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## Abstract

**Background:** The aims of this study are to evaluate and summarize the scientific production in the field of Chinese herbal medicine (CHM) treatment of cardiovascular disease (CVD).

**Methods:** A systematic bibliometric search was performed based on the PubMed database covering relative publications between January 1, 1995, and December 31, 2014. Core of the search strategy include the key word cardiovascular disease and the Medical Subject Heading Chinese herbal medicine. The number, type, country, major journals, and research focus of articles were analyzed in accordance with bibliometrics methodologies.

**Results:** The retrieve results were analyzed and described in the form of texts, tables, and graphs. A total of 3,826 articles were identified, 40.28% of which were original articles. All articles were from 50 countries/territories. China was ranked first with 2,258 articles, followed by Japan with 173 articles. 665 articles were published by *Zhongguo Zhong Xi Yi Jie He Za Zhi*.

**Conclusion:** The publication activity of literature has grown rapidly in the past 20 years, indicating enhanced attention and increasing research input to CHM treatment of CVD. Owing to its great advances in scientific studies, CHM will continue to play an important role in medical research.

**Key words:** bibliometrics analysis; cardiovascular disease; Chinese herbal medicine; research trends

## Introduction

Cardiovascular disease (CVD) is an abnormal function of the heart or blood vessels. It is one of the most dangerous threats to human health manifested by different clinical types such as coronary heart disease, hypertension, myocardial ischemia-reperfusion injury infarction, heart failure, cardiac arrhythmia, and so forth (Hu et al., 2010; Huffman et al., 2015; Janse, 2000). According to the World Health Organization (WHO), CVD is the primary cause of death worldwide, and the number of people who die from CVD every year is more than any other cause of death (Acar 2010; Daubert 2008; Evora et al., 2014). Although treated with intensive medication or revascularization therapy, uncontrolled angina and recurrent acute cardiovascular events are still the major problems confronting modern medicine (Cohen et al., 2008; Qiu et al., 2012). The reasons of CVD are complicated. Many research teams are trying to find the causes and treatment methods. In the past decade, there has been a great increase in the use of complementary treatments such as herbal remedies in the treatment of disease. Some herbal derivations have become standard therapy in cardiovascular disease, e.g. digitalis, reserpine and aspirin. The common use of Chinese herbal medicine (CHM) to treat CVD has a long history and ample experience in some Asian countries (Guo et al., 2013; Tägil et al., 2013). CHM has been studied extensively and seems to be safe and effective in treating CVD. With modern technology widely used in CHM research, the research of the treatment of CVD by CHM has also made a great breakthrough.

Bibliometrics analysis is an applied scientific discipline that is systematically conducted to evaluate the relative importance of scientific production in a specific field. It provides a useful tool to interpret the temporal evolution and geographical distribution of researches on a specific topic (Michalopoulos et al., 2005; Milanez et al., 2013; Rahman et al., 2005). It has been applied to assess the scientific outputs or

research patterns of authors, journals, countries, and institutes and to identify international cooperation (Chabowski et al., 2013; Chiu et al., 2007; Lv et al., 2011). Some studies use bibliometric tools to examine a specific field: Agronomy (Canas-Guerrero et al., 2013), Computer Science (Guan et al., 2004; Uriona-Maldonado et al., 2012), nano science and nanotechnology (Zhou et al., 2006), and Clinical Medicine (Saragiotto et al., 2014). These authors use bibliometrics analysis to present a general view of the scientific and technological production in different fields.

This study provides a retrospective bibliometrics analysis of researches on CHM treatment of CVD from 1995 to 2014. The goals of this study are: (1) identifying general patterns of publication outputs, journals, and subject categories in this field; (2) evaluating national research performance; (3) summarizing global research trends, which may serve as a potential guide for future research. This article is structured as follows: The section of materials and methods describes the study design, including data acquisition, search strategy, inclusion criteria and exclusion criteria, and data analysis; the section of results and discussion shows the evaluate results and discussion; and the last section gives a brief conclusion.

