

Research Trends of Acupuncture Therapy on Fibromyalgia from 2000 to 2021: A Bibliometric Analysis

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Purpose: Fibromyalgia Syndrome causes great physical and mental discomfort and incurs high costs. Acupuncture has been regarded as the mainstay of treatment for Fibromyalgia Syndrome while the bibliometric analysis of this field has not been summarized properly. Thus, the purpose of this study is to analyze the hotspot of acupuncture for Fibromyalgia Syndrome.

Methods: The core collection database of Web of Science were searched for relevant publications from 2000 to 2021, and countries, institutions, authors, keywords, and literature were analyzed and visualized by bibliometric software CiteSpace V software and Vosviewer software, to explore the scientific achievements, research collaboration networks, research hot spots, and research trends.

Results: 868 publications were included in this study. The publications have increased steadily over time, and the type published the most is Article. Pain is the most cited journal. The most prolific country is the USA while the most prolific institution is Univ Michigan. The most prolific and influential authors were Yiwen Lin and Wolfe F respectively. The analysis of keywords and literature showed that long-term efficacy, animal studies, alternative medicine, and electroacupuncture will be the scientific hotspots in acupuncture for fibromyalgia.

Conclusion: This study shows that the number of research studies, researchers, and research institutions on acupuncture for fibromyalgia is increasing from year to year. Future research hotspots will focus on the long-term efficacy of acupuncture in the treatment of fibromyalgia, experimental animal studies, and the development of other alternative medical therapies. In addition, electroacupuncture is receiving more and more attention as a new application of traditional acupuncture therapy.

Keywords: acupuncture, fibromyalgia syndrome, CiteSpace, bibliometric analysis

Introduction

Fibromyalgia Syndrome (FMS), the second most common “rheumatic” disorder, is characterized by chronic pain localized in multiple body areas,¹ with the associated symptoms of sleep disturbances, cognitive dysfunction, fatigue, and a range of gastrointestinal symptoms.² The estimated incidence of FMS is 2–4%, and most patients are female.^{3–6} However, the diagnosis is usually difficult, with a majority of patients waiting for over 2 years to be diagnosed,⁷ which leads to more spending.⁸ At present, FMS is treated by a multi-mode method,⁹ which can be divided into drug therapy and non-drug therapy. The former mainly uses Nonsteroidal Anti-inflammatory Drugs (NSAIDs), opioids, and other drugs.¹⁰ But the research of Ernest Choy shows no significant differences between NSAIDs and placebos in reducing pain.¹¹ In addition, the use of opioids may cause hyperalgesia and paradoxically increase the pain of FMS.¹² The low effectiveness and high side effects of drug therapy make it difficult to choose as a treatment priority.^{13,14} Hence, non-pharmacological therapy is recommended to be first-line therapy by European League Against Rheumatism (EULAR),¹⁵ which includes patient education, exercise, cognitive behavioral therapy, and complementary and alternative medicine.^{15,16} In addition, Wang C¹⁷ in a 2010 study confirmed the therapeutic effect of tai chi on fibromyalgia. Among non-pharmacological treatments, FMS therapeutic guidelines moderately recommend acupuncture as it may improve FMS symptoms. Studies suggest that 60–90% of FMS patients use one or more

complementary or alternative therapeutic methods, and of these 22% try acupuncture therapy.¹⁸ There is strong evidence supporting the therapeutic effects of acupuncture.^{15–19} A review confirmed acupuncture had significant effects in improving the pain and quality of life of patients with FMS, no matter in the short or long term, with fewer adverse reactions and higher safety.²⁰ While in the comparison of acupuncture with other non-pharmacological treatments, Megha Patel¹⁹ concluded that acupuncture has better pain relief. For example, a study by Rosa Alves Targino²¹ concluded that acupuncture has a more significant improvement in FMS compared to exercise alone, the study of Scott D. Mist²² showed that acupuncture showed more significant improvements in symptoms of pain and fatigue in FMS compared to education. This shows that the efficacy of acupuncture is more pronounced than other non-pharmacological treatments.

The specific mechanism of acupuncture for FMS is currently unknown. Now there are two main hypotheses. The first one is the neurohormonal theory,^{23,24} which suggests that by pricking needles into specific locations, A-delta and C afferent nerve fibers are stimulated, which then transmit to multiple locations in the central nervous system to trigger the release of endogenous opioids. Another theory is the long-term depression hypothesis,²⁴ which suggests that acupuncture leads to a release of neurotransmitters that downregulate A-delta fibers and provide long-term pain relief.

At the current stage, the distribution to the study of acupuncture treatment for FMS is scattered relatively, which makes it difficult for clinical practitioners and researchers in related fields to understand the emerging trends of a research field timely and effective. Through bibliometrics, scholars can quantitatively identify detailed research trends and abrupt changes, for making academic decisions.²⁵

Using the topic search, in this study, publications of acupuncture for FMS published from 2000 to 2021 were retrieved from the Science Citation Index Expanded (SCI-Expanded) database of the Web of Science (WoS) to explore. CiteSpace and Vosviewer are visualization software used in this study, both of them are specially designed to meet the demand for generating visualization mapping of specific research areas.

Materials and Methods

Data Collection

The Science Citation Index Expanded (SCI-Expanded) database of Web of Science (WoS) was used as the source of available databases. We set the record content terms as the title = ((Acupuncture OR Needle Acupuncture OR Acupuncture Therapy OR Manual Acupuncture OR Body Acupuncture OR Needle) AND (Fibromyalgia OR Fibromyalgia syndrome OR FM OR FMS OR Primary Fibromyalgia Syndrome OR PFS)). Studies published between 2000 and 2021 were retrieved to explore the global research trends in acupuncture for FMS. Results were restricted to studies published in English. In total, 868 original articles were included.

