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Original article

Current research status and research hotspots in Chinese geriatric medicine: Data retrieved from the *Chinese Journal of Geriatrics*☆

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ABSTRACT

Objective: To investigate the research hotspots and development trends of Chinese geriatric medicine by analyzing the high-frequency keywords, core authors, research institutions and their collaborations in papers published in the *Chinese Journal of Geriatrics*.

Methods: Bibliometric methods and information visualization software (CiteSpace III) were used to analyze the following 3 aspects: keywords, institutions and authors.

Results: Overall, the number of papers published in the *Chinese Journal of Geriatrics* grew between 1994 and 2015. The top 3 institutions with the greatest numbers of published papers were Beijing Hospital, People's Liberation Army General Hospital and the Second Xiangya Hospital of Central South University. The authors with high productivity were Pulin Yu, Jianye Wang and Xiaoying Li. The terms "Diabetes", "hypertension" and "myocardial infarction" were hotspot words that drew sustained attention in this field.

Conclusions: Research on geriatric medicine is growing steadily in China. Hospitals and teaching hospitals are major contributors to publications. The collaboration of authors is more common within the same institutions or in the same regions. Clinical research is still the focus of current research. In the future, basic research should be strengthened, and collaborations between different institutions and regions should be promoted to achieve coordinated and integrated development in Chinese geriatric medicine.

1. Introduction

Geriatric medicine is a specialty that studies mechanisms of human aging, age-related human body changes, prevention of geriatric disease and hygiene and health care for the elderly.[1] In recent years, with increasing geriatric care needs, an analysis of the current research status and hotspots in the field of geriatric medicine will help researchers in geriatric medicine to better grasp the current research trends and to determine the directions for future research, thus promoting the development of geriatric research.

The *Chinese Journal of Geriatrics* was founded by the China Science and Technology Association in 1982 and is managed by the Chinese Medical Association. The journal is an authoritative and influential academic journal distributed both domestically and internationally and has gained a high reputation in the Chinese geriatrics community.[2] To some extent, the papers published in this journal reflect the research status of geriatric medicine. Therefore, from the perspective of bibliometrics, this study applied visualization tools to investigate and analyze the publication data of the *Chinese Journal of Geriatrics*, with a focus on authors, institutions, author collaborations and research hotspots. The aim of this study was to understand the current research status and trends in Chinese geriatric medicine.

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2. Materials and methods

The “China National Knowledge Infrastructure (CNKI)” and “Wanfang Data” were selected as the data sources. The following parameters were set for searching: source = “*Chinese Journal of Geriatrics*” and searching year = “Inception to 2015”. “Wanfang Data” has exclusively included papers published in the *Chinese Journal of Geriatrics* since 2008, which was considered as the main source of data. However, “Wanfang Data” has incomplete citation data, additional data were obtained from the CNKI. To this end, the journal data from 1994 to 1997 and from 1998 to 2015 were, respectively, from the “CNKI” and “Wanfang Data”. These combined data were reviewed, and the repeated papers and non-academic publications, including meeting minutes, calls for papers and indices (by keywords or authors) were removed. The final valid data included 6425 papers. These data were converted into a default format that can be recognized by the visualization analysis software. CiteSpace III (developed by Chen Chaomei's group from Drexel University, the United States) was used for literature data identification and analysis.[3,4] The time span for the analysis was set from 1994 to 2015. The time interval was 1 year. A Top N per slice = 50 was used.[5] The author name, the institution and the keyword were selected as network nodes for the corresponding analysis. In the diagram below, the diameter of a circle represents the number of published papers. The color represents the publication year of the papers. A connecting line between circles represents collaboration between them. The color of the connecting line represents the time at first collaboration or co-appearance. The thickness of the connecting line represents the intensity of their connection. On the top of the diagram, the color bars from green shifting to red represent the time changing from 1994 to 2015.[6]

3. Results

3.1. Analysis of the annual number of published papers

A journal's annual number of published papers reflects the number of published papers in the related disciplines each year and is an important index to measure the information volume of the journal.[7] From 1994 to 2015, the average annual number of published papers in the *Chinese Journal of Geriatrics* referenced in the “CNKI” and “Wanfang Data” was 294.9 papers. The distribution of the annual number of published papers can be divided into two stages. The year 2003 was considered the dividing line. Before 2003, the annual number of published papers was lower than 250, with small fluctuations; thereafter, the number quickly increased to 300. Between 2005 and 2011, the annual number of published papers slightly declined and then returned to the peak level between 2013 and 2014, as shown in Fig. 1.

