# Knowledge Mapping of International Research on Acupuncture for Chronic Pain: A Bibliometric Analysis

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**Introduction:** With the wide acceptance of acupuncture, many papers and guidelines recommend that acupuncture is effective for chronic pain (CP). In this study, we applied bibliometric methods to analyze the current research situation of acupuncture intervention in CP, to gain insight into the current situation and future development trend of this field.

**Material and Methods:** Science Citation Index Expanded was searched for publications related to acupuncture for CP between 1900 and 2022. VOSviewer, CiteSpace and Thomson Data Analyzer were used to analyze the annual publication, authors and cited authors and their countries (regions) and institutions, journals and cited journals, cited references, co-occurrence keywords, burst keywords, and the relevant centrality.

**Results:** A total of 1968 papers were retrieved, the annual publications have shown a rapid growth trend in the recent 20 years. The USA (708) and the Kyung Hee University (31) were the most productive country and institution, respectively, while the USA (0.37) and University of Maryland (0.13) had the highest centrality. MacPherson, Hugh published the most papers in this field (29), and Vickers, A J were the most influential author (289 times cited). Journal of Alternative and Complementary Medicine was the most productive journal (92), whereas PAIN was the most influential one (4743 times cited). Breivik, H's (2006) paper had the most citation count (3025), while Furlan's (2005) paper had the highest centrality (0.23). The research focuses in this field mainly include pain, electroacupuncture, Low back pain, Systematic review, Randomized controlled trial etc. Researchers are currently paying more attention to the psychological problems caused by CP.

**Conclusion:** The research of acupuncture for CP will be further expanded. International cooperation of this research field needs to be further strengthened. More high-quality designed trials need to be conducted.

**Keywords:** chronic pain, acupuncture, bibliometric analysis, VOSviewer, CiteSpace

## Introduction

Chronic pain (CP) usually refers to pain that affects daily functioning for more than three months, which is often accompanied by stress. More than 50% of the elderly population suffers from CP, and 80% of the elderly living in nursing homes has CP.[1] In general, CP can be isolated and requires medical intervention. CP includes various conditions such as fibromyalgia or nonspecific low-back pain, chronic cancer-related pain, chronic neuropathic pain, chronic secondary visceral pain, chronic posttraumatic and postsurgical pain, chronic secondary headache and orofacial pain, and chronic secondary musculoskeletal pain etc.[2,3] Chronic primary musculoskeletal pain is a condition in its own right. Chronic secondary musculoskeletal pain is a symptom that arises from an underlying disease classified elsewhere.[4]

Acupuncture originated from China and has been used in the Far East for more than 2000 years. Since the early 1970s, this therapy has been gaining popularity among Western world.[5] Acupuncture as an important part of complementary and alternative therapies is one of the non-pharmacological therapies has been utilized to treat a wide range of diseases. Acupuncture played an important role in pain management as well.[6–11] Acupuncture is considered to be effective in the treatment of chronic and acute pain.[12–17] Animal and clinical trials related to the mechanism of acupuncture in treating pain have verified the effectiveness of acupuncture for pain.[18–22] More and more insurance companies in different countries or regions have incorporated acupuncture into medical insurance to treat pain and various diseases.[23–31] This also proves that acupuncture is widely accepted worldwide.[32,33]

The research on acupuncture treatment of pain and CP is gradually increasing, which sometimes brings difficulty to researchers in reading relevant literature. Bibliometrics is to analyze the literature data through mathematical and statistical methods and get the useful information hidden in the massive data.[34] It is used in several fields to evaluate the countries, institutions, journals, authors, journals and keywords involved in relevant research.[35–37] Some scholars applied bibliometrics to study the development of acupuncture in various fields and predict its future development.[38–43] As far as we know, currently there is no bibliometric study conducted on acupuncture for CP. In order to understand the development of acupuncture for CP, in this study we used CiteSpace, Thomson Data Analyzer (TDA), Microsoft Excel and VOSviewer to conduct this research of the CP papers.

## Materials and Methods
### Data Collection
The data of this research was collected from Science Citation Index Expanded (SCI-EXPANDED) of the Web of Science (WoS). The search queries were: TS=(chronic pain) AND TS=(acupuncture), Indexes=SCI-EXPANDED, Time span=1900-01-01 to 2022–04-30. No language and document type limited. Retrieval date: May 05, 2022. A total of 1968 papers were included.

### Analysis
The analysis of this paper included the following: (1) descriptive statistical analysis, descriptive analysis of the annual publication volume, countries, institutions, authors, journals, cited authors and cited journals; (2) citation analysis, co-cited maps for journals; (3) co-occurrence analysis, co- occurrence map for keywords; (4) burst keywords.

### Analysis Tools
#### CiteSpace V
CiteSpace (6.1.3) is a bibliometric visualization analysis software that is gradually developed under the background of metrology and data visualization, focusing on the potential knowledge contained in the research society. Since the structure, rules and distribution of scientific knowledge are presented through visual means, the visualized graphs obtain through such methods are also called "scientific knowledge graphs".[44] Betweenness centrality is an important indicator for measuring nodes in the network. CiteSpace uses this indicator to discover and measure the importance of items such as papers, authors, references etc. Burst is used to detect fast-growing or fast-changing events such as topics, papers, authors, and journal citation etc.[45,46]

#### TDA
Thomson Data Analyzer (TDA 6.5) is a Thomson Reuters product that is powered by VantagePoint. TDA has special import filters and reporting macros specifically designed for analyzing scientific literature from Web of Science.

#### VOSviewer
VOSviewer is a software for constructing and visualizing bibliometric networks. These networks may for instance include journals, researchers, or individual publications, and they can be constructed based on citation, bibliographic coupling, co-citation, or co-authorship relations. VOSviewer also offers text mining functionality that can be used to construct and visualize co-occurrence networks of important terms extracted from a body of scientific literature.[47,48] The

VOSviewer (version 1.6.17) was used to explore the network patterns, and identify and visualize countries or regions, institutions, authors and cited authors, journals and cited journals, references, and co-occurrence keywords. The different nodes represent different items while the size of the nodes determined by the weight of the item, reflects the productivity. Lines between items represent links. Thicker lines mean stronger links.

# Results

## Analysis of Annual Publication

In the total of 1968 papers, the number of publications each year was presented in Figure 1. From 1975 to 1996, there were fluctuations of ten or less paper published each year. Started from 1997 (17 papers), the number of relevant research papers reached up to two digits, and then increased year by year. By 2015, the number had exceeded 100 and reached 125. During this period, there were some minor decreases, but overall, it was a rapid growth trend, reaching a peak of 167 papers in the year of 2020.

