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Dynamic and Quantitative CiteSpace Analysis of Chinese Sports Discipline in the Past Decade

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Abstract

Based on the visualizing software of CiteSpace, this paper selects data resources from four Chinese core sports journals chosen by CSSCI, which include Sport Science, Chinese Sport Science and Technology, Academic Journal of Beijing Sports University, Academic Journal of Shanghai Sports University. All the cited papers were published from 2006 to 2015 in the four journals (the deadline of retrieval was on Jan. 10th, 2016). This paper analyzes the co-occurrence of keywords and authors of literature data, draws maps of scientific knowledge in sports discipline over the past decade, researching hotspot, researching front, researching strength and representatives in current study, organizes key nodes about literature in this field. Finally, this paper gets the highest keyword-time trends and the strongest citation bursts, and predicts the developing trends of sports science research in the future.

1. Introduction

In the digital information age, computer network technology develops rapidly, the big data information shows explosively increasing trend. Exploring effective information in massive data, scientists find that it is difficult to figure out the hidden valuable information and to explore the natural feature and rules of information. The development of information visualizing technology provides new methods and means for the process and analysis of contemporary big data. At the beginning, it deprives from computing visualizing and data visualizing technology. With information visualizing technology and a range of computer programs, it shows a large amount of literature information data vividly in the form of scientific knowledge map, which reveals the developing back-

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ground, motivation and overview of scientific knowledge, probes research frontier and hot issues of this field (Hou, J.H, 2009). Drawing scientific knowledge map by the literature information data to achieve academic knowledge visualizing benefits the study of scientific growth, scientific shifting paradigm, development of discipline areas and disciplines structure and so on.

Currently, CiteSpace mainly concentrates on the field of management, such as library information archival management, management science and engineering, public administration and business administration. There are few relative applications on the aspect of sports science research. Some problems existing at the application of CiteSpace mainly manifest several aspects: 1) Scientific knowledge maps rarely use index Q of clustering module and clustering index S to assess the value of spectrum clustering effect; 2) There are relatively few applications on time trends and burst; 3) There are two core functions, namely the explanation of the current field and the foreseeable function of future prospect field. But there are few applications on predictable application. This article will explore and analyze the latest research and research hot-spots in the field of sports. It plays a significant role for research in this area and other related researches, which makes researchers timely grasp and follow the latest research, research hot-spots and the newest dynamics, and predict developing trends and hot issues in the future.

2. Research Tools

CiteSpace visualizing software is a visualizing tool developed by Prof. Chen Chaomei of Dalian University in the new information age. It is based on java-the complex network analysis platform, and it is the most unique and influential visualizing software in recent years in the United States. This software can be used to analyze authors, keyword co-occurrence, cooperating institutions, citation times of author literature, etc, analyzes the latest research in a certain field in different stages, and analyzes the relationship between latest research and knowledge basis. This study draws maps of scientific knowledge in sports discipline over the past decade, cards hot spots, latest research, researching strength and representatives, and predicts the developing trends of sports science research in the future.

3. Data Resources and Process

3.1. Data Resources

This paper selects data resources from four Chinese core sports journals chosen by CSSCI, which include Sport Science, Chinese Sport Science and Technology, Academic Journal of Beijing Sports University, Academic Journal of Shanghai Sports University. All the 8478 cited papers were published from 2006 to 2015 in the four journals, and the deadline of retrieval is on Jan, 10th, 2016. Because not all the articles published in 2015 have not been recorded, so the data in this study comes from papers that are recorded. The literature indexed in CSSCI (Chinese Social Sciences Citation Index) is from Chinese Social Science Research Evaluation Center of Nanjing University, which selects journals according to the principle and method of Chinese Social Science Citation Index Committee. Selected journals should reflect the latest research results from various disciplines of Chinese social science at present, and these journals ought to have high academic level, significant influence, standardized editing publication.