Bibliometric Methods and Analysis Tools

Bibliometric methods were used to explore existing achievements of acupuncture for FMS. CiteSpace (version 5.3 R4) (Chaomei Chen, Drexel University, USA) and VOSviewer (1.6.6) software were used for data processing and result visualization.

CiteSpace is a Java application, that supports visual exploration with knowledge discovery in bibliographic databases.²⁶ The parameters of CiteSpace were as follows: time slicing (2000–2021), years per slice (5), selection criteria (30), pruning (pathfinder, Pruning sliced networks), and node type (author, institution, and keyword. Set the threshold of author, institution, and keyword to the G-index (k=25), and retain the default values for other parameters).

VOSviewer is a freely available computer program that was developed by the Centre for Science and Technology Studies, Leiden University and used for constructing and viewing bibliometric maps.²⁷ Compared with CiteSpace, the functionality of the VOSviewer is especially useful for displaying large bibliometric maps in an easy-to-interpret way, which can be more helpful for researchers in understanding hot topics and current trends.

Results

Analysis of Publications

A total of 868 publications, which met the inclusion criteria, were included in this research. Figure 1A shows the number of publications by year. The number of publications associated with acupuncture treatment with FMS is different by the

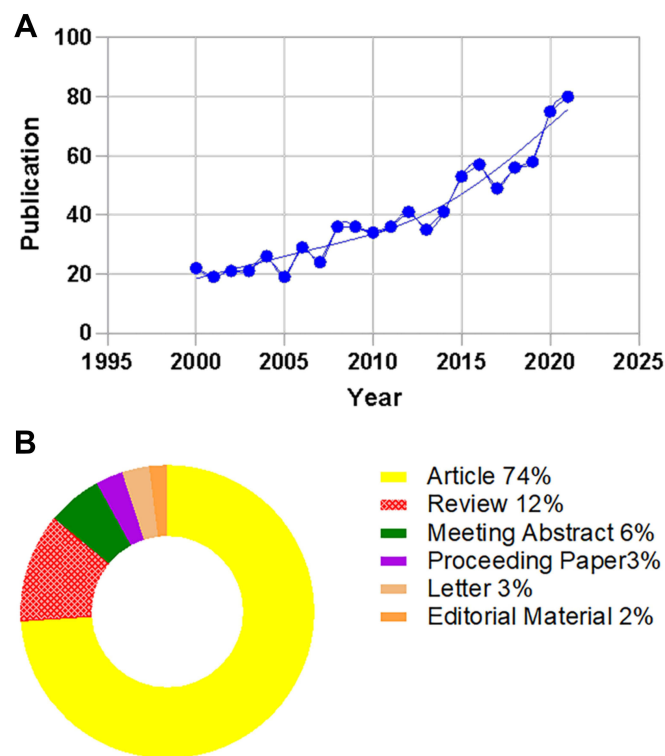


Figure 1 (A) Annual publications of acupuncture for fibromyalgia. (B) Type of publications.

time. According to the result of linear regression analysis, publications had significant growth from 2000 to 2021 ($t=11.721$, $P=0.001$). As Figure 1A shows, the number of articles on Acupuncture on FMS increased yearly, from 22 in 2000 to 80 in 2021. Six publication types of acupuncture on FMS were identified in the past two decades, with the prominent forms including articles (74%), reviews (12%), and meeting abstracts (6%) (Figure 1B).

Analysis of Journals

Approximately 508 journals, related to the research into acupuncture for the treatment of FMS, were screened out and analyzed by CiteSpace (Figure 2). Top 5 cited journals listed in Table 1, of which the most cited is Pain (Citations:193, IF=6.961), Jama-J Am Med Assoc (Citations:161, IF=56.274), Ann Intern Med (Citations:143, IF=25.391) while the highest IF journal is New Engl J Med (IF=91.253, 2020). Among the cited journals, the first one focuses on the nature of pain, its mechanisms, and treatments, so it is not surprising that it has more output in this area. While the latter two focus on research advances in internal diseases. In 2010, the research on a Traditional Chinese Medicine (TCM) method called Tai chi, which was confirmed to have the same effect of relieving pain as acupuncture with FMS, was published in New Engl J Med, which accounts for the high citations of the journal.¹⁷

Table 2 shows the top 10 citing journals of acupuncture treatment for FMS. The average impact factor (IF) of the citing top 10 journals was 5.4157, and Evid-Based Compl Alt (IF2020 2.63, 23 publications) was the most productive journal, followed by the J Altern Complement Med (IF2020 2.582, 18 publications), Acupuncture In Medicine (IF2020 2.267, 14 publications). Among the cited journals, Evid-Based Compl Alt is concerned with the health outcomes of complementary and alternative medicine, J Altern Complement Med focuses on the integration of traditional and mainstream medicine, and Acupuncture In Medicine focuses on understanding the effects of acupuncture in health services as well as clinical practice from the perspective of neurophysiology and anatomy in modern medicine.