## Analysis of Countries or Regions

A total of 59 countries or regions participated in the publication of the 1968 papers. Figure 2 shows the world distribution of the number of papers published by countries or regions. Figure 3 shows USA, people R China, Germany, England, South Korea, ranked the top 5, with more than 100 papers published respectively. Other top 20 countries or regions are Australia, Canada, Taiwan, Brazil, Italy, Switzerland, Sweden, Japan, Netherlands, Spain, Australia, Norway, Turkey, Denmark, and Scotland. Their numbers of publication are greater than or equal to 14. USA (708) and China (418) rank first and second respectively. It can be seen from Figure 4 that the United States has conducted research in this field earlier. Since 1996, the number of papers has been growing steadily until 2019. A small number of research papers were published in China from 1999 to 2011, and there was a rapid growth from 2012 to 2021. China may surpass the United States in the next few years in terms of volume publication. The top ranked item by centrality was USA, with centrality of 0.40. The second one was England, with centrality of 0.29. The third is Germany, with centrality of 0.20; China, with centrality of 0.08; South Korea, with centrality of 0.01. This shows that USA, Germany and England play an important role in the international cooperation community in this field, while China and South Korea have relatively insufficient cooperation.
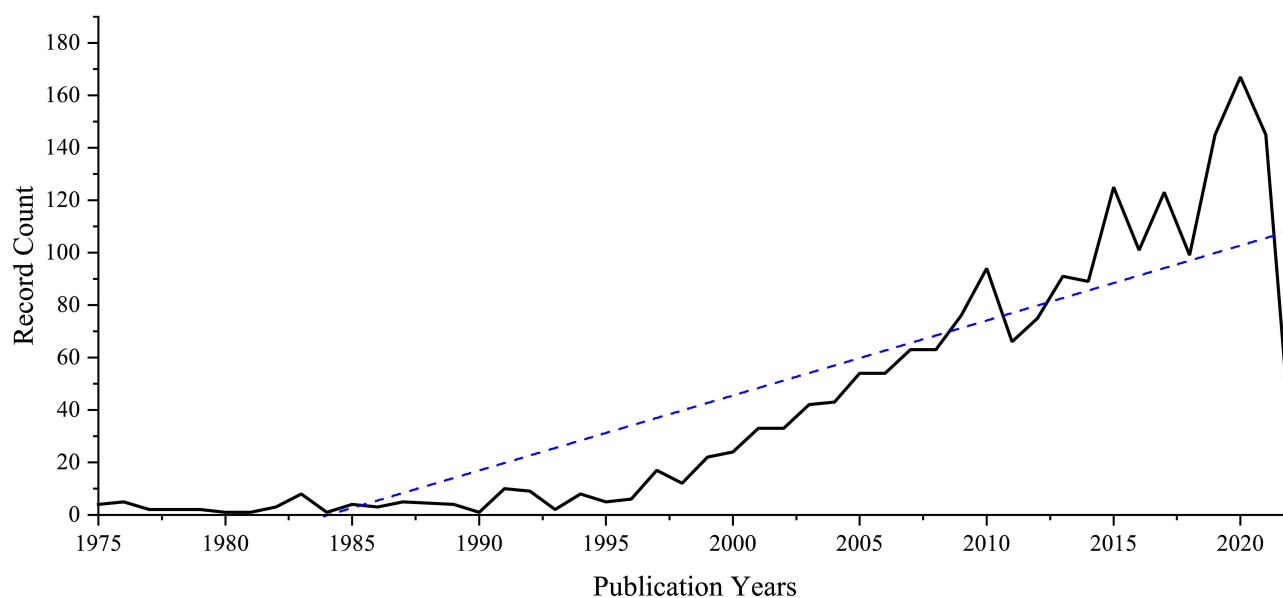


**Figure 1** The annual number of publications on acupuncture for CP indexed by SCI-E.
**Abbreviations**: CP, chronic pain; SCI-E, Science Citation Index-Expanded.
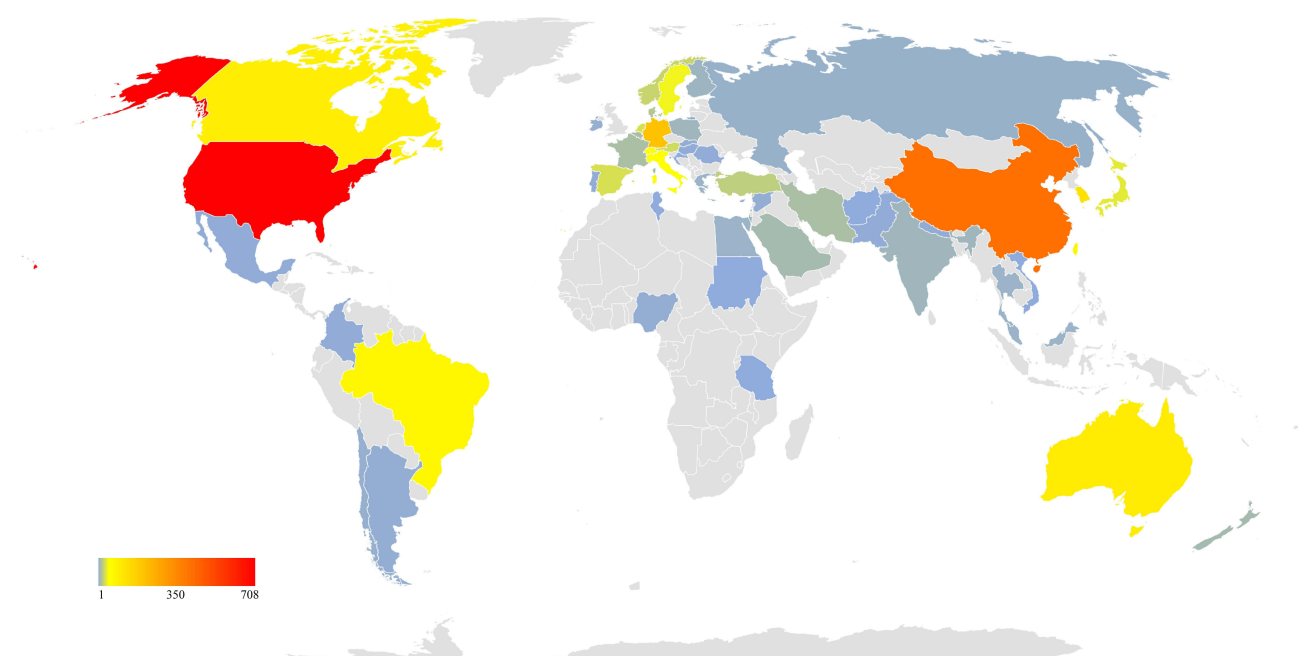
**Figure 2** The world distribution of the number of papers on acupuncture for CP published by countries or regions.
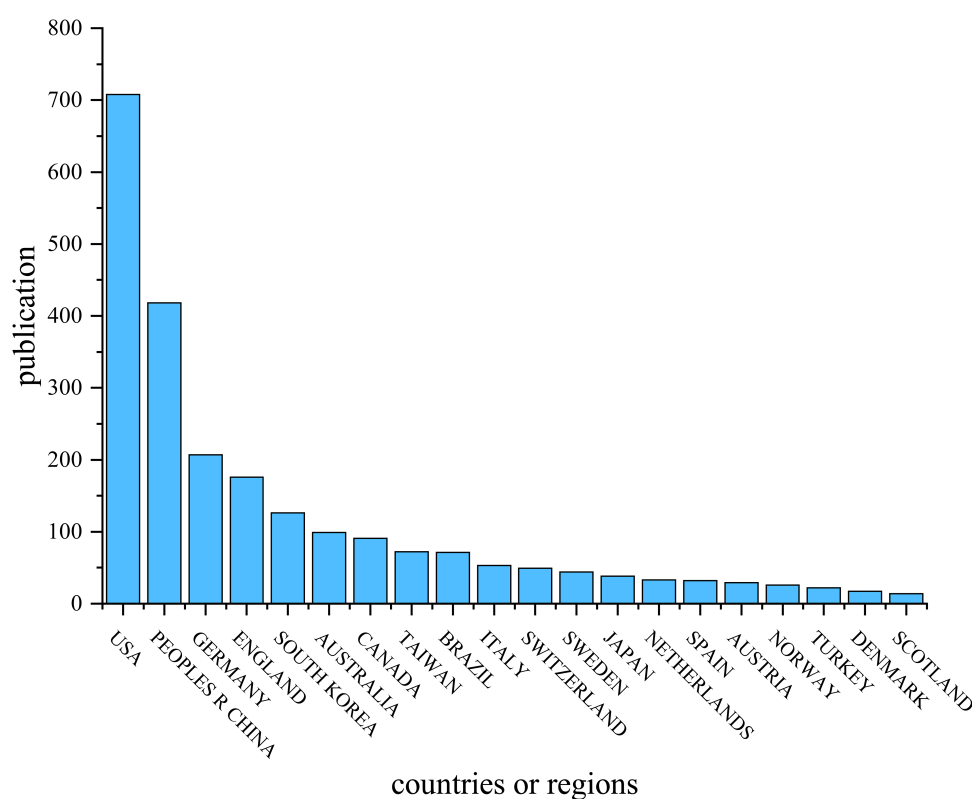


**Figure 3** The annual publications of the top 20 countries or regions on acupuncture for CP.
**Abbreviations**: CP, chronic pain; SCI-E, Science Citation Index-Expanded.