3.2 Research Object

This paper makes a visualizing analysis about 8089 keywords and 57878 effective cited literature that are from four Chinese core sports journals chosen by CSSCI, which include Sport Science, Chinese Sport Science and Technology, Academic Journal of Beijing Sports University, Academic Journal of Shanghai Sports University. All the 8478 cited papers were published from 2006 to 2015. Keywords and cited reference data are normalized to analyze, e.g. "public service", "public sports service", "sports public service" are unified into "public sports service".

4. Results and Analysis

4.1. Research Hot-Spot Analysis about the Keyword Co-Occurrence Network

Research hot-pots are scientific problems or special topics that are discussed in one group of papers which are

intrinsically linked in a period (Yang, Wei, & Li, 2013). The key words co-occurrence networks can show tot-spot vocabulary that are reflected in relevant literature in a period. Hot-spot is an eternal topic of scholars. This paper analyzes the keyword co-occurrence network in sports discipline with this method and technique, explores research hot-spot in sports disciplines.

Import the processed data to CiteSpace III, select Time Slicing from 2006 to 2015, # years per slice are 5, that is to say, every five-years is a time zone; the selection criteria is Top 50, namely, choose the first 50 high frequency nodes in each time zone; pruning selects Path Finder, which simplifies the network and highlights important structure features and has completeness (unique solution); node types choose keyword, click "GO" to get initial the knowledge map. To make the map beautiful and make it easy to interpret, adjust and cluster them, set parameters to obtain keyword co-occurrence map (**Figure 1**), wherein modularity Q and mean silhouette ware 0.6593 and 0.8566. On the basis of clarity degree of network structure and clustering, CiteSpace software provides two indexes about evaluating the mapping effect. Teacher Che stated clearly in his papers, when the Q value is more than 0.3, which means that the carved community structure is significant; when the S value is 0.7, the clustering is convincing; if it is above 0.5, clustering is generally considered to be reasonable. The Q value and S value in this paper is in line with this requirement, and this paper gets a total of 70 nodes and 91 connections, which illustrates that the clustering map is reasonable. Each node represents a keyword, bigger its node is, higher the frequency is, which means that this keyword is more important in network nodes; the number of connection between each node stands the related degree of nodes, the node that has high center degree plays a role of connecting in the social network analysis theory.

According to nodes and links, it will be divided into eight research focusing on the clusters (**Table 1**): Animal experiments class, the class of elite athletes, Chinese athletic sports, school sports, sports and cultural development, sports participation in class crowd, the sports industry and event management classes, public service class sports. So we can see that Sports Sciences in our country is diversified, multi-level nature of sports studies, practical studies and functional studies combined and the research structure is reasonable.

According to **Figure 1**, in cluster 1,the animal experiment studies, "Animal Experiment" is the highest frequency of keywords, frequency of up to 247 times, followed by "Aerobic Exercise" (126), indicating that in recent years, experimental animal studies class with aerobic exercise is centered on a hot sports science. Such articles (Shi et al., 2012, Liu et al., 2010; Shao et al., 2010) study the influence of aerobic exercise on different

Figure 1. Key words co-occurrence network map.

Table 1. 2006-2015 sports science and high-frequency hot keyword statistics on the clusters.

	Keyword	Frequency		Keyword	Frequency
Cluster 1 Animal Experiment	Animal Experiment	247	Cluster 2 Elite Athletes	Elite Athletes	175
	Aerobic Exercise	80		Body Shape	48
	Skeletal Muscle	69		Sports Training	104
	Endurance Training	47		Competitive Ability	32
	Altitude Training	39		Kinematic analysis	41
	Exhausted Exercise)	28		Surface Electromyography	32
Cluster 3 Chinese Competitive Sports	Chinese Sports	146	Cluster 4 School Sports	School Sports	73
	Competitive Sports	214		Physical Education	75
	Athlete	302		Sports Courses	57
	Coach	61		Physical education	65
	Talented	49		Common Colleges	47
	Exercise capacity	44		Sports Colleges	52
Cluster 5 Sports Cultural Development	Sports Research)	205	Cluster 6 Sports Participant	College Students	203
	Sports Development	132		Teens	95
	Sports Cultural	107		The Aged	46
	Olympic Games	162		Physical Exercise	81
	National Traditional Sports	70		Mental Health	56
	Sports Theory	30		Physical Health	22
Cluster 7 Sports Industry and Event Management	Sports Industry	124	Cluster 8 Public Sports Service	Public Sports Service	68
	Sports Event	59		Mass Exercise	43
	Sports Consumption	53		Leisure Sports	39
	Mass Sports	57		Sports Power	33
	Index System	36			
	Sports Activities	48			

