REVIEW ARTICLE

Trends in Acupuncture Therapy in Cardiovascular Disease: A Bibliometric Analysis

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ABSTRACT

Purpose • Acupuncture has been used for almost half a century to treat and prevent cardiovascular (CV) problems. However, most of its effects are poorly understood, and there are few studies based on bibliometric analysis of the general trends in acupuncture therapy in cardiovascular disorders (CVD). Thus, we aimed to show the present state and trends in this sector during the last few years.

Methods • Articles were obtained from the Web of Science Core Collection (WOSCC) from its inception to May 30, 2021. The acquired information from the articles was analyzed by The Online Bibliometric Analysis Platform website (https://bibliometric.com), Citespace and VOSviewer in respective form in order to assess and forecast the hottest areas and trends in this field.

Results • The final analysis included a total of 384 articles and reviews. Over the years, the number of publications has gradually increased. The United States and University of California Irvine were the country and institution that contributed the most to the field. John C Longhurst was the most productive author; Li P the most cited author. Co-occurrence analysis revealed 5 branches (including acupuncture, blood pressure, electroacupuncture, stimulation, cardiovascular responses) and 12 clusters. Recent keyword bursts included "reflex," "arcuate nucleus," "electroacupuncture," "cardiovascular disease" and "hypertension."

Conclusion • Yearly publications continue to increase every decade, indicating a bright future in this scientific field. Acupuncture's function in CVD is a future study priority (*Altern Ther Health Med.* 2023;29(3):74-80).

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INTRODUCTION

Cardiovascular disease (CVD) accounts for more than one-third of all fatalities and is the major cause of morbidity and mortality in high-income industrialized nations,[1] and has received an increasing amount of attention over the past years. According to statistics, in 2020, there were 290 million people with CVD,[2] which included 3.72 million deaths in China and 17.7 million worldwide.[3] The majority of patients with CVD have several symptoms associated with circulation and the adverse events associated with drug therapy.[4,5] As an essential intervention in Traditional Chinese Medicine (TCM), acupuncture has been used to treat various diseases.[6]

A growing number of trials have shown that acupuncture effectively improves cardiovascular (CV)-related symptoms, including hypertension, inflammation, delirium, hormone and autonomic nervous system disorders.[7-11] Bibliometrics is a quantitative evaluation of the corpus of published scholarly literature that examines links within a given field of study, as well as publication influences and trends. Through co-authoring, co-citation and co-occurrence analysis, network analysis employing bibliometric methods can discover and display the established popular study topics, as well as the new emerging ones.

Recently, bibliometric analysis has been used to investigate the overall trend in acupuncture research.[12,13] The state of affairs and emerging trends in the treatment of stroke, cerebral infarction and chronic pain with acupuncture have been identified globally.[14-17] However, based on bibliometric analysis, there aren't many papers about the general trends in acupuncture therapy for cardiovascular disorders (CVD).

We carried out a bibliometric analysis to map the research landscape in terms of year, country, journal, research field, authors and keywords, as well as to investigate hot

Figure 1. Annual publication trend. The X axis = year; Y axis = number of publications.

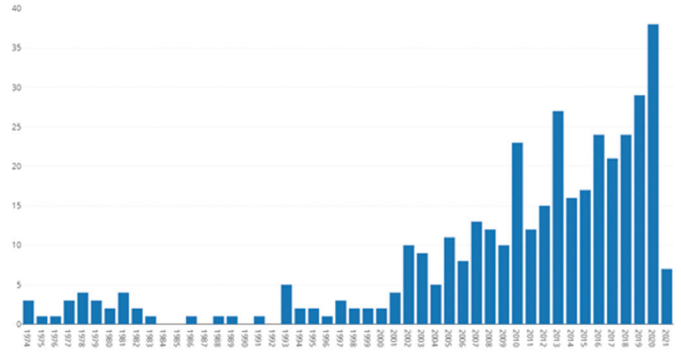


Table 1. Top Five Countries in Terms of Publications and Centrality

	Publication volume		Centrality	
Rank	Countries	#Papers	Countries	Centrality
1	UNITED STATES	94	UNITED STATES	0.62
2	CHINA	73	CHINA	0.28
3	SOUTH KOREA	19	RUSSIA	0.13
4	JAPAN	15	PAKISTAN	0.13
5	GERMANY	12	GERMANY	0.08

Figure 2. Map of countries in terms of publications and relationship.

