

A Bibliometric Analysis of Research Trends of Acupuncture Therapy in the Treatment of Migraine from 2000 to 2020

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Background: Migraine is the second-leading cause of disability worldwide. It is often characterized by attacks of severe, mostly unilateral, pulsating headache associated with symptoms such as photophobia, phonophobia, nausea, vomiting, and cutaneous allodynia. Acupuncture therapy has been used worldwide for the treatment of migraine. However, no visual bibliometric analysis has been conducted on the effects of acupuncture on migraine over the past 20 years. Therefore, this study aimed to explore the current status and trends on the use of acupuncture in the treatment of migraine from 2000 to 2020.

Purpose: The objective of this study is to identify the current status and emerging trends of the global use of acupuncture on migraine from 2000 to 2020 using CiteSpace and VOSviewer.

Methods: Web of Science databases were searched for publications related to acupuncture therapy for treating migraine between 2000 and 2020. CiteSpace and VOSviewer were used to analyze the number of publications per year, countries, institutions, authors, journals, references, and keywords.

Results: A total of 572 publications were included in the final analysis. The total number of publications has continued to increase with some fluctuations over the past 20 years. The most productive country and institution in this field were the USA, and Chengdu University of Traditional Chinese Medicine, respectively. The most active and cited authors were Liang FR and Linde K, respectively. *Cephalalgia* was the most productive, cited, and co-cited journal. The Linde K (2005) had the highest co-citation, citation number and centrality. The keywords "migraine" ranked first in frequency. The common type of migraine (tension-type headache), research method (randomized controlled trial, multicenter, double-blind), acupuncture's role (prophylactic, quality of life, pain), and evaluation (meta-analysis, systematic review) were the hotspots and frontier trends of acupuncture therapy on migraine between 2000 and 2020.

Conclusion: The present study examined the research-related trend in acupuncture therapy on migraine using bibliometric methods and identified the statement and research frontiers over the past two decades. This may help researchers to identify potential hotspots and new directions for future research in this field.

Keywords: acupuncture, migraine, bibliometric analysis, CiteSpace, VOSviewer, network

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Introduction

Migraine is characterized by attacks of throbbing, often unilateral, severe and pulsating headache, and associated with symptoms such as phonophobia, photophobia, vomiting, nausea, and cutaneous allodynia.¹⁻³ As the second leading cause of disability

worldwide,^{4,5} migraine significantly contribute to individual and societal burdens due to severe pain and environmental sensitivities.⁶⁻⁸ Epidemiological studies have shown a higher prevalence of migraine in recent years.^{5,9,10} The pharmacological treatment of migraine includes prophylaxis aimed at reducing the frequency, duration, and severity of migraine attacks, and acute therapy used to relieve pain at the acute stage.¹¹⁻¹³ Several drugs, such as propranolol, metoprolol, flunarizine, valproic acid, topiramate, and divalproex sodium, have been shown to reduce the frequency of migraine attacks.¹⁴⁻¹⁶ However, an obvious risk of adverse effects associated with oral administration is reported, such as weight gain, fatigue, sleep disorders, liver damage, metabolic disorders, and gastrointestinal reactions.^{17,18}

Acupuncture therapy is a widely used treatment to effectively manage migraines, with potential effect.¹⁹⁻²¹ Numerous studies have shown beneficial effects of acupuncture, including pain relief,²² improved quality of life (QoL),²³ reduce anxiety,²⁴ reduce depression,²⁵ and improved brain function.²⁶ Evidence-based multicenter randomized controlled trials (RCT) have suggested that real acupuncture (TA) greatly reduces pain reduction compared with sham acupuncture (SA) and improves the QoL and emotional function.^{8,22} Acupuncture was reported to modulate abnormal brainstem activity in patients with migraine by Li et al, indicating that TA and SA modulate different effects of low-frequency fluctuations of the rostral ventromedial medulla and trigeminocervical complex.²⁷

Bibliometrics refers to a quantitative tool for analysis of published scientific literature. The relationship between a research statement and emerging research frontiers is identified through co-occurrence, citation, and co-citation.²⁸ Recently, several global bibliometric analyses of general status and research trends in acupuncture therapy for pain, cancer, low back pain, insomnia have been conducted using CiteSpace and VOSviewer.²⁹⁻³² However, to the best of our knowledge, a bibliometric analysis of the use of acupuncture for migraine has not yet been performed.

Therefore, the objective of the present study is to evaluate important research trends of acupuncture on migraine, based on the co-occurrence network of countries, institutions, authors, journals, references, and keywords over the past 20 years through bibliometric analysis. The global use of acupuncture on migraine will be explored using CiteSpace and VOSviewer.

Methods

Publications were obtained from the Web of Science (WoS) database via the Nanjing University of Chinese Medicine Library website (Science Citation Index Expanded (SCI-Expanded), Social Sciences Citation Index (SSCI), Arts & Humanities Citation Index (A&HCI), Conference Proceedings Citation Index-Science (CPCI-S), Conference Proceedings Citation Index-Social Sciences & Humanities (CPCI-SSH), Book Citation Index-Science (BKCI-S), Book Citation Index Social Science & Humanities (BKCI-SSH), and Emerging Sources Citation Index (ESCI)). The data search strategy included the topic “migraine” and “acupuncture therapy”, and the publication period of the literature ranged from January 1, 2000, to December 31, 2020. The search was not restricted to the category, language or document type. Two authors independently searched the references. Any differences were resolved by LX Pei and JH Sun, and a total of 572 references were identified (Table 1). We analyzed the document using CiteSpace software, and the results showed that there was no duplicate publication.

Analysis Tool

The intrinsic function of the WoS database was used to analyse publication features, including publication outputs, countries, institutions, authors, and journals. CiteSpace 5.7.R 5 was used to explore the co-occurrence relationships of countries, institutions, authors and keywords, and the co-

Table 1 Search Queries

Set	Result	Search Query
#1	27,451	Acupuncture Therapy OR Acupuncture Treatment OR Pharmacopuncture Treatment OR Acupotomy OR electroacupuncture OR electroacupuncture OR Acupuncture OR body acupuncture OR Manual Acupuncture OR auricular OR Auricular Acupuncture OR auricular needle OR acupuncture point OR Ear Acupuncture OR Warm Acupuncture OR Moxibustion OR Moxibustion OR acupoint injection OR catgut embedding OR catgut implantation at acupoint OR embedding thread
#2	39,507	Migraine Disorders OR migraine OR Migraine Headache OR Migraine Disorder OR Acute Confusional Migraine OR Status Migrainosus OR Hemicrania Migraine OR Migraine Variant OR Sick Headache OR Abdominal Migraine OR Cervical Migraine Syndrome
#3	572	#1 AND #2

citation relationships of authors, journals and references. All documents were downloaded as a.txt and windows UTF-8 file, and imported into CiteSpace and VOSviewer, respectively.

CiteSpace, an excellent scientific econometric analysis software invented by professor Chaomei Chen, and a professional tool used to analyze research literature.^{33,34} The parameters of CiteSpace were set as follows: (1) timespan (2000–2020), years per slice; (2) one node type was selected at a time; (3) selection criteria top 50 objects; (4) pathfinder and pruning sliced networks; (5) look back years (LBV = 8); (6) link retaining factor (LRF = 2); (7) percentage of nodes to label (PNL=5%); (8) maximum links per node (MLPN = 10); (9) e for top N (e = 2). The VOSviewer software was invented by van EckNJ, who worked at Leiden University.^{35,36} The co-occurrence knowledge maps of countries, institutions, authors, journals, keywords, and citation networks of countries, institutions, journals, references were analyzed.