biochemical indicators through mice research, and the results fed back to the sports training so that they can be more reasonable and effective to improve human body through scientific training. Laboratory Animal Science in Sports Technology not only marked a breakthrough in the field of scientific research to improve the level of sports, but also opened up a new field of sports research.

In cluster 2, elite athletes, "Elite Athletes", "Sports Training" and "Body Shape" are the three high-frequency keywords, frequency was 175 times, 104 times, 48 times. Elite athletes are not only primary productive forces of competitive sports, but also on behalf of my level of sports competition. Elite Athletes Training and monitoring training methods to explore, Sports Training of Elite Athletes research body and Athletics Capacity characterized are the research key point in that the clustering research.

In clusters 3, Chinese athletic sports studies, "Sports" posting the highest (214). Followed by the "Player" and "Chinese Sports." Sports has an important social value and overall performance, and the development of China's competitive sports after years of baptism and hugely successful Olympics gradual rise in the New how to achieve sustainable development of Chinese competitive sports on the basis of the rise is necessary to research and important issues resolved. Most studies have analyzed the impact of the Sustainable Development of Sports in China's internal and external factors, putting forward relevant countermeasures and ways of implementation (Shao & Man, 2010). In addition to the focus on training reserve forces, athletes and coaches selection of new management is concerned.

In cluster 4, school sports, the top two high-frequency keywords are "School Sports" (73) "Physical Education" (75). Followed by "Physical Education Curriculum" (57). New Era School under the direction of sports development and break the traditional pattern of teaching Physical Education Curriculum and resource development including new methods and ideas is the research focus of the clusters. School sports is an important part of quality education because it is the basis of competitive sports and mass sports and it has a fundamental and systemic features. The Cluster Analysis (Zhang, & Sun, 2010, & Yan, 2010) section for the teaching aspect and influencing factors of College Sports were discussed. It is noteworthy that studies of school sports policy are also a big key.

In cluster 5, cultural development, the "Sports Studies", "Sports", "Sports Culture" and "Olympics" are the four-frequency keywords. The study involved more clustering sports surface from different angles and it was explained. Sports development includes research on sports development both in foreign and domestic research, especially in the domestic sports development research. We have exploration not only to the entire sports industry development, but also to the development of small research communities including schools, resorts and other specific aspects. At the same time the physical culture research are more diversified including the sports culture compare and the cultural construction of sports at all levels at home and abroad including the traditional national sports.

In cluster 6, Sports Participant, keyword "Students" appear frequency of 203 times, making it the largest research center cluster hot, followed by "Teen" "Exercise" "Mental health" "Old Age" and "Physical health." It can be seen that physical research on the three people involved in college students, teenagers, the elderly are mainly emphasized on their physical and mental aspects. Students as the frontier groups of new technology and new ideas, countries training senior professionals, represent the most advanced pop culture. Sports is one of the largest research groups and the research mainly involves university students and influential factors of motivation, sports consumption, mental health and Physical exercise of its impact; adolescents belonging to a transitional group between children and adults between, it is the critical period to bring them up. It is necessary for adolescent physiological development and mental health personnel training of different projects; the elderly as a sports research a special group has important significance. People enhance physical fitness, adjust the physical and mental health through physical exercise in order to achieve the effect of longevity and quality of life.

