

Artificial Intelligence in Sports Research: A Bibliometric Analysis of Intellectual Structure, Evolving Trends, and Future Directions

Jie Zhu

Hebei College of Science and Technology, Tangshan, Hebei, China

Abstract: *This study presents a bibliometric mapping of artificial intelligence (AI) applications in sports, analyzing 298 core journal articles from the CNKI database over the past three decades using CiteSpace. The analysis reveals a steady growth in publications, a strong disciplinary integration of sports science with automation and computer technologies, and a well-established collaborative network among researchers. Over time, research has shifted from macro- to micro-level inquiries, from theoretical principles to empirical evidence, and from quantitative to mixed-method approaches. Future trajectories point toward AI as a digital driver of new productive forces, facilitating digital transformation and sustainable development within the sports industry. These findings offer a systemic overview of the field's intellectual structure and provide actionable guidance for scholars and practitioners.*

Keywords: Artificial intelligence, Sports science, Bibliometric analysis, CiteSpace, Research trends, Digital transformation.

1. Introduction

Artificial Intelligence (AI) was first proposed in August 1955 in the document “A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence,” which used the term artificial intelligence to describe “enabling machines to mimic human cognition, thinking, and learning, or simulating human intelligence with computers” [1]. From its inception to the present day, AI has gone through three major waves over 70 years: the era of reasoning and exploration in the 1950s-1960s, the era of knowledge learning in the 1980s-1990s, and the era of deep learning in the 2010s-2020s [2]. Sports have been a natural testing ground for AI since its inception. The integration of AI and sports can be traced back to 1951 when Christopher Strachey at the University of Manchester in the UK developed the first computer program capable of playing draughts [3]. The emergence and development of AI in sports became inevitable with the introduction of several key policies, including the State Council’s “Several Opinions on Accelerating the Development of the Sports Industry and Promoting Sports Consumption” in 2014, the “13th Five-Year National Science and Technology Innovation Plan” in August 2016, the “13th Five-Year National Strategic Emerging Industry Development Plan” in November 2016, and the “14th Five-Year National High-Tech Industrial Development Zone Development Plan” in September 2022. Against this backdrop, systematically reviewing relevant research findings on AI in sports is essential. This paper employs bibliometrics as a foundation and uses the visualization software CiteSpace6.3.R1 to map the research hotspots and developmental trajectories of AI in sports. By combining quantitative statistics with qualitative analysis, it provides a more objective overview of the current state, hotspots, and frontier trends in the field, offering a reference for future research.

2. Research Methodology

The data in this article comes from the CNKI (China National Knowledge Infrastructure) database. The sample literature

used in the study was retrieved by searching “Artificial Intelligence + Sports” on CNKI, yielding 2716 documents. After filtering for Peking University Core Journals and Nanjing University Core Journals, 298 valid sample documents were ultimately obtained (search date: April 15, 2024). CiteSpace6.3.R1 was used to convert these 298 documents into a dataset format, with basic parameters set for visualization analysis. Through visual analysis of research hotspots in artificial intelligence within the sports field, trends in annual publication volume, journal source distribution, disciplinary distribution, high-yield author research collaboration networks, and keyword co-occurrence analysis, this study aims to visually present the developmental trajectory and research hotspot trends of artificial intelligence in sports via scientific knowledge mapping, providing theoretical support for researchers and thereby promoting advancements in artificial intelligence research in the sports domain.

3. Research Results

3.1 Annual Publication Trends

Among these 298 documents, the first mention of artificial intelligence appeared in Meng Guangyun’s 1995 article “The Future New Technology of Sports Science – Virtual Reality Technology.” He noted that virtual reality technology represents the latest advancement in the field of computer simulation, and its emergence will drive shifts and developments in other disciplines, bringing another revolution to the development of sports science [4]. Meng Guangyun argued that this technology (1) will promote the creation of new sports entertainment programs and new competition formats; (2) can reduce sports injuries and the risks associated with extreme sports; (3) is conducive to scientific talent selection and advanced training; and (4) will drive the transformation of sports from an experience-based model to a high-tech comprehensive approach.

Academic research results are mainly reflected in published journal articles, and changes in the number of journal

publications to some extent reflect scholars' attention to related issues. Drawing the trend chart of the number of journal publications (Figure 1) shows that the overall number of publications is on the rise. From 1995 to 2016 was the initial stage of related research. In 2014, the State Council issued the "Several Opinions of the State Council on Accelerating the Development of the Sports Industry and Promoting Sports Consumption." From 2017 to 2021, there was growth, and analysis shows that these increases were closely related to policies at the time.