A node represents an element such as country, institution, author, journal, reference, and keyword. A larger width of links between nodes represents stronger cooperation, while a larger size of the node indicates a high number of publications. Nodes with high centrality mean a turning point or pivotal point related to this field,^{37,38} and is represented by purple color.³⁹

Results

Annual Publication and Trends

The number of publications in WoS on acupuncture in migraine has increased from 2000 to 2020, even though there have been some fluctuations (Figure 1A). The model fitting curves of growth was used to predict the publications trend (Figure 1B), and the rate of publication outputs was predicted to increase in the future.

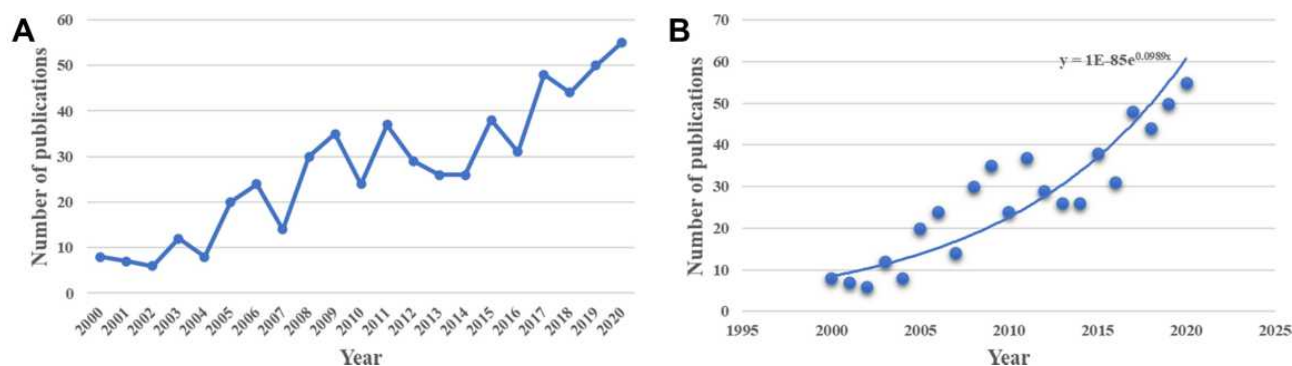


Figure 1 (A). The annual number of publications related to acupuncture on migraine. (B). Model fitting curves of growth trends and prediction of publications numbers in the future.

Analysis of Document Type

Eight document types were identified in 572 documents (Table 2). Articles (377) were the most frequently used document type, accounting for 65.91% of the total publications, and they were followed by reviews (113, 19.76%). “Acupuncture for patients with migraine-A randomized controlled trial” was the most cited article, with 386 citations.³ The most cited review was “Revised standards for reporting interventions in clinical trials of acupuncture (STRICTA): extending the consort statement”.⁴⁰

Distribution of Countries

The co-occurrence analysis of countries and regions in this field was performed using CiteSpace. The merged network comprised 44 nodes and 93 links (Figure 2A), indicating that 44 countries participated in acupuncture research on migraine. As a result, the USA (160) had the most publications, followed by China (148), Germany (103), England (49), and Italy (35). Considering the country centrality, the USA (0.36) ranked first among the countries, followed by Germany (0.13), Switzerland (0.13), China (0.10), and England (0.08). In addition, the overlay, density, and citation visualization of countries were constructed using VOSviewer (Figure 2B–D). Germany had the highest number of citations (3675), followed by the USA (3552), England (2544), China (2190), and Switzerland (1639; Table 3).

Distribution of Institution

CiteSpace was used to estimate the 405 institutions that made significant contributions in this field. Among the 405 nodes and 617 links, Chengdu University of Traditional Chinese Medicine (40) ranked first for publications, followed by Harvard University (33), and Technical University Munich (30). With respect to centrality, the top 3 institutions were

Table 2 Document Types Related to Acupuncture on Migraine

Ranking	Type	Counts (%)
1	Article	377(65.91%)
2	Review	113(19.76%)
3	Editorial Material	35(6.11%)
4	Proceedings Paper	8(1.40%)
5	Meeting Abstract	20(3.50%)
6	Letter	10(1.75%)
7	News Item	6(1.05%)
8	Correction	3(0.52%)

Heidelberg University (0.12), Technical University Munich (0.10), and Ruhr University Bochum (0.09; [Figure 3A](#); [Table 4](#)). Meanwhile, the overlay visualization, minimum of 6 collaborative documents, and citations of institutions were analyzed by VOSviewer ([Figure 3B–D](#)). Technical University Munich had the highest citations (2195), followed by Charite University Medicine Berlin (1129) and University Zurich Hospital (1099).

Analysis of Author

CiteSpace was used to analyze the co-occurrence of authors and co-cited authors, while the overlay visualization and collaboration network of authors were performed by VOSviewer. A total of 556 published authors on acupuncture for migraine were analyzed. [Table 5](#) lists the top 3 productive authors, including Liang FR (29), Linde K (28), and Li Y (18). The top 3 authors in terms of centrality were Claudia M Witt (0.03), Liang FR (0.02), and Lei L (0.02; [Figure 4A](#)). The top 10 co-cited authors are shown in [Table 5](#), with Linde K (260) ranking first, followed by Diener HC (160), and Melchart D (142). HESSE J had the most centrality (0.16), followed by Birch S (0.10), and Macherson H (0.09) ([Table 6](#); [Figure 4B–D](#)).

Analysis of Journals

The VOSviewer was used to analyze the top 10 acupuncture journals on migraine as shown in [Table 7](#). Cephalalgia (31, 5.50%) was the most productive journal, followed by