As shown in Figure 3, a dual-map overlay of the journals was created by CiteSpace to explore the patterns of scientific citation.²⁸ From the result of Figure 3, most of the publications were published in Medicine, Medical, and Clinical journals, which mostly cited journals from Sports, Rehabilitation, and Sport. The data in Tables 1 and 2 show that the top three cited

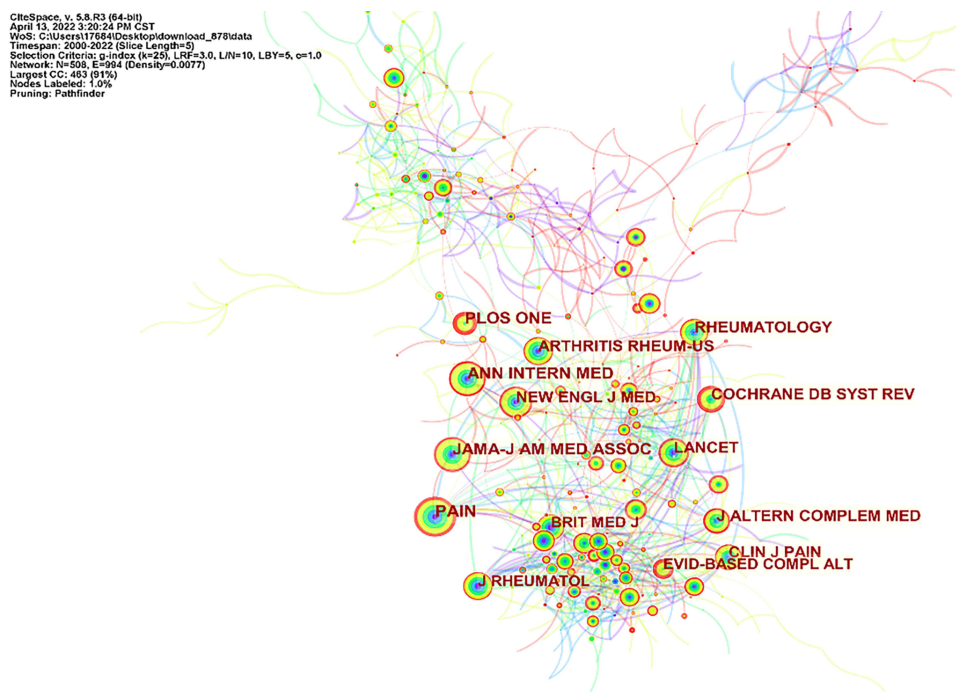


Figure 2 Analysis of cited journals. The larger circle in the graph means that the journal corresponding to that circle has been cited more often and has more influence in the field of acupuncture for fibromyalgia.

journals are mostly from the fields of Medicine, Medical, and Clinical, while the top three cited journals are mostly from the fields of Rehabilitation, Sports, and Medicine.

Analysis of Countries/Regions

149 countries/regions performed research in this field. Figure 4 shows the geographical distribution of acupuncture for FMS. Almost half of the 868 research achievements were from the top two countries. As Figure 4 shows, the country

Table 1 Top 10 Cited Journals Related to Acupuncture for FMS

Journals	Citations	If(2020)	Quantile	Wos Categories	Category Ranking
Pain	193	6.961	Q1	Anesthesiology	4/33
Jama-J Am Med Assoc	161	56.274	Q1	Medicine, Gneral&Internal	3/167
Ann Intern Med	143	25.391	Q1	Medicine, Gneral&Internal	6/167
Plos One	140	3.240	Q2	Multidisciplinary, Science	26/72
New Engl J Med	133	91.253	Q1	Medicine, Gneral&Internal	1/167

Table 2 Top 10 Citing Journals of Acupuncture for FMS

Rank	Publication	Journal	If(2020)
1	23	Evid-Based Compl Alt	2.630
2	18	J Altern Complem Med	2.582
3	14	Acupuncture In Medicine	2.267
4	11	Plos One	3.240
5	10	Gastrointestinal Endoscopy	9.427
6	9	Radiology	11.105
7	9	Scientific Reports9	4.380
8	8	Rheumatology	7.580
9	8	Cancer Cytopathology8	5.284
10	8	Laboratory Investigation	5.662

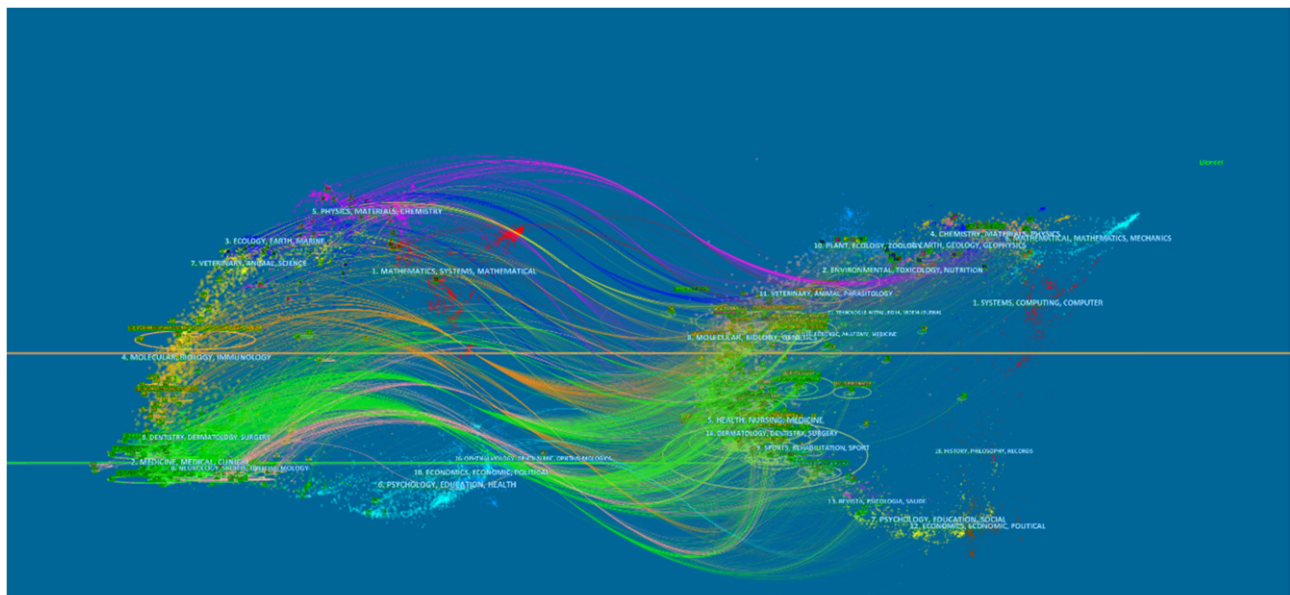


Figure 3 Dual-map overlay of journals related to Acupuncture for fibromyalgia syndrome. The left side of the dual map is citing journals while the right side is cited journals, and the line in the middle indicates the association between them.

