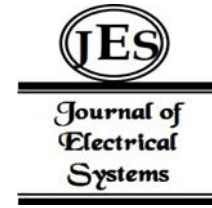[1]Ju'An Wang

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The Current Situation, Characteristics and Prospects of the Research on Tennis Theme Literature in China from the Perspective of Artificial Intelligence

Abstract: - With the rapid development of artificial intelligence technology, the function of artificial intelligence to help the high-quality development of sports is increasingly visible, and the continuous, comprehensive and deep integration of artificial intelligence and sports will be an inevitable trend. This paper summarized and analyzed the characteristics of the tennis research theme literature published in the core journals of China from 2012 to 2022 by using the methods of literature and logical induction. The results show that, in the past 10 years, there are problems such as insufficient use of artificial intelligence in technical and tactical statistical analysis, insufficient use in tennis professionalization research, lack of artificial intelligence perspectives in tennis tournament research, and shortage of artificial intelligence use in tennis psychology research. In the future, scientific research on tennis in China should rely on scientific and technological means such as 5G technology, big data technology, computer vision and intelligent wearable devices. etc, cross integrate multidisciplinary knowledge, accurately locate the physical fitness weaknesses of Chinese tennis players, focus on building an intelligent measurement system for tennis players, and scientifically develop a big data platform for tennis skills and tactics; And guided by practical problems, we should focus on exploring intelligent wearable devices suitable for tennis sports programs, and integrating computer vision technology with intelligent wearable devices to achieve complementary advantages and enhance the accuracy and credibility of data collection. And use natural science methods to conduct quantitative analysis to provide scientific solutions for the development of tennis.

Keywords: Artificial Intelligence, Tennis, Literature Research, Theme Characteristic, Prospects.

I. INTRODUCTION

Artificial Intelligence (AI) technology is profoundly affecting people's work and life as the core driving force of the new round of scientific and technological revolution and industrial revolution. According to the definition of STEPHEN L, artificial intelligence refers to the new technological science through research and development of technologies, methods, theories, etc. that can extend, expand, or simulate human intelligence, so that the machine can do the work that human beings need intelligence to complete [1]. In recent years, the demand for high-quality development of sports has become increasingly strong, and artificial intelligence, as a core technology in the field of science and technology, plays an important role in empowering high-quality development of sports. To summarize, AI has produced corresponding effects in the fields of competitive sports, school sports and national fitness. For example, in the field of competitive sports, training assistance systems, tactical optimization systems, intelligent referees and auxiliary penalties have been widely used in training, competition and refereeing [2]; in the field of school sports, relying on big data and artificial intelligence to assist teachers to carry out personalized, targeted teaching, improve the quality of teaching and training and enhance the efficiency of management [3]; in the field of national fitness, artificial intelligence to obtain various types of fitness data, to develop and deliver accurate fitness programs. In the field of national fitness, artificial intelligence is used to obtain various types of fitness data, develop and push precise fitness programs, and realize scientific fitness.

The tennis program is an important part of the sport. The origin of tennis can be traced back to France, its birthplace is in England, and it reached its peak of popularity and formation in the United States. Therefore, tennis has deep cultural roots in European and American countries. Studies have shown that since the inception of the four Grand Slam tournaments, Europe has been the region with the most Grand Slam medals, followed by North America with the United States as the representative [4], whereas Asia ranks at the bottom of the medal tally. However, Li Na's victory at the French Open in 2011 created a historic milestone for tennis in China and even in Asia, marking a significant breakthrough. Since then, Chinese tennis has been making continuous progress: in 2022, Chinese tennis players experienced "a collective breakthrough" at the US Open; in 2023, 10 Chinese players

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simultaneously entered the main draw of the Australian Open; and in the same year, China won its first ATP250 tennis tour championship. This marks the high-quality development stage of tennis in China. The high-quality development of sports and scientific research and technological progress is closely intertwined, and both mutually contribute to each other's advancement. Based on this, from the perspective of AI, this paper aims to analyze the tennis theme literature published in Chinese core journals over the past decade, systematically organize the literature resources, explore the current status of tennis sports science research, and focuses on analyzing the distribution of research topics by cutting through the AI perspective, understanding the characteristics of tennis theme research in China through the analysis of themes. This research holds significant importance for further promoting the development of tennis in China.

