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Bibliometric Analysis on Sports Research in China from 2013 to 2022

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Abstract: *This study analyzed the time-space distribution, institutions, authors, and keywords of 15,394 sports papers in the CSSCI (Chinese Social Sciences Citation Index) database from 2013 to 2022 using bibliometric methods and visualization analysis. The results revealed that sports research experienced "development-maturity-stability" stages. The research aims to reveal research hotspots and trends in the sports field. Bibliometric analysis is important for understanding knowledge framework and trends in sports research. Methods include word frequency, co-word, social network analysis, and visualized knowledge graphs. The findings show limited collaboration between institutions and refined but not in-depth research content. In conclusion, strengthening cooperation and conducting interdisciplinary studies can contribute to the high-quality development of sports science in China.*

Keywords: *Sports Literature, Knowledge Mapping Analysis, Bibliometrics*

1. Introduction

Sports research is a broad and complex field, which includes sports training, physical education teaching, the sports industry, and many other aspects. As an interdisciplinary field[1]. Sports research needs to integrate different research methods and technologies for a more comprehensive understanding and discussion of the problems and phenomena involved[2]. Bibliometrics is a statistical research method that analyzes the literature and its citations to better reveal the academic pattern and development trend of the research field[3]. As a visualization tool of bibliometrics, a knowledge graph converts bibliographic information into Two-Dimensional (2D) or Three-Dimensional (3D) graphics for visual display, which can help ordinary users understand knowledge development in the research field more intuitively and deeply[4]. It can also reveal relevant information issues such as the research development process, research status, research hotspots, and development trends of the subject field from the macro and micro levels. This provides more comprehensive and accurate academic information and data support for sports research. It helps researchers better grasp the research directions and frontiers of sports disciplines and discover knowledge. At the same time, knowledge graph technology can also promote the application of research results, assist in decision analysis, and serve sports management and training practices. Overall, knowledge graph technology provides richer research support for sports research and promotes effective integration of sports research and practice, providing possibilities and impetus for the sustained healthy development of the sports field.

2. Data sources

This study obtained data from the CSSCI sports core bibliography renewed every two years as the retrieval condition. Initial retrieval from the Chinese Social Science Citation Index (CSSCI) and China National Knowledge Infrastructure (CNKI) yielded 16,261 literature entries. To ensure accuracy and reliability, non-research documents such as reports and interviews were eliminated. Finally, 15,394 research papers were obtained as samples for this study after the screening process. These final samples served as the data sources and research objects for this study's analyses.

3. Results and Discussion

This study employs visualization tools to analyze sports literature distributions and map research trends. Building on the preliminary findings, this section conducts a detailed analysis of the most active institutions, authors, and keyword clusters. This granular analysis provides the basis for targeted recommendations to advance sports science quality, competitiveness, and social value in China's next

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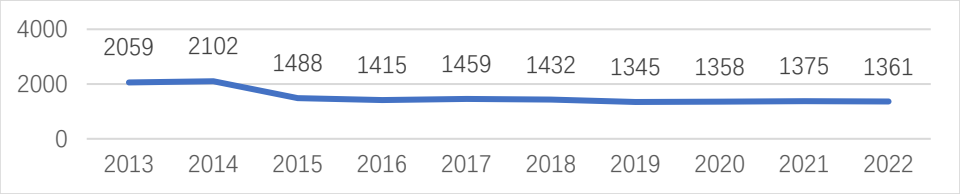
development stage.

3.1 Spatial and Temporal Distribution Characteristics of Sports Literature

According to Lin(2016), the number of published core literature is an important indicator for evaluating progress and level in this field. The spatial and temporal distribution of such publications reflects hot topics and trends, providing insights into discipline development and guiding research[5]. This study uses the number of published papers annually to draw the distribution map of China's CSSCI core sports journals from 2013 to 2022 (Figure 1). Studying these dynamics has important implications for understanding the evolution of exercise science and directing scholarly work accordingly. Figure 1 shows China's core sports journal papers peaked in 2014 before decreasing and stabilizing in recent years. First, China's sports research transitioned from exploratory to mature stages. More researchers led to more submissions but reviewers emphasized quality and significance over quantity. Acceptance requirements became stricter, rejecting more papers, so publications declined despite researcher growth. Second, refined topics caused saturation. Some subjects lost academic interest so researchers shifted domains, further reducing output. Evidence indicates that field maturation and specialization curtailed publications, evolving from quantity to quality focus. China should foster high-impact innovative research across disciplines. This will maximize sports science influence globally.