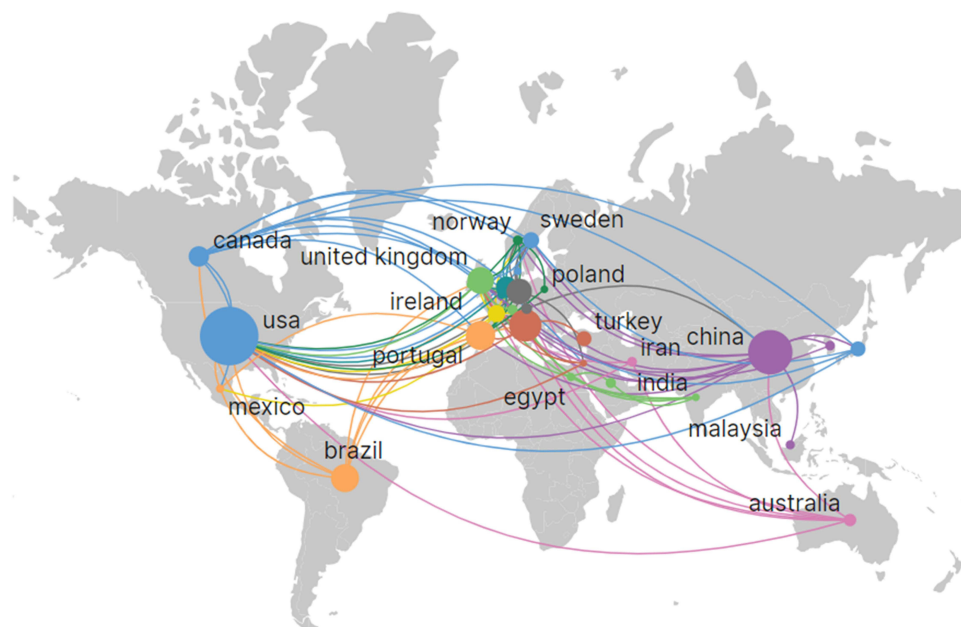


Figure 4 Geographical distribution of acupuncture for fibromyalgia Syndrome. The lines with the same color in the figure represent the closeness of the cooperative relationship between the connected countries, while the size of the circles indicates the magnitude of the country's influence.

with the greatest influence in this field is currently the USA which has extensive cooperation with countries in several regions of the world, mostly concentrated in North America, Europe, and Japan.

As **Figure 5** and **Table 3** show, the USA had the most publications (285, 33%), followed by China (135, 15%). Besides, other countries/regions also displayed a development trend in full flourish. European countries, including the United Kingdom (UK) and Germany, together with Latin American countries such as Mexico and Brazil, showed regional collaborations.

According to the result of the centrality assessment, the USA had a much greater influence than any other country (centrality = 0.45), followed by Italy (0.14) and Australia (0.14). Despite Italy and Australia producing fewer outputs,

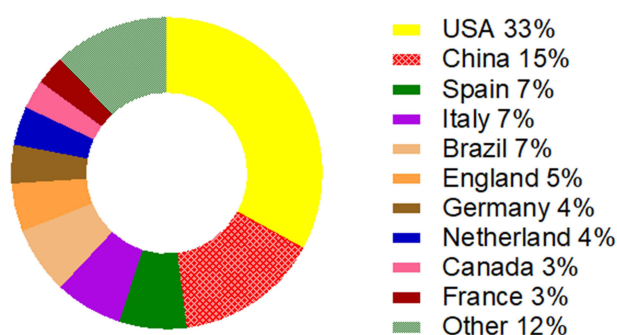


Figure 5 The distribution of publications by country.

their clinical and research values of them higher than several other high-producing countries, indicating that their study has higher quality.

Analysis of Institutions

According to the result of CiteSpace, nearly 255 institutions contribute to the field of acupuncture for FMS. The research network shows a low-density map (density = 0.0181), indicating that the cooperation of research groups is relatively dispersed (**Figure 6A**). Besides, the results of Vosviewer show that collaboration between institutions is inclined to domestic cooperation (**Figure 6B**). **Table 4** shows the top 5 of the most productive and highest centrality institutions. Univ Michigan (17, 1.96%) from the USA was the organization with the most output, followed by China Med Univ (16, 1.84%) and National Cancer Institute (NCI) (14, 1.61%). Brown Univ(0.18), Univ Michigan (0.15), and Massach Usetts Gen Hosp (0.15) were the top three universities based on centrality.

