

Research Hotspots and Trends on Acupuncture for Neuropathic Pain: A Bibliometric Analysis from 2002 to 2021

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Purpose: In this study, we aimed to systematically determine the trend, research hotspots, and directions of the future development of acupuncture for neuropathic pain (NP) by bibliometric analysis.

Methods: Based on the relevant literature on acupuncture for NP in the databases of Web of Science from January 2002 to December 2021, Citespace software and VOSviewer were used to determine the use of acupuncture for the treatment of NP. The annual publications, countries, authors, research institutions, keywords, co-cited references, and journals were analyzed to explore the research hotspot and development trends in this field.

Results: A total of 1462 records of acupuncture for NP from 2002 to 2021 were obtained. Chingliang Hsieh (20) is the most effective author and Han JS (585 co-citations) is the most influential author. The most productive institutions and countries are Kyung Hee UNIV (88) and China, respectively (480). UNIV Maryland of the USA has the highest centrality (0.12). Evidence-based complementary and alternative medicine (89) is the most prolific journal, and Pain is the most influential journal (4200 co-citations). Ji-sheng Han (2003) is the most frequently cited article (158 co-citations). Electroacupuncture, bee-venom acupuncture, and percutaneous electrical stimulation are the most commonly studied acupuncture types. The analgesic mechanism of acupuncture and acupuncture-neuroimaging was a research hotspot over the years. The clinical evidence of acupuncture for NP should be further studied in the future.

Conclusion: The study using bibliometric analysis methods to investigate the publications on acupuncture for NP so as to provide potential research directions in the future.

Keywords: acupuncture, neuropathic pain, therapy, bibliometrics, visualized study

Introduction

Neuropathic pain (NP) is a type of chronic pain, which is caused by a lesion or disease of the somatosensory nervous system, including the central nerves, spinal cord, posterior root of the spinal cord, and peripheral nerves.^{1,2} NP is clinically characterized by spontaneous ongoing or electrical shocking pain, and induced by an amplified pain response after a noxious or non-noxious stimulus. Based on epidemiological surveys, the prevalence of NP in the general population is more than 7%,³⁻⁵ and the degree of NP is more severe than other types of chronic pain diseases.⁶ More people are suffering from NP, which seriously affects the quality of life and becomes a major economic burden.⁷ NP treatment continues to be a challenge,⁸ and the methods include medications and minimally invasive treatment; however, improvement was not distinct and the side effects were also accompanied.⁹ NP has garnered increasing attention of physicians and scholars worldwide, and several studies have been performed on the treatment of NP, such as a vesicular ATP release inhibitor,¹⁰ botulinum toxin A,¹¹ silencing of the TNF-alpha expression,¹² and optogenetics.¹³ However, evidence-based knowledge is lacking regarding the clinical efficacy of these

methods. Therefore, based on the complex pathogenesis of NP, an effective therapy has not been developed, and investigating a new and effective treatment is also an important concern in the field of NP.

Acupuncture, a part of Chinese medicine, is almost 3000 years old. Acupuncture has been used to treat various diseases and is one of the most commonly used complementary and alternative therapy, especially showing remarkable advantages in relieving various types of pain.¹⁴ J Bossy elucidated the mechanism underlying acupuncture nerve analgesia as early as 1979, and he proposed that acupuncture has opened new avenues in the field of pain control and theoretical study for NP.¹⁵ Subsequently, the analgesic mechanism of acupuncture is hot-spot research worldwide. The acupuncture analgesia is thought to be multifactorial, including a variety of bioactive substances and signaling pathways in the peripheral, spinal, and supraspinal mechanisms.¹⁶ Acupuncture has been increasingly used in pain management.¹⁷ Studies have shown that acupuncture has been widely accepted as a treatment in the USA, although reliable evidence is still lacking. It is still an acceptable alternative therapy for NP diseases such as headaches, carpal tunnel syndrome, and post-stroke pain.¹⁸ A frequentist network meta-analysis showed that 7 different acupuncture methods can effectively relieve peripheral NP.¹⁹ The diagnosis and treatment guidelines for low back pain formulated by the American Medical Association and the American Pain Society indicated that acupuncture can be used to treat sciatic nerve-induced low back pain, which is of medium quality evidence.²⁰ Acupuncture has been widely used for the treatment of NP as an alternative therapy.²¹ While substantial research has shown acupuncture to be an effective therapy for NP, there is still a lack of literature visualization research by bibliometric methods.

Knowledge mapping is a graphical visualization of knowledge resources and their associations. It can draw, dig, analyze, and display the interaction among knowledge, create an environment for knowledge sharing, and achieve the purpose of promoting knowledge exchange and in-depth research. It integrates the connotation of sociology of science and scientometrics, shows the hidden structures in scientific literature, and provides a different perspective to reveal the structure of the science frontier. Citespace is an information visualization software developed by Chen Meichao, a Chinese American scholar, for measuring and analyzing scientific literature data.²² VOSviewer is a scientific mapping tool developed by Van Eck and Waltman from the Research Center for Science and Technology of Langton University in the Netherlands.²³ In this study, we aimed to systematically investigate the trend, research hotspots, and future development direction of acupuncture for NP by bibliometric analysis.

Methods

Literature Sources and Search Methods

The articles reviewed in this paper were sourced from the core collection of the Library of Web of Science. An advanced search was adopted using the search formula: TS = (acupuncture OR acupuncture-moxibustion OR acupuncture therapy OR needle moxibustion OR acupuncture treatment OR manual acupuncture OR moxi-acupuncture OR acumoxi) AND TS = (sensorineural OR nervosa OR neurotropism OR neurogenic OR neurologic OR neural OR neuropathic OR neurologic OR nerve OR nervepalsy OR nerval OR nervi OR nervonic OR nerve root OR nerves) AND TS = (pain OR painful OR ache OR pains OR related pain OR analgesia OR irritation OR sore). The search period was set from January 1, 2002 to December 31, 2021; the language type was set to English; the document type was set to Article or Comment. Using the above-mentioned formula, the articles were exported together with the full records including titles, authors, abstracts, and cited references in the TXT format, excluding the duplicate literature.

Analysis Software

VOSviewer is one of the numerous scientific knowledge graph software, which can depict the relationship among knowledge-domain structure, evolution, and cooperation through building a relationship of “network data” (mainly including literature knowledge units) and visual analysis and implementing the mapping of scientific knowledge. It is characterized by a strong graphical representation ability and is suited to large-scale data. Citespace is a software that identifies and displays new trends and emerging dynamics in the scientific literature. This software not only facilitates resolving the past research track but also provides a general understanding of the future research prospect. Centrality analysis was applied to reveal the strength of the partnership, and the strongest burst analysis was applied to show research topics in a certain period. VOSviewer (version 1.6.18) and citespace (6.1.r2) were used in this study to conduct a visual analysis of authors, institutions, countries, keywords, journals, and co-cited literature. [Figure 1](#) displays the specific analysis process adopted in this study.

