



Serve Dynamics: Applying a Bibliometric Approach in the Kinetics and Kinematics Analysis for Flat and Topspin Serves in Tennis

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Abstract

Objectives. The study aimed to completely examine the existing research on the investigation of kinetics and kinematics analysis for flat and topspin serves in tennis, with a special focus on improving performance and reducing injury risks for players.

Material and methods. In order to obtain a comprehensive understanding of the data, Scopus searched three variables in each record: (1) the author's name, (2) the journal name in which the paper was published, and (3) the total number of citations. Bibliometric analysis was used as part of the analysis. To gain a thorough and accurate comprehension, the data was analyzed and interpreted using a variety of data triangulation techniques. Building distance-based co-occurrence networks for bibliometric analysis and synthesis was carried out using the VOSviewer software. The classification and grouping of the terms derived from titles, abstracts, and keywords were carried out based on their degree of interconnectedness. The terms "Serve Dynamics in Tennis", "Kinetic Analysis in Tennis serve", "Kinematic Analysis in Tennis serve", and "Flat and Topspin serve in Tennis" are frequently used in the study, although their meanings are generally interpreted differently. The search yielded 125 papers and 2807 citations, which were used in the study conducted from 2001 to 2024.

Results. The study's findings revealed the primary authors, countries, and subject areas that contribute to a comprehensive understanding of research patterns, influential studies, authorship dynamics, thematic clusters, and international collaborations in the analysis of the kinetics and kinematics for flat and topspin serves in tennis.

Conclusions. The study concludes by consolidating current information and identifying potential avenues for broadening the interdisciplinary scope of tennis serve research.

Keywords: biomechanics, tennis, kinetics and kinematics analysis, flat serve, topspin serve, serve dynamics, bibliometric analysis, and VOSviewer.

Introduction

The tennis serve is one of the most difficult tactics to master, despite the fact that the player appears to have complete control and advancement over it. It is tough to master the most perfect technique because the upper and lower extremities movements require sophisticated coordination (Carboch et al., 2023). Accordingly, the tennis serve is both the most crucial and the most difficult stroke to perfect. It comes in three main types: flat, topspin, and slice (Mourtziios et al., 2022). The flat kick (topspin)

and slice (sidespin) serve to use comparable upper-body temporal as well as kinematic characteristics to generate high translational ball velocities (Sheets et al., 2011). The flat serve may be the fastest, but the topspin serve is frequently the most consistent. Although speed production is essential for flat serve efficiency, the dimensions and boundaries of the service box must be such that an accuracy component is retained (Whiteside et al., 2014).

One of the most crucial aspects of contemporary tennis competition is a superb serve. The flat serve is usually the first serve of a highly skilled tennis player, while the slice or topspin serve is the second serve (Groppe & Roetert, 1992). To be successful as a professional tennis player, one must have a variety of serves, combining flat and topspin

(Giampaolo & Levey, 2013). Both the serve and the return are crucial strokes in tennis, and as a player advances in the professional ranks, so does the difficulty of these two shots (Avilés et al., 2019; Chang & Qiu, 2022).

Based on the racket face position and velocity vector with respect to the ball at impact, three main types of tennis serves are typically recognized. There's the flat approach, which boosts speed while reducing spin; the slice method, which puts an emphasis on sidespin; and the twist method, which uses both topspin and sidespin (Connolly, 2020; Sheets et al., 2011) also known as kick serve (Sakurai et al., 2013; Cross, 2011). After discovering that different tennis serves to require different technique execution, researchers examined the kinematics of the body's segments, the tennis racket, as well as the tennis ball throw (Sheets et al., 2011; Mourtziotis et al., 2022). Scholars and practitioners alike have been captivated by the dynamics of these services, driven by a desire to comprehend the intricate interplay between kinetics and kinematics that determines their effectiveness. When serving flat, the front part of the racket's velocity is important; when serving slicing, the lateral part of the racket's velocity is more important than the forward part; and when serving twisting, the vertical part of the racket's velocity is more important than the forward and lateral parts (Reid et al., 2007). Serving with a lot of speed usually gives you the upper hand in tennis (Fett et al., 2020).