Analysis of Author

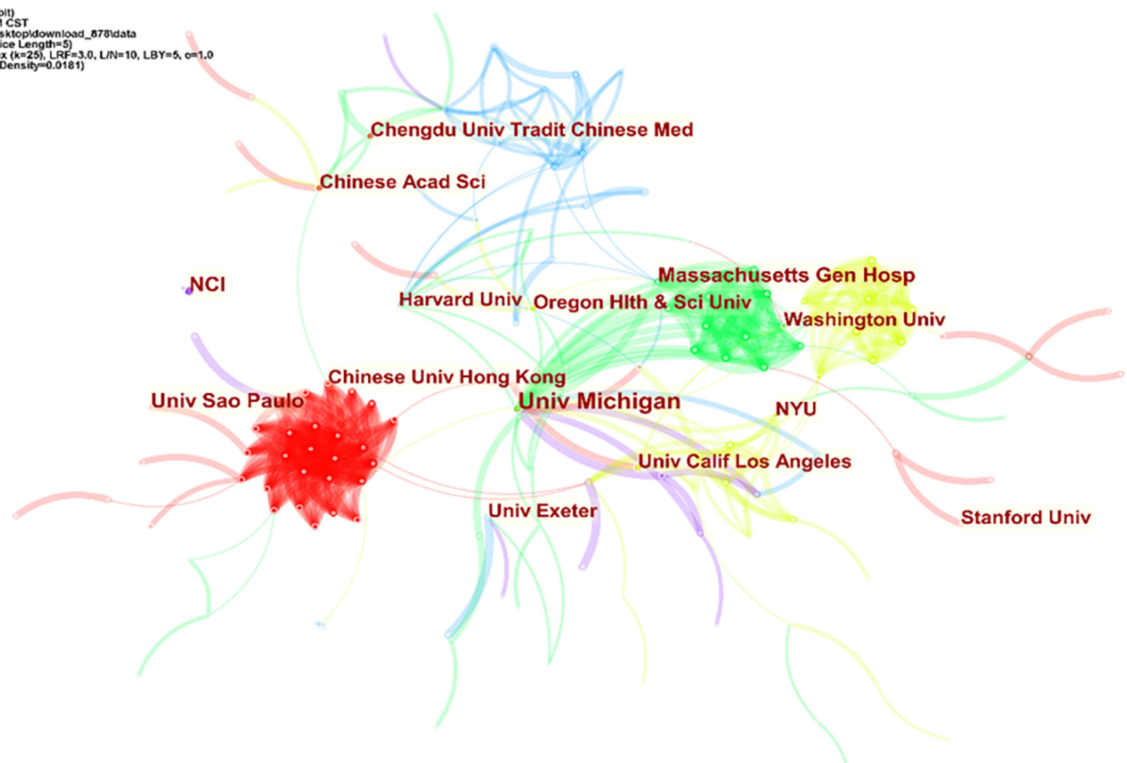
The research results of the most prolific or influential authors can inspire later researchers in the field, and at the same time, it is also conducive to researchers finding reliable collaborators. As **Figure 7** shows, we identified 306 researchers who contributed to the publications over two decades. **Table 5** shows the top 10 most productive and cited authors. As the most productive author, Yiwen Lin contributed 11 articles in this realm. As a professor at China Medical University, Yiwen Lin, engaged in carving animal models to study the physiological mechanism of acupuncture in the treatment of fibromyalgia syndrome.^{29–31} And the highest cited paper (Citation:115) is written by Wolfe Frederick, who comes from the University of Kansas School of Medicine. Wolfe Frederick has engaged in the study of new clinical symptoms, the evaluation of treatment criteria, and the phenomenon of multimorbidity of fibromyalgia Syndrome in recent years.^{32–34} Wolfe Frederick is the most cited and influential author in the field of acupuncture for fibromyalgia, as assessed by CiteSpace software, indicating that Wolfe Frederick's scientific findings are heavily cited by researchers in the field of

Table 3 Top 10 Publications and Centrality of Countries of Acupuncture for FMS

Rank	Count	Country	Centrality	Country
1	285	USA	0.450	USA
2	135	China	0.140	Italy
3	62	Italy	0.140	Australia
4	62	Spain	0.090	Germany
5	58	Brazil	0.060	China
6	43	United Kingdom	0.050	Spain
7	37	Germany	0.050	Sweden
8	36	Netherlands	0.050	Egypt
9	26	Canada	0.040	Canada
10	24	France	0.040	Poland

A

CiteSpace, v. 5.8.R3 (64-bit)
 April 13, 2022 4:09:52 PM CST
 WoS: C:\Users\17684\Desktop\download_87\data
 Timespan: 2009-2022 (Slice Length=5)
 Selection Criteria: g-index (k=25), LRF=3.0, L/N=10, LBY=5, o=1.0
 Network: N=255, E=585 (Density=0.0181)
 Largest CC: 145 (56%)
 Nodes Labeled: 1.0%
 Pruning: Pathfinder