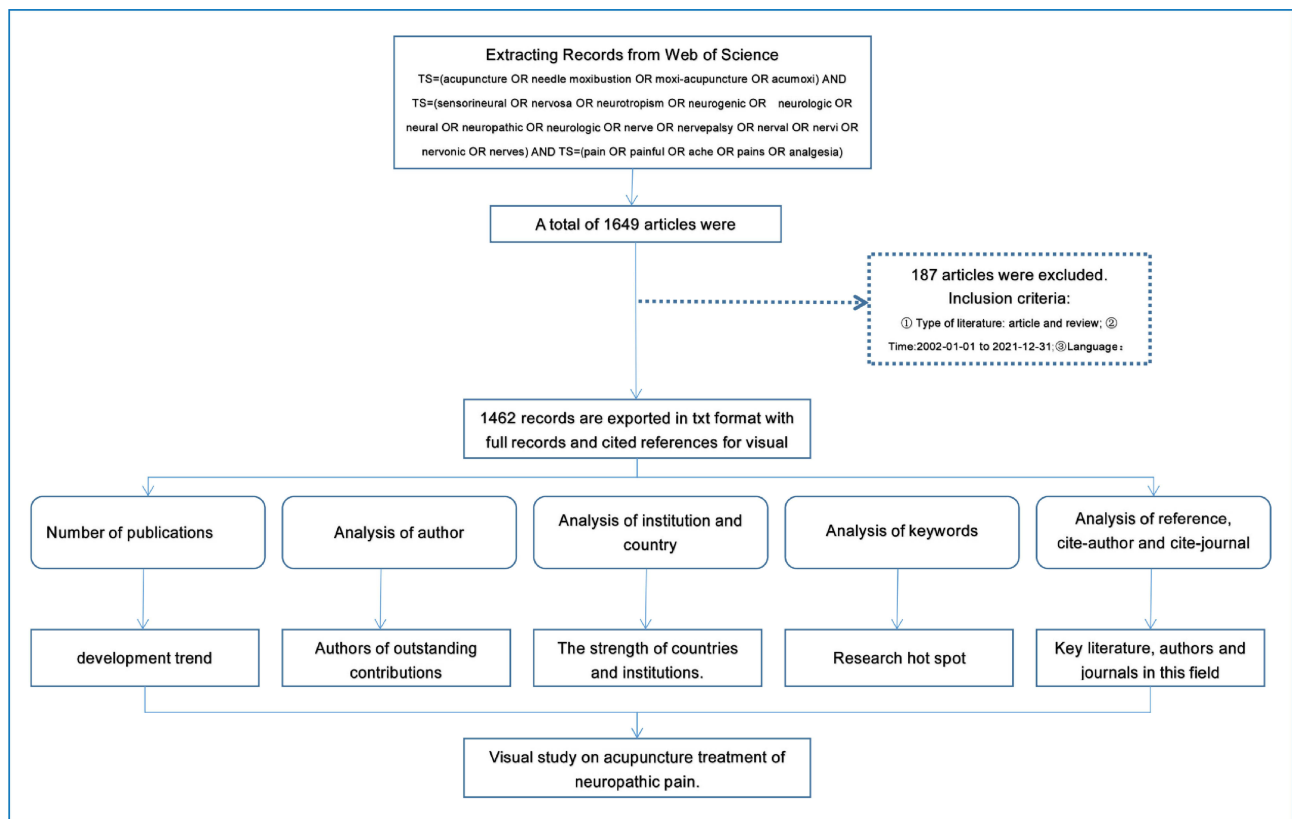


Figure 1 Analysis flow chart of acupuncture for neuropathic pain.

Results

Analysis of Annual Publications

In this study, from January 2002 to December 2021, a total of 1462 records, which included 1118 articles and 344 reviews, were included by subject term search. The annual publications are shown in Figure 2. As shown in Figure 2, annual publications have increased. Since 2017, the number of articles published annually has exceeded 100. In the year

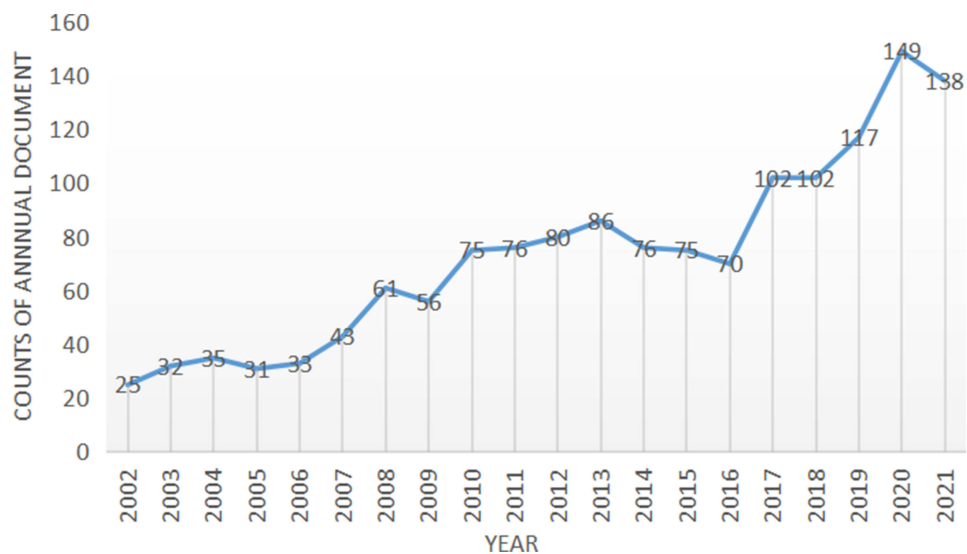


Figure 2 The annual number of publications reported from 2002 to 2021.

2020 highest number of publications, indicated that acupuncture for NP is still a hotspot of the present research, and also reflected the wide clinical application of acupuncture for NP. Continuous and in-depth research is crucial. The most frequently cited of these articles is “Diagnosis and Treatment of Low Back Pain: A joint clinical practice guideline from the American College of Physicians and the American Pain Society”. This guide points out that acupuncture is recommended for low back pain caused by sciatic nerve and has significant clinical efficacy.²⁰

