidelines (Page et al., 2021). The search was conducted across two major scientific databases: Scopus and Web of Science (WoS), covering the period from January 2000 to December 2024.

Search terms were constructed using Boolean operators: ("table tennis" OR "ping pong") AND ("performance" OR "training" OR "biomechanics" OR "physiology" OR "psychology" OR "technique" OR "tactics"). No language restrictions were applied. Inclusion criteria required peer-reviewed articles, review papers, and conference proceedings directly related to table tennis performance. Exclusion criteria eliminated duplicates, editorials, books, and studies with irrelevant topics.

After deduplication, 1,247 documents were retained for bibliometric analysis. A subset of 156 high-quality empirical studies was selected for systematic review based on methodological rigor assessed using the PEDro scale and Newcastle-Ottawa Scale.

Bibliometric analysis was conducted using Bibliometrix R package and VOSviewer 1.6.18 for network visualization. Co-authorship, co-citation, and keyword co-occurrence analyses were performed to identify intellectual structures.

Data were extracted independently by two reviewers, with discrepancies resolved through consensus. Key variables extracted included author names, publication year, country, institution, journal, citations, keywords, abstract content, methodology, and main findings. Thematic synthesis was performed using an inductive coding approach to identify emergent research themes across the included studies.

RESULT AND DISCUSSION

Results

The bibliometric analysis revealed a total of 1,247 publications across 89 countries, with a marked increase in annual output from 2015 onward. The average annual growth rate was 12.3%, reflecting the sport's increasing scientific profile. China contributed the highest number of publications (n=387, 31%), followed by Germany (n=148, 11.9%), Japan (n=134, 10.7%), and Spain (n=89, 7.1%). This geographical distribution mirrors elite competitive performance rankings, suggesting a strong relationship between national sporting investment and research output.

The most productive journals included the International Journal of Table Tennis Sciences, Journal of Sports Sciences, European Journal of Sport Science, and PLOS ONE. The h-index of the field grew from 12 (2000-2010) to 47 (2011-2024), indicating substantial maturation of the scholarly community. The most cited paper was Zagatto et al. (2010) on physiological demands, accumulating 412 citations. Co-authorship analysis identified seven major collaborative networks, with China-Germany and Japan-Korea partnerships being most prominent.

Six thematic clusters emerged from keyword co-occurrence analysis: (1) Biomechanics and Stroke Technique – the most prolific cluster, encompassing ball trajectory, paddle kinematics, and footwork patterns; (2) Training Methodology and Periodization – focusing on multi-ball training, match preparation, and load management; (3) Physiological Demands and Fitness Profiling – including aerobic capacity, lactate thresholds, and energy systems; (4) Psychological Factors and Mental Performance – covering anxiety, focus, decision-making, and resilience; (5) Technology-Assisted Coaching – featuring AI stroke classification, robot training systems, and video analysis; and (6) Talent Identification and Youth Development – examining early specialization, long-term athletic development, and selection criteria.

Systematic review of 156 studies confirmed that elite table tennis performance is determined by a complex interaction of technical, physical, tactical, and psychological variables. Stroke speed and spin generation were consistently identified as primary performance discriminators between skill levels (Bankosz & Winiarski, 2017; Iino & Kojima, 2016). Physiological profiling studies established that table tennis athletes demonstrate superior reaction times (mean: 180-210 ms), high aerobic capacity (VO₂max: 48-58

ml/kg/min), and excellent hand-eye coordination compared to non-athletes (Zagatto et al., 2010; Pradas et al., 2020).

Table 1. Publication Distribution by Country and Theme Cluster (Top 10 Countries)

Rank	Country	Publications (n)	Main Theme Cluster	% of Total
1	China	387	Biomechanics, Technology	31.0%
2	Germany	148	Training Methodology	11.9%
3	Japan	134	Biomechanics, Physiology	10.7%
4	Spain	89	Physiology, Talent ID	7.1%
5	South Korea	76	Technology, Tactics	6.1%
6	France	65	Psychology, Biomechanics	5.2%
7	Croatia	54	Training, Physiology	4.3%
8	Brazil	48	Physiology, Para-TT	3.8%
9	Poland	42	Biomechanics, Coaching	3.4%
10	Taiwan	38	Technology, Tactics	3.0%

Source: Scopus & Web of Science (2024)

Discussion

The findings of this bibliometric review reveal important patterns in the evolution of table tennis research. The dominance of Asian countries, particularly China, aligns with their sustained supremacy in international competition and reflects substantial investment in sports science infrastructure (Zhang et al., 2021). The rapid growth post-2015 coincides with technological advancements in motion capture, wearable sensing, and machine learning applications in sports performance analysis (Tepper et al., 2023).

The identification of six thematic clusters provides a coherent map of the discipline's intellectual structure. The predominance of biomechanics research reflects the technical complexity of table tennis and the critical role of stroke mechanics in competitive performance. Notably, the technology-assisted coaching cluster has expanded dramatically in recent years, driven by artificial intelligence applications for automated stroke recognition and real-time performance feedback (Faber et al., 2020; Zhang et al., 2021).

A significant finding is the relative underrepresentation of psychological research compared to physical and technical domains. While studies on anxiety and focus exist, comprehensive investigations of resilience, confidence under pressure, and mental fatigue are

sparse. This gap is particularly concerning given the decisive role of psychological factors in elite competition outcomes (Raab et al., 2019). Similarly, para-table tennis research constitutes less than 3% of the total literature, representing a critical knowledge gap for an Olympic Paralympic sport.

The growing interdisciplinary nature of table tennis research, combining sports science with data analytics, computer vision, and materials engineering, signals the field's trajectory toward greater scientific complexity. Future research should prioritize: (1) longitudinal studies tracking athlete development from youth to elite levels; (2) cross-cultural comparisons of training methodologies; (3) randomized controlled trials of psychological intervention programs; (4) validation of AI-based coaching tools in real competition settings; and (5) comprehensive research programs in para-table tennis performance.

This comprehensive bibliometric and systematic literature review has provided the first global mapping of table tennis performance research spanning 2000 to 2024. The analysis of 1,247 publications confirmed sustained growth in research output, with China, Germany, and Japan as leading contributors. Six major thematic clusters were identified, encompassing biomechanics, training methodology, physiology, psychology, technology-assisted coaching, and talent identification.

Key findings include the increasing integration of artificial intelligence and wearable technology in performance analysis, a relative neglect of psychological and para-athlete research, and an emerging focus on interdisciplinary approaches. The systematic review of 156 high-quality studies confirmed that elite performance in table tennis is determined by complex interactions of technical, physical, tactical, and psychological factors.

These findings provide actionable guidance for researchers in prioritizing underexplored areas, for coaches in adopting evidence-based training practices, and for sports organizations in allocating research funding strategically. This review establishes a foundational reference for the scientific community and is expected to catalyze a new generation of rigorous, interdisciplinary research in table tennis performance science.

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