B

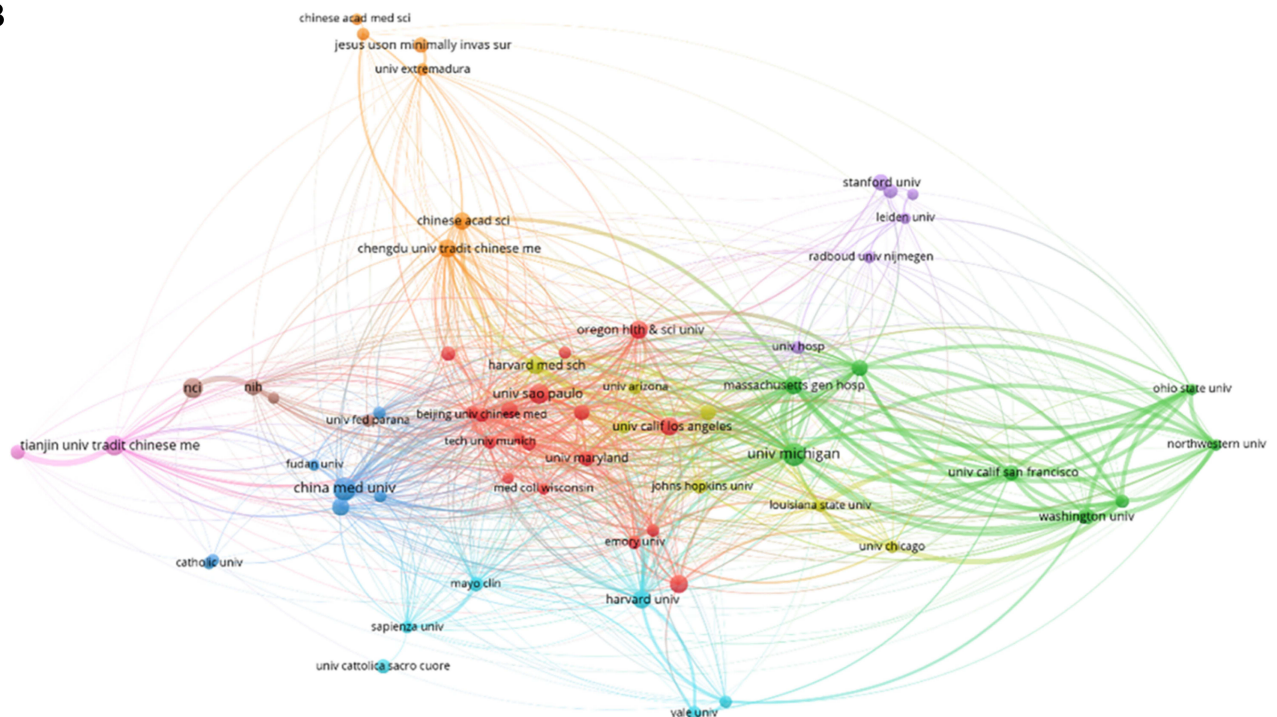


Figure 6 (A) Visualization map of institutions involved in Acupuncture Therapy for fibromyalgia syndrome (CiteSpace). Larger circles and fonts in this figure indicate that the research institution is more influential in the field of acupuncture for fibromyalgia. **(B)** Visualization map of institutions involved in Acupuncture Therapy for fibromyalgia syndrome (Vosviewer). The more identical the colors in the images generated by Vosviewer, the more likely it is that the institution will tend to cooperate.

Table 4 Top 5 Publications and Centrality of Institutions of Acupuncture for FMS

Rank	Count	Institutions	Country	Centrality	Institutions	Country
1	17	Univ Michigan	USA	0.180	Brown Univ	USA
2	16	China Med Univ	China	0.150	Univ Michigan	USA
3	14	NCI	USA	0.150	Massach Usetts Gen Hosp	USA
4	13	Tianjin Univ Tradit Chinese Med	China	0.150	Cleveland Univ	USA
5	13	Univ Sao Paulo	Brazil	0.140	Univ Penn	USA

acupuncture for fibromyalgia. As a long-time leading expert on the diagnostic criteria and pathogenic factors of fibromyalgia, Wolfe Frederick has been cited by researchers in the field of acupuncture for fibromyalgia, despite not having published directly on the subject, which makes him the most influential author in the field. In the light of Price's Law, the quantity of papers published by the lowest prolific author among the core authors is equal to 0.749 times the amount of thesis published by the highest prolific authors, as follows: $m \approx 0.749$ ($n_{\max} 1/2$). Among them, m is the number of papers published by the lowest prolific author among the core authors, while the n_{\max} is the number of theses published by the highest prolific authors.

It could be calculated that the accounts core authors are at least 3 in the field of acupuncture treatment for FMS. The total core authors was 101, about 33.0% of the total 306 authors, and 421 published articles, accounting for 48.5% of the total from 2000 to 2021, respectively. Based on Price's Law, we could conclude that the core team of acupuncture for FMS still no exist because the publications of the core team should come up to half of the whole publications.

Analysis of Reference

Literature on the same topic is clustered together so that researchers in different research directions can easily find relevant literature. Figure 8 shows the scientific correlation between the published papers. Besides, the mean silhouette of all 11 major clusters is 0.9577 (Table 6), which indicated the network map has a high-quality cluster analysis. Among these 11 clusters, Alternative medicine, Rheumatic condition, Mouse model, Chronic pain, and fibromyalgia syndrome treatment are the top 5 contour values, all above 0.98. Among them, fibromyalgia syndrome treatment and Rheumatic condition are related to the definition of fibromyalgia syndrome guidelines and are not analyzed here, the largest contour value is Alternative medicine, which indicates that researchers in this field realized early that the efficacy of alternative

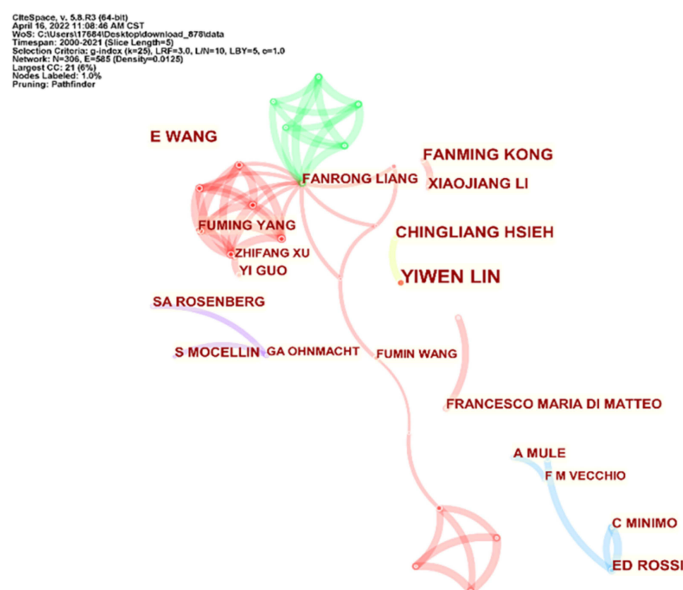


Figure 7 Visualization graph of co-cited authors of Acupuncture for fibromyalgia syndrome. The size of the circle and the author's name in the figure represent the size of that author's influence in the field of acupuncture for fibromyalgia, while authors connected by the same color line indicate the existence of the collaborative relationship.