Analysis of Authors and Co-Cited-Authors

A total of 6321 authors contributed to 1462 articles. The top 10 authors are listed in Table 1, and 105 authors who contributed ≥ 5 articles were selected for visual analysis (shown in Figure 3). Among them, Chingliang Hsieh was the most effective author. He studied the therapeutic effects of different acupuncture types on NP, such as auricular points,²⁴ electroacupuncture,²⁵ and bee venom.²⁶ He also elucidated the mechanism underlying acupuncture for NP from different perspectives, such as signal pathway,^{27,28} neuroendocrine, and central sensitization.^{29,30} As shown in Figures 3A and B, the authors are closely associated, and Liang Fanrong, Liu Lu, and He Wei are the most active authors in recent years. Figure 3D shows the two teams with Tian Jie and Kong Jian as the core that co-operates most closely. Tian Jie mainly studied the mechanism of acupuncture analgesia from imaging omics and published 15 relevant papers, which were cited 564 times.^{31,32} Kong Jian mainly studied the analgesic mechanism of acupuncture based on neuroimaging technology compared with placebo acupuncture and published 17 related papers, which have been cited 998 times.^{33,34} Liang Fanrong, Zeng Fang, and Kong Jian have discovered a neural marker for migraine without aura, which is based on fMRI technology and can correlate disease patterns with brain changes.³⁵ Liang Fanrong, Zeng Fang, and Tian Jie provided initial evidence for the anatomical alterations in acupuncturists, which would possibly be neural correlates underlying the exceptional skills of acupuncturists.³⁶ We found that acupuncture-neuroimaging is a research hotspot. The most prominent authors are shown in Figure 3C. The top three authors with the strongest citation bursts are Yang J (2014–2017), Lee H (2006–2012), and Wang Y (2018–2021). Wang Y is likely to continue to produce in this field in the future.

A total of 33,269 co-cited authors were included in the analysis, and the authors cited more than 50 times were visually analyzed, as shown in Figure 4A. Table 2 lists the top 10 authors in citation frequency and centrality, among which Han JS is the author with the highest citation frequency (585 times) and the strongest centrality (0.15). He published his first article in 1984 and showed the relationship between the mechanism of electroacupuncture analgesia and microinjection of antibodies against beta-endorphin, Enkephalin, and substance P.³⁷ The most frequently cited article by Han JS introduced that 2 Hz and 100 Hz peripheral stimulation induces the differential release of peptides from

Table 1 Top 10 Authors of Publications on Acupuncture for NP

Rank	Author	Counts	Citations	Country or Territory
1	Hsieh Chingliang	20	453	TAIWAN
2	Kong Jian	17	998	USA
3	Lao Lixing	16	809	China
4	Lin Yiwen	15	343	TAIWAN
5	Tian Jie	15	564	China
6	Johnson Marki.	14	572	UK
7	Kim Sun kwan	14	348	South Korea
8	Napadow Vitaly	13	643	USA
9	Park Hijoan	13	205	South Korea
10	Bai Lijun	11	469	China

Abbreviation: NP, neuropathic pain.

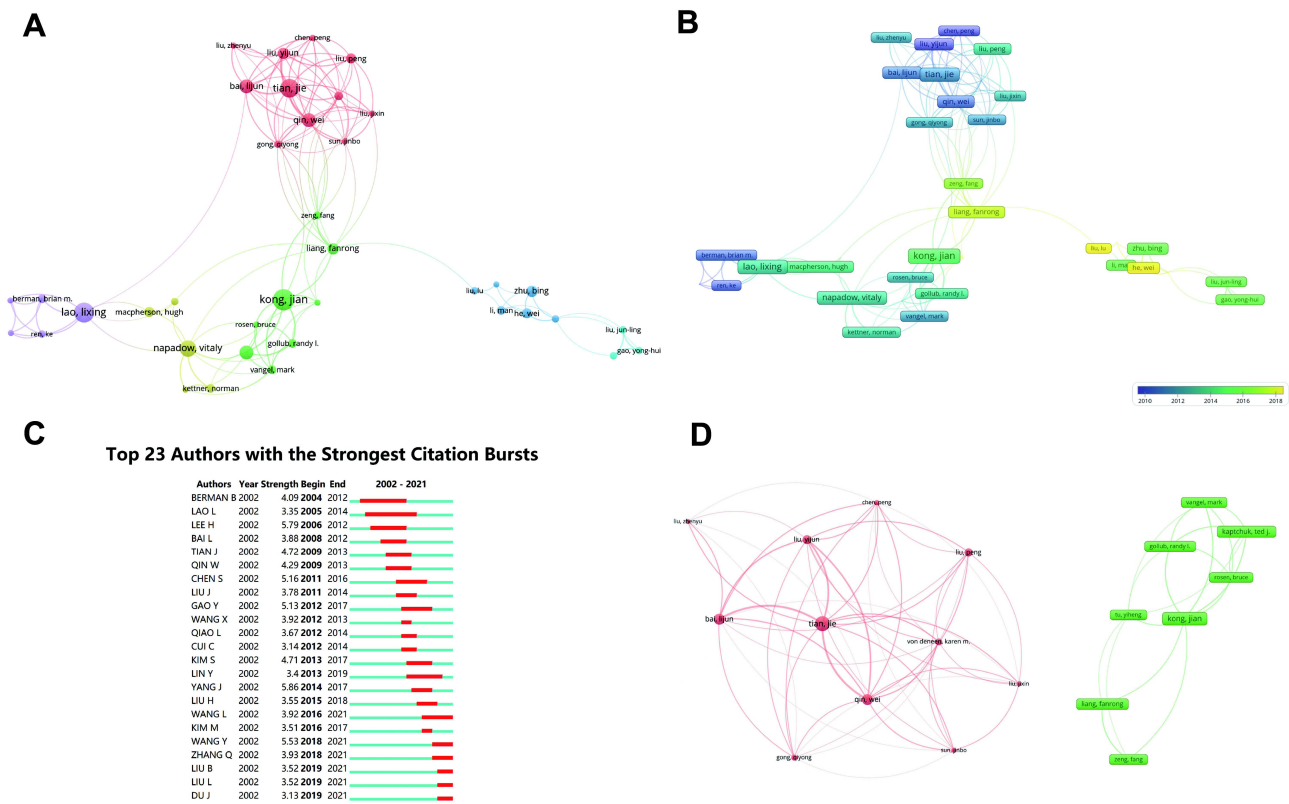


Figure 3 Co-occurrence analysis of authors. (A) Author collaborative network clustering view. (B) Author collaboration network label view. (C) Authors with the strongest citation bursts. (D) Collaboration network of some of the top authors.