VOSviewer is used for co-occurrence cluster analysis of countries or regions in this study. Eight clusters are obtained (Figure 5). The clusters showed the cooperative relationship between countries or regions. The largest cluster is the red one, most of them are from Europe, including Belgium, Denmark, England, Greece, Israel, Italy, Norway, Russia, Spain,
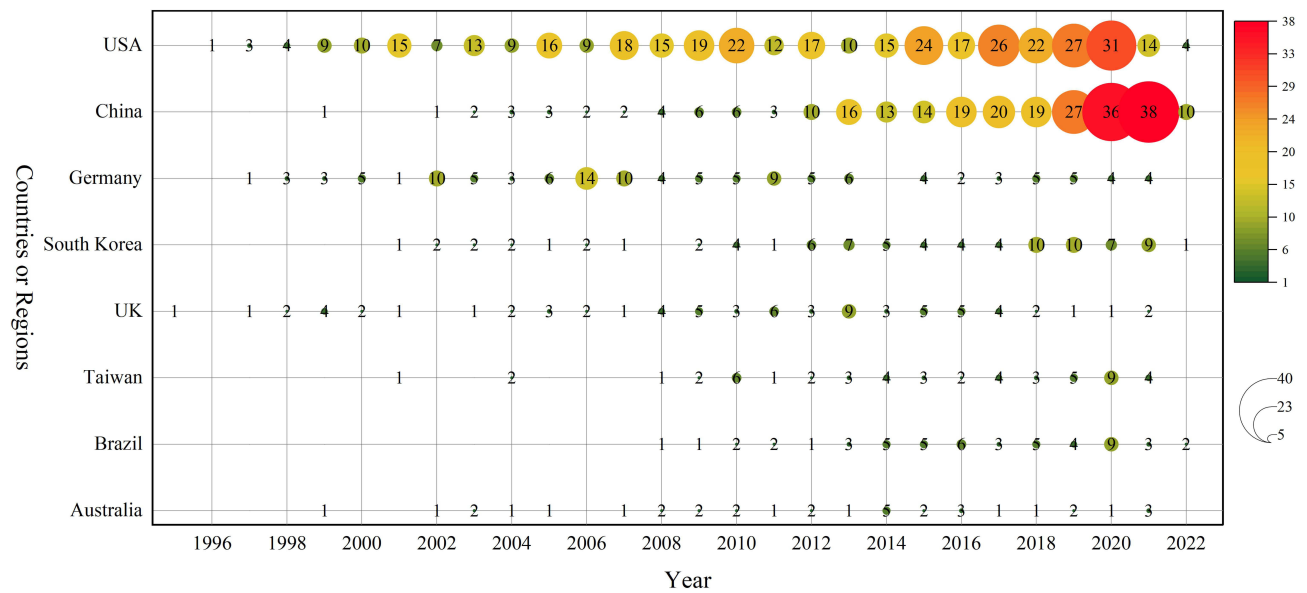
**Figure 4** The annual publications of countries or regions on acupuncture for CP.
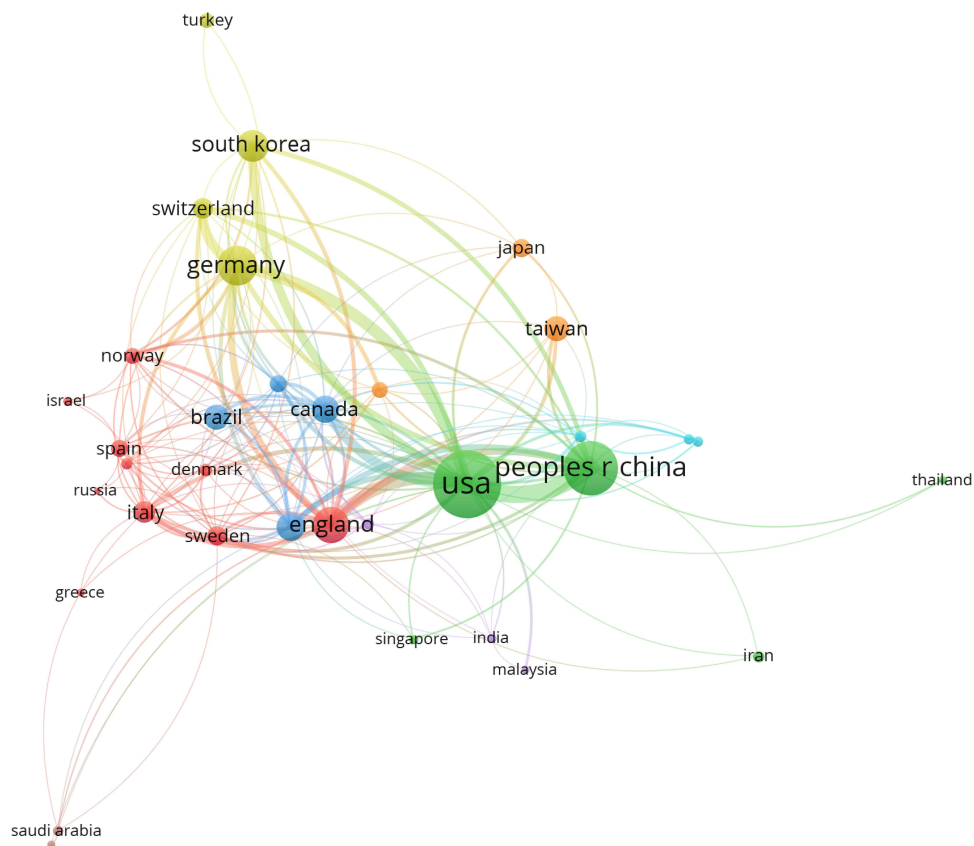**Abbreviation**: CP, chronic pain.



**Figure 5** Map of countries or regions' collaborations on acupuncture for CP.
**Abbreviation**: CP, chronic pain.

and Sweden. The second largest cluster is green, including Iran, people R China, Singapore, Thailand, USA. The third cluster is dark blue, including Australia, Brazil, Canada and Netherlands. The fourth cluster is yellow, including Germany, South Korea, Switzerland, and Turkey. The other four clusters are purple cluster, including France, India

and Malaysia; Light blue cluster, including New Zealand, North Ireland and Scotland; Orange cluster, including Austria, Japan, Taiwan; And brown cluster, including Egypt and Saudi Arabia.

## Analysis of Institutions

A total of 909 institutions published the 1968 papers. And 29 institutions published more than 20 papers were chosen for visualization (Figure 6). The figure displays the change of institutions in terms of time. Harvard University, Univ Calif Los Angeles, Tech Univ Munich, Univ Washington and the University of Maryland initiated the relevant study in early time. Research institutions represented by Beijing University of Chinese Medicine, Kyung Hee University, China Acad Chinese Med Sci, Chengdu Univ Tradit Chinese Med and Harvard Medical School started acupuncture for CP research in recent years. The top 15 first author's institutions are listed in Table 1, of which Kyung Hee University had the most research papers on acupuncture for CP (31). The other four institutions of the top five are China Acad Chinese Med Sci, Chengdu Univ Tradit Chinese Med, Univ York, Beijing Univ Chinese Med. The top ranked institution by centrality was Harvard Univ, with centrality of 0.34. Tech Univ Munich was 0.26. China Acad Chinese Med Sci was 0.20.