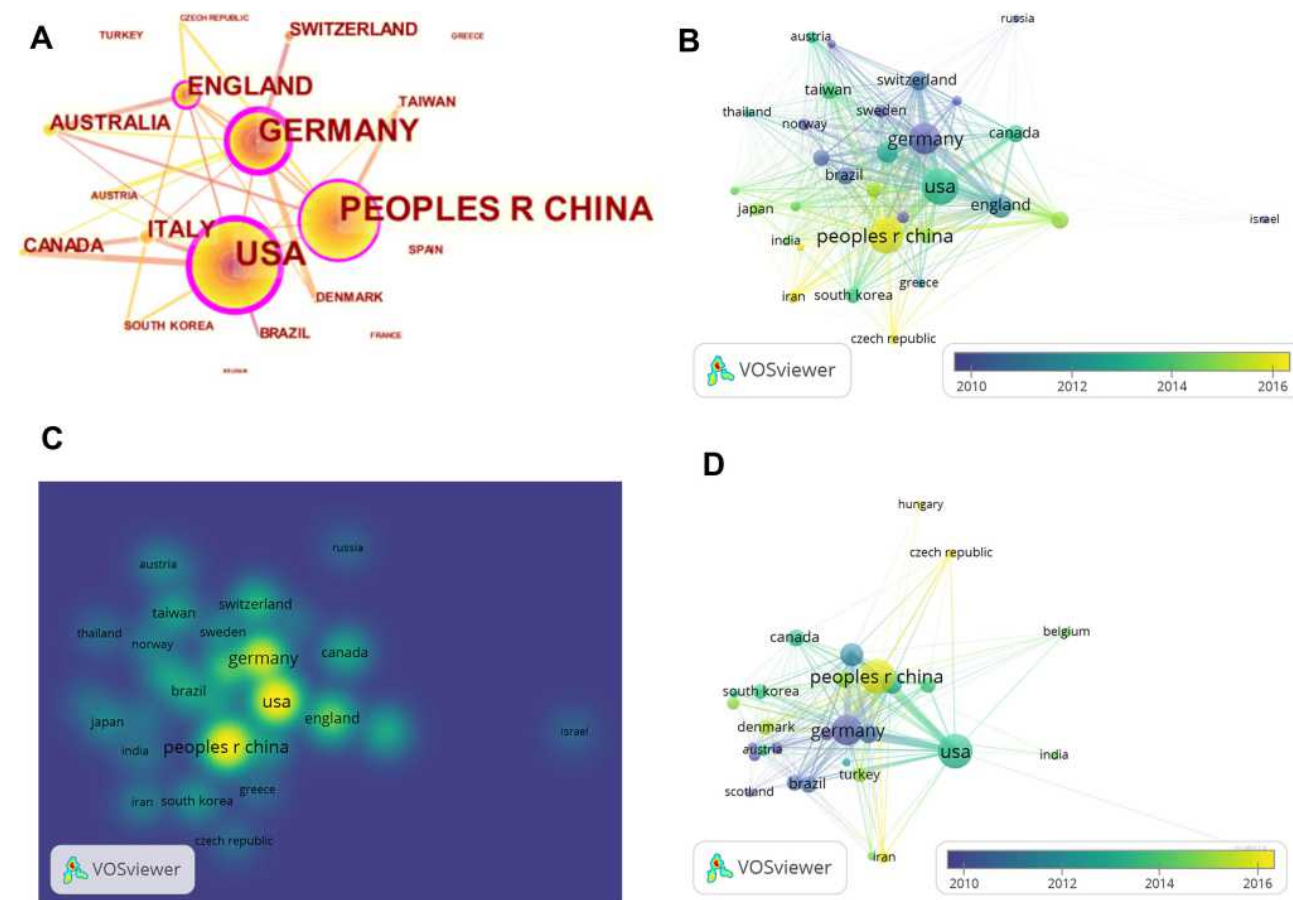


Figure 2 (A) The collaboration network of countries researching acupuncture on migraine. (B) The overlay visualization network of countries related to acupuncture on migraine. (C) The density visualization of countries related to acupuncture on migraine. (D) The overlay visualization network of cited countries related to acupuncture on migraine.

Table 3 Top 10 Publications, Centrality and Citations of Countries Related to Acupuncture on Migraine

Rank	Publications	Countries	Centrality	Countries	Citations	Countries
1	160	USA	0.36	USA	3675	Germany
2	148	China	0.13	Germany	3552	USA
3	103	Germany	0.13	Switzerland	2544	England
4	49	England	0.10	China	2190	China
5	36	Italy	0.08	England	1639	Switzerland
6	27	Switzerland	0.08	Denmark	1054	Italy
7	20	Australia	0.07	Canada	621	Canada
8	20	Canada	0.07	Sweden	390	Denmark
9	19	Brazil	0.06	Iran	297	Sweden
10	17	Taiwan	0.05	Italy	292	Australia

Headache (28, 4.96%), and Acupuncture In Medicine (22, 3.90%; **Figure 5A** and **B**). Cephalalgia ranked first in the number of citations (672), followed by *Pain* (666), and Headache (665; **Table 7**; **Figure 5C**). Co-citation was determined using CiteSpace. In terms of frequency, Cephalalgia (326) ranked first, followed by *Headache*

(314), *Pain* (272), and *JAMA-Journal of the American Medical Association* (260). The journal of *Acupuncture Electro-Therapeutics Research* ranked (0.13) first in centrality, followed by *Brain research* (0.11), and *Journal of Neurology Neurosurgery and Psychiatry* (0.10; **Table 8**; **Figure 5D**).

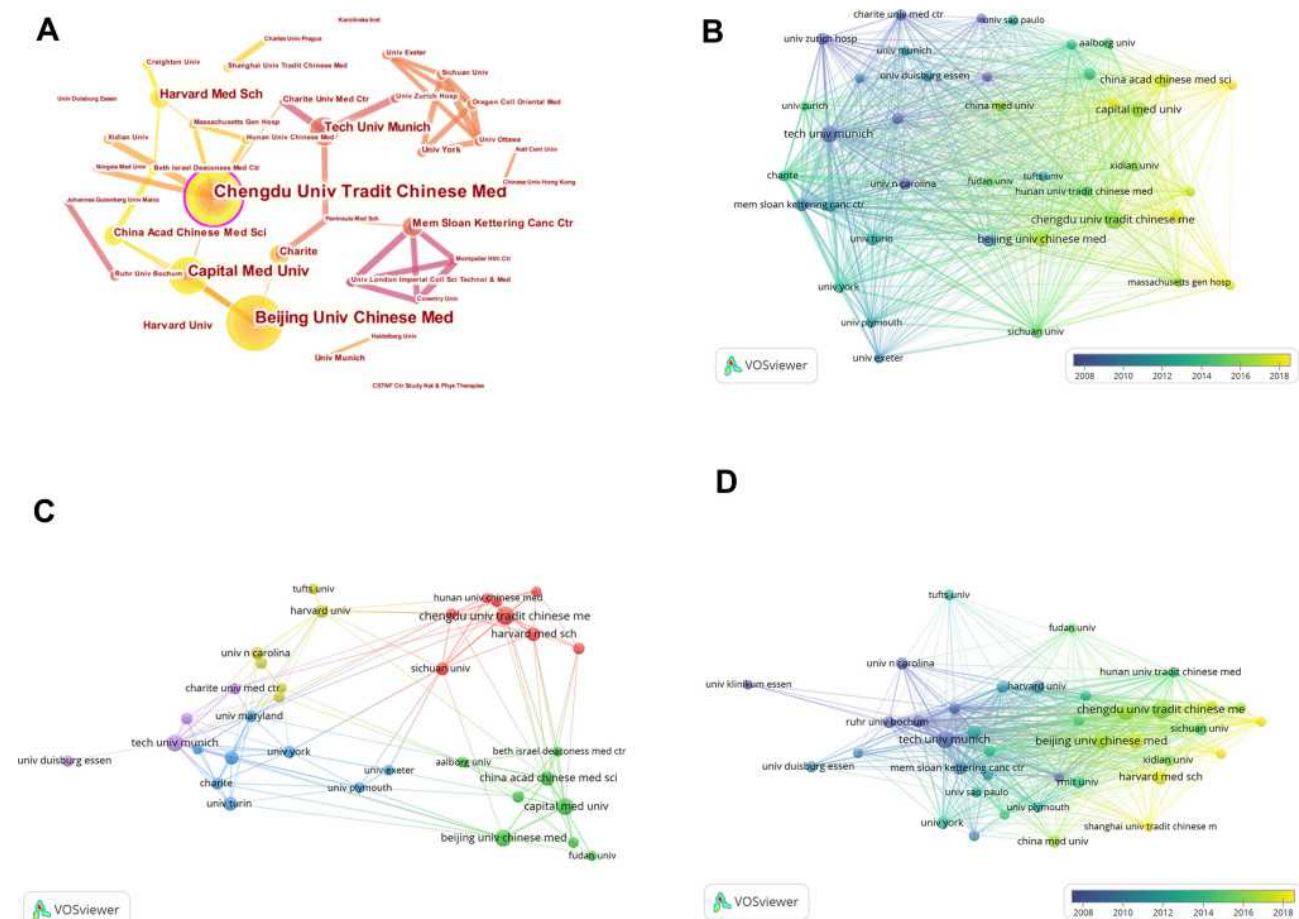


Figure 3 (A) The collaboration of institutions related to acupuncture on migraine. (B) The overlay visualization network of institutions related to acupuncture on migraine. (C) The collaboration between institutions with more than 6 publications. (D) The overlay visualization network of cited institutions related to acupuncture on migraine.