II.   ANALYSIS CURRENT SITUATION OF THE RESEARCH FROM THE PERSPECTIVE OF AI

The theme of "tennis" "AI" was used to search for literature from the China National Knowledge Infrastructure (CNKI) database, specifically the "Peking University Core Journal List" and "CSSCI" sources, covering the period from 2012 to 2022. A total of 639 documents were initially retrieved, which were subsequently screened to remove irrelevant literature, resulting in a final selection of 305 articles. Analyzing the selected literature in a chronological order, it is observed that the overall number of research papers on the tennis theme in Chinese core journals has shown a downward trend over the past decade, with an average annual decline of approximately 4.3 articles. In 2022, only two tennis-themed articles were published in the core journals (refer to Figure 1).
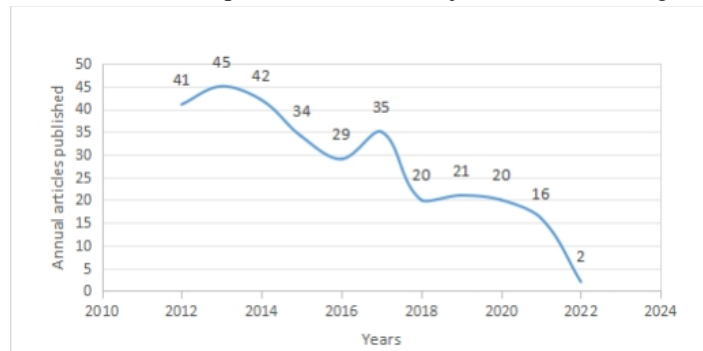

Figure 1: Trends of Articles Published in Tennis Research Field of Chinese Core Journals from 2012 to 2022

After a systematic analysis of the retrieved literature, it can be observed that the research in the field is predominantly focused on aspects such as technical and tactical statistical analysis, tennis professionalization, tennis events, tennis psychology, biomechanics and tennis teaching. These areas account for a significant proportion of the overall literature, amounting to 70.8% (216 articles). Among them, the highest number of publications is found in the field of technical and tactical statistical analysis research (102 articles), followed by studies on the tennis professionalization (45 articles), and tennis events research ranking third (30 articles), as illustrated in Figure 2.
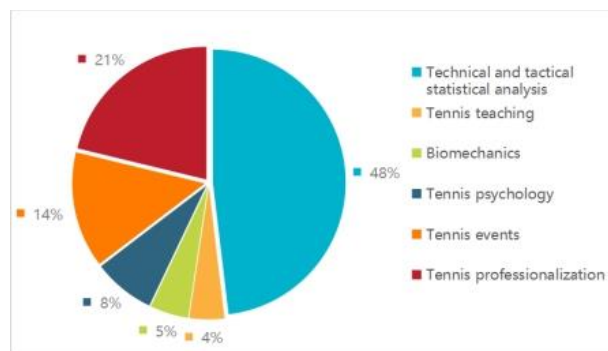

Figure 2: Distribution of Tennis Research Topics in Chinese Core Journals from 2012 to 2022

From the trend chart (Figure 1), it is evident that there was a significant "Li Na Effect" in terms of research output. Years 2012-2014 witnessed a concentrated increase in scholarly publications, while there was a sharp decline after 2017, followed by a gradual decrease. The thematic distribution chart (Figure 2) reveals that Chinese core journal literature on tennis primarily focuses on technical and tactical statistical analysis. This could be attributed to the positioning of tennis as a skill-dominated sport in China, leading researchers to primarily study it from a technical and tactical perspective [5]. The emphasis on the tennis professionalization as a research hotspot is closely related to the athlete development system. China predominantly adopts a centralized system to foster