## Analysis of Authors

A total of 7820 authors participated in the publication of the papers. Top 15 authors are listed in Table 2. The top 5 authors are MacPherson, Hugh from Univ York, England; Linde, Klaus from Tech Univ Munich, Germany; Witt, Claudia M from Charite Med Ctr, Germany; Sherman, Karen J from Ctr Hlth Studies, USA; Kaptchuk, Ted J from Harvard Univ, USA. Co-occurrence analysis can reveal the cooperative relationship between authors. Figure 7 presents the cooperative relationship of the authors have published five or more papers. The thickness of connections between nodes or groups shows the strength of their cooperation. The figure shows that there are ten mature cooperation teams. The top ranked authors by centrality was LEE J, with centrality of 0.41, the second one was LIU J, with centrality of 0.39, which indicates that these two authors are important authors of their cooperation with other authors.
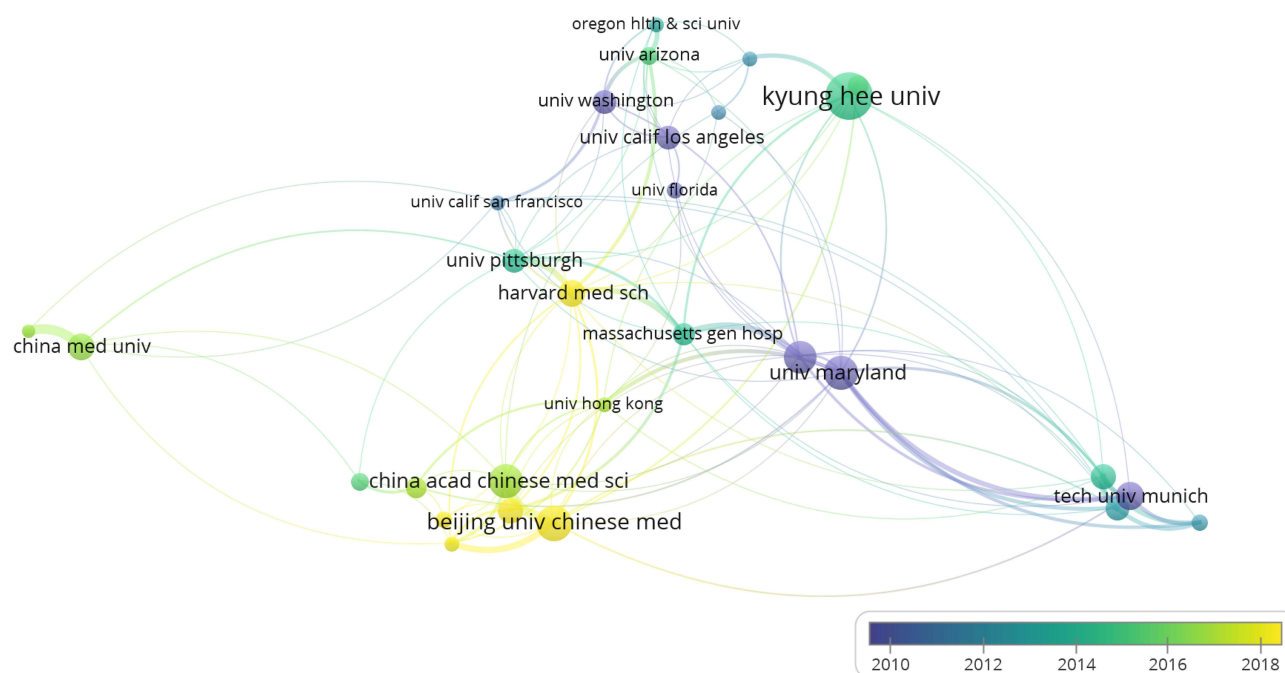


**Figure 6** Map of institutions' collaborations on acupuncture for CP.
**Abbreviation**: CP, chronic pain.

**Table I** Top 15 First Author's Institutions Performed Research on Acupuncture for CP

| Ranking | Institutions | Abbreviations | Frequency | % of 909 | Centrality |
|---|---|---|---|---|---|
| 1 | Kyung Hee University | Kyung Hee Univ | 31 | 3.41 | 0.12 |
| 2 | China Academy of Chinese Medical Sciences | China Acad Chinese Med Sci | 30 | 3.30 | 0.20 |
| 3 | Chengdu University of Traditional Chinese Medicine | Chengdu Univ Tradit Chinese Med | 26 | 2.86 | 0.10 |
| 4 | University of York | Univ York | 24 | 2.64 | 0.06 |
| 5 | Beijing University of Chinese Medicine | Beijing Univ Chinese Med | 22 | 2.42 | 0.17 |
| 6 | Shanghai University of Traditional Chinese Medicine | Shanghai Univ Tradit Chinese Med | 21 | 2.31 | 0.01 |
| 7 | Zhejiang Chinese Medical University | Zhejiang Chinese Med Univ | 21 | 2.31 | 0.08 |
| 8 | Memorial Sloan Kettering Cancer Center | Mem Sloan Kettering Canc Ctr | 20 | 2.20 | 0.06 |
| 9 | University of California, Los Angeles | Univ Calif Los Angeles | 20 | 2.20 | 0.02 |
| 10 | China Medical University | China Med Univ | 18 | 1.98 | 0.06 |
| 11 | Fudan University | Fudan Univ | 18 | 1.98 | 0.01 |
| 12 | Harvard University | Harvard Univ | 18 | 1.98 | 0.34 |
| 13 | Technical University Munich | Tech Univ Munich | 18 | 1.98 | 0.26 |
| 14 | Harvard Medical School | Harvard Med Sch | 17 | 1.87 | 0.08 |
| 15 | University of Maryland | Univ Maryland | 17 | 1.87 | 0.14 |

**Abbreviation**: CP, chronic pain.

**Table 2** Top 15 Authors Who Performed Research on Acupuncture for CP

| Ranking | Authors | Records | Centrality |
|---|---|---|---|
| 1 | MacPherson, H | 37 | 0.01 |
| 2 | Linde, K | 35 | 0.07 |
| 3 | Witt, C M | 33 | 0.16 |
| 4 | Sherman, K J | 32 | 0.11 |
| 5 | Kaptchuk, T J | 24 | 0.03 |
| 6 | Lee, J H | 24 | 0.41 |
| 7 | Cherkin, D C | 23 | 0.02 |
| 8 | Napadow, V | 21 | 0.02 |
| 9 | Brinkhaus, B | 20 | 0.02 |
| 10 | Kong, J | 20 | 0.16 |
| 11 | Lao, L X | 20 | 0.00 |
| 12 | Vickers, A J | 20 | 0.24 |
| 13 | Willich, S N | 20 | 0.01 |
| 14 | Fang, J Q | 19 | 0.08 |
| 15 | Zhang, Y | 19 | 0.07 |

**Abbreviation**: CP, chronic pain.

## Analysis of Cited Authors

Table 3 presents Top 10 cited authors performed research on acupuncture for CP. The first 5 authors are: Vickers, A J from Mem Sloan Kettering Canc Ctr, USA; MacPherson, Hugh from Univ York, England; Ernst, E from Univ Exeter, England; Han, J S from Peking Univ, Peoples R China; Linde, Klaus from Tech Univ Munich, Germany. These scholars have high influence in this research field.

## Analysis of Journals

A total of 547 journals published the 1968 papers. The top 10 journals account for 28% of the whole production (Table 4). The categories of journals mainly include complementary and alternative medicine, acupuncture, pain, and general medicine. The top five journals are: JOURNAL OF ALTERNATIVE AND COMPLEMENTARY MEDICINE (92), EVIDENCE BASED
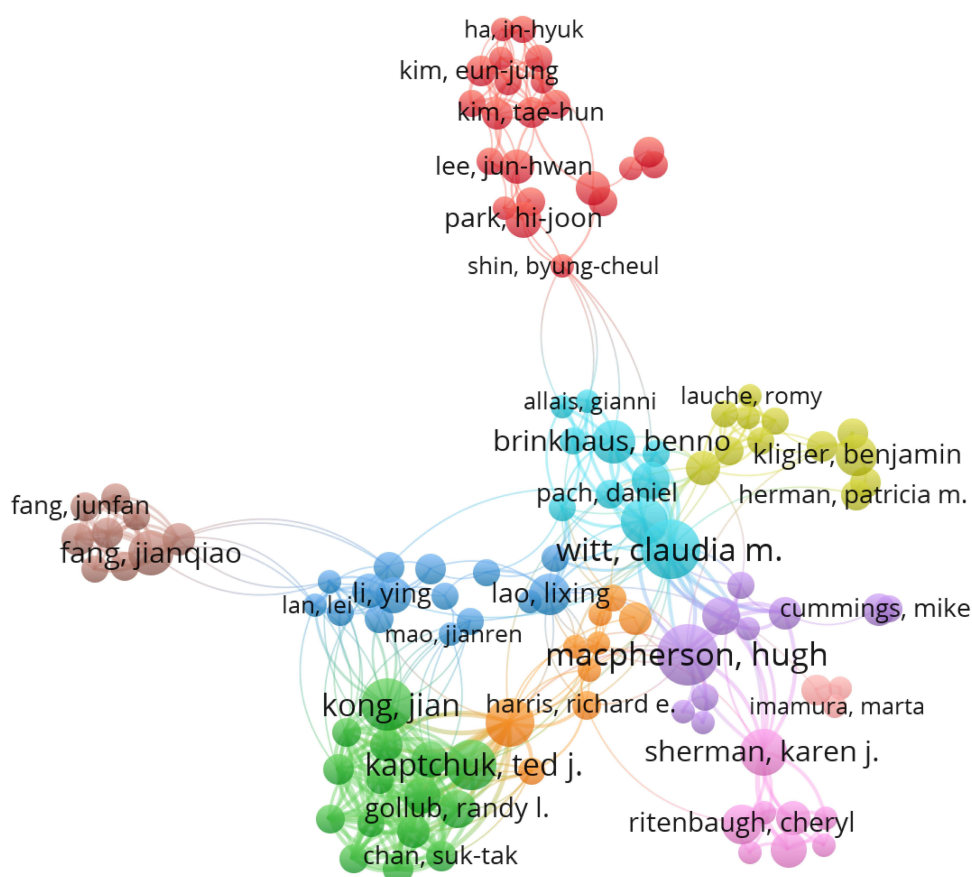
**Figure 7** Map of authors' collaborations on acupuncture for CP.
**Abbreviation**: CP, chronic pain.