3.2. Analysts of institutional collaborations

Institutions with publishing frequencies >12 were selected as network nodes. The number of papers published by these institutions between 1994 and 2015 was analyzed to create a network mapping for institutional collaboration, which included 62 connecting lines and 261 network nodes, as shown in Fig. 2. It was impossible to evaluate the overall condition of these institutions objectively because some authors failed to use identical institutional names for their papers; furthermore, some institutions changed their names during that time period. Therefore, various names for the same institution were changed to the latest unique name for analysis. For example, the names “Department of Cardiovascular Medicine, Beijing Hospital of Ministry of Health” and “Department of Neurology, Beijing Hospital of Ministry of Health” were both replaced with “Beijing Hospital”. The names “Department of Neurology, Shanghai Second Medical University affiliated Rui Jin Hospital” and “Department of Geriatrics, Rui Jin Hospital, Shanghai, Jiaotong University School of Medicine” were both replaced with “Rui Jin Hospital, Shanghai, Jiaotong University School of Medicine”. The institutions with high numbers of published papers mainly included regional hospitals and top-ranked teaching hospitals, among which “Beijing Hospital” placed first based on the number of published papers. In addition, “Beijing Hospital” was considered the center of institutional collaboration, as it established the largest radial distribution network of collaboration in the *Chinese Journal of Geriatrics*.

3.3. Analysis of author collaborations

The *Chinese Journal of Geriatrics* listed both the English and Chinese names of the authors. Only the author's Chinese name (the English name was removed from the data) was used for mapping and graphing author collaboration networks. The authors in the mapping included all authors on the author list of a given paper, regardless of their contribution. Fig. 3 shows a network knowledge

Fig. 1. Trend line of the annual number of published papers in the *Chinese Journal of Geriatrics*.

Fig. 2. Knowledge network mapping of institutional collaborations.

mapping of author collaborations in which the authors were considered as network nodes. The criterion for author selection was a publishing frequency >10. The mapping includes 270 nodes and 136 connecting lines in total. The top five researchers were Pulin Yu, Jianye Wang, Xiaoying Li, Haiqing Gao and Xinde Wang. Among them, Jianye Wang, Pulin Yu and Xinde Wang are the current editor, the director and the former editor of the *Chinese Journal of Geriatrics*, respectively. The other 2 researchers are editorial board members of this journal. Pulin Yu is considered as the center to directly or indirectly connect with Chunbo Duan, Zhenqiu Sun and Lin Wang to form the most widely reaching collaboration network.

3.4. Analysis of research hotspots

The knowledge mapping of the shared keywords was built to analyze distribution, changes and links in keyword frequency to study the research hotspots in this field.[8,9] Given the existence of variations of the same keyword in different papers, these keywords were standardized before analysis. For example, "ultrasound examination, Doppler" and "echocardiography, Doppler, color" were standardized as "Doppler ultrasound examination". Some keywords with special characters that cannot be recognized by the software program, such as "angioplasty, transluminal, percutaneous coronary", were standardized as "percutaneous transluminal coronary angioplasty". Fig. 4 shows the knowledge mapping of keywords with word frequencies >33 from 1994 to 2015 in the *Chinese Journal of Geriatrics*. The high-frequency keywords were those describing common geriatric diseases. In addition, the high-frequency keywords were also related to medical examination, risk factors and quality of life. Of these keywords, "diabetes" had the highest frequency, followed by "hypertension", "myocardial infarction", "coronary artery disease", "Alzheimer's disease" and