Biomechanical research has helped to identify the essential kinetic and kinematic components of racquet velocity in the first serve. Many studies have been undertaken to understand these kinematics (Lambrich & Muehlbauer, 2023; Ramasamy et al., 2023; Mishra, 2023; Ramasamy, 2021; Ibrahim, 2020). Factors such as the racquet's velocity and direction, the ball's height at stroke, the racket's overall weight, the racket's angle at impact, and the ball's speed along with direction at this instant are among the most important elements in a serve. The biomechanics study of tennis serves has evolved significantly with the development of motion capture technology and high-speed cameras, which enable exact analysis and measurement of player motions (Abrams et al., 2016). Researchers have used a variety of methods, including 3D motion analysis, force plates, and wearable sensors, to collect data on joint angles, velocities, accelerations, and forces during serves. These data-driven approaches have not only enhanced the comprehension of serve mechanics but also permitted comparisons between different serving methodologies and player characteristics.

Bibliometric analysis is an effective approach for visualizing the intellectual landscape of a study topic, providing insights into the evolution of thoughts, crucial contributions, and emerging trends (Hallinger & Nguyen, 2020). A bibliometric approach to tennis serves allows for the discovery of major studies, influential scholars, and promising research pathways. By synthesizing and synthesizing findings from a variety of sources (Martín-García et al., 2022).

This study seeks to identify key patterns and trends that characterize the current level of research on service dynamics. The purpose of this study is to investigate and analyze the dynamics of tennis serve approaches, notably flat serves and topspin serves, utilizing a bibliometric approach to kinetics and kinematics. The research will help us understand the biomechanical principles that underlie

different kinds of tennis serves, which could lead to new insights that help us play better and avoid injuries. The paper will map out the existing literature landscape using bibliometric methods, identifying key trends, gaps, and areas ripe for future research in the field of tennis biomechanics. Such insights are critical for coaches, athletes, and sports scientists looking to improve training tactics and technical abilities in competitive tennis. Based on the aforementioned need for the study, the following research questions are generated:

- Q1. What is the current research landscape for analyzing kinetics and kinematics in tennis flat and topspin serves?
- Q2. What are the key biomechanical characteristics investigated for flat and topspin serves?
- Q3. How has research on service dynamics developed over time in terms of techniques and technical advancements?
- Q4. What are the most cited papers and authors in the field of tennis serve biomechanics?
- Q5. What are the current gaps and emerging research directions in tennis serve biomechanics?

By combining existing literature and academic works on this topic, the study attempts to give a comprehensive review and critical analysis of the techniques, conclusions, and trends in tennis to serve biomechanics research. Its specific goal is to uncover relevant studies, notable academics, and prominent journals that contribute to a better knowledge of how flat and topspin serves are completed and optimized mechanically. The purpose of this bibliometric analysis is to provide insights into the current state of research, identify areas of agreement or disagreement, and recommend routes for future research aimed at improving performance and minimizing injury risk in tennis serve mechanics.

Materials and Methods

There are several approaches to doing systematic reviews, one of which is the framework-based review (Robinson et al., 2011), meta-analyses (Zhang et al., 2022), and bibliometric reviews (Li et al., 2023). This also refers to the breadth and comprehensiveness with which scholars review and analyze data. One unique feature of bibliometric analysis is the user-friendly interface for accessing the co-citation network.

Citation analysis is commonly utilized in bibliometrics to conduct basic research (Van Eck et al., 2013). Depending on the unit of analysis, different aspects of a study issue might be examined. Keywords, institutions, organizations, countries, journals, and publications are common research analysis units. Citation analysis presupposes that writers reference or discuss articles that they believe are significant (Moed, 2006). By analyzing the interdependence of later publications, author co-citation analysis can shed light on the intellectual structure of multiple fields, including science and others (Van Eck & Waltman, 2017). The steps in generating bibliometric data involve choosing a database, analyzing bibliographic information, and making them more accessible. Then, it is necessary to select the program and decide how to exhibit the data.

According to the study, researchers should prioritize the most significant papers for their investigation on "Serve Dynamics: A Bibliometric Exploration of Kinetics

and Kinematics Analysis in Flat Serve and Topspin Serve in Tennis”. The Scopus database was chosen as a reliable source for gathering citation data due to the necessity of understanding the role of biomechanics in tennis play, as well as kinetics and kinematics analysis. Understanding the principles and importance of kinetics and kinematics analysis in tennis is one of the key objectives. This is critical since the words “Kinetics and Kinematics analysis”, “Tennis Serves”, and “tennis performance” are often used but can be interpreted differently according to the circumstances. The search yielded 137 papers and 2807 citations, which were used in the study conducted between 2001 and 2024. This huge dataset provides a solid foundation for examining the significance of kinetics and kinematics analysis in tennis serve and performance, as well as understanding how flat and topspin serves are executed and optimized globally. Figure 1 depicts the flow of information during various stages of a systemic screening process.