athletes; however, given the highly professionalized, internationalized, and market-oriented nature of tennis, researchers advocate for aligning Chinese tennis with international trends and embracing a path of professional development. Furthermore, Li Na's success serves as a representative example of the reforms in China's athlete development system, particularly the implementation of the "independent flying" model. These factors contribute to the motivation of researchers to delve into the topic of tennis professionalization. In 2014, the government released the Opinions on Accelerating the Development of the Sports Industry and Promoting Sports Consumption (G.F. Document [2014] No. 46), advocating for the development of the sports industry, particularly focusing on sports events and performances. Consequently, tennis events naturally became one of the primary research directions. However, on the whole, in the era of scientific and technological informationization, few tennis-themed studies have dealt with artificial intelligence, and the intrinsic mechanism of cross-fertilization between artificial intelligence and tennis has yet to be studied.

III. ANALYSIS OF RESEARCH TOPIC CHARACTERISTICS FROM THE PERSPECTIVE OF AI

A. AI is Underutilized in Technical and Tactical Statistical Analysis

In analyzing the characteristics of research topics, it is evident that technical and tactical statistical analysis is a common concern among Chinese coaches and researchers. They aim to explore the technical and tactical features [6-12] of world-class tennis players, such as performance indicators for success [13-18].

Regarding the analysis of technical and tactical features, after Li Na's victory at the French Open, she became the subject of research. The analysis of her performance in the four Grand Slam finals provided valuable insights [11]. It emphasized the importance of balancing national systems with market mechanisms and further enhancing the professionalization of Chinese tennis. Comparisons between Li Na's technical and tactical features and those of other outstanding Chinese female singles players revealed that Li Na displays good stability in terms of unforced errors, scoring ability, proactive scoring, and serving and receiving scoring rates. In contrast, other players showed less emphasis on aggressive serving and receiving, had fewer winners, and made fewer unforced errors. However, they fell slightly short in terms of saving break points [12].

In analyzing the factors for success, Zhao Yue et al. [16] conducted a study on the relationship between technical, tactical, and physical performance and match outcomes in Grand Slam tournaments. Through modeling, they identified the decisive factors for success among professional male tennis players. It was found that first serve percentage, first serve return points won, and break point conversion rate had the highest impact on match results. Following closely were second serve percentage, second serve return points won, rally points won, break point success rate, and the ratio of winners to unforced errors. Interestingly, the selection of serve placement was deemed more significant than serve velocity, while increased net approaches diminished the chances of victory. Further research on factors influencing outcomes in men's singles professional tennis matches revealed the utmost importance of serving, returning, and break point conversion rate. In fact, first serve percentage emerged as the optimal predictor of match results [17]. Additionally, it was observed that different tennis court surfaces exhibit distinct technical and tactical characteristics. For instance, in grass court women's singles matches, three key indicators affecting victory were identified: first serve percentage, second serve percentage, and first serve return points won. It was also noted that Chinese players need to strengthen their serving abilities on grass courts [18]. However, contrasting views exist among scholars, suggesting that different court surfaces do not significantly impact match outcomes. This is attributed to the International Tennis Federation's usage of tennis balls with varying bounce types for different court surfaces [17].

In a comprehensive analysis, Chinese researchers have summarized the technical and tactical characteristics of tennis in both singles and doubles matches, different court surfaces, and certain tennis players. They have identified the key factors for success in tennis matches, which primarily include serving, returning, and scoring abilities. These indicators have significant implications for match outcomes. However, serving technique remains a weak point for Chinese tennis players, hindering the overall improvement of Chinese tennis [19]. Among high-level Chinese tennis players, male athletes demonstrate noticeable deficiencies in serving stability, success rate, and consistency. Some lack the basic qualities required for serving, while others struggle to effectively handle the complex and competitive demands of a match [20]. Thus, it is evident that exploring the patterns of winning through extensive analysis of technical and tactical data is an effective method for identifying the existing issues among Chinese tennis players. However, literature studies showed that the means of obtaining technical and tactical data by researchers in China were still relatively traditional, and few studies have utilized artificial intelligence means such as computer vision technology, intelligent wearable devices and big data technology to obtain accurate data of athletes. Taking computer vision technology as an example, the recognition and tracking of fast-moving balls

and athletes through relevant algorithms can improve the efficiency of technical and tactical analysis and effect judgments [21-22].