(Abscissa: Year, Ordinate: Number of articles)

Figure 1: 2013-2022 Spatial and Temporal Distribution Map of Sports Core Journals

3.2 Analysis of Publishing Institutions

According to Liu (2022), in the knowledge map, the area of the circular nodes represents the number of papers published by the institution. The lines between nodes depict collaboration between institutions – the more and thicker the lines, the closer the collaboration[6]. Analysis of the paper publishing units can reflect the overall strength, resource allocation, and academic exchange in this scientific research field to some extent. This provides an important reference for better understanding the disciplinary development and collaboration networks of sports science research institutions in China.

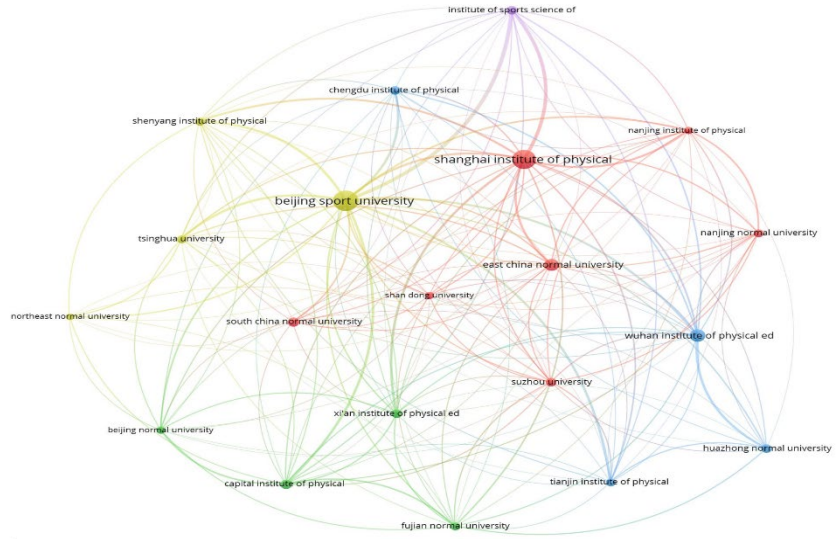


Figure *2: Co-Occurrence Map of Domestic Institutions Conducting Sports Science Research.*

As shown in Figure 2: Beijing Sport University ranks first with 1,739 occurrences. It has multiple research centers and labs engaged in various sports and exercise-related research projects. The university's faculty and researchers have profound academic backgrounds and rich practical experience,

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making tremendous contributions to China's sports science. It has close partnerships with institutions like Tsinghua University, Research Institute of Sport Science, Shenyang Sport University, Chengdu Sport University, etc., indicating Beijing Sport University values inter-university collaboration in sports science research to share findings and yield research outcomes of greater breadth and depth. Shanghai University of Sport ranks second with 1,506 occurrences. It collaborates closely with nearby universities in East China like Nanjing Sport University, Nanjing Normal University, Soochow University, and East China Normal University to form a large cooperative network. This model provides diverse research perspectives and helps achieve a balance of depth and breadth in scientific research. Moreover, such interdisciplinary and inter-university cooperation also aids in promoting and applying research outcomes, enhancing the social impact of research.

In summary, the high level of research collaboration between Beijing Sport University, Shanghai University of Sport, and other regional universities demonstrates the value of cooperative networks in advancing sports science in China. By working together across institutional boundaries, researchers can pool expertise, share resources, and conduct studies with greater scope and impact. Fostering these cooperative relationships has strengthened the overall quality and productivity of sports science research in China. Moving forward, continued inter-university collaboration will be key to further developing the field and applying findings to benefit athletic performance, exercise science, and physical education across the country.

3.3 Analysis of Publishing Authors

In scientific research, collaboration relationships, number of publications, and number of citations are important criteria for evaluating researchers' contributions in their field. Analyzing authors' publication counts and collaboration can reveal research activities in this area. This study analyzed 14,380 authors. Since the number was large, 8,251 authors appeared only once in the data. We used VOSviewer to analyze author collaboration. We set the maximum number of authors per document to 20 and the minimum number of occurrences per author to 30 and generated a map. From the node areas, the number of publications reflects the authors' activity level, as shown in Figure 3. Ji Liu (163), Wang Jian (108), Wang Jiahong (84), and others were the top authors by publication count, indicating their research experience and accumulation in sports science. They contributed significantly to the field. Ji Liu, Ding Shuzhe, Yang Jian, and Ma Dehao clustered together and collaborated with others like Wang Jiahong and Wang Xiaozan. Some authors like Yu Wenqian were independent clusters without collaborations, possibly due to their unique perspectives. Analyzing collaboration networks helps understand the research landscape. This guides future research, and policies, and evaluates impact.