Table 5 Top 10 Productive Authors and Co-Cited Authors of Acupuncture for FMS

Author	Published Articles	Co-Cited Author	Cited Times
Yiwen Lin	11	Wolfe F	115
E Wang	8	Berman Bm	51
Chingliang Hsieh	7	Deluze C	47
Fanming Kong	7	Harris Re	46
Xiaojiang Li	6	Langhorst	42
Ed Rossi	6	Assefi Np	42
Fuming Yang	5	Han Js	41
Sa Rosenberg	5	Ernst E	41
Francesco Maria Dm	5	Martin Dp	40
S Mocellin	5	Bennett Rm	39

medicine in the treatment of FMS. Chronic pain is the most recent cluster (2017), indicating that researchers are gradually increasing their research on the long-term efficacy of acupuncture in the treatment of FMS, which may become the next new hot research direction. The mouse model is a cluster that emerged in 2015 and has a profile value of 0.989, ranking third, indicating that researchers are gradually transforming from clinical trials focusing only on acupuncture for FMS to using animal experiments to study the physiological mechanisms behind it.

As Table 7 shows, the review written by Wolfe et al published in *Seminars in arthritis and rheumatism* in 2016³⁵ is the most cited publication. This article reviewed 14 studies to provide a 2016 update to the classification and clinical criteria. The criteria modified by Wolfe et al not only function as diagnostic criteria but also are useful for classification. Among the top 10 kinds of literature, the newest article was written by Karata Saliha and his collaborators in 2018, which showed that acupuncture has a clear advantage in the long-term effect of FMS compared with the placebo group or sham

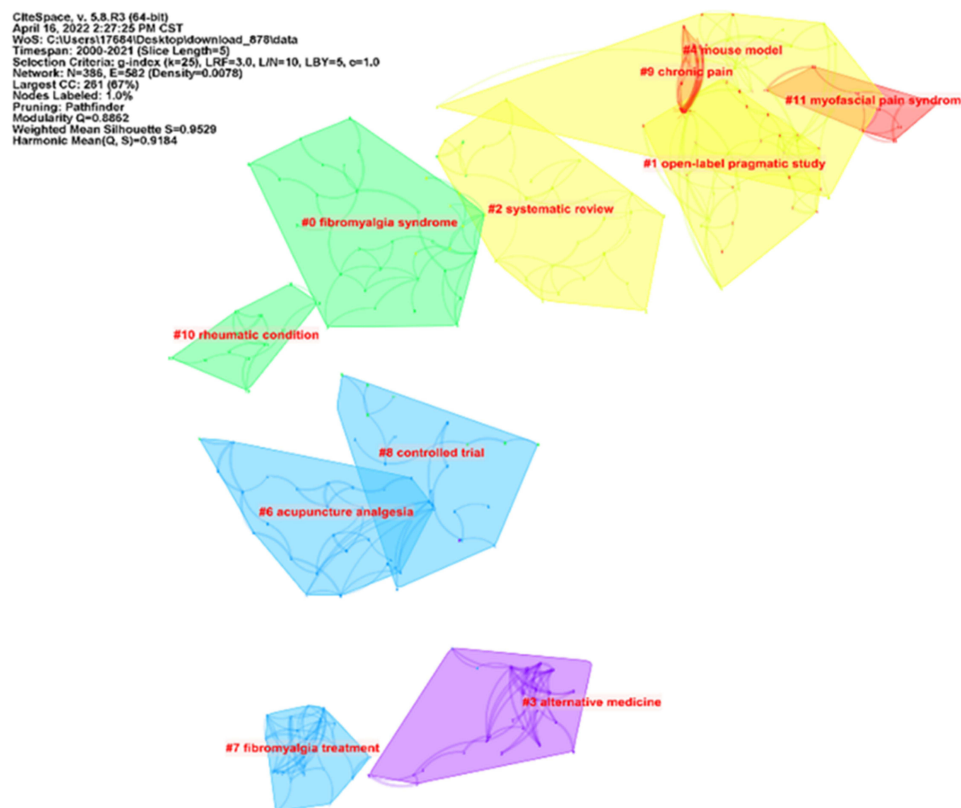


Figure 8 Co-cited references of acupuncture for fibromyalgia syndrome. A total of 11 clusters representing different research directions were generated for this study. The higher the contour values of each cluster, the greater the impact of the research direction in the field of acupuncture for fibromyalgia.