B. AI Not Used Enough in Tennis Professionalization Research

1)   The reasons for professionalization in tennis

Tennis is a highly professionalized sport. As early as the 1992 Olympics, when professional athletes were allowed to compete and seedings were determined by international rankings, Chinese tennis realized the necessity of participating in professional tournaments to improve their international rankings [23]. However, Chinese tennis has long been under a centralized management system that relies heavily on administrative control and directives [24]. Under this management system, players rarely participate in professional tennis events, stagnating their skill levels and becoming stuck in a cycle of "limited participation in professional events, low rankings, lack of qualification, difficulty in improving skills, and even less opportunities for professional events" [25]. With the rapid improvement in players' own abilities and exposure to advanced international professional tennis models, the existing training and management system cannot meet the strong demands of athletes like Li Na to fully engage in international professional tennis competitions. Therefore, after the defeat in Busan, the National Tennis Management Center faced the need for reform in order to seek development and put forward the path of professionalization. In summary, considering the highly professional nature of tennis, the competition rules of the Olympics, the athletes' performance under the existing management system, and the lessons learned from the defeat in Busan, China has proposed the guiding principle of "adhering to the path of professionalization" to reform the management system and conform to the development laws of international tennis. This is the necessary route to enhance China's competitive strength in tennis.

2)   Pathways to professionalization in tennis

Once the guiding principle of "adhering to the path of professionalization" was established, researchers conducted extensive studies on how to professionalize tennis to improve athletic performance. This primarily includes: (1) Pathways to professionalization for Chinese women's tennis. Following the reform of tennis professionalization, Chinese women's tennis has experienced remarkable progress.

From the perspective of path dependence theory, the reform of professionalization in Chinese women's tennis necessitates a transformation of central functions, continuous advancement of the institutionalization of the Chinese Tennis Association, coordination of diverse stakeholder interests to achieve mutually beneficial outcomes, innovative human capital property rights system for women's tennis, establishment of new management models, and the development of a new talent cultivation model for women's tennis to promote sustainable growth [26]. Some scholars also suggest that accelerating the professionalization process in Chinese women's tennis requires a steadfast commitment to the path of professional development, strengthening the coaching workforce, accelerating the reform of the competition system, and constructing a new bonus distribution system [27]. (2) Pathways to professionalization for Chinese men's tennis. The professionalization of men's tennis necessitates the improvement of a "national system", gradually developing a distinctive Chinese pathway to professionalize men's tennis in accordance with tennis training principles, continuous exploration of the factors leading to victory in Chinese men's tennis, establishment of a comprehensive management mechanism, promotion of the professionalization process, and the guidance and creation of a commercial system that aligns with the characteristics of Chinese men's tennis [28]. (3) Policy-driven promotion of tennis professionalization. The "Olympic Glory Enhancement" program laid the foundation for the development of professional tennis in China. The "national system" has created conditions for the transition to professionalization. The pursuit of mutual benefits has achieved substantial transformation in the development of tennis professionalization [29]. In addition, some scholars believe that collaborating with professional agents is an important step for athletes towards professionalization [30]. Moreover, it is crucial to follow social laws, cultivate the social and humanistic qualities of tennis athletes, open up the tennis market, nurture a tennis industry that aligns with professionalization, improve tennis facilities, and firmly establish a solid foundation for the development of tennis among the public [31].

In conclusion, through extensive research, scholars have elucidated the reasons behind the professionalization of tennis in China and proposed diverse pathways towards this goal. These efforts have provided a solid theoretical foundation for the development of tennis in China and are instrumental in discovering a distinctive Chinese pathway to professionalize tennis. However, scholars in the tennis professionalization research in the use of big data and other artificial intelligence means to capture information is insufficient, the theoretical analysis is mostly from the policy text research, rarely through big data and other artificial intelligence means to obtain information to accurately identify whether the athlete has the ability to take the road of professional tennis.