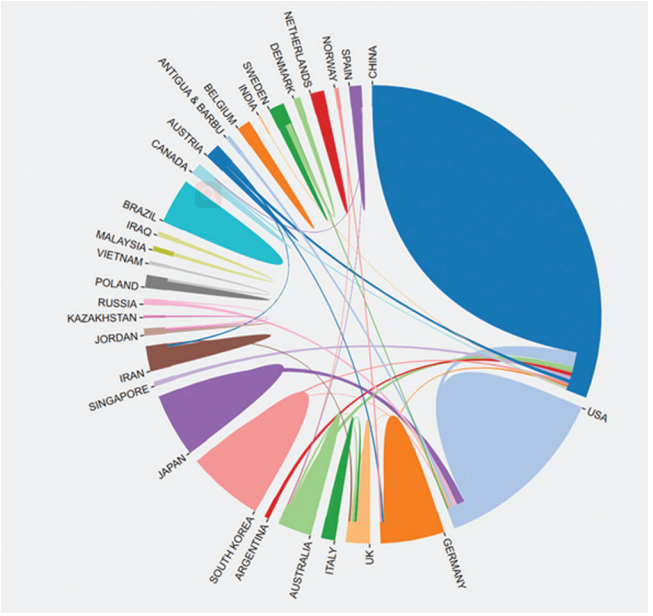


Table 2. Top Five Institutions in Terms of Publications and Citations

	Publication volume		Citation	
Rank	Institution	#Papers	Institution	#Citations
1	Univ Calif Irvine	76	Univ Calif Irvine	960
2	Med Coll of Ohio	23	Univ Calif Davis	156
3	Beijing Univ Chinese Med	22	Shanghai Med Univ	96
4	Kyung Hee Univ	20	Med Coll of Ohio	80
5	China Med Univ	19	Wake Forest Univ	55

issues and new trends in the use of acupuncture therapy in CVD.

METHODS

Data Sources and Search Strategy

All data were collected from the Web of Science Core Collection (WOSCC) from inception to the end of May 2021.The search strategy of WoS was TS = cardiovascular disease AND TS = (*acupuncture* OR moxibustion*).

Bibliometric Analysis

The inherent function of WoSCC was used to categorize and analyze publishing features. To display a map of the relationships between all the nations, institutions, and authors, the WoSCC data was translated to UTF-8 format and put into a particular website. The widely used scientific econometric analysis application CiteSpace (Version 5.7.R5, Drexel University, Philadelphia, Pennsylvania USA) is a strong choice for the bibliometric study of the literature. For the co-citation network of burst detection of cited journals, CiteSpace was employed. A burst of quotations indicated an increased focus on work over a specified period of time, which is an important signal for identifying trends in progress. The CiteSpace settings were: time period (1974-2021), year of slice (1), selection criterion (Top 50), link retention factor (LRF = 3), look back years (LBY = 10), e for top N (e = 2), and pruning (Pathfinder). VOSviewer (Version 1.6.16, Leiden University, The Netherlands) was used to display the author network and co-occurrence. In our study, networks were built using co-authorship and co-citation analysis of authors, as well as keyword co-occurrence.

RESULTS

Analysis of Publication in Timeline

From 1974 to 2020, the number of publications on acupuncture therapy in CVD steadily increased, with some fluctuations, from 3 to 38 over the past half century, as shown in Figure 1.

Distribution of Countries and Institutions

The United States, Chinese mainland, Chinese Taiwan, South Korea and Japan were the top 5 productive countries and regions; the United States, China, Russia, Pakistan and Germany were the 5 main central countries, as listed in Table 1.

Overall, 30 countries/regions and 494 institutions have been involved in publications on acupuncture for CVD, as shown in Figures 2 and 3. Table 2 lists the 5 most active and cited institutions.

Distribution of Journal and Research Area

There were 384 articles published in 189 journals. Table 3 presents the top 10 magazines for publishing articles on acupuncture for CVD. *Evidence Based Complementary and Alternative Medicine* produced the highest volume of articles (24 records; 6.25% of all

Figure 3. Map of publications and relationship of the institutions.