## Materials and Methods

In this study, a systematic bibliometric search was performed based on the PubMed database covering related publications between January 1, 1995, and December 31, 2014. We initially searched for all articles with MeSH Terms including “Cardiovascular System”, “Cardiovascular Physiological Phenomena”, “Cardiovascular Diseases”, “Cardiovascular Agents”, “Cardiology” and “Drugs, Chinese Herbal”. The final search strategy was the following: “Cardiovascular System” [MeSH] OR “Cardiovascular Physiological Phenomena” [MeSH] OR “Cardiovascular Diseases” [MeSH] OR “Cardiovascular Agents” [MeSH] OR “Cardiology” [MeSH] AND “Drugs, Chinese Herbal” [MeSH]. As a result, a total of 3,826 articles were identified. Then, specialized analysis software, GoPubMed analytical tools (Doms et al., 2005), and Microsoft Excel 2010 software (Winston 2011) were applied to general data manipulation. The documents were analyzed according to the following indicators: (1) publication output; (2) publication distribution by countries/territories; (3) type of document; (4) publication patterns; (5) research tendencies and focus; (6) frequency Chinese medicines.

## Results and Discussion

In this study, bibliometrics analysis on published CHM treatment of CVD research articles that are of sufficient quantity and high quality was conducted. A total of 3,834 articles from 1995 to 2014 (20 years) were identified with 8 articles excluded. The analysis results of this study are represented in the following graphs and tables:

### Publication Output

During the period from 1995 to 2014, 3,826 relative articles were indexed in PubMed. In 1995, 66 articles were published, while in 2013 the number of publications rose to 233. Results of publication output are shown in Figure 1. In the past twenty years, the number of publications in this area has increased steadily. It is worth noting that the 2014 data may not be comprehensively included up to January, 2015, as this analysis performed. According to the obvious overall rising trend, it can be predicted that the numbers of articles on CHM prevention and treatment of diseases will keep growing at a high rate in the future.

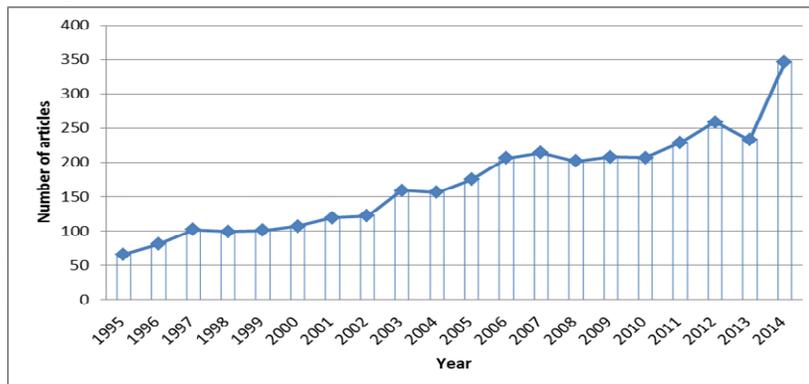
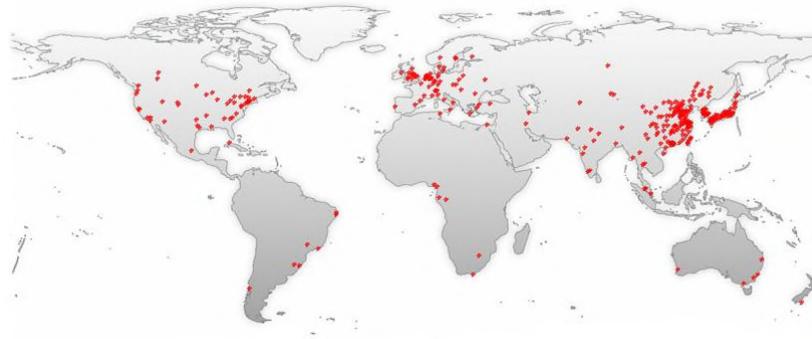


Figure 1: The relationship between years and the total number of published papers from 1995 to 2014