In cluster 7, Sports Industry and Event Management, "Sports Industry" highest frequency of 124 times, followed by "Sports", "Mass sports", "Sports consumption." Sports industry is an important economic function embodied in market-oriented and economic benefits, while its products compared with other industries have different characteristics. Important features of their products lies in increasing household physical fitness, development of social production, encouraging the national spirit, achieve all-round progress of the overall personal development and social civilization. Development of sports industry provides support for mass sports, and for the development of mass sports consumption and sports industry to grow and give them protection. Sports industry and mass of Sports Development are important for clustering.

In cluster 8, Public Sports Service, "Public Sports Service" appears most frequently as 68 times, followed by the "Fitness" (43 times), "Leisure Sports" (39 times), "Sports power" (33). Sports power is the goal and task of the new period of reform and development of sports in China. We should strive to achieve a Major Sports power transformation, and then the sports public service system construction as the basis for a sports power is especially important and comprehensive fitness and sports power exist organic links (Li, Zheng, & Bi, 2012). The leisure sports are the main way to promote citizens to develop good fitness habits and the three common services the sports power strategy. Around the center of sports power, related research from three different dimensions is a major feature of the cluster.

4.2. Latest Research—The Strongest Citations Appears Keyword Analysis

Research front can be seen within a certain period of time, in order to document the emergence of knowledge-based set of literature discuss scientific issues or topics, emphasizing the emergence of new trends and characteristics. The study is based on the analysis of the strongest citation emergent keywords and emergent literature, combined with the emergent literature citing document clustering, comprehensive judgment and probing of the frontier research in the next few years the field of sports science. In the keyword visual map interface, based on the click citation/frequency burst, click View to obtain quotations/frequency bursts record (**Figure 2**), Citation/frequency higher bursts intensity in **Figure 2** by bold color bar performance. **Figure 2** shows: In recent years, sports science research emergent intensity of 6 or more and continues to this day there are "public sports

Top 13 Keywords with Strongest Citation Bursts

	Keywords	Year	Strength	Begin	End	2006-2015
体育研究	(Sports research)	2006	41.3239	2007	2008	
体育发展	(Sports development)	2006	24.2733	2006	2008	
中国体育	(China Sports)	2006	15.7686	2007	2008	
公共体育服务	**(Public sports service)**	2006	15.3718	2012	2015	
青少年	**(Teenagers)**	2006	8.58	2011	2013	
运动生理学	**(Exercise physiology)**	2006	8.4923	2006	2007	
体育强国	**(Sports power)**	2006	8.4544	2010	2012	
动物实验	(Animal experiment)	2006	7.0383	2006	2007	
可持续发展	(Sustainable development)	2006	6.5855	2009	2012	
指标体系	(Index system)	2006	6.544	2010	2015	
体育教学	(Physical education)	2006	6.2733	2006	2007	
表面肌电	(Surface electromyography)	2006	6.1382	2010	2013	
体育政策	(Sports policy)	2006	6.1212	2012	2015	

Figure 2. 13 keywords of the strongest citation appear—the time trend chart.

service" (15.3718) "index system" (6.544), "Sports Policy" (6.1212) 3 keywords emergent research fields they represent the future of China will be the leading edge of sports science research.

Figure 2 shows the forefront of the word "public sports service" (15.3718): In February 2011 document issued by the "National Fitness Program (2011-2015)" clearly requires the formation of covering urban and rural areas by 2015 a more robust fitness of public service system, efforts to lay a solid foundation for the construction of sports power. After the promulgation of the document, public sport service started concern, many scholars from different angles, which have put forward their views. Such as Liu Hong stated that "government should be established as the mainstay of the diversified sports public service delivery system, the establishment of the national sports equalization of public services standards, the establishment of pluralistic evaluation system, etc." in an article named Equalization of Public Services in the Perspective of Sports Management System (Liu, 2010); Chunmei Yuan in "evaluation of Physical efficiency of public services and influencing factors Empirical Study", an article on the efficiency of Sports public service scores were evaluated, and as a basis for the level of economic development that affect the physical efficiency of public services areas, government investment scale, the sports public service accessibility, geographical factors It was analyzed. CiteSpace III LIS analysis is consistent with the historical background to a sports power as the starting point of public sport service is not only our country in recent years, the hot sports science, but also the frontier to explore, with the goal of promoting sports power, public sports services the next few years will still be the focus of the study.