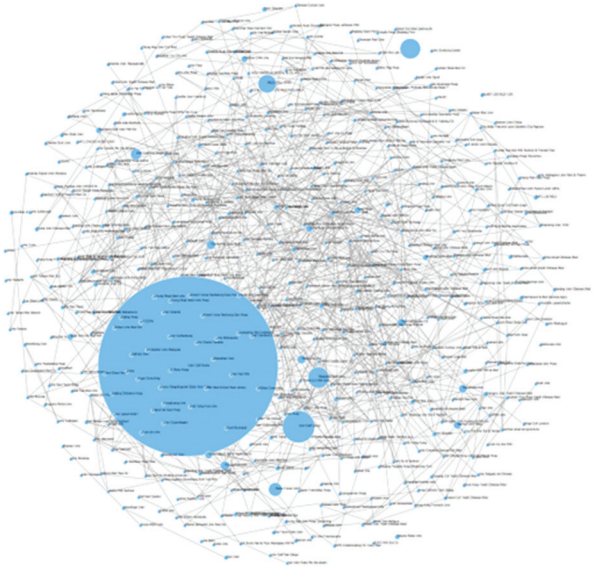


Table 3. Top Ten Journals in Terms of Publications

Rank	Journal	Publication
1	*Evidence Based Complementary and Alternative Medicine*	24
2	*Medicine*	14
3	*American Journal of Chinese Medicine*	13
4	*Acupuncture & Electro —— Therapeutics Research*	11
5	*American Journal of Physiology-Heart and Circulatory Physiology*	10
6	*Autonomic Neuroscience——Basic & Clinical*	10
7	*American Journal of Physiology-Regulatory Integrative and Comparative Physiology*	10
8	*Acupuncture in Medicine*	10
9	*Brain Research*	9
10	*Journal of Alternative and Complementary Medicine*	9

Table 4. Top Ten Cited Journals

Rank	Cited Journal	Citations (n)
1	*American Journal of Physiology-Heart and Circulatory Physiology*	156
2	*Journal of Applied Physiology*	151
3	*Acupuncture in Medicine*	132
4	*American Journal of Physiology-Regulatory Integrative and Comparative Physiology*	111
5	*Brain Research*	104
6	*Circulation*	60
7	*Journal of the Autonomic Nervous System*	32
8	*Evidence-Based Complementary and Alternative Medicine*	27
9	*American Journal of Chinese Medicine*	25
10	*Acupuncture & Electro —— Therapeutics Research*	21

Figure 4. A map of 67 journals of 189 with more than 10 citations.

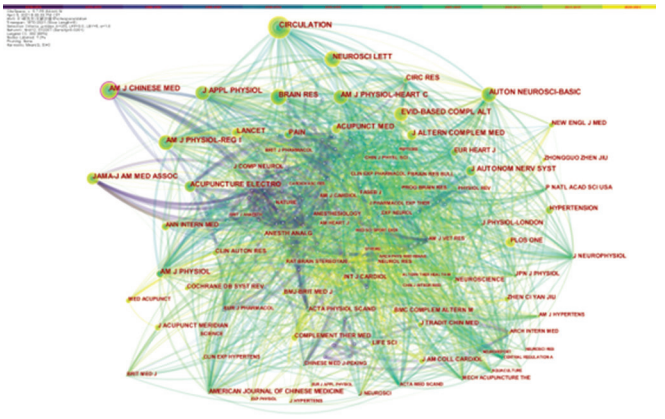


Figure 5. Top ten cited journals with the strongest citation bursts.