**Distribution of Publication by Countries/ Territories**

According to the author’s information, of the 3,826 articles published between 1995 and 2014, a total of 50 countries/territories are involved. China heads the article number ranking with the largest number of articles (2,258, 59.02%), followed by Japan (173, 4.52%), Taiwan (94, 2.46%), and Hong Kong (72, 1.88%). The result shows that Asian countries/territories lead the researches of CHM in the world, particularly China. Figure 2 illustrates the global distribution of published articles and Table 1 shows top 10 countries / territories. It is not surprising that China is the most active country on CHM research, whereas the researches in several other countries also thrive. In China, China Academy of Chinese Medical Sciences, Beijing University of Chinese Medicine, Guang’anmen Hospital, and Xiyuan Hospital have become the main scientific research institutions in this area. In the future, multinational collaboration can help CHM researches make more achievements.



**Figure 2:** Distribution of articles published in the countries/territories

**Table 1:** Top 10 countries / territories of distribution of articles published

Rank	Country/territory	Number of publications	Percentage (%)
1	China	2,258	59.02
2	Japan	173	4.52
3	Taiwan	94	2.46
4	Hong Kong	72	1.88
5	United States	69	1.80
6	South Korea	66	1.73
7	Singapore	18	0.47
8	United Kingdom	15	0.39
9	Australia	14	0.37
10	Germany	14	0.37

**Type of Document**

After the analysis of the types of documents, 12 types were identified. Journal article (1,541, 40.28%) was the most frequently used type, followed by English abstract (1,260, 32.93%), clinical trial (689, 18.01%), comparative study (189, 4.94%), case report (94, 2.46%), comment (19, 0.50%). From Figure 4, it is evident that the article, abstract and clinical trial constituted the major types of publications relating to CHM research over this period, which is similar to the results of the bibliometric research based on the PubMed database, and that is the reason why articles are usually chosen as the document type for analysis.

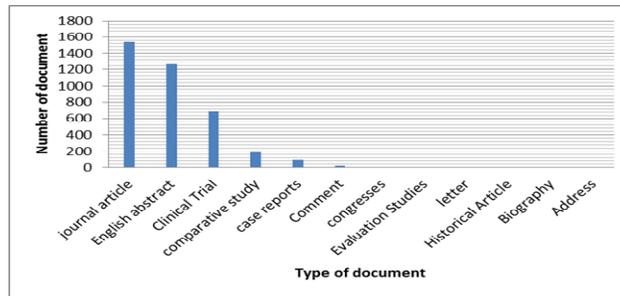


Figure 4: Distribution of the document type

**Publication Patterns**

Zhongguo Zhong Xi Yi Jie He Za Zhi was the most productive journal with 665 publications, followed by Zhongguo Zhong Yao Za Zhi (385), Zhong Yao Cai (151), Journal of Traditional Chinese Medicine (127), and Journal of Ethnopharmacology (126). Table 2 shows the top 10 most active journals with their impact factors. The journal impact factor is computed from JCR report, and is usually used to evaluate the relative importance of a journal, especially among the same field of journals.

**Table 2:** The 10 most active journals with the number of articles, impact factor (IF), ISI Journals category, and the position of the journals in its category

Rank	Journal	Number	Percentage (%)	IF	5-year IF	Place of Publication
1	Zhongguo Zhong Xi Yi Jie He Za Zhi	665	17.38	N/A	N/A	China
2	Zhongguo Zhong Yao Za Zhi	385	10.06	N/A	N/A	China
3	Zhong Yao Cai	151	3.95	N/A	N/A	China
4	Journal of traditional Chinese medicine	127	3.32	0.667	N/A	China
5	Journal of ethnopharmacology	126	3.32	2.939	3.284	Ireland
6	Zhong Xi Yi Jie He Xue Bao	107	2.80	N/A	N/A	China
7	Chinese Journal of Integrive Medicine	90	2.35	1.401	1.232	China
8	American Journal of Chinese medicine	68	1.78	2.625	2.119	England
9	Phytomedicine	47	1.23	2.877	3.237	Germany
10	Acta pharmacologica sinica	45	1.18	2.496	2.673	China

IF: impact factor in 2013 JCR; N/A: not available.