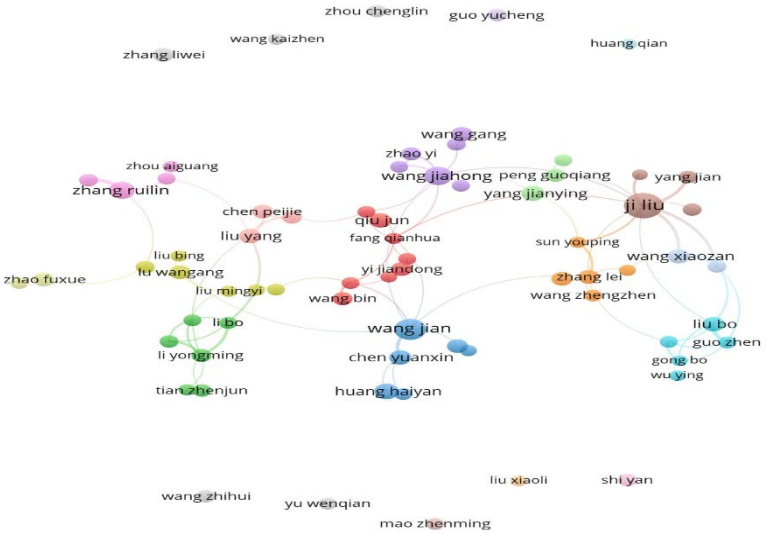

Figure 3*: Co-occurrence map of authors conducting sports science research in China.*

3.4 Analysis of Keywords in Publications

Analysis of keywords in academic papers refers to the research and analysis of keywords in academic papers. Keywords play an important role in academic papers, representing the core content of a paper and a highly condensed summarization of the research. Keyword analysis reveals trends in research

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directions, topic correlations, fields, and methods[7]. In visualized knowledge maps, nodes of different sizes display keyword frequency and importance. Larger nodes denote more frequent keywords, while smaller nodes indicate less frequent ones. Each color typically represents a topic cluster, allowing intuitive identification and distinction of clusters. Nodes of the same color belong to the same cluster, with similar co-occurrence patterns and correlations. The visualization enables easy recognition of keyword distribution and significance in the knowledge map, according to the researchers. This facilitates navigation and exploration of the map. The VOSviewer operation mode was "co-occurrence" with "Keywords" as the analysis unit. With minimum occurrences set at 1, there were 27,867 total keywords. As the minimum increased by 10, within 1-10 there were 26,974 keywords.

To more comprehensively present the hot topics and themes in this research field, VOSviewer was used to conduct keyword clustering analysis on the sports core journal articles in the CSSCI (Chinese Social Sciences Citation Index) citation database from 2013-2022. The minimum number of occurrences for keywords was set to 40, and the minimum cluster size was set to 20. A total of 133 items were obtained, which were classified into 5 clusters, connected by 2,009 links, with a total link strength of 5,465. Based on this data, we generated a visualized knowledge map of research hotspots, as shown below.

3.5 Cluster classification

3.5.1 Cluster I: School Physical Education

"School physical education" appeared 537 times. The keyword cluster centered around it has 84 links and a link strength of 443, making it the keyword with the highest frequency. The "school physical education" cluster includes 28 keywords such as school physical education, physical education teaching, physical education teachers, physical education, physical education curriculum, moral education, and universities.

For "school physical education", the VOSviewer cluster analysis revealed the significant influence of factors like curriculum design, teaching methods, and teacher qualifications on the quality of school physical education. It also highlights China's firm commitment and concrete actions to improve the quality of physical education, promote the physical and mental health of adolescents, and boost regional development. In addition, the cluster analysis highlighted "core literacy" and "moral education" as important new directions in China's education involving moral education, character building, and the all-round development of students. "Universities" play a crucial role in this hotspot cluster. University physical education curriculums and teacher training are critical for the development of school physical education. The physical education teachers produced by universities have solid expertise in PE, good educational teaching abilities, and a commitment to moral education. They are a key force promoting the healthy development of school physical education. In summary, the VOSviewer cluster analysis revealed the key influencing factors in the "school physical education" domain. This is valuable for better understanding and optimizing school physical education and improving the quality of physical education. The keywords and themes need further investigation and research in practice to advance the healthy development of physical education in China.

3.5.2 Cluster II: Competitive Sports

"Competitive sports" appeared 495 times. The keyword cluster centered around it has 77 links and a link strength of 432. The "competitive sports" cluster includes 27 keywords such as table tennis, elite athletes, London Olympics, volleyball, and swimming.

"Competitive sports" is a broad topic that can be further divided into many subtopics, such as specific sports (table tennis, volleyball, swimming, etc.), athlete training and development, and athlete performance. The keyword "elite athletes" refers to outstanding performers in competitive sports, whose success factors may include physical qualities, skill levels, psychological qualities, etc. "Athlete psychology" studies how athletes handle pressure, stay motivated and deal with wins and losses. "Athlete injury" is also an important topic concerning the prevention and treatment of injuries athletes may sustain during training and competition. Research on "competitive sports" covers multiple aspects, from athletes' psychological and physical health, and their performance in specific sports, to achieving optimal results in competitions.