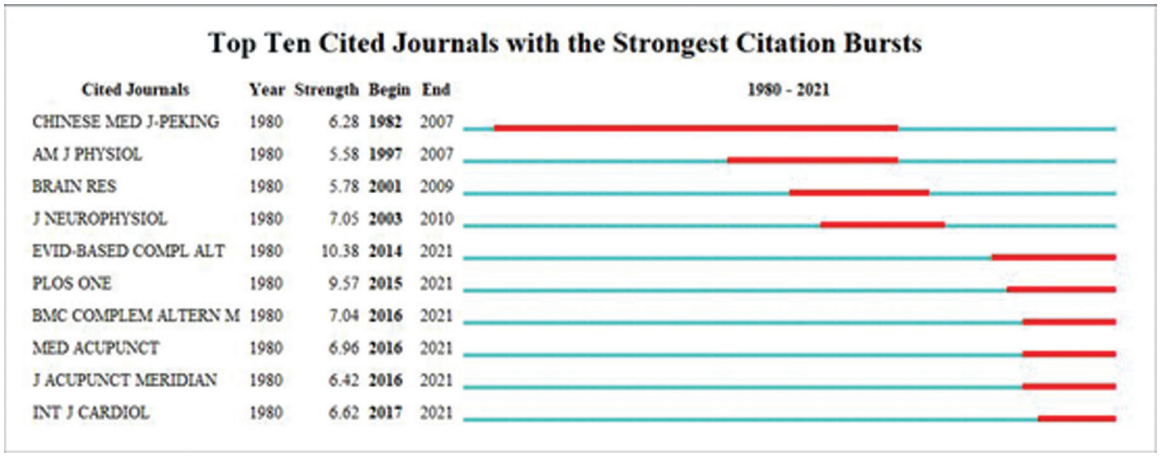


Figure 6. A map of all authors in terms of publications and relationships.

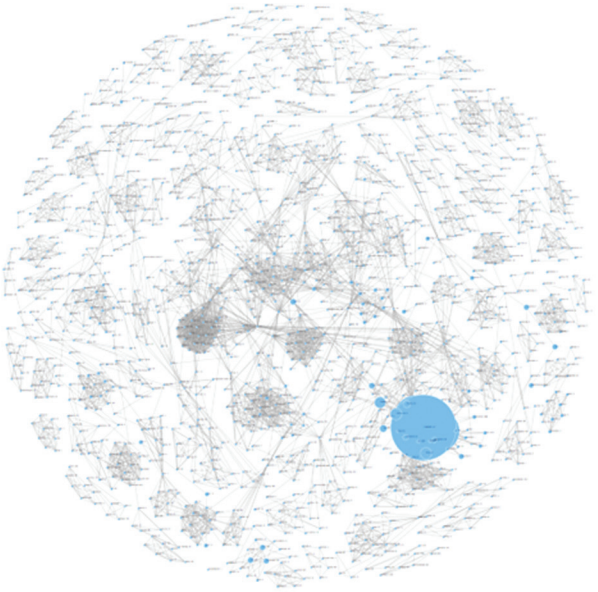


Table 5. Top Five Authors and Cited Authors

Rank	Active authors	#Documents	Cited authors	#Citations
1	Longhurst, John C	21	Li, p	327
2	Lee DC	16	Tjenalool, Stephanie C	204
3	Tjenalool, Stephanie C	15	Omura Y	143
4	Lee, Mo	15	Zhou W	116
5	Clifford DH	15	Guo ZL	91

Figure 7. A map of 170 co-cited authors with more than 50 citations.

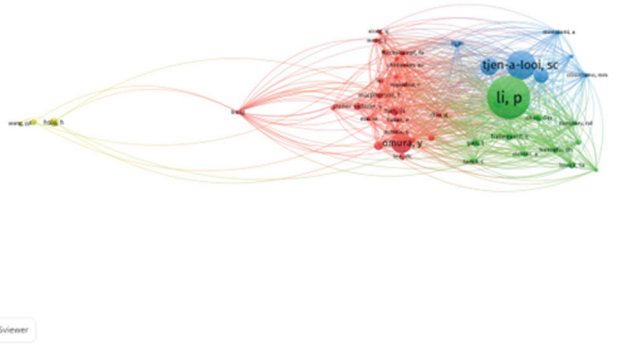
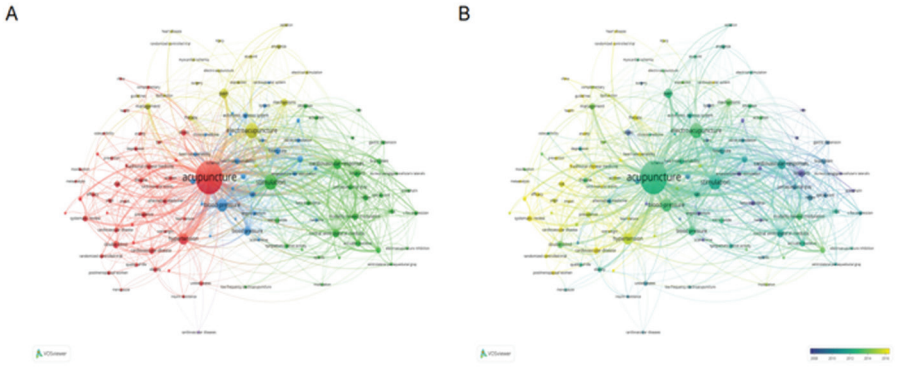