C. Lack of AI Perspective in Tennis Events Research

The China Open, Guangzhou Open, and Shanghai Masters are prestigious international tennis events in China with a long history and well-established operational mechanisms. These events not only provide Chinese athletes with the opportunity to compete alongside world-class players but also bring about social, economic, cultural, and tourism benefits to the host cities. As a result, they have become typical subjects of study within the sports industry. Scholars have primarily conducted research on these three major international tennis events from the perspectives of event marketing, management and operations, social benefits, and commercial sponsorships. Few scholars have analyzed the internal mechanism and logic of cross-fertilization between AI and tennis tournaments in depth from the perspective of AI.

Firstly, from a marketing perspective, the online marketing strategy of the China Open primarily focuses on five aspects: website, product, pricing, promotion, and customer service. It is crucial to emphasize the development of non-competition features on the official website, integrate the unique characteristics of the event with the internet, enhance collaboration with the tourism and leisure industries, and improve the ability for sustained marketing efforts [32]. Despite being the highest-level tennis event in Asia, the commercial operations of the China Open still face challenges in market development, including an irrational income structure and the need to establish a stronger event culture [33]. Moreover, there is a need to address issues such as low revenue from media copyrights [34]. Therefore, it is imperative to enhance the event branding and create a strategic brand for the China Open, cultivating a distinctive event culture.

Secondly, from a management and operational perspective, researchers have analyzed the volunteer management system of the China Open and believe that it is worth promoting and learning from [35]. After reviewing the historical development of the Guangzhou Open, it is evident that its venue facilities are not conducive to the further advancement of the event. Therefore, it is necessary to enhance the market-oriented management of the event and improve the event culture by refining the hardware facilities [36]. Additionally, there is a lack of sponsorship and standardized organization in Chinese professional tennis events, as well as insufficient development and utilization of media communication. It is crucial to initiate reforms in terms of institutional innovation, cultural development, media promotion, and talent cultivation [37].

Thirdly, from a social benefit perspective, the research primarily focuses on the dimension of psychological benefits. Researchers have studied the relationship between the level of involvement, psychological benefits, and support attitudes of residents in the host cities of sports events, using the Shanghai Masters as an example. They found that it is necessary to broaden residents' channels for involvement in sports events in the Shanghai region and enhance their perception of psychological benefits from sports events [38]. Following the China Open, the Guangzhou Open, and the Shanghai Maters, China has successively hosted the Wuhan Open [39-41], Chengdu Open, Tianjin Open, and so on.

Fourthly, from a commercial sponsorship perspective, the operation of large international sports events relies heavily on commercial sponsorships. Commercial sponsorships not only ensure the funding sources of the events but also guarantee the smooth operation of the events. Taking the China Open as an example, the primary key factors affecting the sponsorship revenue of Chinese professional tennis events are the duration of TV broadcasts, followed by the prize money or the participation of top players [42]. Through a comparison of the sponsorship markets of domestic and foreign top-level tennis events, it has been found that there are fewer international brand sponsors for the China Open, the exclusivity of sponsors is not obvious, the sponsor structure is unreasonable, and the sponsor lineup is not stable [43].

D. Shortage of AI Use in Tennis Psychology Research

1) Perceptual anticipation in tennis

Perceptual anticipation in sports is the expectation of internal factors for potential events based on background knowledge. It serves as a crucial foundation for executing rapid and accurate motor responses. Tennis, as a highly strategic and open-ended sport, places significant demands on athletes' perceptual-cognitive skills, making it a typical domain for studying perceptual anticipation [44]. In recent years, domestic scholars have attempted to utilize event-related potentials (ERPs), a technique with high temporal resolution, to detect the electrophysiological activity in the cortical regions of the brain during the process of perceptual anticipation.