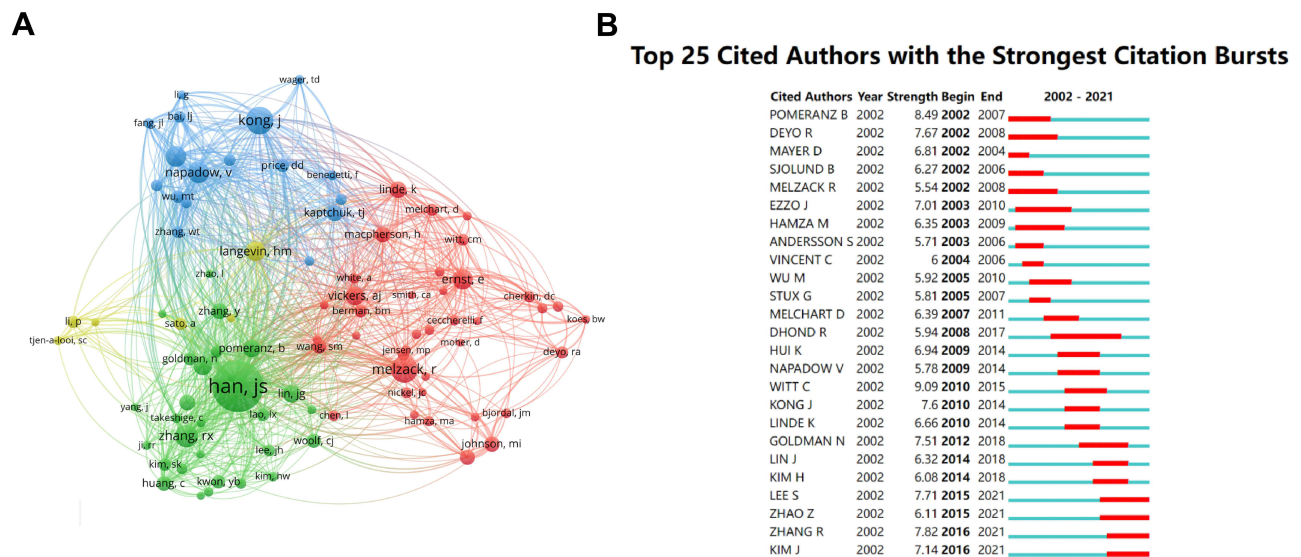


Figure 4 Analysis of the co-cited authors. (A) Co-cited authors' collaborative network clustering view. (B) Co-cited author with the strongest citation bursts.

preproenkephalin and prodynorphin, respectively for the first time.³⁸ The second co-cited author, Kong J, is also a prolific author in this field. His most frequently cited article introduces that acupuncture can play anti-analgesic, anti-anxiety, and other therapeutic effects by regulating limbic-paralimbic-neocortical network modulation.³⁹ The strongest burst co-cited authors are shown in Figure 4B. The top three co-cited authors with the strongest citation bursts are Witt

Table 2 Top 10 Co-Cited Authors of Publications on Acupuncture for NP

Rank	Co-Cited Author	Fre	Co-Cited Author	Centrality
1	Han JS	585	Han J	0.15
2	Kong J	255	Ernst E	0.14
3	Melzack R	242	Berman B	0.13
4	Zhang RX	198	Melzack R	0.09
5	Napadow V	185	Birch S	0.09
6	Hui Kks	175	Cherkin D	0.08
7	Ernst E	169	Hui K	0.07
8	Langevin HM	159	White A	0.07
9	Vickers AJ	153	Deyo R	0.07
10	Zhao ZQ	150	Kong J	0.06

Abbreviations: NP, neuropathic pain; Fre, frequency.

C (2010–2015), Pomeranz B (2002–2007), Zhang R (2016–2021). Through the above, we found that the mechanism underlying acupuncture analgesia is also a research hotspot, and many studies on the neural circuit have been performed.

Analysis of Institutions

In the last 20 years, 1762 institutions contributed 1462 articles. Visualization analysis was performed on 129 institutions with more than 5 articles published (Figure 5A). The top 10 institutions in the field of publications are shown in Figure 5C, and the top 5 institutions of centrality are shown in Figure 5D. Table 3 lists the specific information of the top 10 institutions in terms of publications and centrality. Kyung Hee Univ of South Korea ranked first, followed by China Med Univ, China Acad Chinese Med SCI and Fudan Univ, and Harvard Univ of the USA ranked fifth in the number of publications. There is a close link strength between these institutions. Univ Maryland, with the highest centrality, cooperates with 31 institutions, and Univ Calif Irvine, with the second highest centrality, cooperates with 17 institutions, which indicated that the two institutions have the highest influence. However, cooperation between other institutions should be further strengthened. The three institutions with the strongest burst are Harvard Med Sch (2016–2021), Harvard Univ (2005–2010), and Xidian Univ (2009–2013), as shown in Figure 5B.

Analysis of Countries

Authors from 63 countries or territories participated in this field, and the collaboration network is shown in Figure 6A. Countries or territories have a certain degree of cooperation, especially the USA and China, and other countries such as the United Kingdom, South Korea, Australia, and Switzerland also have close cooperation in this field. The top 10 countries or territories in terms of publications and centrality are shown in Table 4. China is the country with the largest number of articles published, which is closely related to the origin of acupuncture in China, followed by the USA with 430 articles published, which indicates that the USA also pays immense attention to acupuncture (Figure 6C). Norway, England, and France are the top three countries for centrality (Figure 6D). Sweden (2002–2008), Japan (2008–2010), and India (2018–2021) are the strongest burst countries (Figure 6B). Based on the above analysis, we found that China ranked first in the number of publications. However, its centrality did not enter the top ten, indicating that the international influence of China needs to be further improved.