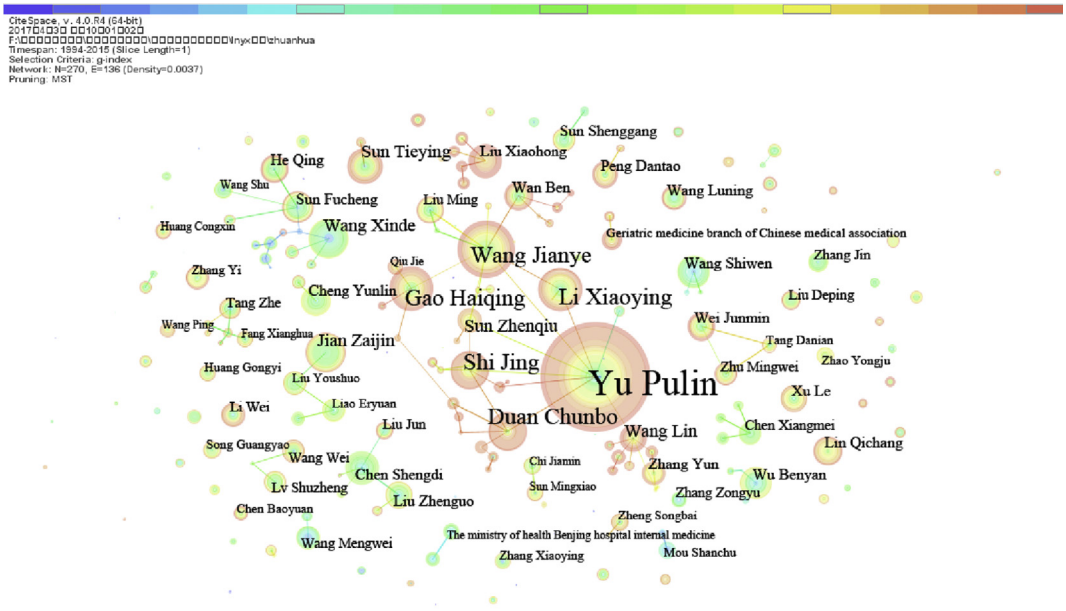

Fig. 3. Knowledge network mapping of author collaborations.

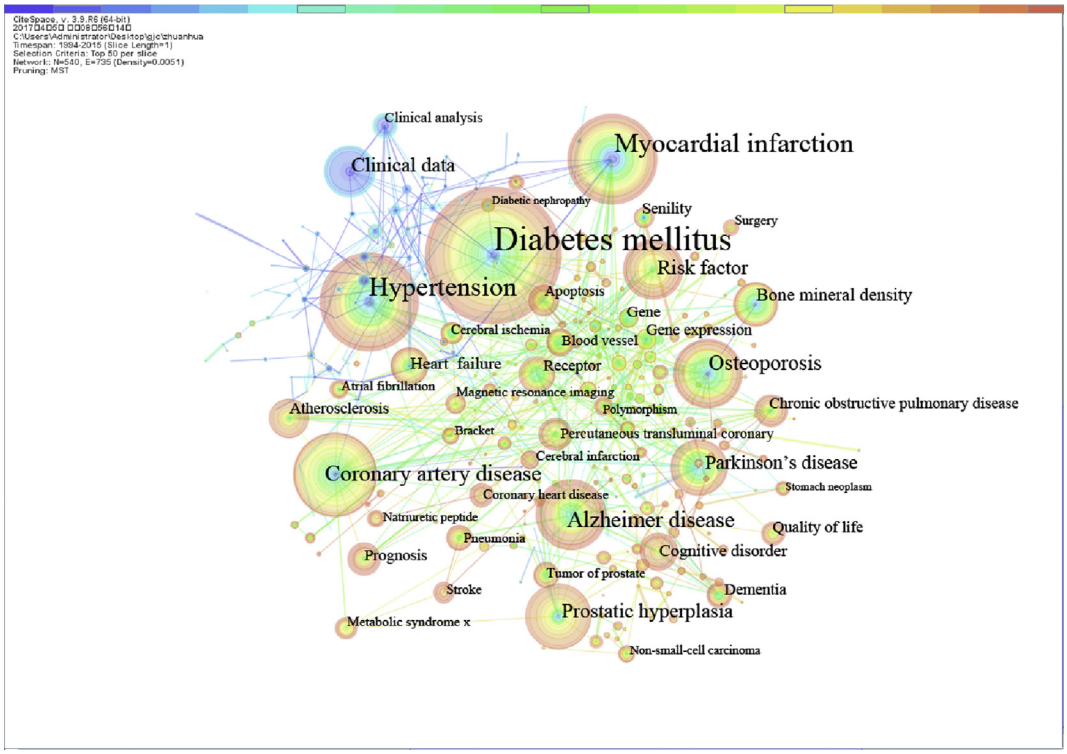

Fig. 4. Knowledge mapping of shared keywords.