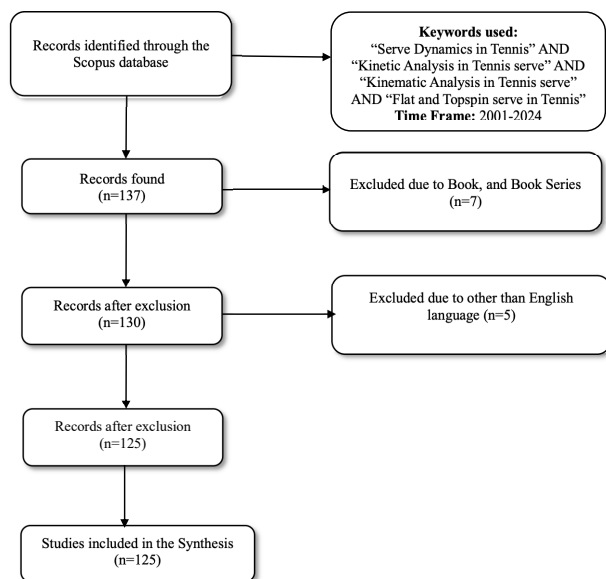


Fig. 1. Visual representation of the flow of information through the different phases of a systemic screening process

Figure 1 depicts the PRISMA paradigm, which gives an organized and clear picture of the screening process used to find relevant studies. Initially, 137 documents were identified through the Scopus database using particular keywords linked to “Serve Dynamics in Tennis”, “Kinetic Analysis in Tennis serve”, “Kinematic Analysis in Tennis serve”, and “Flat and Topspin serve in Tennis” throughout the span of 2000-2024. Seven records were omitted from this original group because they were published as books or book series. After applying the exclusion criteria, 130 records remained. 5 records were then eliminated because they were in languages other than English, leaving a total of 125 records. Finally, 125 studies were included in the synthesis, fitting the criteria for relevance and providing the foundation for analysis. Overall, the PRISMA model shows how the original pool of records is gradually filtered to choose studies for

synthesis and analysis, ensuring a methodical and thorough approach to the literature review.

Scopus searched three variables in each record: (1) the author’s name, (2) the journal name in which the paper was published, and (3) the total number of citations. Bibliometric analysis was used as part of the analysis. To gain a thorough and accurate understanding, the data was analyzed and interpreted using a variety of data triangulation techniques. Bibliometric analysis and synthesis were conducted by creating distance-based co-occurrence maps using the VOSviewer software. Classification and grouping of the terms received from titles, abstracts, and keywords were done based on their degree of interconnectedness.

Table 1. Inclusion and Exclusion Criteria

Criterion	Inclusion	Exclusion
Keywords	Records conferring the role of Kinetics and Kinematics analysis in tennis serve and performance and the understanding of how flat and topspin serves are executed and optimized	Records excluded in which variables have no relation.
Type of Literature	Journals, Review Articles	Book series, book, chapter in book,
Language	English	Other than English
Time frame	Concerning 2001-2024	<2001
Paper Stage	Final stage	Excluded that are on the running stage

Supplementary Table 1 summarizes the criteria used to choose papers for the study Exploration of Kinetics and Kinematics Analysis in Flat and Topspin Serve in Tennis. The “Criterion” column’s inclusion standards state that records must demonstrate the role of Kinetics and Kinematics analysis in tennis serve and performance, as well as a grasp of how flat and topspin serves are executed and maximized. This guarantees that only papers directly related to the study topic are included. In contrast, the exclusion criteria state that records are removed if the variables are unrelated to the issue. This technique helps to eliminate extraneous papers that may not provide any useful insights into the research. Journals and review articles are among the types of literature evaluated, as they are known for their thorough and focused attention to specific concerns. Book series, individual books, and book chapters must be excluded since they may lack the depth or relevance needed for the study.