COMPLEMENTARY AND ALTERNATIVE MEDICINE (88), ACUPUNCTURE IN MEDICINE (74), MEDICINE (61), TRIALS (50). According to the Journal Citation Reports (2021), the average Impact factor (IF) of these top 10 journals is 4.19.

## Analysis of Cited Journals

A total of 10,828 journals were cited. Figure 8 shows 58 journals have been cited more than 200 times are included in the map. Clustering relationship between nodes is represented by color. The closer the journals are, the thicker the links are which means that they are more relevant in the field of CP research and are cited together. Table 5 presents Top 10 Cited

**Table 3** Top 10 Cited Authors Performed Research on Acupuncture for CP

| Ranking | Records | Cited Authors |
|---------|---------|---------------|
| 1 | 289 | Vickers, A J |
| 2 | 255 | Macpherson, H |
| 3 | 254 | Ernst, E |
| 4 | 237 | Han, J S |
| 5 | 222 | Linde, K |
| 6 | 218 | Cherkin, D C |
| 7 | 189 | Furlan, A D |
| 8 | 181 | Berman, B M |
| 9 | 181 | Witt, C M |
| 10 | 172 | Melzack, R |

**Abbreviation**: CP, chronic pain.

**Table 4** Top 10 Relevant Journals on Acupuncture for CP Research

| Ranking | Journals | Abbreviations | Count | % of 1968 | IF* |
|---|---|---|---|---|---|
| 1 | Journal of Alternative and Complementary Medicine | J Altern Complem Med | 92 | 4.67 | 2.381 |
| 2 | Evidence Based Complementary and Alternative Medicine | Evid-Based Compl Alt | 88 | 4.47 | 2.650 |
| 3 | Acupuncture in Medicine | Acupunct Med | 74 | 3.76 | 1.984 |
| 4 | Medicine | Medicine | 61 | 3.1 | 1.817 |
| 5 | Trials | Trials | 50 | 2.54 | 2.728 |
| 6 | Cochrane Database of Systematic Reviews | Cochrane DB Syst Rev | 43 | 2.18 | 12.008 |
| 7 | Pain | Pain | 43 | 2.18 | 7.926 |
| 8 | Clinical Journal of Pain | Clin J Pain | 35 | 1.77 | 3.423 |
| 9 | Complementary Therapies in Medicine | Complement Ther Med | 32 | 1.62 | 3.335 |
| 10 | Pain Medicine | Pain Med | 32 | 1.62 | 3.637 |

**Note:** *IF according to Journal Citation Reports (2021).
**Abbreviation**: CP, chronic pain.

Journals on Acupuncture for CP Research. The top 10 cited journals are: PAIN (4743), SPINE (2314), COCHRANE DB SYST REV (1499), J ALTERN COMPLEM MED (1298), ANN INTERN MED (1256), ACUPUNCT MED (1203), JAMA-J AM MED ASSOC (1157), EVID-BASED COMPL ALT (1107), BMJ-BRIT MED J (1046), CLIN J PAIN (989).

## Analysis of Keywords

A total of 2709 keywords were included in this study. For better visualization from a total of 176 keywords with frequency greater than or equal to five were included in VOSviewer for co-occurrence analysis (Figures 9 and 10).
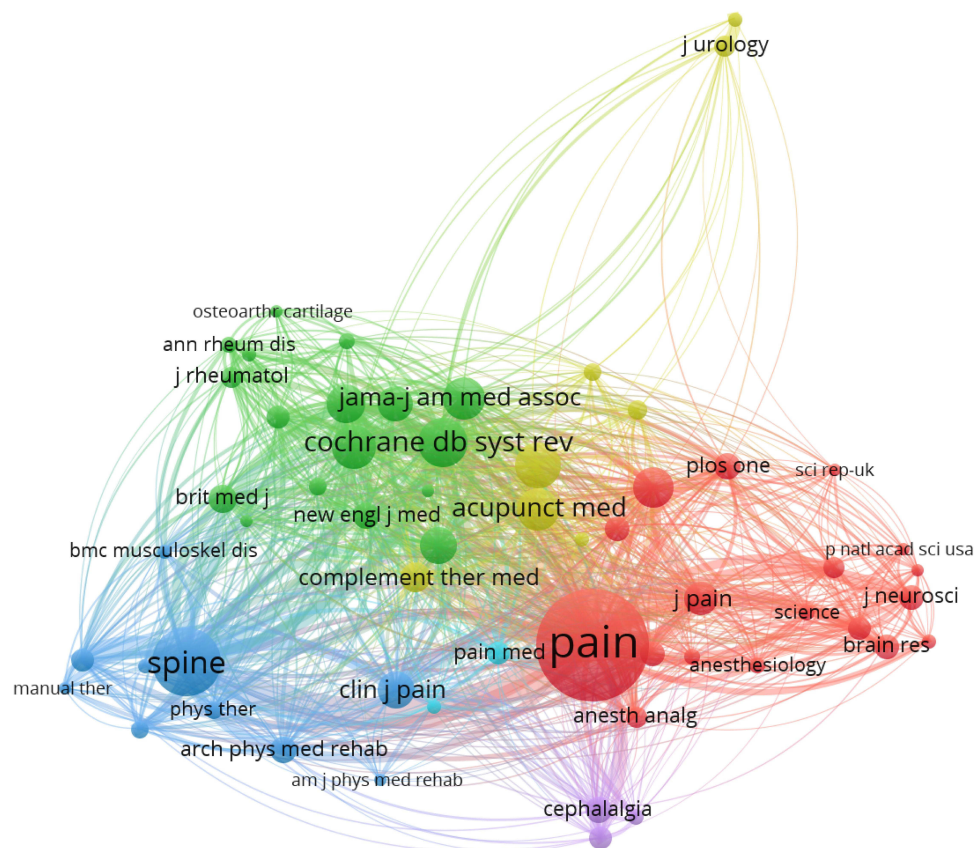


**Figure 8** Map of co-cited journals on acupuncture for CP.
**Abbreviation**: CP, chronic pain.

**Table 5** Top 10 Cited Journals on Acupuncture for CP Research

| No. | Frequency | Cited Journals | Abbreviations | IF* |
|---|---|---|---|---|
| 1 | 4743 | Pain | Pain | 7.926 |
| 2 | 2314 | Spine | Spine | 3.241 |
| 3 | 1499 | Cochrane Database of Systematic Reviews | Cochrane DB Syst Rev | 12.008 |
| 4 | 1298 | Journal of Alternative and Complementary Medicine | J Altern Complem Med | 2.381 |
| 5 | 1256 | Annals of Internal Medicine | Ann Intern Med | 51.598 |
| 6 | 1203 | Acupuncture in Medicine | Acupunct Med | 1.984 |
| 7 | 1157 | JAMA-Journal of the American Medical Association | JAMA-J Am Med Assoc | 157.335 |
| 8 | 1107 | Evidence Based Complementary and Alternative Medicine | Evid-Based Compl Alt | 2.650 |
| 9 | 1046 | BMJ-British Medical Journal | BMJ-Brit Med J | 93.467 |
| 10 | 989 | Clinical Journal of Pain | Clin J Pain | 3.423 |