"osteoporosis". From the time point of view, most high-frequency words emerged in the past decade, while the others, such as "clinical data" and "clinical analysis", were used frequently earlier.

4. Discussion

At present, China has become the country with the largest elderly population and the fastest growing rate of elderly individuals. Rapid aging status has brought great motivation and challenges for the development of geriatric medicine.

Overall, the annual number of published papers in the *Chinese Journal of Geriatrics* has trended upward. In 1981, the Geriatrics Society of the Chinese Medical Association, together with researchers in the different societies, proposed and founded the *Chinese Journal of Geriatrics* under the support of national policy. In 1982, the journal officially began to release issues quarterly. Between 1982 and 1993, the papers published in this journal were not cited by the "CNKI" and "Wanfang Data". In 1992, the *Chinese Journal of Geriatrics* became a bimonthly instead of a quarterly journal. In 1999, the *Chinese Journal of Geriatrics* was recognized by the Research Center for China Science Evaluation as a source journal of the Chinese Science Citation Database (CSCD) and the China Academic Journal Citation and Evaluation Database (CAJCED) and earned a certificate as a source journal of the CAJCED. From 1996 to 2001, the *Chinese Journal of Geriatrics* was accredited as an outstanding journal on several occasions. With the improvement of the quality of the journal, a large number of researchers started submitting their works to this journal. Thus, the number of published papers in this period was higher than that before 1992, exhibiting a steady upward trend. In 2003, the *Chinese Journal of Geriatrics* became a monthly journal and included the following sections: clinical research, basic research, epidemiology and investigation, review, expert forum and geriatrics update. With its doubled publication capacity, clear academic section and short publication waiting time, the upgraded journal could timely and effectively report new scientific research and practical experiences in the field of geriatric medicine. More and more researchers have submitted their work to this journal. Thus, the annual number of published papers increased significantly. The history of this journal reflects the development of geriatrics[10] in China, i.e., trends from invalid to valid, from weak to strong and from limited to extensive.

The research teams for geriatrics in China are commonly affiliated with various regional and teaching hospitals. Only a few publications have originated from other types of institutions. Physician-scientists who practice medicine and do research highly contributed to the annual publication number. These individuals have had extensive experience through long-term clinical practice and can combine theory with practice to contribute to the development of geriatrics. The institutions on the top 5 list are high-tier hospitals or research institutes and have complete clinical data records and well-established scientific research facilities. Except for the Beijing Institute of Geriatrics of the Ministry of Health, which is an institution for geriatric medicine, the rest of the institutes are comprehensive affiliated hospitals and have highly qualified research teams. The published papers from these teams have high scientific value and innovation. "Beijing Hospital", at the very top of the list, is at the center of a network of institutional collaboration. Beijing Hospital is the host institute of the *Chinese Journal of Geriatrics* and can take advantage of its central geographical superiority to constitute the most extensive radial distribution collaboration network. Collaborations between institutions can complement each other, allow institutions to share resources and are of positive significance in boosting scientific thinking and accentuating academic development. In terms of regional distribution, the institutions in Beijing, Shanghai, Shandong, Tianjin and the regions around the middle and lower reaches of the Yangtze River have been most productive. These regions include many highly qualified scientific research institutions and researchers and are always considered as active academic

regions.[11] In contrast, some remote areas, such as Hainan and Tibet, are less productive. This fact suggests that the development of geriatric medicine is closely related to economic development and regional research and education status. The institutions with high productivity should attempt to collaborate with the institutions and researchers in remote regions to help them face the national aging challenges.