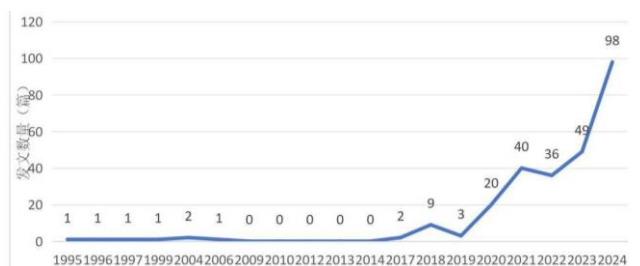


Figure 1: Annual publication volume trend (1995-2024)

A summary table of sports industry and artificial

intelligence-related policies over the past decade (Table 1) indicates that the 2017 "New Generation Artificial Intelligence Development Plan" elevated AI to a national strategic level, with China making AI a key development focus; in 2018, there was a small peak in publication volume. From 2020 to 2023 was a period of rapid growth. In 2019, the General Office of the State Council issued the "Outline for Building a Leading Sports Nation," which mentioned promoting intelligent development. In 2019, the State Council promulgated the "Outline for Building a Leading Sports Nation"; in 2020, the State Council issued the "Several Opinions of the State Council on Promoting High-Quality Development of National High-Tech Industrial Development Zones"; in 2021, the General Administration of Sport issued the "14th Five-Year Plan for Sports Development," with the number of articles published that year reaching 40. In 2024, it peaked at 98 articles, forming a research boom. It is predicted that by 2025, research interest in this field will increase compared to 2024, and with the further development of artificial intelligence, research output in this area will continue to grow.

Table 1: Overview of sports industry and artificial intelligence-related policies in recent years

Time	Competent Authority	Policy Name
October 2014	State Council	The State Council's Several Opinions on Accelerating the Development of the Sports Industry and Promoting Sports Consumption
July 2016	General Administration of Sport of China	The "13th Five-Year Plan" for the Development of the Sports Industry
July 2016	State Council	The "13th Five-Year National Science and Technology Innovation Plan"
November 2016	State Council	The "13th Five-Year Plan" for National Strategic Emerging Industries Development
July 2017	State Council	The New Generation Artificial Intelligence Development Plan
August 2019	State Council	"Outline of the Construction of a Sports Power"
July 2020	State Council	Several Opinions of the State Council on Promoting the High-Quality Development of National High-Tech Industrial Development Zones
October 2021	General Administration of Sport of China	"14th Five-Year Plan" Sports Development Plan
September 2022	Ministry of Science and Technology of the People's Republic of China	"14th Five-Year Plan" for National High-Tech Industrial Development Zones

3.2 Journal Source Overview

The distribution of journal sources reflects the disciplinary characteristics and overall academic level of the research field, providing a reference for scholars' in-depth research and submission [5]. Among the 2,716 retrieved documents, 1,091 were from academic journals, with 298 from Peking University Core and CSSCI journals. Analyzing the journal source table (Table 2) in this field shows that the main sources are the "Journal of Shanghai University of Sport," "Sports Studies," "Sport Science," "Sports Culture Guide," and "Journal of Wuhan Institute of Physical Education."

Table 2: Statistics on Source Journals (Top 10)

Serial Number	Journal Name	Number of Articles
1	Journal of Shanghai University of Sport	33
2	Sports Studies	26
3	Sports Science	25
4	Sports Culture Guide	23
5	Journal of Wuhan Institute of Physical Education	23
6	Journal of Xi'an Physical Education University	21
7	Journal of Shenyang Sport University	17
8	Sports and Science	12
9	China Sports Science and Technology	12
10	Journal of Chengdu Sport University	10

3.3 Discipline Distribution

Artificial intelligence research involves a wide range of

disciplines, such as engineering, computer science, electronics, etc. Conducting comprehensive research on sports artificial intelligence in the context of multidisciplinary integration has become a trend. It can be seen that research on artificial intelligence in the sports field is still based on sports science, combined with automation technology and computer software for practical application in sports science.

3.4 Research Collaboration Network

The collaboration situation of research teams promotes the progress of related research fields. By reading the research results of high-yield institutions and authors, one can quickly understand the current research status and cutting-edge trends [6]. This article uses the author analysis option (Author) and institution analysis option (Institution) in the visualization analysis software CiteSpace6.3.R1 to generate knowledge maps of author collaborations (Figure 3) and institutional collaborations (Figure 4) in the field of artificial intelligence in sports. The size of the nodes represents the number of publications by the author or institution, the lines between nodes represent collaboration relationships, and the thickness of the lines indicates the strength of these relationships.