In a study conducted by Zhang et al. [44], tennis players were divided into expert group, intermediate group, and novice group, with the tennis match phase serving as the background. The researchers used ERP to record the participants' behavioral characteristics and event-related potentials during different moments of ball judgment. The results revealed that expert tennis players were able to seize advantageous opportunities even when the information

presented was incomplete, showing remarkably fast and accurate decision-making responses and highlighting their cognitive advantages. High-level players were found to allocate more cognitive resources to determine the accuracy of the ball's trajectory and the optimal timing of the shot, extracting relevant perceptual information based on specific sport scenarios and forming automatic decision-making patterns for retrieving specific information [45]. Additionally, another study utilized images captured at different time points during the match phase as stimuli for anticipatory judgments of ball trajectories. Results showed a positive correlation between the level of tennis players and the performance in ball trajectory anticipation, with the expert group being able to make correct predictions at earlier time points [46].

2) The visual characteristics of tennis performance

Studies have revealed that high-level tennis players are capable of diverting their gaze from the actual flight path of the ball without compromising their shot effectiveness. They are able to utilize various cues such as the opponent's stance, grip, racket angle, swing trajectory, body movements, and shot types to infer the speed, height, direction, and spin of the ball [47]. Huang Hongyuan et al. [48] employed eye-tracking technology to examine the visual search patterns of tennis players of different levels, as they autonomously viewed static tennis images without any task requirements. Significant differences were observed between expert and novice players in terms of their visual search patterns, with experts demonstrating superiority over novices. Furthermore, experts exhibited greater temporal and spatial advantages, along with higher information processing efficiency and more rational processing strategies [49]. Liu Yang et al. [50] further validated through experiments that visual tracking training can enhance perceptual prediction abilities in tennis players.

In addition, research has also explored the impact of spatial-temporal information and skill level on the anticipatory performance of tennis players in serving and receiving. It has been found that spatial-temporal information and skill level significantly influence the anticipatory performance of tennis players, with expert players demonstrating superior predictive skills [51]. Wang Liyan et al. [52] conducted exploratory research on the recognition of on-court emotions among athletes using a picture emotion task paradigm. The results revealed that body language conveys more and more accurate emotional information in the context of tennis, with hand gestures being a key factor in emotion recognition. Li Jing et al. [53] compared the state anxiety and self-control of outstanding female tennis players from China and abroad when faced with the pressure of maintaining a serve. The results showed that, compared to foreign athletes, Chinese players had lower levels of state confidence and primarily used inhibitory strategies for emotional control, as well as conservative strategies for behavioral control.

Moreover, research in the field of tennis psychology has primarily focused on analyzing the perceptual anticipation, decision-making responses, and visual search characteristics of individuals involved in tennis. This has been done to demonstrate the superiority of expert groups over novice groups. However, the mechanisms underlying why expert groups outperform novice groups have not been sufficiently explained. Moreover, most of the tennis psychological studies are conducted under laboratory conditions, and few studies are actually measured in real match environments, which is related to factors such as the fast speed and short time of movement in matches. To address this difficulty, smart wearable devices in artificial intelligence technology use embedded technology to make motion detection sensors wearable in various parts of the human body, and then collect real-time human motion and physiological data through the global positioning system, heart rate detector, et al. [54]. However, few scholars in China have used artificial intelligence means such as intelligent wearable devices to collect athletes' psychological data in real time during the game to conduct research, and there is a shortage of the use of artificial intelligence in tennis psychological research.

IV. SUMMARY AND OUTLOOK

A. Summary

In general, this paper analyzes and summarizes the literature research on the topic of tennis in China in the past ten years from the perspective of artificial intelligence, and finds that the research on the cross-integration of tennis and artificial intelligence has yet to be explored. There are mainly problems such as insufficient use of artificial intelligence in technical and tactical statistical analysis, insufficient use in the study of tennis professionalization, lack of artificial intelligence perspective in the study of tennis events, and shortage of the use of artificial intelligence in the study of tennis psychology. At present, the wide application of computer vision technology and other artificial intelligence means in the field of competitive sports has greatly improved the efficiency of training monitoring and technical and tactical analysis of sports events, and in the field of school sports and national fitness, it can comprehensively monitor the quality of the movements of students or sports enthusiasts, etc. However, there

is very little literature exploring the development of tennis from the perspective of artificial intelligence in tennis thematic research.