Table 4 Top 10 Publications, Centrality, and Citations of Institutions Related to Acupuncture on Migraine

Rank	Counts	Institution	Centrality	Institutions	Citations	Institution
1	40	Chengdu Univ Tradit Chinese Med	0.12	Heidelberg Univ	2195	Tech Univ Munich
2	33	Harvard Univ	0.10	Tech Univ Munich	1129	Charite Univ Med Berlin
3	30	Tech Univ Munich	0.09	Ruhr Univ Bochum	1099	Univ Zurich Hosp
4	27	Beijing Univ Chinese Med	0.08	Chengdu Univ Tradit Chinese Med	1064	Mem Sloan Kettering Canc Ctr
5	26	Capital Med Univ	0.07	Harvard Univ	885	Univ York
6	25	Charite Univ Med Berlin	0.06	Mem Sloan Kettering Canc Ctr	717	Sichuan Univ
7	25	Free Univ Berlin	0.05	Duke Univ	701	Charite
8	25	Humboldt Univ Berlin	0.04	Beijing Univ Chinese Med	700	Univ Maryland
9	25	Univ Duisburg Essen	0.04	Charite Univ Med Berlin	670	Univ Plymouth
10	19	Univ Zurich	0.03	Aalborg Univ	640	Univ Exeter

Table 5 Top 10 Publications and Centrality of Authors Related to Acupuncture on Migraine

Rank	Publications	Author	Rank	Centrality	Author
1	29	Liang FR	1	0.03	Witt CM
2	28	Linde K	2	0.02	Liang FR
3	18	Li Y	3	0.02	Lei L
4	18	Zheng H	4	0.01	Linde K
5	17	Diener HC	5	0.01	Allais G
6	17	Wang LP	6	0.01	Brinkhaus B
7	15	Allais G	7	0.01	Vickers A J
8	15	Mel Chart D	8	0.01	Macpherson H
9	14	Witt CM	9	0.01	Sun GJ
10	13	Brinkhaus B	10	0.00	Zheng H

Analysis of References

CiteSpace was used to analyze the co-citation count, centrality, and cluster. The top 10 cited references are shown in Table 9 and Figure 6. The article published by Linde K in 2005 had the highest co-citation counts (91),³ followed by Diener HC, 2006 (79), and Li Y, 2012 (53). With respect to centrality of co-cited references, Linde K (2005; 0.85) ranked first, with the article, elucidating acupuncture and routine care in migraine patients had significant improvement of symptoms compared with routine care.⁴¹ Besides, articles published by Diener HC (2006; 0.70), and Allais G (2002; 0.67) also attracted significant attention in co-citation of acupuncture for migraine (Figure 6A).

Noun phrases were obtained from the cited reference to obtain clusters, which reflected the research patterns and frontier topics in networks. The top 5 clusters were “manual acupuncture”, “acupuncture study”, “chronic headache”, “chronic headache disorders”, and “consort statement” (Figure 6B and C). “Chronic headache” was an earlier cluster, while “manual acupuncture” was the

cluster in the last few years. In terms of citations, Linde K, 2005 (386) was the most cited article in this field, followed by MacPherson, 2010 (353) published in *PLoS Medicine*, and Dowson, 2008 (351; Figure 6D).

Analysis of Keywords

The keywords “migraine”, “headache”, “tension-type headache”, “chronic pain”, “analgesia”, “pain”, “acupuncture”, “electroacupuncture”, “randomized controlled trial”, “double-blind”, “prophylaxis”, “placebo”, “complementary medicine”, “management”, “meta-analysis”, “QoL”, “systematic review”, and “fMRI” were popular keywords over the past two decades. The top 3 clusters were “prevention”, “electroacupuncture”, and “functional magnetic resonance imaging” (Table 10; Figures 7A–D and 8A). The burst keywords showed increasing attention on research in acupuncture on migraine in recent years, which is the main indicator for frontier trends in this field.⁴² The keywords “management”, “meta-analysis”, “QoL”, and “systematic review” had the strongest keyword bursts in the recent four years (Figure 8B).

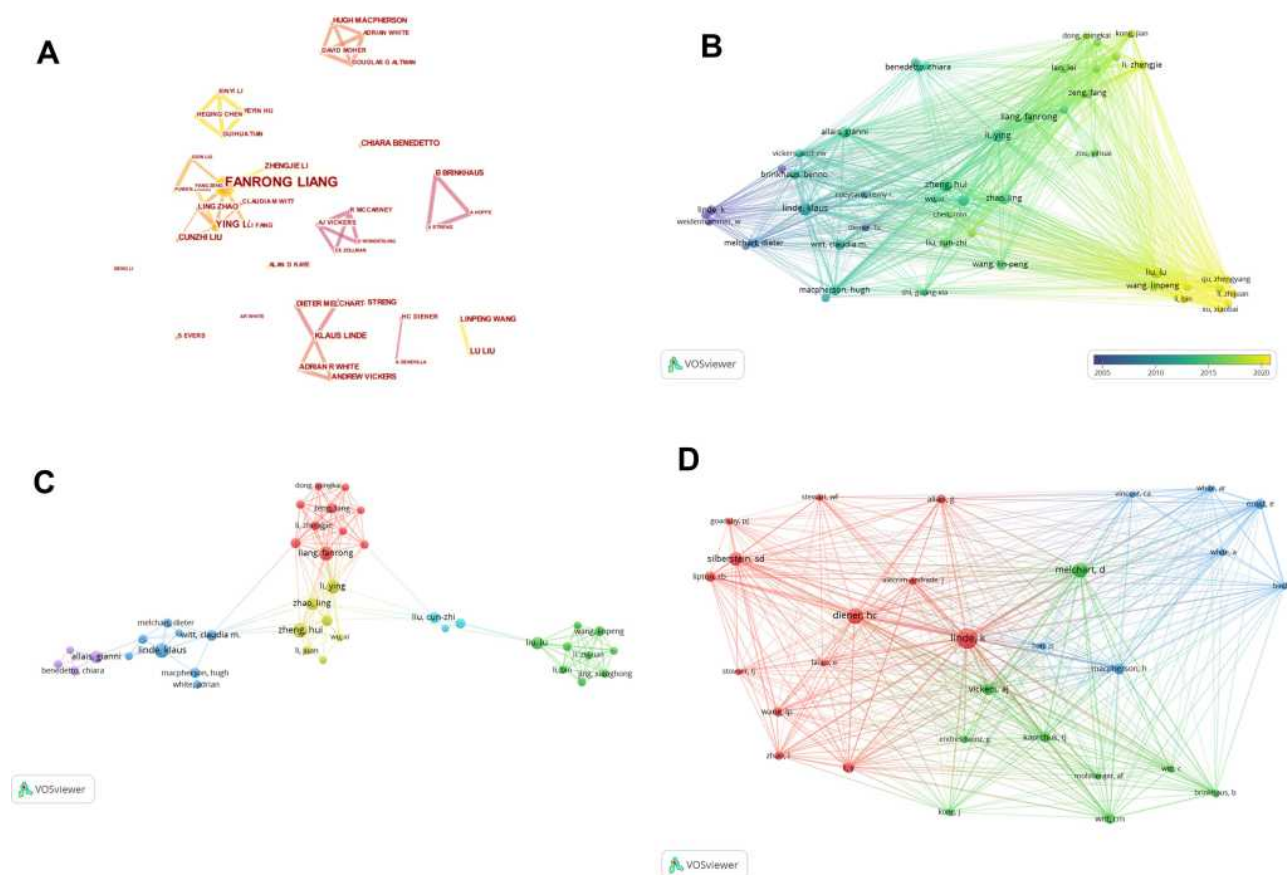


Figure 4 (A) The collaboration network of authors related to acupuncture on migraine. (B) The overlay visualization network of authors related to acupuncture on migraine. (C) The network of co-authorship between authors. (D) The collaboration network of co-cited authors related to acupuncture on migraine.