**Note:** *IF according to Journal Citation Reports (2021).
**Abbreviation**: CP, chronic pain,

Table 6 presents the top 10 keywords. In addition to acupuncture and chronic pain, other keywords include pain, electroacupuncture, Low back pain, Systematic review, Randomized controlled trial, chronic low back pain, meta-analysis, neuropathic pain.
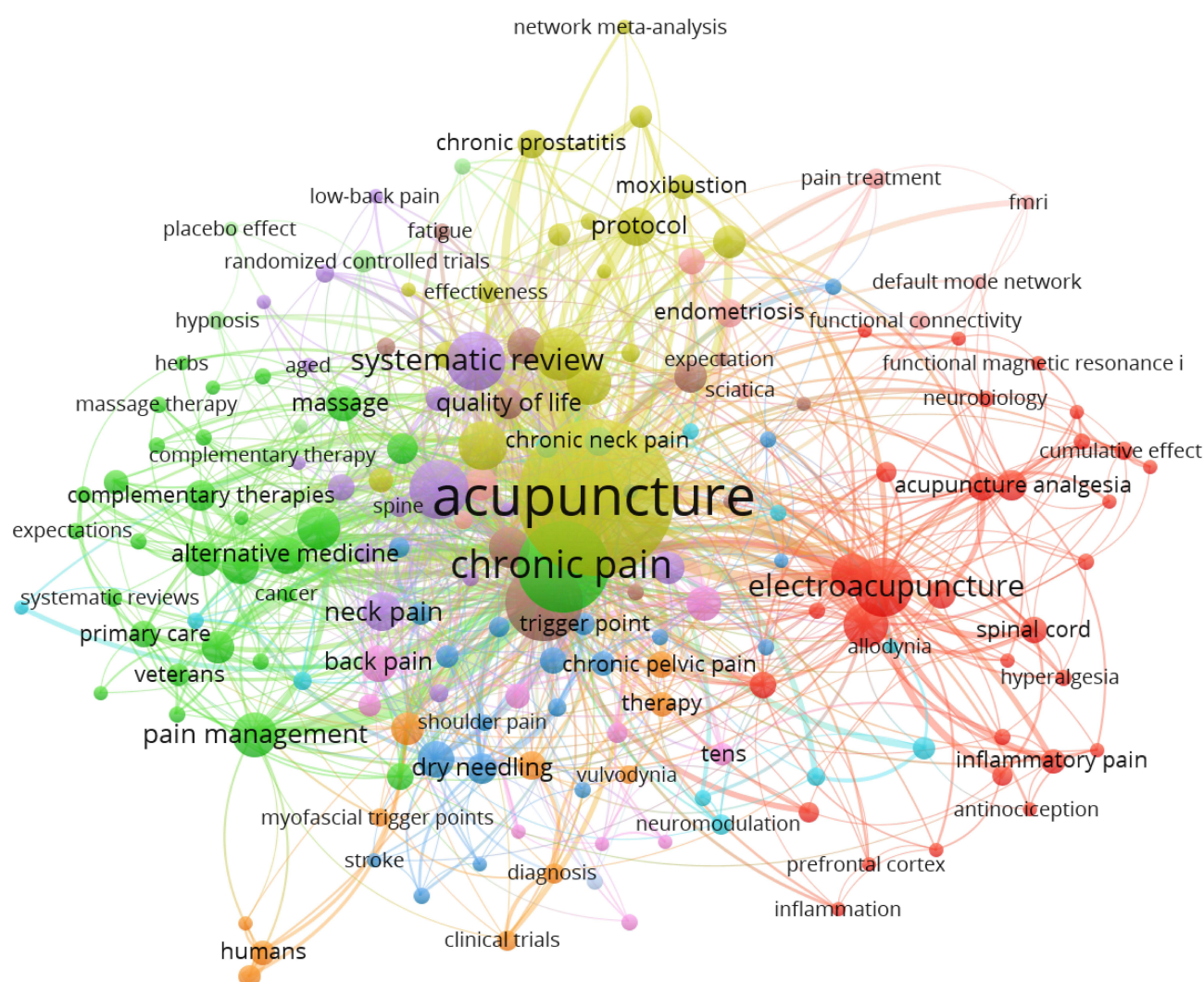


**Figure 9** Map of co-occurrence keywords on acupuncture for CP.
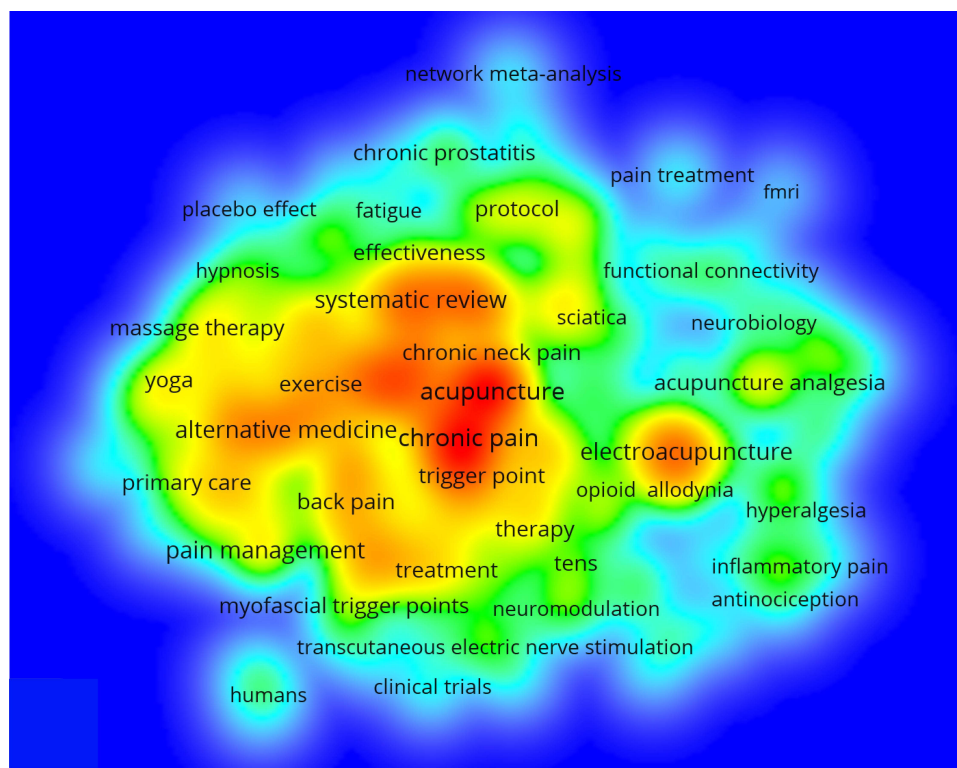**Abbreviation**: CP, chronic pain.

**Figure 10** Heat map of co-occurrence keywords on acupuncture for CP.
**Abbreviation**: CP, chronic pain.

## Analysis of Burst Keywords

"Burst keywords" refers to keywords cited frequently over some time, thereby indicating the frontier areas.[44,49] Figure 11 shows 20 burst keywords sorted by the "begin year". As can be seen from the figure, the keyword "electrical nerve stimulation" was the earliest burst keyword, with the highest strength (11.42) and lasted a very long period among these 20 burst keywords. The current burst keywords include impact, symptom, depression and stress, indicating that researchers are currently paying more attention to the psychological problems caused by CP.