Specifically, over the past decade, research literature on tennis in Chinese core journals has shown a decreasing trend year by year. The research topics have primarily focused on six areas: technical and tactical statistical analysis, tennis professionalization, tennis events, tennis psychology, tennis biomechanics, and tennis teaching. Among these, the main research fields have been technical and tactical statistical analysis, tennis professionalization, tennis events, and tennis psychology, accounting for 70.8% of the total literature. These studies have made significant contributions to the development of tennis in China.

In the field of technical and tactical statistical analysis, research has summarized the technical and tactical characteristics of singles and doubles tennis, different types of court surfaces, and certain tennis players. It has also identified the factors that contribute to victory in tennis matches, helping to uncover the dynamics of tennis competitions in China. Research on the tennis professionalization has explored the reasons why it is necessary to embrace the path of professionalization and has discussed the various pathways towards tennis professionalization. This research has aided in the proper understanding of the necessity of professionalization reforms in China. The study of tennis events has analyzed the Chinese Tennis Open, Guangzhou Tennis Open, and Shanghai Tennis Masters from a sports industry perspective. It has identified issues in areas such as marketing, management, commercial sponsorship, and social impact. This analysis has helped China recognize the indispensable role of establishing independent intellectual property tennis events and cultural development. Research in the field of tennis psychology has focused on perceptual anticipation and visual characteristics in tennis, emphasizing the importance of psychological training in Chinese tennis. Furthermore, although Chinese scholars have published some articles in the fields of tennis biomechanics and tennis curriculum teaching, these areas have not formed a systematic body of literature compared to the other four main research themes.

B. Outlook

Based on the aforementioned, scientific research has made significant contributions to the development of tennis in China. However, there are still some shortcomings that need to be addressed. These include: 1. Insufficient research on tennis fitness: Over the past decade, there has been a scarcity of research articles in core Chinese journals focusing on tennis fitness. Given that fitness is the foundation of sports performance, this area should not be overlooked. 2. Gap in research on tennis intelligence: Intelligence is an essential component of competitive ability and should not be underestimated. However, there is a lack of literature exploring this aspect of tennis. 3. Overemphasis on exploring competition rules and characteristics in tactical analysis, while neglecting the establishment of a comprehensive technical and tactical data platform. 4. Excessive focus on event management and market-oriented development in tennis event research, with insufficient attention given to studying the construction of the event system itself. 5. Tennis psychology research primarily relies on experimental validation studies, with a lack of research that addresses practical issues and applies findings to real-world scenarios. 6. Overreliance on humanistic and social science methods in tennis sports science research, with limited utilization of natural science approaches.

In light of the aforementioned deficiencies, this paper proposes future research directions. On one hand, future research on the cross-fertilization of tennis fitness, intelligence, technical and tactical data with artificial intelligence should be strengthened from an artificial intelligence perspective. This can be accomplished through the utilization of cutting-edge technologies such as 5G, big data technology, computer vision and intelligente wearable devices.etc, while integrating interdisciplinary knowledge to accurately identify the areas of weakness in Chinese tennis athletes' physical fitness. Emphasis should be placed on establishing an intelligent assessment system for tennis players and scientifically developing a comprehensive data platform for tennis techniques and tactics. On the other hand, in the future, we should be oriented to the actual problems in tennis sports competitions, focus on exploring intelligent wearable devices suitable for tennis sports programs, and integrate computer vision technology with intelligent wearable devices to achieve complementary advantages and enhance the accuracy and credibility of data collection. Additionally, it is crucial to conduct research on tennis from a natural science perspective, employing experimental methods for quantitative analysis.

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