The analysis only includes papers written in English because the researchers are fluent in the language. Papers produced in languages other than English are excluded because they may contain language hurdles. The study spans 2001 to 2024, allowing for the inclusion of current research while also capturing a large volume of relevant literature. Papers published before 2001 are excluded because they

may not be relevant to current trends or discoveries in the field. Finally, papers at the final stage are included, whilst those in the running stage are excluded. This ensures that only research completed and evaluated by specialists is considered for the study.

Citation Analysis

The study titled “Serve Dynamics: Applying a Bibliometric Approach in the Kinetics and Kinematics Analysis for Flat and Topspin Serves in Tennis” provides comprehensive research data on various aspects of the field. This includes the annual publication count, the most frequently cited documents, notable authors, influential journals, and leading countries in the domain.

Table 2 provides a concise overview of citations, specifically highlighting the 15 publications that have been cited most frequently on the given subject. The material presented above is the basis for a comprehensive examination of the study of Kinetics and Kinematics in the Flat serve and Topspin Serve in Tennis on a global scale.

The table presents the articles with the highest number of citations in the field of tennis serve analysis, emphasizing their noteworthy contributions to this area of research. With 200 citations, the study on anticipatory skills by Farrow and Abernethy (2002) is the most mentioned. A study on the loading of the upper limbs during tennis serves was carried out by Elliott et al. (2003) and garnered 198 citations. The study’s findings were published in the science journal *Sports Medicine*. An extensive 107-citation study of Grand Slam Matchplay’s features was carried out by Reid et al. (2016). The *Journal of Sports Sciences* published this work. The 2009 study by Gillet et al. received 103 citations in the *Journal of Strength and Conditioning Research* for its examination of elite athletes’ advanced serving and returning techniques. In their study, Farrow and Reid (2012) investigated the impact of scenario probability knowledge on anticipatory competence. Their research has been cited 101 times. Additional noteworthy research includes the study conducted by Hornery et al. (2007) which examined physiological profiles in tennis and has received 92 citations. Another significant study by Gordon and Dapena (2006) investigated

Table 2. Citation Analysis of Different Authors

No.	Most cited papers and Authors	Source/journal	Total Citations
1.	Can anticipatory skills be learned through implicit video-based perceptual training? (Farrow and Abernethy, 2002)	Journal of Sports Sciences	200
2.	Technique effects on upper limb loading in the tennis serve (Elliott et al., 2003)	Journal of Science and Medicine in Sport	198
3.	Matchplay characteristics of Grand Slam tennis: implications for training and conditioning (Reid et al., 2016)	Journal of Sports Sciences	107
4.	A notational analysis of elite tennis serves and serve-return strategies on the slow surface (Gillet et al., 2009)	Journal of Strength and Conditioning Research	103
5.	The contribution of situational probability information to anticipatory skill (Farrow & Reid, 2012)	Journal of Science and Medicine in Sport	101
6.	An integrated physiological and performance profile of professional tennis (Hornery et al., 2007)	British Journal of Sports Medicine	92
7.	Contributions of joint rotations to racquet speed in the tennis serve (Gordon and Dapena, 2006)	Journal of Sports Sciences	75
8.	Lower-limb coordination and shoulder joint mechanics in the tennis serve (Reid et al., 2008)	Medicine and Science in Sports and Exercise	68
9.	Upper Limb Biomechanics During the Volleyball Serve and Spike (Reeser et al., 2010)	Sports Health	67
10.	Tactical determinants of the setting zone in elite men’s volleyball (Afonso et al., 2012)	Journal of Sports Science and Medicine	67
11.	Recognising the style of spatially exaggerated tennis serves (Pollick et al., 2001)	Sustainability (Switzerland)	67
12.	Comparing the pre- and post-impact ball and racquet kinematics of elite tennis players’ first and second serves: A preliminary study (Chow et al., 2003)	Journal of Sports Sciences	64
13.	Energy flow analysis during the tennis serve: Comparison between injured and non-injured tennis players (Martin et al., 2014)	American Journal of Sports Medicine	59
14.	Caffeine, carbohydrate, and cooling use during prolonged simulated tennis (Hornery et al., 2007)	International journal of sports physiology and performance	59
15.	Shoulder joint loading in the high performance flat and kick tennis serves (Reid et al., 2007)	British Journal of Sports Medicine	57

the impact of joint rotations on racquet speed and has been cited 75 times. The list also encompasses studies on shoulder mechanics, lower-limb coordination, and comparisons of serve kinematics, demonstrating a wide-ranging fascination with diverse biomechanical and physiological facets of tennis serves. The presence of prestigious journals such as the American Journal of Sports Medicine, Medicine and Science in Sports and Exercise, and the British Journal of Sports Medicine demonstrates that this field of study is very interdisciplinary.