Discussion

Research Trends in Acupuncture on Migraine from 2000 to 2020

The increasing number of publications in acupuncture on migraine show that research in this field is gaining significant attention. Besides, the annual number of publications is

predicted to markedly increase in the future. Acupuncture, as one of the most common complementary and alternative therapy for migraine, is widely used for managing migraine in many countries.^{1,43,44} Countries that greatly contributed to acupuncture on migraine research are the USA, China, Germany, England, and Italy. Besides, the USA, Germany, and Switzerland have maintained a high degree of cooperation with other countries. In this study, considering the number of publications, centrality, and citations, the USA was found to play a key role in this field. Additionally, China, Turkey, Czech Republic, and Iran are other countries shown to play a significant role in acupuncture on migraine research over the last few years.

The analysis of collaborating institutions can help identify the most productive groups on a topic.³¹ Chengdu University of Traditional Chinese Medicine had the highest number of publications, an indication that the institution made significant contributions to acupuncture on migraine research. Technical University Munich published 30 articles, cited at 2195, and with a centrality of 0.12, suggesting that it also played an important role in this field. Furthermore, the

Table 6 Top 10 Counts and Centrality of Co-Cited Authors Related to Acupuncture on Migraine

Rank	Counts	Author	Centrality	Author
1	260	Linde K	0.16	Hesse J
2	165	Diener HC	0.10	Birch S
3	142	Mel Chart D	0.09	Macpherson H
4	131	Silberstein SD	0.08	Mel Chart D
5	106	Vickers AJ	0.08	Lipton RB
6	86	Lipton RB	0.07	Kaptschuk TJ
7	77	Li Y	0.07	Han JS
8	77	Macpherson H	0.07	Silberstein SD
9	76	Allais G	0.07	Diener HC
10	64	Witt CM	0.06	Allais G

Table 7 Top 10 Publications, Citation Journals Related to Acupuncture on Migraine

Rank	Publications	Journal	Citation	Journal
1	31	Cephalalgia	672	Cephalalgia
2	28	Headache	666	Pain
3	22	Acupuncture Med	665	Headache
4	21	J Altern Complem Med	615	J Altern Complem Med
5	16	Evid-Based Compl Alt	485	Cochrane Db Syst Rev
6	16	Trials	379	Acupuncture Med
7	13	Neurol Sci	338	BMJ-Brit Med J
8	10	Chin J Integr Med	235	Complement Ther Med
9	10	Deutsche Zeitschrift Fur Akupunktur	223	Trials
10	10	Medicine	205	Evid-Based Compl Alt

overlay visualization revealed that Chengdu University of Traditional Chinese Medicine, Beijing University Chinese Medicine, Capital Medicine University, and Harvard Medical School made significant contributions to the field in recent years.

The network analysis of publications, co-authorship and co-citation of authors identifies influential authors and potential collaborations related to acupuncture on migraine.³¹ Liang FR, Linde K, Li Y, Zheng H, and Diener HC were important authors of publications related

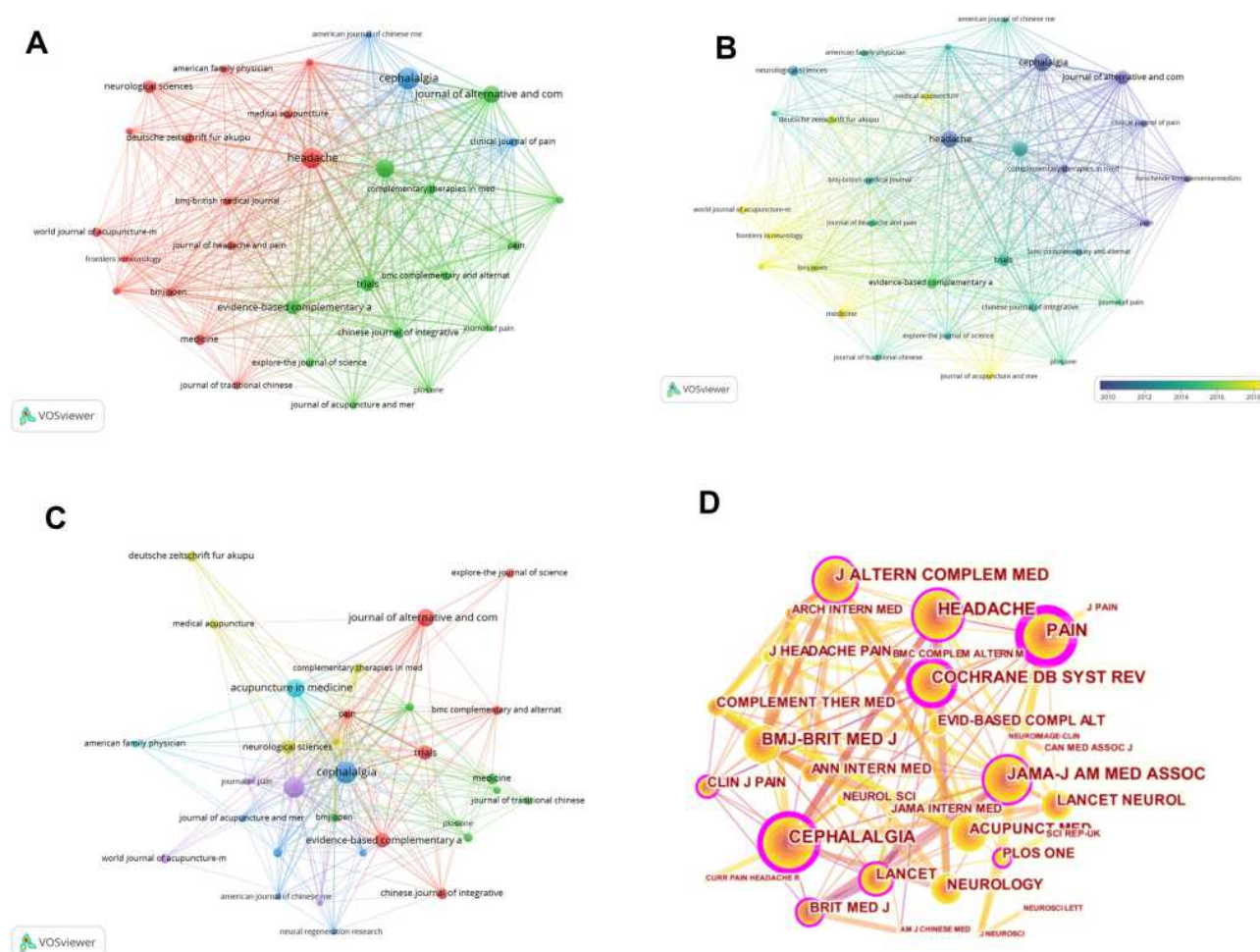


Figure 5 (A) The visualization network of journals in acupuncture for migraine. (B) The overlay network of journals in acupuncture on migraine. (C) The visualization network of cited journals in acupuncture on migraine. (D) The co-citation network of journals in acupuncture on migraine.