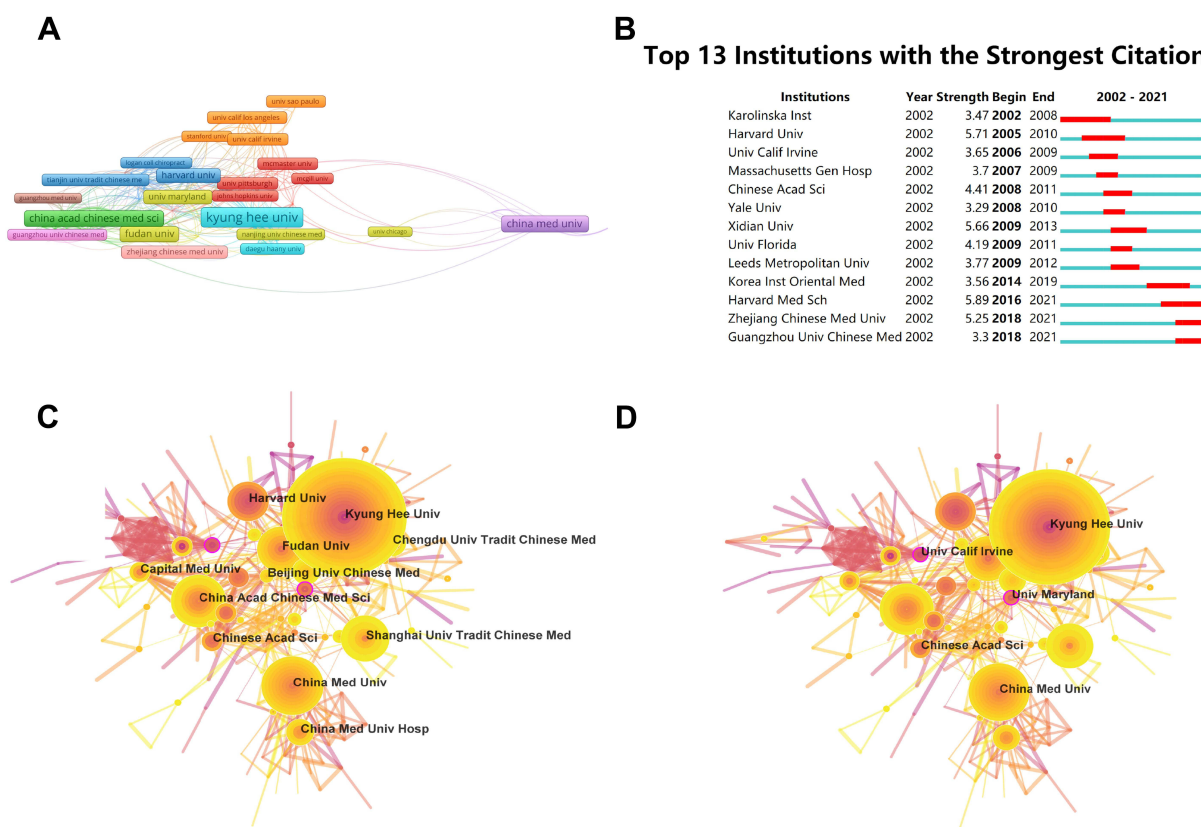


Figure 5 Co-occurrence analysis of institutions. (A) Institutions’ collaborative network clustering view. (B) Co-cited institutions with the strongest citation bursts. (C) Top 10 institutions with publications. (D) Top 5 institutions with centrality.

Analysis of Journals and Co-Cited Journals

A total of 532 journals contributed to 1462 articles, among which 68 journals published more than 5 articles that were visually analyzed, as shown in Figure 7A. Evidence-based Complementary and Alternative Medicine was the most productive journal, with 89 papers published, followed by Acupuncture in Medicine (Table 5).

Table 3 Top 10 Institutions of Publications and Centrality on Acupuncture for NP

Rank	Fre	Institutions	Country	Centrality	Institutions	Country
1	88	Kyung Hee University	South Korea	0.12	University of Maryland	USA
2	51	China Med Univ	China	0.11	Univ Calif Irvine	USA
3	47	China Acad Chinese Med Sci	China	0.08	Kyung Hee Univ	South Korea
4	43	Fudan University	China	0.08	Chinese Acad Sci	China
5	34	Harvard University	USA	0.07	China Med Univ	China
6	34	Shanghai Univ Tradit Chinese Med	China	0.06	Harvard Univ	USA
7	31	China Med Univ Hosp	China	0.05	Massachusetts Gen Hosp	USA
8	28	Chinese Acad Sci	China	0.04	China Acad Chinese Med Sci	China
9	28	Univ Maryland	USA	0.04	Fudan Univ	China
10	26	Chengdu Univ Tradit Chinese Med	China	0.04	Chengdu Univ Tradit Chinese Med	China

Abbreviations: NP, neuropathic pain; Fre, frequency.

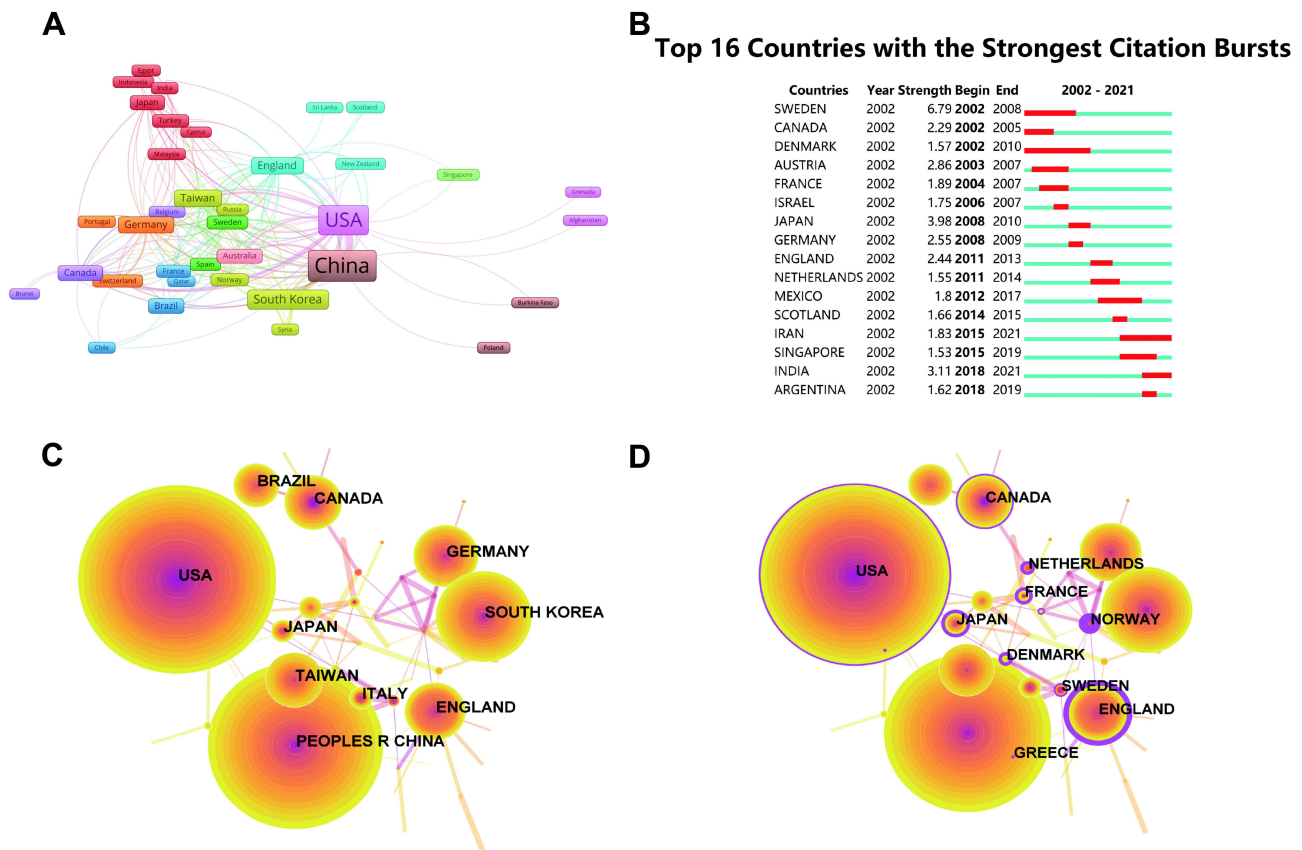


Figure 6 Co-occurrence analysis of countries or territories. (A) Countries or territories collaborative network clustering view. (B) Co-cited countries or territories with the strongest citation bursts. (C) Top 10 countries or territories with publications. (D) Top 10 countries or territories with centrality.