Figure 8. (**8A**) Map of keywords that occurred >5 times. (**8B**) Distribution of keywords in terms of average publication year (blue = earlier; yellow = later)



articles), followed by *Medicine* (14; 3.65%) and the *American Journal of Chinese Medicine* (13; 3.38%).

The 10 journals with the most substantial citation bursts are shown in Table 4 and Figure 5. The *American Journal of Physiology-Heart and Circulatory Physiology* had the most significant number of citations (156), followed by the *Journal of Applied Physiology* (151) and *Acupuncture in Medicine* (132).

A total of 67 journals from all publications cited in more than 10 citations were analyzed by CiteSpace, as illustrated in Figure 4. The top 10 cited journals with the most vigorous citation bursts are shown in Figure 5.

Analysis of Authors

In total, 48 authors from more than 5 publications were reviewed by VOSviewer (Figure 6). Among these, the 5 most active and most frequently mentioned are listed in Table 5.

The Online Bibliometric Analysis Platform showed all the authors with publications and their relationships. Overall, 170 authors had more than 50 quotations in the co-cited network analyzed by VOSviewer (Figure 7).

Keywords Analysis

The most frequently used keyword in the 384 publications was "acupuncture," followed by "stimulation," "electroacupuncture," "blood pressure" and "hypertension." In order to show the co-occurrence of keywords from the 384 publications across all documents we used VOSviewer (Figure 8A). A total of 124 keywords appeared more than 5 times, indicating 5 main branches in the field, including acupuncture, blood pressure, electroacupuncture, stimulation and cardiovascular responses. Figure 8B displays the distribution of keywords in terms of average publication year. These keywords

Figure 9. A timeline map of co-occurrence of keywords.