From the author collaboration knowledge map, it can be seen that research in the field of artificial intelligence in sports involves 169 nodes (N) and 123 connections (E), with a network density (Density) of 0.0087, indicating that this field

has become a widely focused hotspot. Although there are many contributing authors, cooperation and exchanges among authors need further enhancement, and overall research efforts remain relatively dispersed.

According to Price’s Law [7], the certification formula for high-yield authors is $m = 0.749\sqrt{n_{\max}}$. Here, $n_{\max}$ represents the number of papers published by the most prolific author in a certain field, and m represents the minimum number of publications required for an author to be considered a high-yield author in that field. In this study, the threshold $m = 0.749 \times \sqrt{11} \approx 2.48$ is set to an integer of 3, meaning that authors who have published 3 or more papers in the field are recognized as high-yield authors. Statistics on high-yield authors’ information (Table 3) show that there are 7 authors who have published more than 6 papers: Huang Haiyan from Beijing Sport University (11 papers), Ren Bo from Shanghai University of Sport (8 papers), Zhong Yaping

from Wuhan Sports University (7 papers), Wu Zhangzhong from Wuhan Sports University, Wang Zhihui from Renmin University of China, Huang Qian from Wuhan Sports University, and Xu Weikang from the Law School of China University of Political Science and Law (all with 6 papers). Some well-cooperating research teams have also formed in this field, mainly including: the research team composed of Zhong Yaping, Wu Zhangzhong, Wei Mengli from the Big Data Center of Wuhan Institute of Physical Education and Hubei Provincial Innovation Development Research Center for Sports and Health, and Zhang Li from the Sports Information Center of the General Administration of Sport of China (7 co-authored papers); the research team of Huang Haiyan from Beijing Sport University and Ren Bo, Kang Lu from Shanghai University of Sport (6 co-authored papers); and the research team composed of Shen Keyin, Dong Qinqin, Lü Wangang, and Lin Shuting from Wuhan Institute of Physical Education (4 co-authored papers), etc.