Table 8 Top 10 Co-Citation Journals Related to Acupuncture on Migraine

Rank	Frequency	Journal	Centrality	Journal
1	326	<i>Cephalalgia</i>	0.13	<i>Acupuncture Electro</i>
2	314	<i>Headache</i>	0.11	<i>Brain Res</i>
3	272	<i>Pain</i>	0.10	<i>J Neurol Neurosur Ps</i>
4	260	<i>JAMA-J Am Med Assoc</i>	0.10	<i>Acupuncture Clin Pra</i>
5	205	<i>Cochrane Db Syst Rev</i>	0.09	<i>Brain</i>
6	191	<i>J Altern Complem Med</i>	0.09	<i>J Tradit Chin Med</i>
7	189	<i>BMJ-Brit Med J</i>	0.08	<i>Clin J Pain</i>
8	183	<i>Neurology</i>	0.08	<i>Anesth Analg</i>
9	167	<i>Lancet Neurol</i>	0.07	<i>Am J Chinese Med</i>
10	165	<i>Lancet</i>	0.07	<i>J Acupunct Meridian</i>

Table 9 Top 10 References Related to Acupuncture on Migraine

Rank	Co-Citation Counts	Reference (Publication Year)	Centrality	Reference (Publication Year)	Citation Counts	Reference (Publication Year)
1	91	Linde K, 2005	0.85	Linde K, 2005	386	Linde K, 2005
2	79	Diener HC, 2006	0.70	Diener HC, 2006	353	Macpherson, 2010 (<i>PLoS Medicine</i>)
3	53	Li Y, 2012	0.67	Allais G, 2002	351	Dowson, 2008
4	50	Linde K, 2009	0.42	Wang LP, 2011	335	Linde K, 2007
5	41	Bes A, 2013	0.36	Melchart D, 2005	236	Diener HC, 2006
6	39	Wang LP, 2011	0.33	Li Y, 2012	220	Melchart D, 2005
7	38	Zhao L, 2017	0.27	Zhao L, 2017	212	Linde K, 2009 (<i>Cochrane Db Syst Rev</i>)
8	37	Vickers AJ, 2012	0.27	Melchart D, 1999	163	Moffet, 2009
9	37	Linde K, 2016	0.25	Linde K, 2016	157	Vickers AJ, 2004
10	37	Melchart D, 2005	0.23	Ramsay DJ, 1998	143	White, AR, 2001

to acupuncture on migraine. Liang, F, is the main researcher working at Chengdu University of Traditional Chinese Medicine devoted to research on acupuncture for migraine over the last few years. A study performed by Liang, F research showed the regional homogeneity change in migraine without aura patients using fMRI.⁴⁵ Linde K from the Technical University Munich had the highest number of co-citations. Moreover, Liu L, Li B, Xu XB, and Qu ZY were newly, but highly published authors in acupuncture on migraine research in recent years.

In the co-authorship analysis knowledge map, the blue cluster demonstrated that Linde K from Technical University Munich collaborated with Witt CM from the University of Zurich. The purple cluster suggested a collaboration between Allais et al from the Center for

the Study of Natural and Physical Therapies and Airola G from the University of Turin. The red cluster showed that Liang FR from Chengdu University of Traditional Chinese Medicine collaborated with Dong MK from Xinjin Hospital of Traditional Chinese Medicine and Liu ML from the Hunan University of Chinese Medicine. The green cluster indicated that Li B from Capital Medical University collaborated with Jing XH from China Academy of Chinese Medical Sciences. The light blue cluster indicated that Liu et al were from Beijing Hospital of Traditional Chinese Medicine. The light green cluster indicated that Zhao et al were from Chengdu University of Traditional Chinese Medicine.

In this study, numerous publications in high impact factor and cited journals showed the importance of acupuncture on

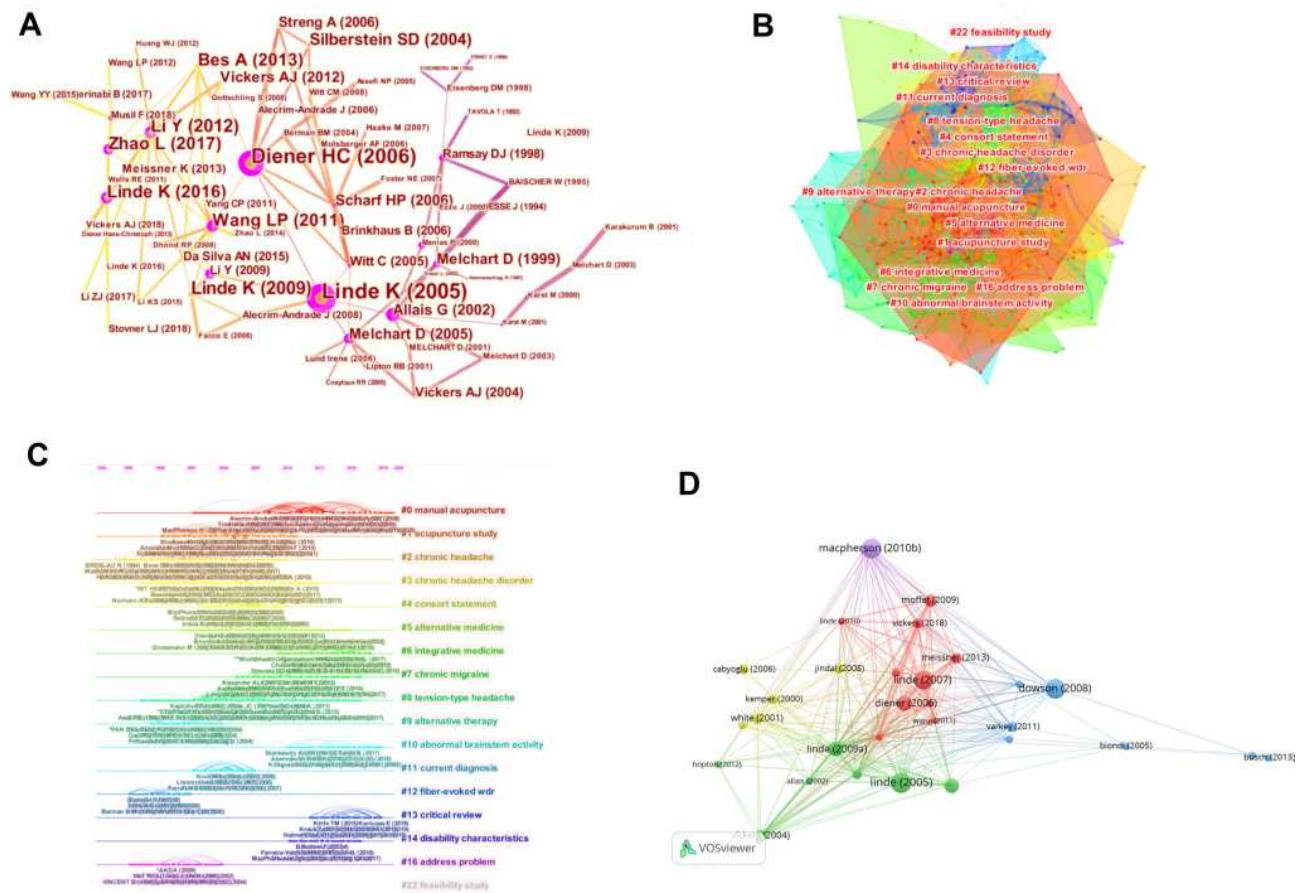


Figure 6 (A) The network of co-cited references related to acupuncture on migraine. (B) The cluster network of co-cited references related to acupuncture on migraine. (C) The timeline view network of co-cited references related to acupuncture on migraine. (D) The network visualization of cited references related to acupuncture on migraine.

migraine. The average impact factor (IF) of the top 10 journals was 2.3106. Interestingly, the journal of *Cephalalgia* ranked first in the number of publications, citation, co-citation, and IF (4.868), indicating that it played a key role in this field. Therefore, publications related to acupuncture on migraine in *Cephalalgia* are considered

landmark studies. In addition, the journal of *Medicine*, *World Journal of Acupuncture*, and *Frontiers in Neurology* were newly published journals associated with acupuncture on migraine research. With respect to centrality, collaboration among countries, authors, and institutions was low, suggesting that cooperation is inadequate.^{30,31} Therefore,