## Analysis of Citation

A total of 54,255 references were generated from the 1968 papers. Table 7 presents the top 10 cited references sorted by the citation counts. Of these ten references, one reference was survey on CP, five references were

**Table 6** Top 10 Keywords Related to Acupuncture for CP Research

| Ranking | Keywords | Count | % of 2709 |
|---------|----------|-------|-----------|
| 1 | Acupuncture | 567 | 8.75 |
| 2 | Chronic pain | 192 | 2.96 |
| 3 | Pain | 139 | 2.14 |
| 4 | Electroacupuncture | 81 | 1.25 |
| 5 | Low back pain | 81 | 1.25 |
| 6 | Systematic review | 78 | 1.20 |
| 7 | Randomized controlled trial | 64 | 0.99 |
| 8 | Chronic low back pain | 53 | 0.82 |
| 9 | Meta-analysis | 47 | 0.72 |
| 10 | Neuropathic pain | 45 | 0.69 |

**Abbreviation**: CP, chronic pain.

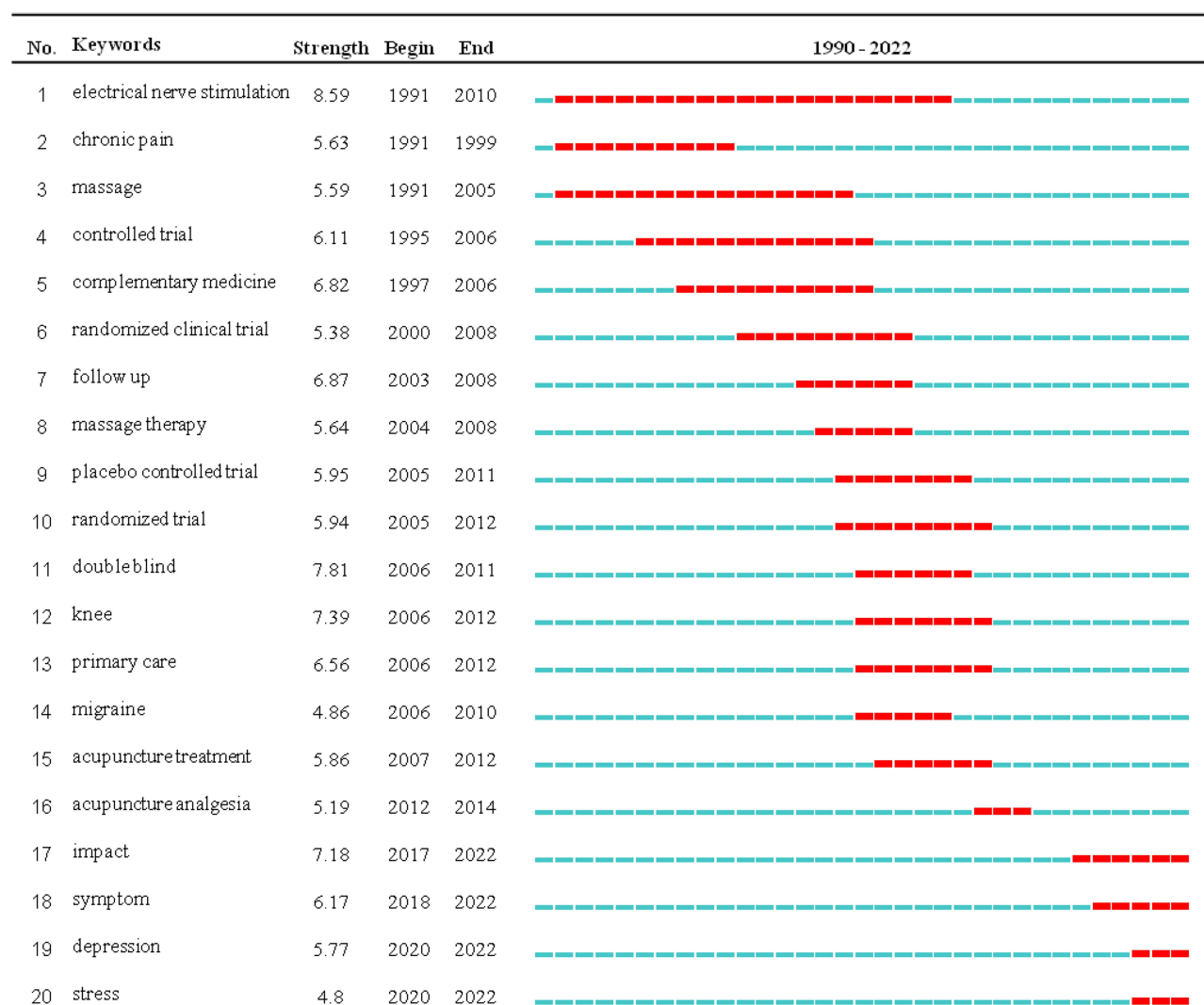| No. | Keywords | Strength | Begin | End | 1990 - 2022 |
|-----|----------|----------|-------|-----|-------------|
| 1 | electrical nerve stimulation | 8.59 | 1991 | 2010 | |
| 2 | chronic pain | 5.63 | 1991 | 1999 | |
| 3 | massage | 5.59 | 1991 | 2005 | |
| 4 | controlled trial | 6.11 | 1995 | 2006 | |
| 5 | complementary medicine | 6.82 | 1997 | 2006 | |
| 6 | randomized clinical trial | 5.38 | 2000 | 2008 | |
| 7 | follow up | 6.87 | 2003 | 2008 | |
| 8 | massage therapy | 5.64 | 2004 | 2008 | |
| 9 | placebo controlled trial | 5.95 | 2005 | 2011 | |
| 10 | randomized trial | 5.94 | 2005 | 2012 | |
| 11 | double blind | 7.81 | 2006 | 2011 | |
| 12 | knee | 7.39 | 2006 | 2012 | |
| 13 | primary care | 6.56 | 2006 | 2012 | |
| 14 | migraine | 4.86 | 2006 | 2010 | |
| 15 | acupuncture treatment | 5.86 | 2007 | 2012 | |
| 16 | acupuncture analgesia | 5.19 | 2012 | 2014 | |
| 17 | impact | 7.18 | 2017 | 2022 | |
| 18 | symptom | 6.17 | 2018 | 2022 | |
| 19 | depression | 5.77 | 2020 | 2022 | |
| 20 | stress | 4.8 | 2020 | 2022 | |

**Figure 11** Top 20 Keywords with the Strongest Citation Bursts.

guidelines for pain including CP, one is Meta-analysis on acupuncture for CP.[50] The first one introduces the situation of CP in 15 European countries and Israel, which shows that CP is widespread and the effective medical treatment is relatively insufficient.[13] The second paper introduces the diagnosis and treatment of low back pain, and introduces the treatment suggestions for different types of low back pain, among which acupuncture, one of the therapies, is recommended to treat acute and chronic low back pain.[51] The third and fifth are systematic reviews published by Zhang, W. OARSI recommendations for the management of hip and knee osteoarthritis, they recommended acupuncture as one of 12 non-pharmacological modalities of therapy for the pain of hip and knee osteoarthritis.[14,52] The fourth reference found no consistent evidence that acupuncture provides anything more than a placebo effect in the treatment of low back pain. So, the authors cannot recommend acupuncture for the treatment of chronic low back pain.[53] Zhao, Zhi-Qi studied on neural mechanisms underlying acupuncture analgesia from cellular and molecular substrate and functional brain imaging aspect.[54] Kaptchuk, TJ and Han, JS found out acupuncture activates endogenous opioid mechanisms and acupuncture has regionally specific, quantifiable effects on relevant brain structures.[55,56]