As shown in Figure 7B, visual analysis was performed on co-cited journals that were cited more than 30 times. Pain (4200 times) was cited the most frequently, which was related to the topic of pain in our study, followed by Brain Research (1273 times), which was related to the topic of NP (Table 5).

Table 4 Top 10 Countries or Territories of Publications and Centrality on Acupuncture for NP

Rank	Counts	Country or Territory	Centrality	Country or Territory
1	480	China	0.85	Norway
2	430	USA	0.48	England
3	141	South Korea	0.31	France
4	91	England	0.31	Netherlands
5	91	TAIWAN	0.27	Denmark
6	80	Germany	0.27	Japan
7	65	Canada	0.22	USA
8	55	Brazil	0.17	Canada
9	50	Japan	0.16	Sweden
10	39	Italy	0.14	Greece

Abbreviation: NP, neuropathic pain.

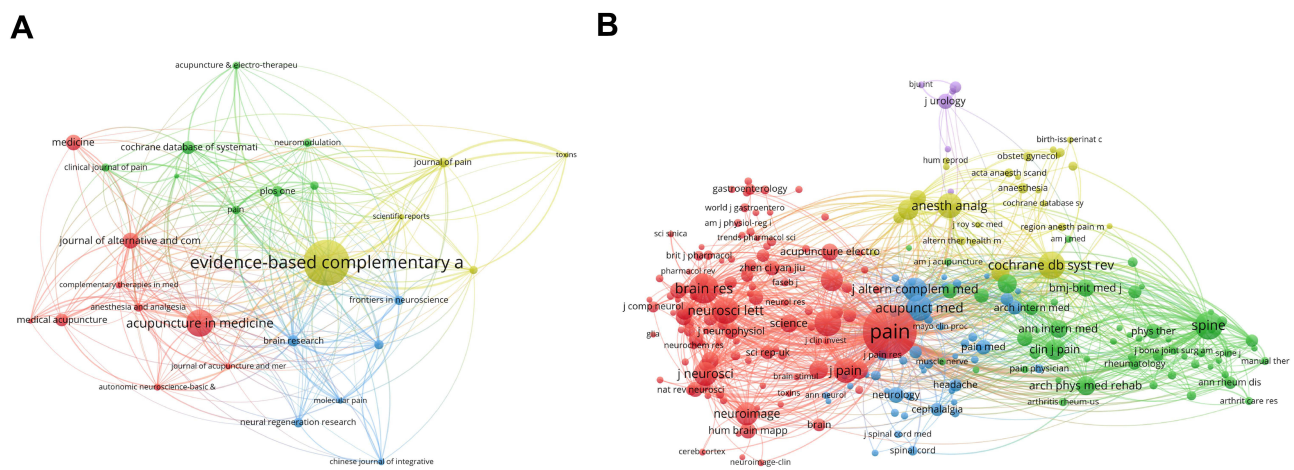


Figure 7 Analysis of journals and co-cited journals. (A) Top 10 journal with publications. (B) Top 10 co-cited journals with centrality.

Analysis of Co-Cited References

The visual analysis of 49,838 references cited more than 30 times is shown in Figure 8A, and the top 10 cited references are listed in Table 6. Among the ten articles, four are reviews, and six are research articles, which are mainly about the evidence of the clinical application of acupuncture and the mechanism of acupuncture analgesia. Among them, “The Acupuncture” (IF: 56.274) was published in JAMA in 1998. This article mainly provides evidence for the clinical application of acupuncture via the systematic evaluation of 2307 studies from January 1970 to October 1997. The article highlights that acupuncture, an alternative therapy, can be used as an adjunct treatment option or an acceptable alternative in conditions including stroke rehabilitation, headache, and carpal tunnel syndrome.¹⁸ The most frequently cited article by Jisheng Han in *TRENDS in Neurosciences*⁴⁰ presents a new idea: The mechanism of analgesic action generated by different frequencies of electroacupuncture may be realized by promoting the release of certain neuropeptides in the central nervous system. This paper was also the most explosive article from 2004 to 2008 (strength: 8.83), indicating that it might be the research hotspot at that time (Figure 8B). Zhang Ruixin,¹⁶ Jisheng Han,⁴¹ George A Ulett,⁴² and Zhiqi Zhao⁴³ revealed the mechanism of electroacupuncture from different perspectives. Thus, electroacupuncture is the most important intervention for the treatment of pain conditions in acupuncture practice, and the mechanism of electroacupuncture has attracted the attention of scholars worldwide. Nanna Goldman is one of the top ten cited references and the second burst reference (2011–2014).⁴⁴ This article reveals that adenosine mediates the effects of acupuncture,

Table 5 Top 5 Journals and Co-Cited-Journals of Publications on Acupuncture for NP

Rank	Journal	Counts	IF	Co-Cited-Journal	Counts	IF
1	Evidence-based Complementary and Alternative Medicine	89	2.65	Pain	4200	7.926
2	Acupuncture in Medicine	53	1.976	Brain Res	1273	3.61
3	Journal of Alternative and Complementary Medicine	31	2.381	Spine	1129	3.241
4	Medicine	30	1.644	Cochrane Db Syst Rev	1068	3.225
5	Cochrane Database of Systematic Reviews	26	12.008	Neurosci Lett	1056	3.197

Abbreviations: NP, neuropathic pain; IF, Impact Factor.

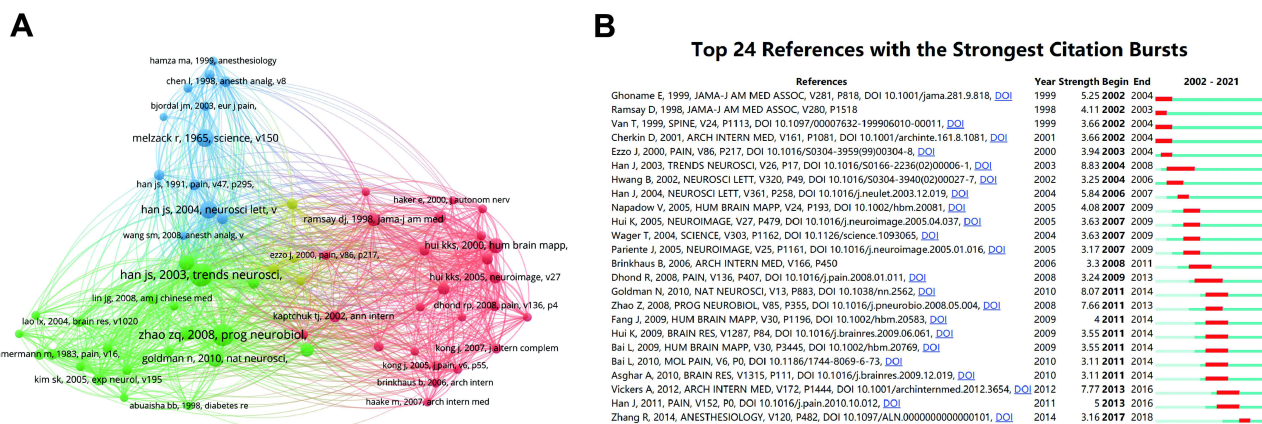


Figure 8 Analysis of co-cited references. (A) Network of co-cited references. (B) Co-cited references with the strongest citation bursts.