Yearly Publication

Figure 2 depicts the cumulative count of articles on the examination of Kinetics and Kinematics in Flat Serve and Topspin Serve in Tennis that have been included in the Scopus database from 2015 to 2024.

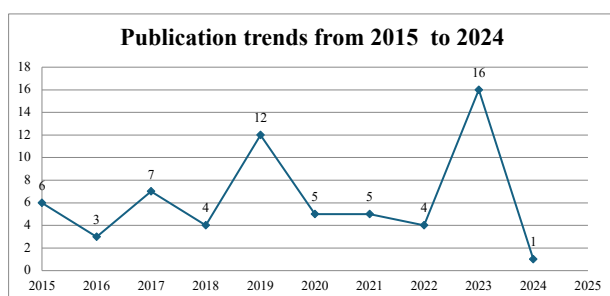


Fig. 2. The number of total publications on Kinetics and Kinematics analysis in Flat Serve and Topspin Serve in Tennis indexed in Scopus 2015-2024

The data on annual publications from 2015 to 2024 demonstrates varying levels of interest and research activity in the study of kinetics and kinematics analysis of flat and topspin serves in tennis. The initial research output was limited, consisting of only 6 papers in 2015, which saw a decrease to 3 in 2016. There was a substantial increase in publications in 2017, with a total of 7 papers. However, there was a notable decrease in the following years, with just 4 publications in 2018. The research activity had a gradual rise and then stabilization in 2019, with the number of publications varying by 12 in 2019. From 2020 to 2022, there was a consistent decrement, such as 5 publications in 2020, 5 publications in 2021, and 4 publications in 2022. Following this, there was a subsequent surge to 16 publications in 2023. Nevertheless, in 2024 there was a significant decrease to only one publication, suggesting a possible recent reduction in research productivity or a delay in submitting data for the present year. In general, the pattern shows intermittent increases and decreases, indicating fluctuating levels of research interest and funding availability in this specific field across time.

Top Authors

Figure 3 shows a list of authors and the number of papers they have written on kinetics and kinematics analysis in flat and topspin serves in tennis. Reid M. leads the contributions with 33 documents, demonstrating a strong influence and prolific productivity in this research area. Elliott B. has 25 documents, followed by Farrow D., who

has 11. Both are important contributors. Rogowski I. and Chèze L. have created seven and five documents, respectively, demonstrating active involvement in the field. Several authors, notably Mujika I., Hornery D.J., Campbell A., and Gillet B. have four documents, while O'Sullivan P. and Dumas R. have three. Begon M., Buszard T., and Pinder R. have all submitted two documents. This distribution illustrates a core group of scholars with varied degrees of impact and output in the study of tennis serve mechanics.

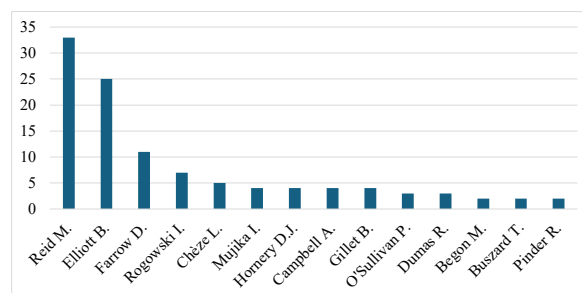


Fig. 3. Top authors and the number of documents they have published in the field

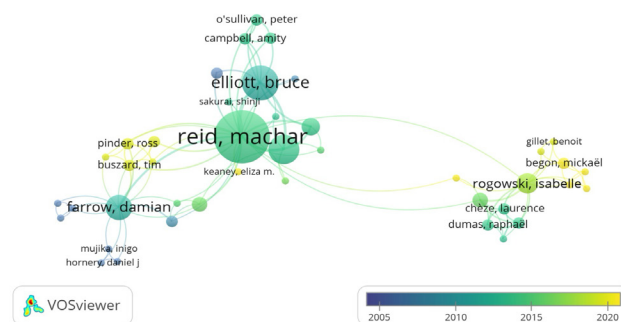


Fig. 4. Co-authorship between Authors

The first analysis of co-citations looked at the author's network of Scopus citations. In author co-citation analysis, the choice of which authors to map is the most important decision. A field's or topic's intellectual structure can be mapped using co-citation analysis, as mentioned above. Consequently, Scopus uses author co-citation analysis to discover the intellectual structure of authors, who are significant contributors who produce a collection of papers connected to a subject.