Figure 2 shows the forefront of the word "index system" (6.544): With the development of science and technology, computer widely used in various fields, the abstract object of study according to their nature and characteristics of the properties identified as having a particular aspect of decomposition the behavior of the opera-

tive of the structure, and each component of the index system (index) gives the corresponding weight complex statistical calculations possible. As the first Chunxian Gu (Gu, Wu, Xiao, & He, 2010), Xue Qiu (Xue, 2010), Lin Li (Li et al., 2010) and so on sports culture, sports power, regional sports industry abstract concepts of sustainable development indicators for evaluating separately and empowerment. Sports science research involves many abstract concepts through specific indicators to measure more convenient to evaluate the effectiveness of its development is the call of the times, "sport" the big abstractions contain different types of small abstractions by constantly build and improve all kinds of evaluation index system, the sports research specific and clear is the future trend of research.

Figure 2 shows the forefront of the word "Sports Policy" (6.1212): Sports policy not only involves the macroscopic problems, such as national sports development, but also involves the cultivation of specific problems, such as sports events held and athlete-training. Different for different stages of social development of the sports of different countries of different ideologies determine the value of sports policy embodied. At present, the general direction of two sports policy research: the study of Chinese sports policy is conducive to better grasp the direction of sports development; study of foreign policy in favor of sport to provide a reference for the development of sports in China. PeiLing Xia in the "International Sports Policy Analysis hotspot" Discovery international research focus mainly concentrated in public health, public health, sports and other children's range, display port standard international sports policy research is very clear, both to promote the social function of sport fitness maximize (Xia & Wang, 2012). Shaw seek text in the "From functional interpretation to the institutional change: After reform and opening up the evolution of sports policy", a paper reveals China's sports policy from "key sports development" to "sports and mass sport development" to "Harmony Sports' policy Evolution path and future directions (Xiao, 2012). With the continuous advance social development and reform, people's legal awareness, value and unique sport performance slowly emergent, but also sports a new sunrise industry, the government will promote the development of sport at all levels, sports policy research has important value, Therefore, the sports policy analysis and future requirements to become a hot research, provide information and reference for the development of sports policy.

4.3. Power Research-Analysis of Center Author

In the visual analysis operation of CiteSpace Ⅲ software, node types selects Author, time slicing select 2, other parameters remain unchanged, click "GO" to start visual analysis, you will get the author's cluster map, as shown in **Figure 3**, which receives a total of 149 nodes and 104 connections.
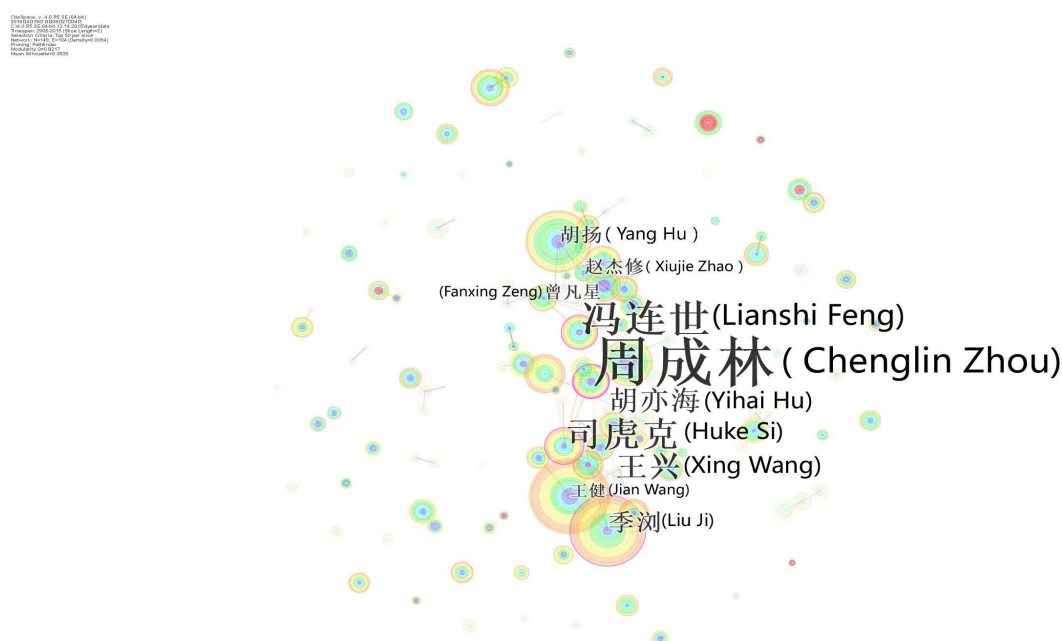