and interfering with adenosine metabolism may prolong the clinical benefit of acupuncture. It showed that the mechanism of acupuncture analgesia around adenosine was the research hotspot at that time. Vickers Andrew concluded acupuncture is an effective method for treating chronic pain via a systematic review, indicating that acupuncture is not only a placebo.⁴⁵ Hui revealed from the perspective of fMRI that the regulation of subcortical structure might be an essential mechanism for acupuncture to play its complex multi-system role,⁴⁶ and acupuncture-fMRI is also a research hotspot.⁴⁷

Analysis of Keywords

Keywords can reflect hotspots and research directions in the research field to a certain extent. Table 7 lists the specific information of the top ten keywords in frequency and centrality. Figure 9A shows the top ten keywords in frequency, among which “acupuncture” (frequency = 421) and “NP” (277) have the highest frequency, indicating

Table 6 Top 10 Co-Cited References Related to on Acupuncture for NP

Rank	Counts	Title	Investigator (Year)	Journal	IF
1	153	Acupuncture: neuropeptide release produced by electrical stimulation of different frequencies	Jisheng Han (2003) ⁴⁰	Trends in Neuroscience	7.801
2	145	Neural mechanism underlying acupuncture analgesia	Zhiqi Zhao (2008) ⁴³	Progress in Neurobiology	10.984
3	103	Pain Mechanisms - a new theory	Melzac R (1965) ⁴⁸	Science	47.728
4	99	Acupuncture and endorphins	Jisheng Han (2004) ⁴¹	Neuro Science Letters	3.046
5	91	Adenosine A1 receptors mediate local anti-nociceptive effects of acupuncture	Nanna Goldman (2010) ⁴⁴	Nature Neuroscience	24.884

(Continued)

Table 6 (Continued).

Rank	Counts	Title	Investigator (Year)	Journal	IF
6	82	Electroacupuncture: Mechanisms and Clinical Application	George A Ulett (1998) ⁴²	Biological Psychiatry	13.382
7	78	Acupuncture modulates the limbic system and subcortical gray structures of the human brain: Evidence from fMRI studies in normal subjects	Hui KKS (2000) ⁴⁶	Human Brain Figureping	5.038
8	73	Mechanisms of Acupuncture-Electroacupuncture on Persistent Pain	Zhang Ruixin (2014) ¹⁶	Anesthesiology	7.892
9	66	Acupuncture	Ramsay DJ (1998) ¹⁸	JAMA	56.274
10	64	Acupuncture for Chronic Pain Individual Patient Data Meta-analysis	Vickers Andrew J (2012) ⁴⁵	Journal of Pain	5.383

Abbreviations: NP, neuropathic pain; IF, Impact Factor.

Table 7 Top 10 Keywords of Publications and Centrality on Acupuncture for NP

Rank	Keywords	Fre	Keywords	Centrality
1	Acupuncture	421	Acupuncture analgesia	0.13
2	Neuropathic	277	Electrical stimulation	0.13
3	Pain	264	Acupuncture treatment	0.13
4	Electroacupuncture	213	Antinociception	0.13
5	Rat model	204	Inflammation	0.12
6	Chronic spinal pain	176	Acupuncture stimulation	0.12
7	Electrical nerve stimulation	162	Alternative therapy	0.12
8	Stimulation	159	Alternative medicine	0.11
9	Mechanism	153	Acupoint stimulation	0.11
10	Management	147	Auricular acupuncture	0.1

Abbreviations: NP, neuropathic pain; Fre, frequency.

that acupuncture for NP has always been a research hotspot worldwide. Moreover, “frequency of pain”, “electroacupuncture”, and “rat model” all exceeded 200 times, indicating that the research type of acupuncture was mainly electroacupuncture, and rat model is the most commonly used animal carrier for mechanism research. **Figure 9B** shows the top ten keywords in centrality. Among them, “acupuncture analgesia”, “electrical stimulation”, “acupuncture treatment”, and “antinociception” (centrality = 0.13, for all four) were the most central keywords. The keywords cluster map consisted of 20 clusters with $Q = 0.8074$ and $S = 0.879$. **Figure 9C** shows the top ten largest keyword-term cluster views: 0# electrical nerve stimulation, 1# transcutaneous electrical nerve stimulation, 2# physical therapy, 3# acupuncture, 4# spinal cord, 5# acupuncture therapy, 6# osteoarthritis, 7#



Figure 9 Co-occurrence analysis of the keywords. (A) Top 10 keywords for co-occurrence counts. (B) Top 10 keywords for centrality. (C) Cluster map of keywords. (D) Keywords with the strongest citation bursts.

bee venom, 8# NP, and 9# analgesia. The modules closely related to acupuncture for NP are as follows: ①The largest cluster (#0) has 47 members and a silhouette value of 0.762. Hu and Xiaoyang evaluated the clinical efficacy of acupuncture or percutaneous electrical nerve stimulation for treating phantom pain via a retrospective study and found that acupuncture could improve phantom pain compared with conventional nursing; however, the study lacked high-quality evidence, which would be a direction of future research to select reliable evidence for acupuncture or percutaneous electrical nerve stimulation for treating NP.⁴⁹ Zhu and Jinmin reported in a systematic review that a neural-mediated model is a biological mechanism of acupuncture signal transmission in the body and an important way to mediate the therapeutic effect of acupuncture.⁵⁰ However, further clinical evidence is needed to validate the results. ②The 4th largest cluster (#3) has 37 members and a silhouette value of 0.828. Penza and Paola found no difference in pain intensity improvement between patients who received electroacupuncture and sham electroacupuncture.^{51,52} However, Ali U proposed that electroacupuncture stimulation can release endogenous opioid peptides and cause analgesia in various pain models, which can be used as an alternative therapy to control the opioid crisis.⁵²

Therefore, whether electroacupuncture is effective for chronic NP requires in-depth validation and the analysis of large-sample randomized controlled clinical studies to provide reliable evidence. ③The 9th largest cluster (#8) has 31 members and a silhouette value of 0.882. Huang C further explained the relationship between the mechanism of electroacupuncture therapy for NP and mu-opioid agonists and N-methyl-D-Aspartate receptor

antagonists.⁵³ The 10th largest cluster (#9) has 31 members and a silhouette value of 0.926. Li, Si-Si reported that chronic constriction injury was associated with the kCC2-GABA_A pathway in rats.⁵⁴ By analyzing the above keywords, we found that the analgesic mechanism of electroacupuncture for NP is a research hotspot, and the therapeutic effect of acupuncture on NP needs more reliable evidence. “Electrical nerve stimulation” (2003–2008), “human brain” (2007–2010), and “systematic review” (2019–2021) were the strongest burst keywords (Figure 9D).