The bibliometric network visualization depicts the relationships and partnerships between authors working on the kinetics and kinematics of flat and topspin serves in tennis. Reid, Machar, and Elliott, Bruce are central people with notable publications and substantial collaborations, as seen by their enormous rings and numerous connecting lines. The network shows different groupings of regular collaborators, including Rogowski, Isabelle, and Farrow, Damian. Temporal patterns reveal that authors such as Rogowski and Gillet, Benoit, have been more active recently, although Farrow and Mujika, Inigo, have previously contributed. The connection is underscored by thick lines

connecting closely collaborating authors, particularly Reid and Elliott. Recent papers and developing network ties highlight emerging researchers, like Begon, Mickaël, and Chèze, Laurence. This image effectively illustrates the primary contributors, their cooperation networks, and the evolution of research over time in this specialized sector.

Subject area Analysis

Figure 5 depicts the distribution of research publications across disciplines. Medicine accounts for 38% of the papers, demonstrating a strong emphasis on medical research within the studied body of work. Health Professions follow closely after with 32%, indicating a strong concentration on health-related occupations. Engineering and computer science both contribute to 7% of the texts, indicating moderate contributions from these technological fields. Social Science and Psychology account for 5% and 4%, respectively, reflecting their importance in the larger study landscape. Neuroscience and Arts & Humanities have the smallest shares, accounting for 4% and 3% of articles, respectively. This distribution emphasizes the overwhelming significance of medical and health professions research, with diverse but minor contributions from other disciplines.

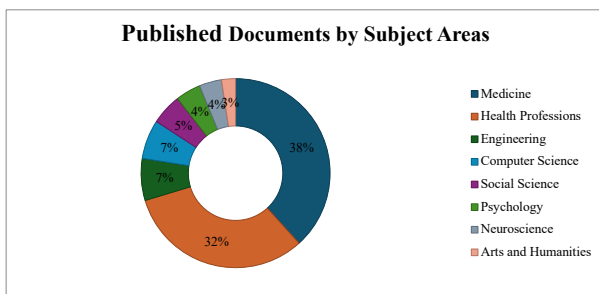


Fig. 5. Distribution of documentation in various subject areas

Country Analysis

Figure 6 depicts the top countries and regions in research collaboration linked to kinetics and kinematics analysis in flat and topspin tennis serves from 2001 to 2024. The figures presented show the number of publications from various nations, with Australia having the most at 39, followed by France with 22. The United States and China are also significant, with 20 and 18 publications each. Germany has seven publications, followed by Japan, which has five. The United Kingdom and Switzerland have four publications each, while India and Thailand have two. This distribution implies various degrees of research production or importance in publications across these countries, with Australia and France at the top.

The bibliometric network visualization depicts international links and collaborations in the subject of kinetics and kinematics analysis of flat and topspin serves in tennis. The United States, Australia, and France are key players with big publications and extensive partnerships, as seen by their large rings and numerous connecting lines. The network identifies various groupings of regular collaborators, including China, Germany, and Japan.

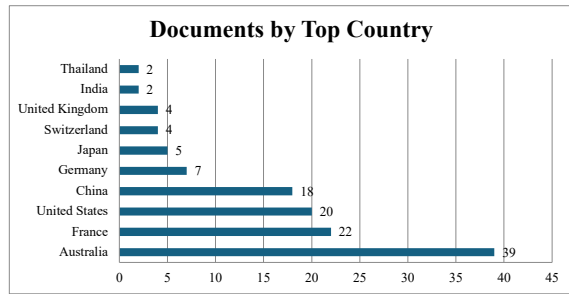


Fig. 6. Top Countries and Regions in Research on Documents

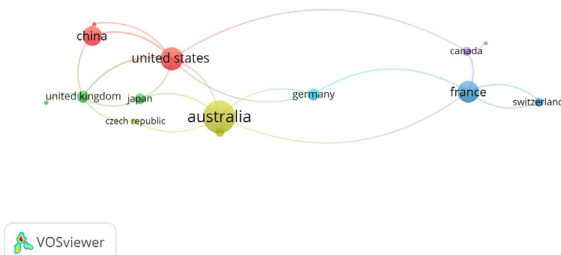


Fig. 7. Cluster Diagram depicting Top Countries indicating a significant contribution to research

Temporal trends reveal that countries like Switzerland and the United Kingdom have been increasingly active recently, whereas India and Thailand make modest contributions.