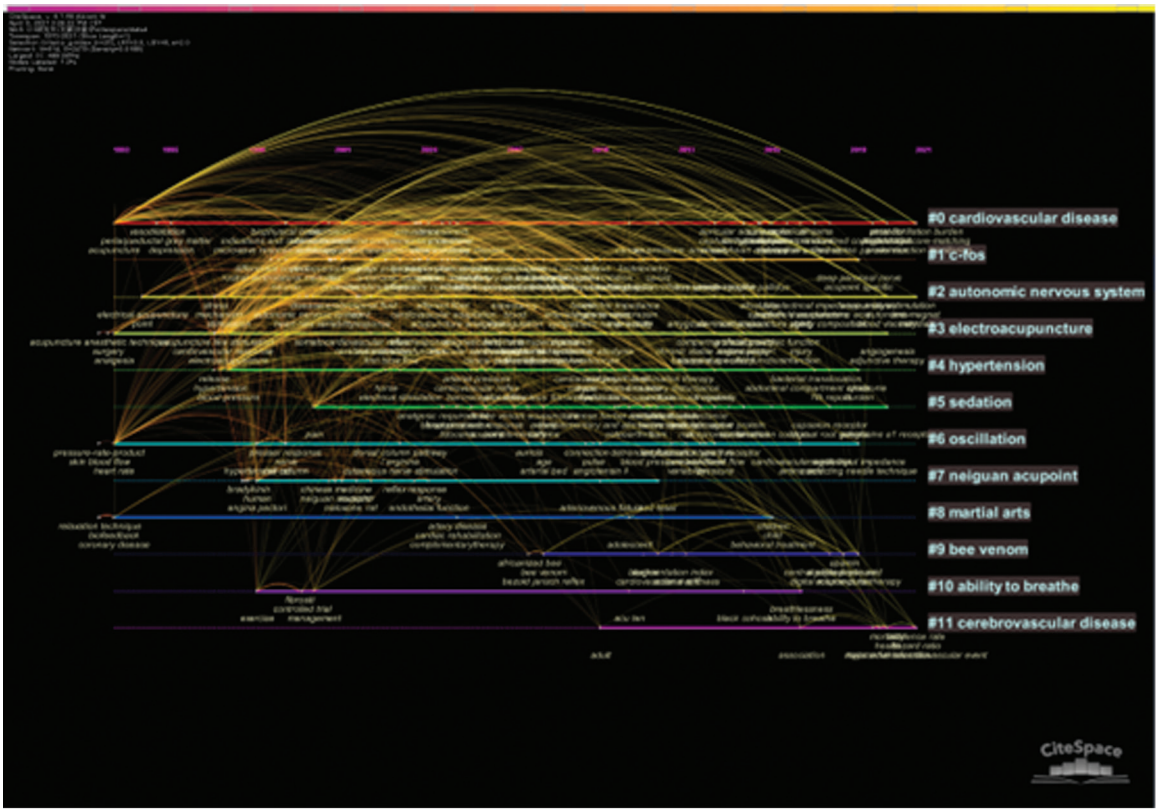
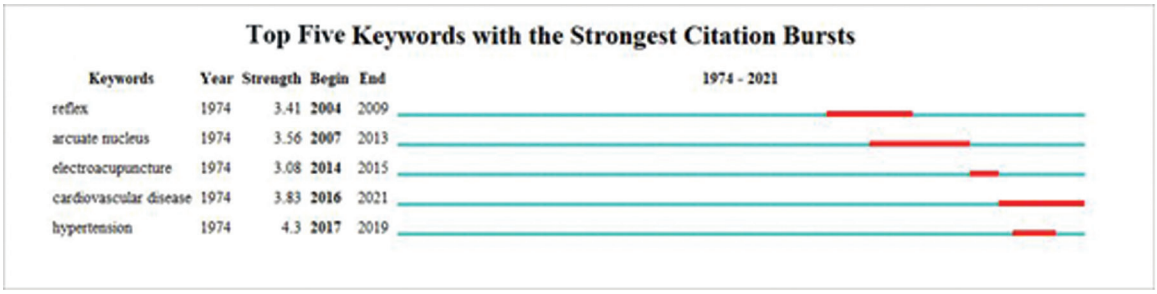


Figure 10. Top 5 keywords with strongest citation bursts.



were classified into 12 clusters and identified by a timeline in CiteSpace, as shown in Figure 9. Figure 10 illustrates the top 5 keywords with the highest number of quotes.

DISCUSSION

Based on these statistics, acupuncture therapy for CVD has gotten more and more attention; the total number of publications has increased over the past half century. However, the production of annual publications was expected to rise rapidly over the first 30 years but intermittently and explosively over the past 20 years. The United States, China, South Korea and Japan contributed significantly to the publication of these papers. The United States, China and Russia collaborated with different countries in this area. The first 5 productive institutions were made up of 76 journals. Among them, 4 were universities and only 1 was a hospital. The University of California Irvine ranked first, followed by Medical College of Ohio, Beijing University of Chinese Medicine, Kyung Hee University and China Medicine University. The University of California Irvine, with the highest centrality (960 citations), suggests its close cooperation with many institutions. Analysis of co-authors in countries and institutions has shown that international cooperation has emerged as a trend in this area. Fortunately,Chinese institutions and authors have established close cooperation with foreign institutions and authors. The 10 most successful journals published 111 papers, representing 28.90% of all papers. The 2020 impact drivers for these reviews are between 0.25 and 3.894. *Circulation* (IF, 2020 = 14.065), with the most critical citations (156), has published high-quality studies related to peripheral vascular disease, basic experiments and anesthesia. The role of blood circulation is essential in the CV system. With the further development of science and technology, rational research will inevitably become an important future trend.