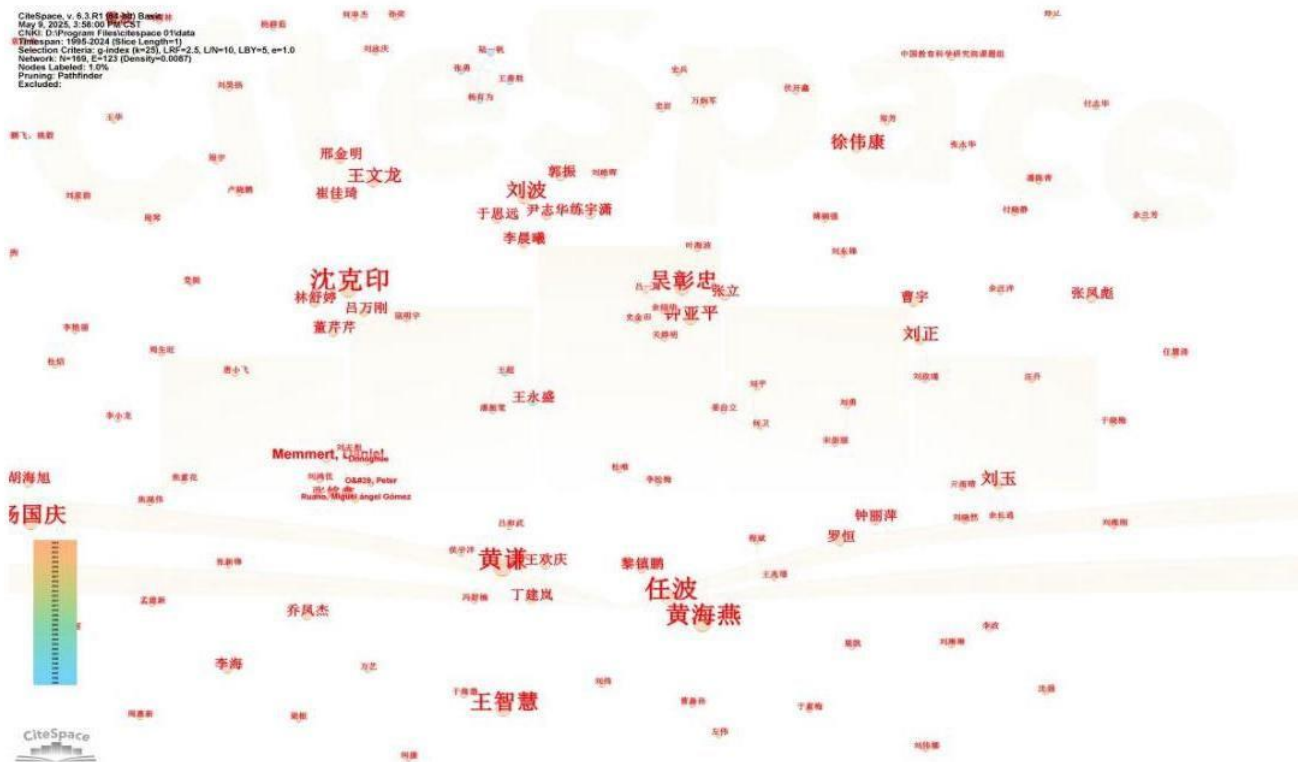


Figure 3: Author Collaboration Knowledge Graph

Table 3: Statistics of High-Yield Authors (Publications ≥ 3)

Serial Number	Author	Number of Articles Published	Year of First Article Publication	Serial Number	Author	Number of Articles Published	Year of First Article Publication
1	Huang Haiyan	11	2020	15	Bao Mingxiao	4	2022
2	Ren Bo	8	2020	16	Dong Qinqin	3	2021
3	Zhong Yaping	7	2023	17	Wang Peng	3	2021
4	Huang Qian	6	2022	18	Li Rongri	3	2022
5	Wu Zhangzhong	6	2021	19	Li Chenxi	3	2023
6	Xu Weikang	6	2019	20	Duan Rui	3	2023
7	Wang Zhihui	6	2023	21	Wang Jiahong	3	2021
8	Shen Keyin	5	2021	22	Hu Haixu	3	2021
9	Yang Guoqing	5	2021	23	Liu Zheng	3	2018
10	Guo Jianghao	5	2023	24	Huo Bo	3	2022
11	Zhang Zhen	5	2022	25	Wang Wenlong	3	2024
12	Chai Wangjun	5	2022	26	Cao Yu	3	2018
13	Liu Bo	4	2024	27	Wang Zipu	3	2022
14	Yin Zhihua	4	2024				