Co-Occurrence of Keywords

The visualization for the bibliometric study “Serve Dynamics: A Bibliometric Exploration of Kinetics and Kinematics Analysis in Flat Serve and Topspin Serve in Tennis” identifies major thematic clusters and correlations in the academic literature. Central concepts like “tennis,” “humans,” and “sports” dominate the graphic, suggesting their popularity and significance in the field. The term “tennis serve” appears prominently, highlighting the research’s major focus. The visualization shows several distinct clusters: one centered on “sports,” “average speed,” “flat serve,” and “court,” which emphasizes the physical and performance aspects of tennis serves; another cluster includes terms like “mechanical

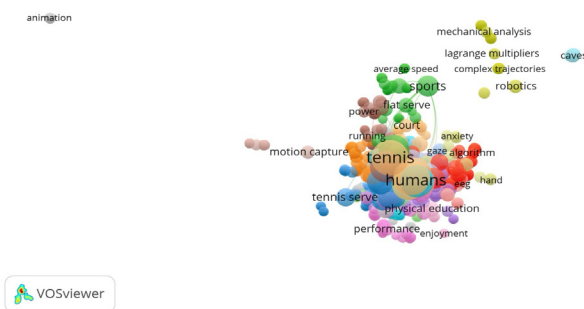


Fig. 8. Co-occurrence of Keywords

analysis,” “LaGrange multipliers,” and “complex trajectories,” reflecting the biomechanical and analytical approaches used in the study of serve dynamics. There are also smaller clusters connected to psychological and physiological factors, as demonstrated by phrases such as “anxiety,” “gaze,” and “eeg,” as well as technology and methodology, seen in terms such as “motion capture” and “algorithm.” This extensive network map captures the diverse nature of research on tennis serve dynamics, including performance analysis, biomechanics, psychological aspects, and technological techniques.

Findings and Discussion

The results of the bibliometric investigation of kinetics and kinematics analysis in flat and topspin serves in tennis provide important insights into the evolution and current landscape of research in this specialized topic. First, an examination of highly cited papers reveals key contributions that shaped the debate. Farrow and Abernethy’s (2002) study of anticipatory skills received 200 citations, highlighting the importance of cognitive factors in service dynamics. Elliott et al. (2003) follow closely, emphasizing upper limb loading during serves, which is critical for understanding biomechanical stresses in tennis. Reid et al. (2016) and Gillet et al. (2009) provide insights into Matchplay features and elite strategies, respectively, adding to the research on competitive tennis dynamics.

Second, considering the publishing patterns from 2001 to 2024 demonstrates fluctuations in research efforts. Early years witnessed modest output, with irregular peaks such as in 2003, indicating intermittent surges in interest, maybe due to technical developments or sporting events. Significant recent growth in 2019 and 2023 contrasts with a fall in 2024, indicating potential adjustments in financing or research priorities in the subject. Third, the distribution of author contributions highlights prominent figures in research. Reid M. emerges as a prolific researcher, with 33 documents demonstrating significant influence and ongoing interaction. Elliott B. and Farrow D., with 25 and 11 documents respectively, also play important roles, proving their long-term contributions to service dynamics research. The collaborative network analysis emphasizes major figures like Reid and Elliott, exhibiting dense linkages suggestive of long-term cooperation and cooperative research pursuits.

Furthermore, the distribution across topic areas demonstrates the interdisciplinary character of research, with medicine and health professions dominating, highlighting the biomechanical and physiological foundations of serve dynamics. Engineering and computer science also make contributions, demonstrating technological advances in motion analysis and simulation approaches. Geographically, Australia and France lead in research production, with significant contributions from the United States, China, and other countries, demonstrating worldwide interest and collaboration in tennis serve kinetics and kinematics study. Overall, this bibliometric analysis gives a comprehensive view of the research environment, highlighting significant authors, topic clusters, and global collaborations that shape our understanding of tennis serve dynamics. The findings highlight the diverse approach – from cognitive and biomechanical studies to technological advancements – which jointly increase knowledge and practice in sports science and performance analysis.