3.5.3 Cluster III: Sports Industry

"Sports industry" appeared 413 times. The keyword cluster centered around it has 66 links and a link strength of 305. The "sports industry" cluster includes 28 keywords such as sports communication, sports

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venues, sports tourism, sports consumption, competitive sports.

The "sports industry" is a very broad field that involves not just sports activities themselves, but also advertising, culture, tourism, education, health, and other industries. The keyword clustering analysis of "sports industry" shows its highly diverse contents. These keywords represent different closely related aspects and domains of the sports industry that are interconnected and mutually reinforcing, jointly promoting the development of the industry. Therefore, in future development, we need to pay more attention to the integrated advancement across all domains of the sports industry, innovate business models, enhance market competitiveness, and stimulate robust growth of the industry. We also need to emphasize the social value of the sports industry and leverage its unique positive role in society.

3.5.4 Cluster IV: Sports Management

"Sports management" appeared 350 times. The keyword cluster centered around it has 77 links and a link strength of 357. The "sports management" cluster includes 33 keywords such as sports-medicine integration, sports reform, sports policy, national fitness. "Sports management" is a diverse academic field integrating knowledge from economics, management, medicine, psychology and more. It involves research on various aspects like sports organizations, events, policies, marketing. For example, "sports-medicine integration" combines sports and medical healthcare to explore how medical knowledge can improve athlete performance, prevent injury and illness, and enhance rehabilitation. "Sports policy" includes various policies related to sports activities, such as public sports facility construction, athlete training, event organization and management, and public health policy making. These topics demonstrate a shared focus - how effective sports management can improve public health and sports performance.

3.5.5 Cluster V: Adolescents

"Adolescents" appeared 269 times. The keyword cluster centered around it has 70 links and a link strength of 276. The "adolescents" cluster includes 19 keywords such as adolescents, sports activities, sports-education integration, physical exercise, physical fitness, health. Based on the keyword clustering analysis, research topics related to "adolescents" are closely associated with sports and health. Therefore, researchers and educators should pay attention to the impact of sports and health on adolescents' development and seek ways to improve adolescents' physique and health through sports activities and exercise. In addition, sports-education integration is also a very important research topic, referring to the integration of sports and education. Through this integration, adolescents can develop positive lifestyle habits, improve physical fitness, and promote mental health and social skills while learning. Researchers should focus more on how to advance the all-round development of adolescents through integrating education and sports, targeting relevant research topics, and striving to promote adolescents' moral, intellectual, physical, and aesthetic development.

4. Conclusion and Recommendations

4.1 Conclusions

Domestic sports research has gone through the stages of "development-maturity-stability." The number of papers published in China's core sports journals reached its peak in 2014, then decreased over the following years, stabilizing in recent years. Sports research in China has gradually transitioned from an exploratory stage to a mature one. Requirements for journal submissions have become more stringent, and research topics more refined. Reviewers are placing more emphasis on evaluating manuscript quality and significance, which has constrained the increase in publication to some extent.

Collaboration between research institutions is relatively limited and should be further strengthened. Major sports research institutions are concentrated among the top 5 - Beijing Sport University, Shanghai University of Sport, Wuhan Sports University, East China Normal University, and Capital University of Physical Education. Beijing Sport University and Capital University of Physical Education have close ties due to geographical proximity, while collaborations between other institutions are more limited. It is suggested that high-level institutions strengthen research collaborations for synergistic effects, explore interdisciplinary integration, and promote high-level sports science development. Collaborations between high-level and medium/low-level institutions should also be enhanced to form extensive cooperative networks and collectively advance the research level in sports science.

Research topics have become more specific, but there is still room for in-depth study. Current sports research mainly focuses on areas like school PE, competitive sports, sports industry, sports management, and adolescents. Integrated research with education, medicine, economics, and management is increasing,

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indicating enhanced applicability and quality of sports research in China. However, some topics are rigid and findings are not highly innovative, suggesting a need for more in-depth research to meet requirements for high-quality development of sports science.

4.2 Recommendations

4.2.1 Encourage Original Research

Continue to encourage high-quality and original sports research while maintaining rigorous peer review standards to ensure research quality. Establish reward mechanisms to motivate innovative research.

4.2.2 Strengthen Institutional Collaboration

Build extensive and close cooperative networks between institutions of all levels and types to maximize resource sharing, talent flow, and research output conversion. Emphasize fostering cooperative awareness and sound cooperation mechanisms.

4.2.3 Promote Cutting-edge Interdisciplinary Research

Encourage cutting-edge and interdisciplinary research, and adopt comprehensive multidisciplinary methodologies to produce more original, practical, and forward-looking research outcomes. Increase efforts in fundamental and applied research to better align research outputs with national development strategies.

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