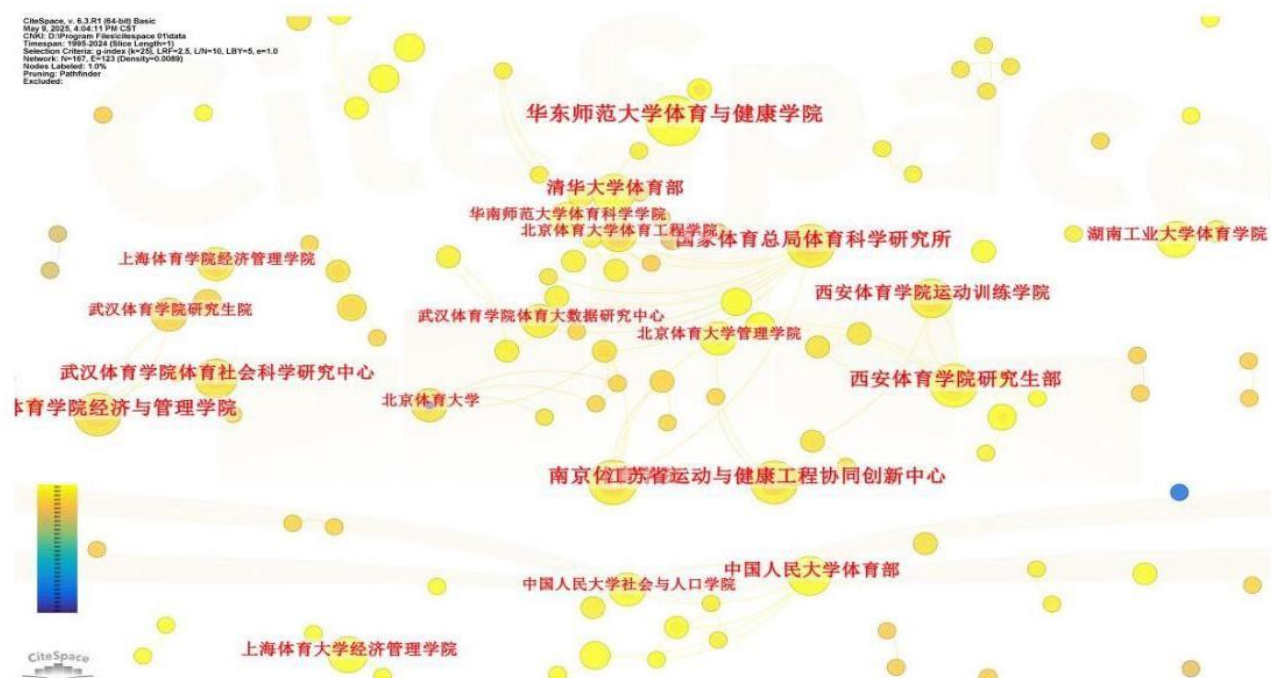


Figure 4: Knowledge Graph of Institutional Collaboration

As can be seen from the knowledge graph of institutional collaboration, the field of artificial intelligence in sports research involves a total of 167 nodes (N) and 123 links (E), with a network density (Density) of 0.089, indicating that connections and academic exchanges among research institutions in this field need to be further strengthened. Statistics on the number of publications by research institutions (Table 4) show that the institutions with the highest number of publications in the field of artificial intelligence in sports research are Shanghai University of Sport, Beijing Sport University, Wuhan Sports University, East China Normal University, and Xi'an Physical Education University, etc. Research in this field combines artificial intelligence with sports, forming a certain scale of academic-research collaboration, which is conducive to leveraging respective strengths to promote in-depth development of research in this field.

Table 4: Statistics of High-yield Institutions (top10)

Serial Number	Journal Name	Number of Articles
1	Shanghai University of Sport	34
2	Beijing Sport University	30
3	Wuhan Sports University	28
4	East China Normal University	16
5	Xi'an Physical Education University	15
6	Capital University of Physical Education and Sports	14
7	Tsinghua University	13
8	Nanjing Sport Institute	12
9	Renmin University of China	10
10	Chengdu Sport University	10

3.5 Keyword Clustering Co-occurrence and Cluster Analysis

Keywords are a high-level summary of the research content in literature, and those with high frequency often reflect the

research hotspots in the field [7]. This paper uses the keyword analysis option (Keyword) in the visualization software CiteSpace to generate a keyword co-occurrence knowledge map for AI in sports research (Figure 5). In the knowledge map, the size of the nodes represents the frequency of the keywords, the lines between nodes represent the co-occurrence relationships between keywords, and the thickness of the lines indicates the strength of these co-occurrence relationships.

From the keyword clustering knowledge map, the top six clusters in this field are: #0 Artificial Intelligence, #1 Sports Powerhouse, #2 Digital Economy, #3 Machine Learning, #4 New Quality Productivity, and #5 Autonomous Knowledge System. Keywords ranked by centrality show the top six as: Smart Sports, Artificial Intelligence, Digital Economy, Sports Powerhouse, Competitive Sports, and Industrial Digitization. Combined with the evolution path of cluster groups in the keyword timeline (Figure 6), the period from 1995 to 2016 was the initial stage of related research, mainly covering basic practical applications of AI as an emerging science and technology in the sports field. With national policy analysis, since the introduction of the "New Generation Artificial Intelligence Development Plan" in 2017 and the "Sports Powerhouse Construction Outline" in 2019, the keyword "Sports Powerhouse" began to appear, becoming a research hotspot from 2019 to 2024. During this time, elements such as "sports management," "Chinese-style modernization," "public sports services," "big data," and "competitive sports" also started to become prominent. In summary, future research directions for AI in the sports field will focus on AI as a digital technology becoming new quality productivity and driving the accelerated digital transformation and development of the sports industry.