Discussion

Citespace and VOSviewer were used to visually analyze the articles on acupuncture for NP from 2002 to 2021. We found that the annual output of acupuncture in treating NP was increasing, and it has been included in the guidelines for various painful diseases. For example, electroacupuncture combined with filiform needle and filiform needle therapy combined with TDP lamp irradiation therapy for patients with cervical spondylotic radiculopathy is recommended [GRADE IC], and warming-needle moxibustion and heat-sensitive moxibustion are also recommended [GRADE 2C].⁵⁵ The 2017 ACP Clinical Practice guidelines proposed acupuncture as one of the treatment methods for acute low back pain and one of the preferred treatment options for chronic low back pain.⁵⁶ Bloodletting and fire needle therapy are recommended for herpes zoster [GRADE Ib].⁵⁷ The clinical efficacy of acupuncture has also been confirmed in treating stroke survivors with shoulder pain.⁵⁸ In terms of peripheral NP, warm acupuncture, fire needles, and moxibustion are the most effective treatment methods, which are superior to drugs and more cost-effective.¹⁹ Acupuncture has been widely accepted and recommended for treating cancer pain, although the evidence for its effectiveness in relieving cancer pain is weak.⁵⁹ Although we have seen a gradual increase in the recommendation of acupuncture in clinical treatment guidelines, the evidence is still relatively scarce. Therefore, excavating and updating the evidence is necessary for providing the best evidence to support the mentioned guidelines.

In the country-wise analysis, we found that all countries agree with the importance of this field, led by the USA and China, followed by South Korea, the United Kingdom, Japan, and Taiwan. Countries have closely cooperated in the progress of this field; however, China, as the birthplace of acupuncture, has a poor contribution. Thus, strengthening cooperation with other countries is necessary, which is crucial to promote the modernization and internationalization of acupuncture.

By analyzing authors and co-cited authors, we found that Kong Jian, an American Scholar of Chinese origin, is a comprehensive and in-depth schola in this field. Tian Jie and Liang Fanrong from China have also contributed to the field, and the three authors have cooperated closely. In the analysis of institutions, we observed that institutions in the USA and China are the prominent institutions for research on acupuncture. With the largest output in this field, China and the USA will strongly promote acupuncture internationalization.

In an analysis of 532 journals, Evidence-based Complementary and Alternative Medicine, Acupuncture in Medicine, and Journal of Alternative and Therapy Complementary Medicine received 12% of the articles in this area, which is relevant to the present research topic. Pain was the most cited journal in the co-cited journal analysis, which was relevant to the research topic NP. This helps choose journals in related research fields.

By analyzing keywords and references, we found that electroacupuncture, bee venom, and percutaneous electrical stimulation were the most commonly studied types of acupuncture in the field of acupuncture for NP, and osteoarthritis, low back pain, headache, cancerous pain, chronic spinal pain, carpal tunnel syndrome, and herpes zoster disease were the most common diseases. Current research is focused on the analgesic mechanism of acupuncture. The clinical evidence of acupuncture in treating various NPs needs further exploration.

Following are the three main findings regarding recent emerging trends in acupuncture for NP according to keywords burst:

1. Chemotherapy-induced peripheral neuropathy (CIPN): CIPN is a neurotoxic lesion resulting from the toxic effects of chemotherapy, predominantly affecting the peripheral nervous system.⁶⁰ American Society of Clinical Oncology guidelines states that acupuncture can be used to treat CIPN.⁶¹ A systemic review and meta-analysis showed a promising result that acupuncture could effectively improve pain and the quality of life in patients with CIPN.⁶² However, it did not show satisfactory results in preventing CIPN.⁶³ Therefore, additional high-quality

- randomized controlled studies are needed in the future to further verify the efficacy and safety of acupuncture in CIPN treatment. Further studies investigating the mechanism of acupuncture for CIPN are also needed.
2. Prevention: As an essential part of traditional Chinese medicine, acupuncture plays a major role in preventing diseases. Studies have shown that acupuncture can prevent several diseases including cardiac arrhythmias,⁶⁴ migraine,^{65,66} and stroke.⁶⁷ Whether it can prevent the onset of NP has also attracted the attention of scholars. A limited randomized controlled study on 63 patients with taxane-induced CIPN treated with acupuncture or sham acupuncture for 12 weeks showed no significant difference in CIPN prevention.⁶³ Another study provided preliminary evidence that acupuncture reduces CIPN incidence.⁶⁸ Therefore, randomized controlled studies with large samples are needed to clarify the role of acupuncture in preventing PN.
 3. Acupuncture therapy: As a treatment method, acupuncture mainly includes filiform needles, electroacupuncture, moxibustion, fire needles, auricular acupuncture, thread embedding acupuncture, acupoint injection, and warm acupuncture. Its clinical application is becoming popular in Western countries and is usually used to relieve musculoskeletal diseases, pain, and stress-related diseases. In this study, we found that studies on electroacupuncture have attracted the attention of scholars; however, reliable randomized controlled studies on other types of acupuncture are lacking. The lack of high-quality studies restricts acupuncture internationalization. The characteristics of acupuncture therapy lead to difficulties in clinical quality control; hence, confirming its clinical efficacy by a more specific research design is necessary.

In summary, literature metrology was adopted in this study to visually analyze the research status of acupuncture for NP in the past 20 years and to clarify its development trend, research hotspots, and future research direction preemptively, which are consistent with the current research results of acupuncture for NP.^{19,69} However, in this study, only articles from the Web of Science written in English were selected. Moreover, as China is the origin of acupuncture, Chinese records cannot be ignored. Therefore, this study has some limitations. We hope to perform a more comprehensive and in-depth study in the future.

Conclusion

In this study, bibliometrics was used to analyze the research on acupuncture for NP comprehensively, including the number of publications, authors, institutions, countries, journals, references, and keywords. The results showed that acupuncture for NP has drawn the attention of scholars internationally, and they have close cooperation between countries. Interestingly, China, as the birthplace of acupuncture, has poor centrality. To accelerate acupuncture internationalization, strengthening cooperation with other countries is essential. The mechanism of acupuncture analgesia has been the focus of research over the years; however, there is scope for developing acupuncture for treating NP. Thus, more comprehensive and in-depth clinical evidence is needed. The treatment and prevention of CIPN by acupuncture can be a future research hotspot. Additional clinical studies are needed to find evidence for other acupuncture methods besides electroacupuncture, transcutaneous electrical stimulation, and bee venom to accelerate acupuncture internationalization.

Data Sharing Statement

The data used to support the present findings are available from the corresponding author upon a reasonable request.

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Disclosure

The authors declare no conflicts of interest.

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