Conclusion

Finally, the bibliometric investigation into kinetics and kinematics analysis in flat and topspin serves in tennis reveals numerous noteworthy discoveries. To begin, it lists seminal contributions to the subject, such as Farrow and Abernethy’s work on anticipatory skills and Elliott et al.’s research on upper limb loads, both of which have had a substantial impact on research paths and have received numerous citations. The shifting pattern of annual publications highlights variable research interest and funding availability throughout time, displaying peaks and valleys in research production. Authors such as Reid, Elliott, and Farrow emerge as key personalities, with significant contributions and large collaboration networks. The prevalence of medical and health-related fields in published publications indicates a strong emphasis on the biomechanical and physiological elements of tennis serves. Geographically, Australia and France lead in research output, with major collaborations seen amongst countries such as the United States, China, and Germany. Future research should investigate broadening interdisciplinary cooperation, incorporating technological improvements, and investigating underrepresented topics including psychological aspects and novel methodological approaches. By addressing these features, researchers might further improve our understanding of tennis serve mechanics, perhaps improving player performance and injury prevention techniques.

However, it is critical to recognize some limitations in this study. Citation counts may be biased towards older, more established works, perhaps disregarding recent advances or developing trends. The bibliometric study is also largely concerned with quantitative indicators, which may not fully represent the qualitative impact or innovative contributions of certain books. Furthermore, the geographical concentration on individual countries may leave out significant findings from locations with burgeoning tennis research communities.

This research has consequences beyond academia, including practical applications in sports science and training. Researchers may enhance the subject of serve dynamics in tennis by encouraging ongoing collaboration and innovation, providing players, coaches, and sports enthusiasts with better insights into performance optimization and injury prevention techniques.

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Conflict of interest

All authors declare no conflict of interest.

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Динаміка подачі: Застосування бібліометричного методу в контексті аналізу кінетики та кінематики виконання техніки подач "flat" та "topspin" у тенісі

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 10 с., 2 табл., 8 рис., 41 джерело.

Мета дослідження. Мета дослідження полягала в комплексному вивченні існуючих наукових праць з аналізу кінетики та кінематики виконання техніки подач "flat" (удар з невеликим бічним обертанням або плоска подача) та "topspin" (удар із сильним верхнім обертанням або топ-спін) у тенісі, з особливим акцентом на покращенні результативності та зниженні ризику травмування гравців.

Матеріал та методи. Задля отримання цілісного розуміння даних, у наукометричній базі Scopus здійснювався пошук за трьома змінними в кожному записі: (1) ім'я автора, (2) назва журналу, в якому було опубліковано статтю, та (3) загальна кількість цитувань. Бібліометричний аналіз було застосовано як складову аналізу. З метою отримання ґрунтовного і точного осмислення інформації, отримані результати були проаналізовані та інтерпретовані з використанням різноманітних методів триангуляції даних. Побудова дистанційних мереж суміжностей для проведення бібліометричного аналізу та синтезу здійснювалася за допомогою програмного забезпечення VOSviewer. Класифікація та групування термінів, отриманих з назв, анотацій та ключових слів, проводилися на основі ступеня їх взаємозв'язку. Терміни «Динаміка подачі в тенісі», «Кінетичний аналіз подачі в тенісі», «Кінематичний аналіз подачі в тенісі», «Плоска і топспін подача в тенісі» часто використовуються в дослідженні, однак їх значення, як правило, трактуються по-різному. За результатами пошуку було виявлено 125 робіт і 2807 цитувань, які використовувалися в дослідженні, проведеному в період з 2001 по 2024 рік.

Результати. Отримані результати дослідження визначили провідних науковців, країни та предметні області, які сприяють всебічному розумінню дослідницьких моделей, найбільш вагомим досліджень, авторської динаміки, тематичних кластерів та міжнародної співпраці щодо аналізу кінетики та кінематики виконання плоскої та топ-спін подач у тенісі.

Висновки. Отже, дослідження консолидувало наявну інформацію та визначило потенційні шляхи подальшого розширення спектра міждисциплінарних досліджень у галузі техніки виконання подач у тенісі.

Ключові слова: біомеханіка, теніс, аналіз кінетики та кінематики, плоска подача, подача із сильним верхнім обертанням, динаміка подачі, бібліометричний аналіз, програмне забезпечення VOSviewer.

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