Figure 5: Keyword Co-occurrence Knowledge Map

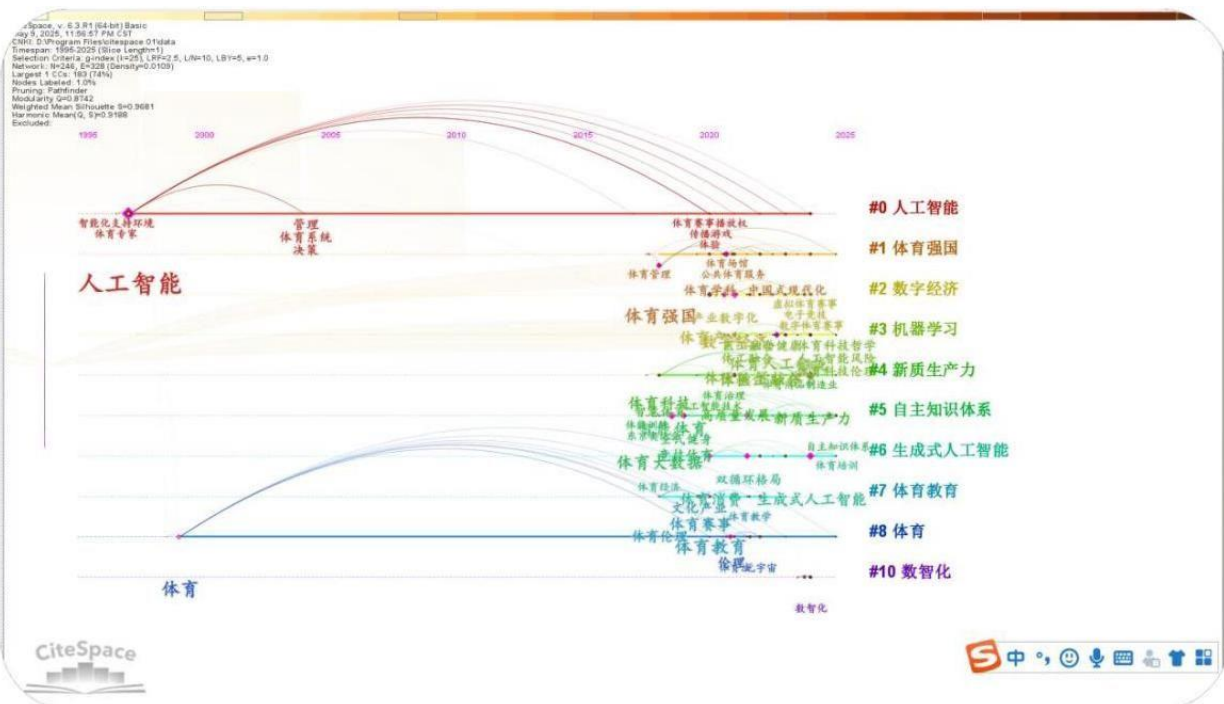


Figure 6: Keyword Timeline

4. Research Conclusions

The research results show that: (1) The number of publications on the development of artificial intelligence in the sports field was in the initial research stage from 1995 to 2016. With the introduction of national policies, it began to grow from 2017 to 2021, and experienced rapid growth from 2020 to 2023. In 2024, it peaked at 98 articles, forming a research boom, and it is predicted that the number of publications will continue to increase in 2025; (2) The main journal sources in this field are “Journal of Shanghai University of Sport,” “Sports Science Research,” “Sports Science,” etc.; (3) Artificial intelligence research in the sports field is still based on sports science, combined with

automation technology, computer software, and applications for practical use in sports science. (4) There is a strong cooperative relationship between authors or research institutions. Huang Haiyan, Ren Bo, Zhong Yaping, Shen Keyin, Wu Zhangzhong, Wang Zhihui, Huang Qian, Xu Weikang, etc., are high-yield authors in this field and have formed some well-cooperative research teams. These include the research team composed of the Big Data Center of Wuhan Sports University and the Hubei Provincial Innovation and Development Research Center for Sports and Health, including Zhong Yaping and Wu Zhangzhong; the research team from Beijing Sport University including Huang Haiyan and Shanghai University of Sport’s Ren Bo; and the research team from Wuhan Sports University including Shen Keyin

and Dong Qinqin. (5) The knowledge map of keyword clustering shows that this field involves six clustering groups: #0 Artificial Intelligence, #1 Sports Power, #2 Digital Economy, #3 Machine Learning, #4 New Quality Productivity, #5 Autonomous Knowledge System. Considering the evolution path of clustering groups in the keyword timeline, the main research content from 1995 to 2016 focused on basic practical applications of artificial intelligence as an emerging future science and technology in the sports field. Since the introduction of the “New Generation Artificial Intelligence Development Plan” in 2017 and the “Outline of Building a Sports Power” in 2019, the keyword “Sports Power” began to appear, becoming a research hotspot from 2019 to 2024. Elements such as “sports management,” “Chinese-style modernization,” “public sports services,” “big data,” and “competitive sports” also began to stand out. (6) Overall, the research on artificial intelligence in the sports field has gradually shifted from macro research to micro research, from principle research to empirical research^[8]. In summary, the future research direction of artificial intelligence in the sports field will focus on artificial intelligence as a digital technology becoming a new quality productivity, promoting the accelerated digital transformation and development of the sports industry.

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