Figure 3. Co-occurrence network map of the center author.

In the visual analysis operation of CiteSpace III software, centrality and issued amount of the center author are shown in **Table 2**.

Table 2 lists the top ten authors about centrality in four core journals from 2006 to 2015, these authors are leaders in the Sports field or well-known experts in a related field, whose research fields are hot topics in recent years. Based on centrality parameters, this table analyzes authors' representative papers to confirm the research fields of core authors in recent years. For example, Chenglin Zhou (Zhou & Zhao, 2009; Hou et al, 2011; Zhou & Liu, 2010) is mainly engaged in the theory and application research of sports psychology, the theory and application of exercise psychology, and he has made remarkable achievements and scientific research in sports psychology and its measurement and evaluation research; Shilian Feng (Feng et al., 2005; Feng et al., 2013) mainly studies theory and methods of altitude training and hypoxic training, theory and methods about weight control of athletes, in 1998 he researched and explored altitude training and its research status. He is one of the central figure in this field in China; Huke Si (Si et al., 2007; Si et al., 2012) is mainly engaged in basic theories about mutual development research in Science technology and Competitive Sports, especially in the achievements change of sports science and technology. The paper amount and quality of these center authors is high, which represents the cutting-edge research in some fields. **Figure 3** also reflects one situation, in addition to few core type, streamlined type and dual-core cooperative network architecture, many nodes are isolated points, few connections between nodes, which shows the structure of "small gathering, large dispersion", collaborative research in related fields of some center authors concentrated with good network connectivity, which forms an authors group of different sizes. But the cooperation of core authors in other areas is relatively little, it is the same case with resource sharing and cooperation of scientific research.

5. Conclusions

1) The scientific study of Chinese sports is diversified and multi-layered, which combines essential study, practical study and functional study. The hot spot of researching is divided into eight clusters: animal experiment, elite athletes, Chinese athletic sports, school sports, sports and culture development, sports participant, sports industry and event management, public sports service; and the study structure is reasonable.

2) The important research points in the future will be public sports service study, whose starting point is powerful sports country, the index system of research, the grasping of the direction of sports policy research and so on.

3) The studies core of Chinese sports research presents the structure of "small aggregates, large decentralized", only few center authors cooperate closely, the majority of them cooperate less. And network connectivity is not enough.

Funds of the Project

Table 2. Statistics about centrality and issued amount of the center author.

Number	Author	Working Place	Centrality	Issued amount
1	Chenglin Zhou	Shanghai Sports University	0.27	32
2	Shilian Feng	Science Institute of National Sports General Administration	0.19	33
3	Huke Si	Shanghai Sports University	0.17	35
4	Xing Wang	Shanghai Sports University	0.14	15
5	Yihai Hu	Wuhan Sports University	0.14	8
6	Liu Ji	Physical Education and Health college of East China Normal University	0.12	66
7	Yang Hu	Beijing Sports University	0.10	58
8	Fanxing Zeng	Beijing Sports University	0.09	28
9	Jiexiu Zhao	Physical Education and Health college of East China Normal University	0.09	18
10	Jian Wang	Sports College of Central China Normal University	0.08	70

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