The collaborative coefficient is a quantitative indicator to measure the degree of collaboration in scientific research and is also a key factor to assess the interdisciplinary research and insight of research papers.[12] From 1994 to 2015, satisfactory collaborations between authors in the *Chinese Journal of Geriatrics* have demonstrated excellent awareness of author collaborations in the field of geriatric medicine. In different periods, study teams with different research directions have been the reliable sources of publication. In terms of the number of publications and publication time, Xinde Wang, Shengdi Chen, Zaijin Sai and Shiwen Wang were at the top of the list in the early stage; Pulin Yu, Jianye Wang, Xiaoying Li and Haiqing Gao consistently contributed to the annual number of published papers in the middle and latest stages; and Chunbo Duan and Xiaohong Liu's publications constantly increased in the latest stage. Overall, authors with high productivity were more common in the entire collaborative network. Publications in the middle and latest stages had more contributions to network formations. Noticeably, collaboration between authors was more common within the same organization or in the same regions rather than between different organizations or regions. International collaboration was relatively rare. International collaboration should be encouraged because it can not only promote the internationalization of Chinese geriatric medicine but also enhance the international competition of our research.

Visualization mapping and frequency distribution of keywords can help to fully understand the research hotspots and publication types in the field of geriatric medicine.[13,14] In terms of keyword frequency, the terms “diabetes”, “hypertension”, “myocardial infarction”, “coronary artery disease” and “Alzheimer's disease” were at the top and were associated with highly cited and frequently downloaded papers. Of these high-frequency keywords, the term “diabetes” refers to type II diabetes. According to the Chinese Health Survey, the prevalence of diabetes was 1.07% of the total population in 2008 and is among the most prevalent of the chronic diseases. Between 2007 and 2008, the survey showed that the prevalence of senile diabetes was above 20% in the population aged over 60, which was 10-fold higher than that in the population aged between 20 and 30. Therefore, the high frequency of the term “senile diabetes” may reflect the current state of the aging population with the disease and the incurable features of diabetes.[15] In addition, a paper titled “Comprehensive assessment of the current state of hypertension prevention in aging populations in Beijing communities” was cited 56 times and covers various aspects of hypertension prevention and control among the aging population in Beijing. This highly cited paper provides references for hypertension researchers. Most researchers believe that hypertension is a risk factor for “myocardial infarction”[16]; their papers studied both conditions to investigate the relationship between them to better prevent the occurrence of myocardial infarction among the elderly. In the studies related to “coronary artery disease”, the researchers usually used spiral computed tomography (CT) examination to diagnose the disease and percutaneous coronary intervention. These studies also investigated the risk factors and treatment of “coronary artery disease” and its relationship with other diseases.[17] Alzheimer's disease is a fatal neurodegenerative disease that manifests as reduced cognitive performance and memory capacity. Alzheimer's disease is difficult to diagnose early; thus, it is easy to miss the best treatment window. With the rapid aging in society, the prevalence of Alzheimer's disease has gradually increased to the point that the disease has become the fourth leading killer of the elderly. Therefore, in the field of geriatric medicine, the research hotspots regarding Alzheimer's disease include investigation of its pathogenesis and treatment. In the lifetime of the *Chinese Journal of Geriatrics*, the terms “clinical data” and “clinical analysis” were only used in the early stage. This usage was consistent with the research level in the field of geriatric medicine at that time, when most papers published were confined to clinical studies for case analyses and reports. Subsequently, researchers started a series of studies on its etiology, pathogenesis and treatment on the basis of clinical data. In recent years, the studies regarding “quality of life” have been gradually increasing, indicating that the medical research is transforming from emphasizing treatment to emphasizing preventive healthcare in the field of geriatric medicine, paying attention to quality of life while focusing on studies of clinical disease and increased life span in the aging population.

5. Conclusions

In summary, studies in the field of geriatric medicine reflect the development of geriatrics in China, i.e., trending from invalid to valid, from weak to strong and from limited to extensive. The academic journal is considered a platform to reflect the research achievements of geriatric medicine and plays an important role in promoting the development of Chinese geriatric medicine. Given the information from the literature data investigated, geriatric research has mainly focused on clinical studies on chronic diseases and coronary heart disease. In the future, research should further include basic and preventive medical research and should promote collaborations between different institutions and regions and international communication to enhance geriatric research in remote regions with the goal of achieving the coordinated development of geriatric medicine in China.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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