The keywords were divided into 12 clusters, showing the general trends during the past 50 years. These keywords were:

1. **CVD** has attracted attention since it was discovered in the 1970s, becoming the leading cause of disease and death worldwide.[18] Atherosclerosis is the main contributing factor to the pathology of CVD.[19]
2. **Protein c-Fos** was found to be a marker of neuron activation in nociceptive stimulation.[20] One study confirmed that c-Fos is a critical transcription factor controlling thrombin, which gives rise to vascular permeability factor endothelial cells (VEGF EC) synthesis and angiogenesis.[21] Researchers also found that c-Fos expression was related to vascular smooth muscle cell (VSMC) phenotypic switching because of inducement of neuronal depolarization.[22]
3. **Autonomic nervous system**: The autonomic nervous system (ANS) comprises the sympathetic nervous system and the parasympathetic nervous system.[23] The role of ANS in the pathogenesis of atrial and ventricular arrhythmia (VA) has long been recognized.[24]
4. **Electroacupuncture**. Electroacupuncture is a treatment based on manual acupuncture combined with electrical stimulation.[25] Both animal and clinical studies have documented that electroacupuncture may achieve a more favorable outcome than ordinary acupuncture, not only in the CV system but also in other systems.[26,27]
5. **Hypertension**. Blood pressure is a recognized cause of many diseases, not only CVD but also cerebrovascular and neurodegenerative diseases.[28] A meta-analysis shows that acupuncture may have the same effect as common medication in treating hypertension.[29] On the other hand, reports state that due to economic limitations and the adverse events involved with the use of drugs, non-pharmacological management of hypertension such as acupuncture and the martial arts have become more attractive in both developed and developing countries.[30]
6. **Sedation**. As early as the 1970s, acupuncture and moxibustion had an analgesic effect, as shown on electrocardiogram.[31]
7. **Oscillation**. Electrocardiogram is known as an essential method to evaluate heart function. The latest research has shown that low frequent oscillation in ventricular repolarization is influenced by ischemic and non-ischemic cardiomyopathy.[32] Coupling and oscillation can be fundamental to acupuncture and growth regulation mechanisms.[33] In addition, the forced oscillation technique was used to distinguish cardiopulmonary dyspnea with satisfactory results.[34]
8. **Neiguan acupoint**. Neiguan acupoint belongs to the pericardial meridian.[35] Research has also proved that using electroacupuncture on this acupoint can reduce cardiotoxicity caused by drugs[35] to some degree, as it can balance heart function. A study also corroborated that electroacupuncture pre-treatment at the Neiguan acupoint positively protected the myocardium and genome-wide gene expressions.[36]
9. **Martial arts**. Martial arts and acupuncture are important complements of alternative medicine, as well as in traditional Chinese medicine. Research has found that martial arts is conducive to the well-being of the ventricular function in athletes.[37]
10. **Bee venom**. Bee venom as a trigger, though uncommon, has a nasty effect on CV circulation. The central histaminergic system and endogenous cerebrospinal kininogenase were involved in the inhibition of CV circulation.[38,39]
11. **Ability to breathe**. Heart failure is most closely related to respiratory function. The first manifestation of left heart failure is dyspnea. The ability to breathe naturally becomes one of the critical indicators for evaluating heart function.
12. **Cerebrovascular disease**. It is well known that there is a close association exists between CV and cerebrovascular diseases. Both are the leading causes of death worldwide.[40]

This bibliometric analysis is the first to investigate the development of acupuncture research in CVD. By analyzing co-authorship, co-occurrence, co-citation and citation bursts, we were able to design and display the bibliometric networks using 2 scientometric software tools (VOSviewer and CiteSpace), as well as 1 particular website (https://bibliometric.com).

Study Limitations

However, this study does have certain shortcomings. First, quantitative analysis receives greater attention in this study than qualitative analysis. Furthermore, the search is primarily done in the WoS database. If data from other sources (such as PubMed and Scopus) were combined with the results, the data would be better. Nevertheless, WoS is the most widely used database.

CONCLUSION

The bibliometric study map may help researchers be aware of current and general trends in acupuncture therapy in CVD. The co-occurrence analysis revealed 5 branches, including acupuncture, blood pressure, electroacupuncture, stimulation, CV responses, and 12 clusters. Recent keyword bursts revealed that the latest research frontiers might be in the areas of reflex, arcuate nucleus, electroacupuncture, CV illness and hypertension. In the future, more thorough clinical trials and studies examining similar pathways should be carried out.

CONFLICT OF INTEREST

None.

FUNDING

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