Table 10 Top 10 Keywords Related to Acupuncture on Migraine

Rank	Frequency	Keyword	Rank	Centrality	Keyword
1	283	Migraine	1	0.17	Electroacupuncture
2	276	Acupuncture	2	0.17	Tension type headache
3	132	Headache	3	0.14	Double blind
4	115	Pain	4	0.13	Efficacy
5	80	Efficacy	5	0.12	Pain
6	79	Randomized controlled trial	6	0.12	Placebo
7	72	Placebo	7	0.12	Clinical trial
8	70	Prophylaxi	8	0.11	Chronic pain
9	70	Double blind	9	0.11	Prophylaxi
10	65	Tension type headache	10	0.10	Analgesia

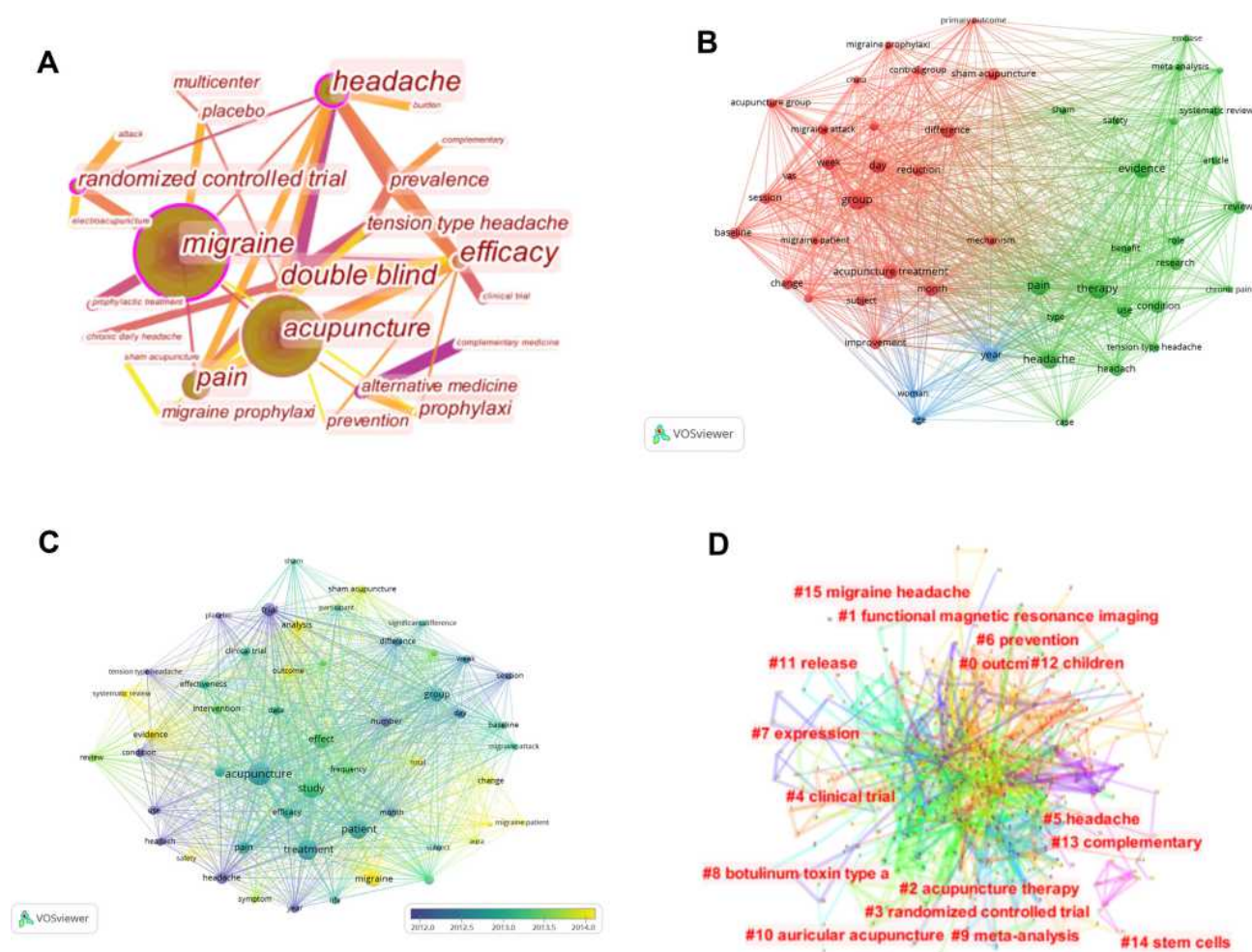


Figure 7 (A) Analysis of keyword related to acupuncture on migraine. (B) The visualization network of keywords related to acupuncture on migraine. (C) The overlay visualization network of keywords related to acupuncture on migraine. (D) The cluster network of keywords related to acupuncture on migraine.

researchers from different research areas and institutions should enhance cooperation for high-quality studies.

Analysis of the high co-citation frequency and centrality revealed adequate knowledge foundation related to acupuncture on migraine.³⁰ A total of nine journals and two articles published by *Cochrane Database of Systematic Reviews*^{16,46} demonstrated the importance and influence of the journals in this field. Three articles were published by Linde K in *JAMA-Journal of The American Medical Association*³ and *Cochrane Database of Systematic Reviews*.^{16,46} The modularity Q (0.847) and the mean silhouette (0.9205) scores,²⁹ obtained by CiteSpace. “Manual acupuncture” was the largest cluster, consisting of 114 members, and a silhouette value of 0.78. The most active citer of this cluster was the review “Acupuncture for migraine prophylaxis” published by Linde et al.⁴⁷ The second cluster “acupuncture study”, had a silhouette value of 0.936 and a number of 78. Furthermore, from the clusters of chronic headache, chronic headache disorder,

consort statement, and alternative medicine, we could identify research directions in acupuncture for migraine, including the type of migraine, treatment and research, and acupuncture method.

Emerging Research Trends Over the Past 20 Years

Based on frequency, centrality, clusters and burst keywords, we identified hotspots and emerging research trends related to acupuncture on migraine.⁴²

The Most Common Type of Migraine

Tension-type headache (TTH) is the most prevalent primary migraine.⁴⁸ The keyword “TTH”, emerged from 2008, with a strength of citation burst of 3.79, demonstrating that TTH has been more popular than other types of migraine over the past two decades. A previously published review indicated