**Research Tendencies and Focus**

The search results were analyzed by using the statistical function of Excel based on the subject terms that are indexed to each article by PubMed. In these articles, “Herbal Medicines for Cardiovascular Diseases” introduces the research status (Xiong et al., 2014). Other articles addressed the clinical application and the mechanism of herbal medicines in the treatment of CVD (Li et al., 2009; Liu et al., 2015). In addition,

European countries, the United States and other developed countries in modern medicine also begin to pay close attention to the researches that have been published in the literature of these countries. Their attention hotspots mainly are Chinese medicine ingredients and efficacy, and a lot of researches have been conducted on the molecular level (Sayers et al., 2011; Wheeler et al., 2007) .Table 3 shows the top 10 high-frequency subject terms of the articles related to the study, by which it can be observed that the recent research focus are mainly pharmacology and therapeutic use of CHM, Phytotherapy, chemistry and application of Chinese herbal. The results are showed in table 3.

**Table 3:** Top 10 high frequency MeSH terms

Rank	MeSH terms	Frequency	Percentage (%)
1	Drugs, Chinese Herbal/*pharmacology	226	13.90
2	Drugs, Chinese Herbal/*therapeutic use	171	13.69
3	Drugs, Chinese Herbal/*administration & dosage	81	10.37
4	Drugs, Chinese Herbal/*chemistry	59	10.16
5	*Phytotherapy	49	6.21
6	Apoptosis/drug effects	33	4.54
7	Drug, Chinese Herbal/isolation & purification	458	2.97
8	<i>Salvia miltiorrhiza</i> / chemistry	427	2.56
9	Cell Proliferation / drug effects	236	2.35
10	Oxidative Stress/ drug effects	233	1.49

#### Chinese Herbal Medicine in the Treatment of Cardiovascular Disease

In recent years, there has been a great increase in the use of CHM remedies in the treatment of disease. Recently, a great progress has been made focusing on the effectiveness and safety of herbal medicines in patients with CVD (Li et al., 2012; Tan et al., 204). “Analysis of Anaphylactic Shock Caused by 17 Types of Traditional Chinese Medicine Injections Used to Treat Cardiovascular and Cerebrovascular Diseases” (Guo et al., 2015) and “Application of traditional Chinese medicine injection in the cardiovascular and cerebrovascular disease” (Fang et al., 2011) described pharmacological action mechanism. There still were other articles of relative research (Chen et al., 2014; Huang et al., 2015; Tian et al., 2015; Xin et al., 2014; Xu et al., 2015). Table 4 shows some common herbal therapies that may affect CVD, according to clustering analysis.

**Table 4:** Top 10 herbal medicine

Rank	Herbal medicine	English name	Frequency
1	RenShen	Ginseng Radix Et Rhizoma	304
2	DanShen	salvia miltiorrhiza	197
3	SanQi	Notoginseng Radix Et Rhizoma	134
4	BaiGuo	Ginkgo Semen	108
5	HuangQi	Astmgali Radix	60
6	DangGui	Angelicae Sinensis Radix	37
7	JuHua	Chrysanthemi Flos	32
8	ChuanXiong	Chuanxiong Rhizoma	27
9	ChaShuGen	Tea root	24
10	HuangLian	Coptidis Rhizoma	21

## Conclusion

In this study, we summarized and analyzed the literature of CHM treatment of CVD in PubMed from 1995 to 2014. In the past twenty years, the number of publications in this area has increased steadily. The results show that CHM plays an important role in treating CVD. Many researches and clinical experiments have confirmed that CHM for patients with CVD is safe and feasible. With the development of modern scientific techniques, we hope that the effectiveness and safety of CHM treatment CVD can be improved in the near future. However, we also acknowledge that the bibliometric method has some limitations. The PubMed database has a bias in favor of journals published in English. Therefore, nations with a strong traditional of publishing in their native languages may be underestimated in comparative studies. As some of the literature could not be calculated, evidence for its effectiveness is limited. In spite of these limitations, this study is believed to be useful for researchers to improve their performance in the field of CHM research and new drug discovery.

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**Conflicts of Interest:** The authors declare that there is no conflict of interest associated with this work.

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