**Table 7** Top 10 Cited References Related to Acupuncture for CP

| No. | Title | Authors | Journal | year | Total Citation | Average Citation Per Year |
|---|---|---|---|---|---|---|
| 1 | Survey of chronic pain in Europe: Prevalence, impact on daily life, and treatment[13] | Breivik, H; Collett, B; Ventafridda, V; Cohen, R; Gallacher, D | EUROPEAN JOURNAL OF PAIN | 2006 | 3025 | 177.94 |
| 2 | Diagnosis and treatment of low back pain: A joint clinical practice guideline from the American college of physicians and the American pain society[51] | Chou, Roger; Qaseem, Amir; Snow, Vincenza; Casey, Donald; Cross, J. Thomas, Jr.; Shekelle, Paul; Owens, Douglas K. | ANNALS OF INTERNAL MEDICINE | 2007 | 1916 | 119.75 |
| 3 | OARSI recommendations for the management of hip and knee osteoarthritis, Part II: OARSI evidence-based, expert consensus guidelines[52] | Zhang, W.; Moskowitz, R. W.; Nuki, G.; Abramson, S.; Altman, R. D.; Arden, N.; Bierma-Zeinstra, S.; Brandt, K. D.; Croft, P.; Doherty, M.; Dougados, M.; Hochberg, M.; Hunter, D. J.; Kwoh, K.; Lohmander, L. S.; Tugwell, P. | OSTEOARTHRITIS AND CARTILAGE | 2008 | 1803 | 120.2 |
| 4 | Chapter 4 - European guidelines for the management of chronic nonspecific low back pain[53] | Airaksinen, O.; Brox, J. I.; Cedraschi, C.; Hildebrandt, J.; Klaber-Moffett, J.; Kovacs, F.; Mannion, A. F.; Reis, S.; Staal, J. B.; Ursin, H.; Zanoli, G. | EUROPEAN SPINE JOURNAL | 2006 | 1510 | 88.82 |
| 5 | OARSI recommendations for the management of hip and knee osteoarthritis Part III: changes in evidence following systematic cumulative update of research published through January 2009[14] | Zhang, W.; Nuki, G.; Moskowitz, R. W.; Abramson, S.; Altman, R. D.; Arden, N. K.; Bierma-Zeinstra, S.; Brandt, K. D.; Croft, P.; Doherty, M.; Dougados, M.; Hochberg, M.; Hunter, D. J.; Kwoh, K.; Lohmander, L. S.; Tugwell, P. | OSTEOARTHRITIS AND CARTILAGE | 2010 | 1041 | 80.08 |
| 6 | Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of Physicians[15] | Qaseem, Amir; Wilt, Timothy J.; McLean, Robert M.; Forciea, Mary Ann | ANNALS OF INTERNAL MEDICINE | 2017 | 917 | 152.83 |
| 7 | Acupuncture for Chronic Pain Individual Patient Data Meta-analysis[50] | Vickers, Andrew J.; Cronin, Angel M.; Maschino, Alexandra C.; Lewith, George; MacPherson, Hugh; Foster, Nadine E.; Sherman, Karen J.; Witt, Claudia M.; Linde, Klaus | ARCHIVES OF INTERNAL MEDICINE | 2012 | 629 | 57.18 |
| 8 | Neural mechanism underlying acupuncture analgesia[54] | Zhao, Zhi-Qi | PROGRESS IN NEUROBIOLOGY | 2008 | 624 | 41.6 |
| 9 | Acupuncture: Theory, efficacy, and practice[55] | Kaptchuk, TJ | ANNALS OF INTERNAL MEDICINE | 2002 | 545 | 25.95 |
| 10 | Acupuncture and endorphins[56] | Han, JS | NEUROSCIENCE LETTERS | 2004 | 475 | 25 |

**Abbreviation**: CP, chronic pain.

## Discussion

CP is a kind of primary or secondary pain with a long duration. CP is often accompanied by depression, which seriously affects people's quality of life. CP is more common in the elderly.[1] Acupuncture as an effective non drug therapy for CP, is widely accepted and recommended by clinical guidelines (OARSI recommendations for the management of hip and knee osteoarthritis Part II, III; Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of Physicians), Physicians, etc.[15,36] Including acupuncture, Complementary and alternative medicine is often used for lower pain intensity pain.[57]

In this study, we used bibliometric methods to study papers related to acupuncture for CP between 1975 and 2022. Since the first paper was published in 1975, the number of papers published in the first 20 years has remained steady at around ten per year, showing a rapid growth trend from 1997 to 2020. At present, it still shows the momentum of continuous growth. The USA, people R China, Germany, England, South Korea, ranked the top 5, with more than 100 papers published respectively. The USA as the most prolific country has researched in this field earlier.[58] From 2012 to 2021, China's research in this field shows a rapid growth trend. The annual volume of papers published by other countries or regions remained basically stable It shows that the research on acupuncture for CP has gradually shifted from the USA centered western world to China centered East world.[59] There are extensive cooperative relations between countries or regions. In terms of the importance of international cooperation, The USA is the pivot of the cooperative team. The USA, Germany and England played a major role in the international research cooperation team and have a high influence. On the contrary, China and South Korea, despite their high volume of production, have made little contribution to team cooperation. The co-occurrence cluster analysis of countries or regions shows that there are several cooperative teams, ie European team, China-USA team, Australia-Canada team, South Korea Europe team, and other small teams including Europe Asia team, East Asia team, Middle East team etc. As for research institutions, the institutions in the United States and Germany studied CP earlier than those in China and South Korea, they have more exchanges and cooperation. Kyung Hee University in South Korea has the largest number of papers. Several institutions in China have also published a large number of papers immediately after it. The institutions of the USA, Germany and China play a major role in connecting the cooperation team. As the birthplace of acupuncture, China also has more participation in the international cooperation team. From the perspective of the author analysis, the top prolific authors are from the USA and Europe. As to author cooperation network, there are several mature cooperation teams with a certain degree of cooperation between them. There are ten mature cooperation teams. However, the relationship between the cooperative teams is relatively loose, which indicates that the cooperation between prolific authors is relatively limited to smaller groups. Top five cited authors performed research on acupuncture for CP are from USA, England; China and Germany. The journals that published research papers on acupuncture for CP are mainly those in complementary alternative medicine and pain related journals. This shows that acupuncture is an important part of complementary and alternative medicine, and relevant research is not limited to complementary and alternative medicine. Moreover, there are many pain related journals, which indicates that acupuncture intervention on pain is being widely studied.[60–72] But the top productive journals on acupuncture for CP's average IF is not high (4.19). Therefore, the international influence of research on acupuncture for CP is relatively insufficient. More high-quality designed trials and papers on acupuncture for CP need to be implemented. For the cited journals, PAIN and SPINE are the core citation source journals of acupuncture for CP research. The high citation rate of SPINE indicates that CP related to spine is the focus of acupuncture for CP.[69,73–87] From the perspective of research areas, electroacupuncture, low back pain, systematic review, randomized controlled trial, meta analysis are the main research focuses, which shows that researchers are very interested in verification of the effectiveness on acupuncture for CP. Trials to prove the effectiveness of acupuncture in the treatment of pain is and will be the focuses of this research field.[88–92] The current burst keywords include impact, symptom, depression and stress, indicating that researchers are currently paying more attention to the psychological problems caused by CP. This shows that in recent years, researchers have gradually shifted from simply focusing on chronic pain to secondary symptoms of psychological problems caused by chronic pain, such as depression and stress.[93–96] It can be seen from the highly cited papers that several clinical guidelines suggesting the application of acupuncture for CP have been cited most frequently, which also shows that demonstrating the effectiveness of acupuncture for CP is the

focus of researchers in this field.[14,15,51,52] However, there are also a few highly cited papers with different opinions on the efficacy of acupuncture for CP, which indicates that whether acupuncture has a therapeutic effect on pain is still controversial.[53,97] This also reflects that the research on acupuncture treatment of pain will be further increased.

Some limitations should be addressed in our study. Firstly, we only used the data from the SCIE of Web of Science and most of the papers are written in English rather than other languages. Therefore, our results may not be comprehensive. In future research, if data from multiple databases are used, such as Chinese, Japanese, Korean and other languages, the research might be more comprehensive. In addition, some data are not standardized, which may lead to biased results. For example, the analysis software treats "Harvard University" and "Harvard Medical School" as two different institutions. However, as the first bibliometric analysis of acupuncture for CP research, we believe that this study can still be used to describe the overall situation and trends in this research field on a global scale.

## Conclusion

CP is a common symptom that affects the entire population, especially among the elderly. The aging population has greatly increased this issue. The research papers in relevant fields in the last two decades are almost ten times that of the previous two decades. The USA and China are leading countries in this field. China may surpass the United States in the next few years in terms of volume of publication. The USA, England and Germany have high influence in international cooperation. Research institutions from the USA, Germany and China play an important role in the international cooperation team of the institution. International cooperation is relatively insufficient, which needs to be further strengthened. The overwhelming majority of the papers verified that acupuncture for CP is effective. Many highly cited literatures, such as systematic reviews and clinical guidelines, recommend acupuncture for CP. Acupuncture for CP related research might gradually shift from just pain to pain and secondary symptoms caused by pain, such as depression and stress. More rigorous trial designs and methods need to be further developed.

In summary, this bibliometric study summarizes the current situation and possible future development of acupuncture for CP, which provides a reference for further research on acupuncture for CP. The research of acupuncture for CP will be further expanded, and acupuncture will be more widely accepted by the international community.

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