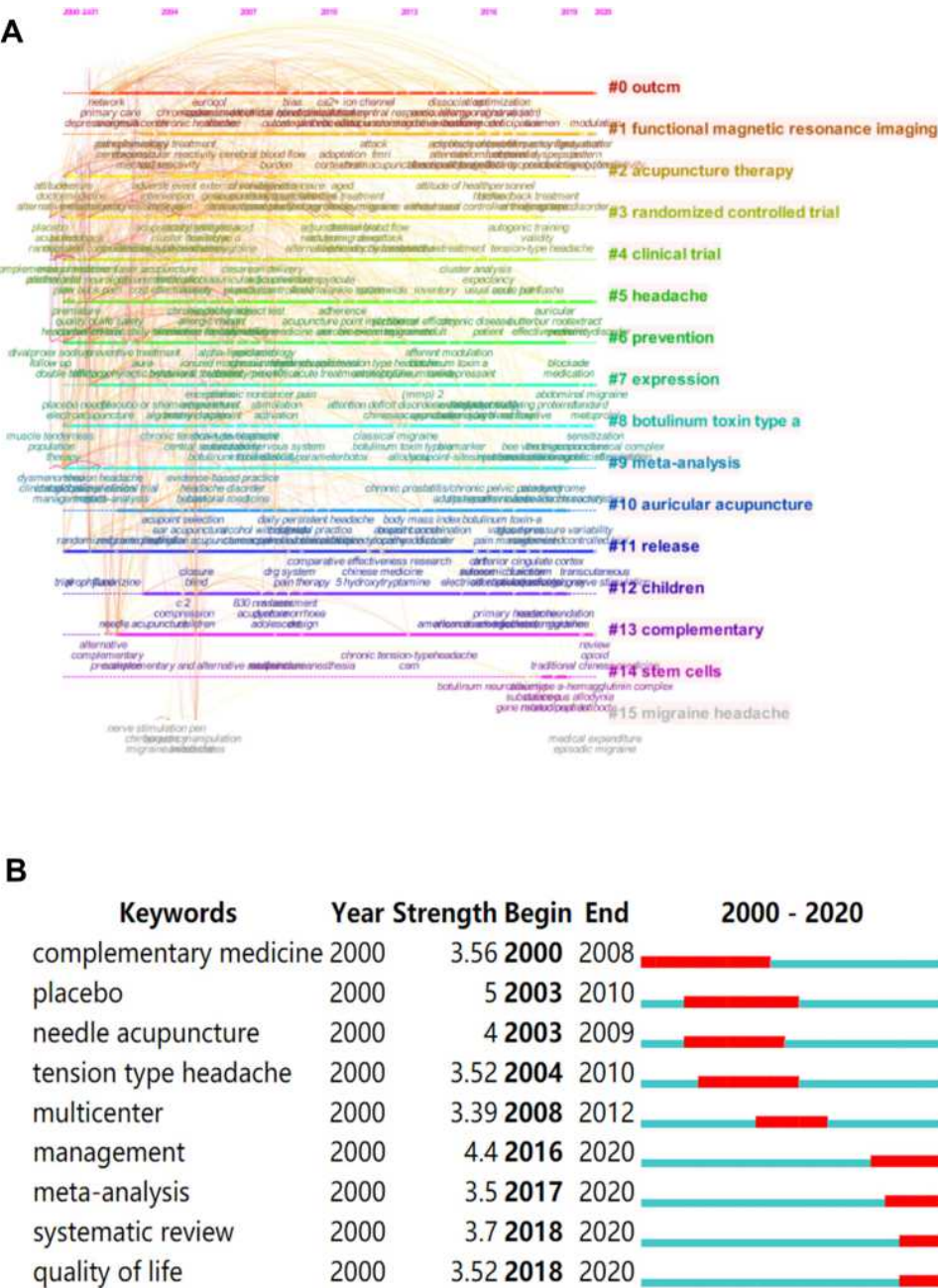


Figure 8 (A) The cluster timeline view network of keywords related to acupuncture on migraine. **(B)** The top 9 keywords with the strongest citation bursts related to acupuncture on migraine. The color represents different frequent keywords (red: frequent; green: infrequent).

that acupuncture could be a valuable option for TTH therapy.⁴⁹ Moreover, clinical data from a study by Georgoudis G's suggests that TTH patients receiving acupuncture experienced significant improvement in psychosomatic pain, disability index, and QoL.⁵⁰

Research Method

RCTs, multicenter, and double-blind studies are common research methods in acupuncture for migraine, providing

high-quality clinical evidence. An RCT on acupuncture on migraine was published in *JAMA Internal Medicine*, with a high IF of 18.625. In this article, Zhao et al showed that the long-term reduction of migraine recurrence in the TA group was higher compared with the SA group and waiting-list control group.⁸ Besides, a randomized, double-blind, placebo-controlled trial, conducted by Gottschling et al found active acupuncture benefits compared with placebo acupuncture for headache patients.⁵¹

In acupuncture clinical research, it is difficult for researchers to conduct double-blind trials.⁵² Patient blinding can be achieved using sham acupuncture, but it is not easy to blind acupuncturist of manual treatments. Because the blinding of the observer and the analyst should be considered ideal for all studies. Although some attempts have been made using the novice and diagnostic blindness of acupuncturist, the quality of treatment may not be optimal and diagnosis may be irrelevant.⁵² Therefore, it is necessary to evaluate double-blind trials in future studies. Single-blinded trials are therefore popular in acupuncture on migraine.⁵³

Effect of Acupuncture on Migraine

Studies report that approximately 25–38% of patients with migraine need preventive therapy.^{15,17} Acupuncture, as a method with no side effects, should be considered as a beneficial prophylactic treatment to reduce the frequency of migraine.^{49,54} Acute effect and long-term effect are the goals of acupuncture therapy on migraine, including pain relief and prevention of the frequency of migraine attacks in the future.^{55,56} Current research provides evidence for the potential role of acupuncture in the treatment and prophylaxis of migraine (acute migraine and TTH).^{20,57}

Acupuncture treatment, a supplementary therapy, can reduce pain in patients with migraine.⁴⁹ However, there are some divergent views on the effects of acupuncture among TA, SA, and placebo groups.^{58,59} These differences may be attributed to acupuncture method, acupoint prescription, and type of migraine.^{3,8,60} Therefore, the effect of TA, SA, and placebo should be studied in future. In addition, The QoL of migraine patients is significantly decreased.²³ The recurrent and severe pain in patients with migraine can aggravate psychological pressure such as tension and anxiety. Acupuncture can result in reduced Visual Analog Scale scores and days of the attack, and improve QoL in migraine patients.⁶¹

Evaluation

Meta-analysis and systematic reviews evaluate the efficacy of acupuncture in terms of pain, frequency of migraine attacks, anxiety and depression, and QoL,⁶² and compare with no treatment or other forms of therapy (blank control, usual care, waiting-list control, acupoint catgut embedding treatment, Western medication, SA, and placebo) in patients with migraine.⁶² However, results are limited due to the various methodological heterogeneity in the quality of the studies.^{11,61} Therefore, it is necessary to

perform a high-quality meta-analysis to determine the effect of acupuncture in the future.

There were some limitations in this study. First, we mainly concentrated on quantitative analysis and focused less on qualitative analysis. Second, only articles recorded in WoS were analyzed; therefore, it is necessary to perform further analysis in other databases such as PubMed, Scopus, China National Knowledge Infrastructure, Wan Fang, and Wei Pu. However, WoS is the most commonly used database for scientometrics.³²

Conclusion

Using CiteSpace and VOSviewer, a bibliometric analysis of acupuncture therapy on migraine over the past two decades is performed. The top five most prolific countries reporting high acupuncture on migraine research are the USA, China, Germany, England, and Italy. The most productive institutions in terms of publications in this field are Chengdu University of Traditional Chinese Medicine, Harvard University, and Technical University Munich. The most active authors are Liang FR, Linde K, and Li Y. *Cephalalgia*, *Headache*, and *Acupuncture In Medicine* are the most productive journals in this field. TTH and chronic migraine are the main types of migraine in acupuncture. The most common acupuncture methods applied to migraine are manual acupuncture and electroacupuncture. Moreover, RCT, multicenter, double-blind, and functional magnetic resonance imaging studies, are the current main research methods used to study acupuncture on migraine. Acupuncture can affect migraine as the role of prophylactic, and alleviate QoL, and pain. Meta-analysis and systematic reviews have been widely used to evaluate the efficacy of acupuncture for migraine.

In summary, this study is the first bibliometric analysis to investigate the current status and emerging trends related to acupuncture on migraine using CiteSpace and VOSviewer over the last 20 years. The trends demonstrated of acupuncture therapy on migraine may help researchers explore new directions for future research in this field.

Abbreviations

QoL, Quality of life; RCT, randomized controlled trials; TA, true acupuncture; SA, sham acupuncture; WoS, Web of Science; IF, Impact factor; TTH, Tension-type headache.

Data Sharing Statement

The raw data used in this article can be obtained from the Web of Science (WoS) database.

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Author Contributions

All authors made a significant contribution to the work reported, whether in the conception, study design, execution, acquisition of data, analysis and interpretation, or in drafting, revising or critically reviewing the article. All authors approved the final version of this manuscript submitted for publication, agreed on the journal to which the article has been submitted, and to be accountable for all aspects of the work.

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Disclosure

The authors declare no potential conflicts of interest in this research.

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