Table 6 Top 11 Clusters of References Related to Acupuncture for FMS

Cluster	Size	Silhouette	Mean (Year)	Label (LLR)
0	33	0.911	2010	Fibromyalgia Syndrome
1	30	0.943	2017	Open-Label Pragmatic Study
2	30	0.923	2013	Systematic Medicine
3	28	1.000	2000	Alternative Medicine
4	28	0.989	2015	Mouse Model
6	28	0.906	2005	Acupuncture Analgesia
7	26	0.980	2003	Fibromyalgia Syndrome Treatment
8	24	0.954	2006	Controlled Trial
9	13	0.985	2017	Chronic Pain
10	12	0.996	2008	Rheumatic Condition
11	9	0.948	2016	Myofascial Pain Syndrome

Table 7 Top 10 Co-Cited References in Acupuncture Treaty on FMS

Study (First Author, Year)	Citation	Centrality
Wolfe Frederick, 2016 ³⁵	604	0.040
Carville Sf, 2008 ³⁶	504	0.030
Martin Dp, 2006 ³⁷	99	0.080
Harris Re, 2005 ³⁸	89	0.100
Deare JC, 2013 ³⁹	83	0.140
Lu Kw, 2016 ⁴⁰	52	0.010
Martin-Sanchez, 2009 ¹⁸	36	0.010
Jorge Vas, 2016 ⁴¹	32	0.130
Karata Saliha, 2018 ⁴²	30	0.020
Bai Y, 2014 ⁴³	30	0.010

acupuncture group, and it is speculated that the physiological mechanism of treatment may be related to changes in serum serotonin. In addition, the highest centrality article was Acupuncture for treating fibromyalgia published by Deare in 2013,³⁹ which included nine clinical trials (395 participants) to evaluate the efficacy and safety of acupuncture for FMS. The researchers concluded that: in terms of efficacy, electroacupuncture was found to be more effective than traditional acupuncture in reducing pain and stiffness, and improving sleep and fatigue, and the efficacy of acupuncture for treating FMS often lasted for one month, but rarely for more than six months.

The reference timeline map (Figure 9) is clustered in the papers in chronological order. It can be obtained from Figure 6B that the research directions represented by these four clusters (#1 Open-label pragmatic study, #4 Mouse model, #9 Chronic pain, #11 Myofascial pain syndrome) are recent research hotspots, and also indicate the research directions of new research hotspots. Among these four research directions, the node size and the silhouette value of #1 Open-label pragmatic study are the maximum values, indicating that the cluster represents the research direction that is not only popular at present but will still have a high influence in the future. Marco Di Carlo has published related studies on this theme in 2020⁴⁴ and 2021⁴⁵ respectively. The former believe that acupuncture has a significant effect on the treatment of FMS, while the latter believes that acupuncture has good results in treating abdominal and forearm FMS. Behind the #1 Open-label pragmatic study is the #4 Mouse model, which may be related to Yiwen Lin, the most prolific author in this field because his published literature focuses on animal experiments on acupuncture treatment for FMS. To a certain extent, it affects the clustering of papers, which is also in line with the impact of the most prolific authors on related fields in Price Law.

We seek kinds of literature that had a citation burst in recent years to track the evolution of references. According to the alluvial diagram (Figure 10), the article authored by Zucker⁴⁶ has been cited from 2019 to 2021, the study included 144 subjects and finally proved that the role of acupuncture in the treatment of FMS has been underestimated in the past, and it is believed that a personalized treatment plan should be developed as much as possible.

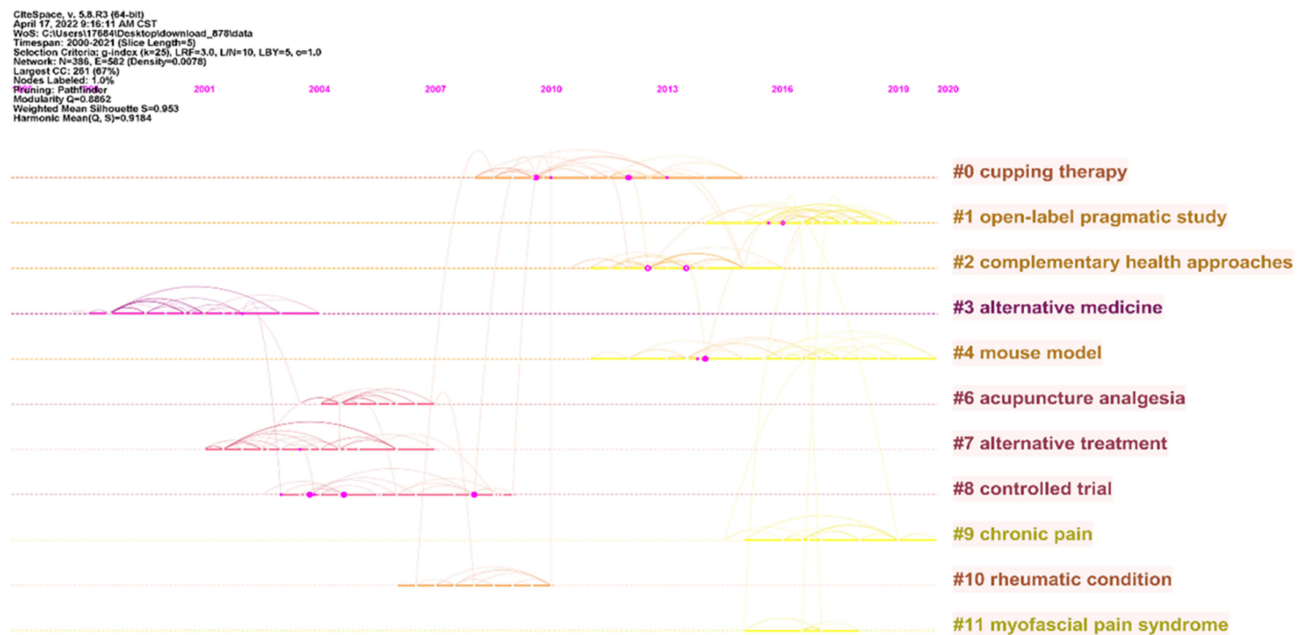


Figure 9 Timeline view of acupuncture for fibromyalgia Syndrome. In the map, the later the timeline corresponding to each cluster indicates that the more likely the cluster is to become a new research hotspot.

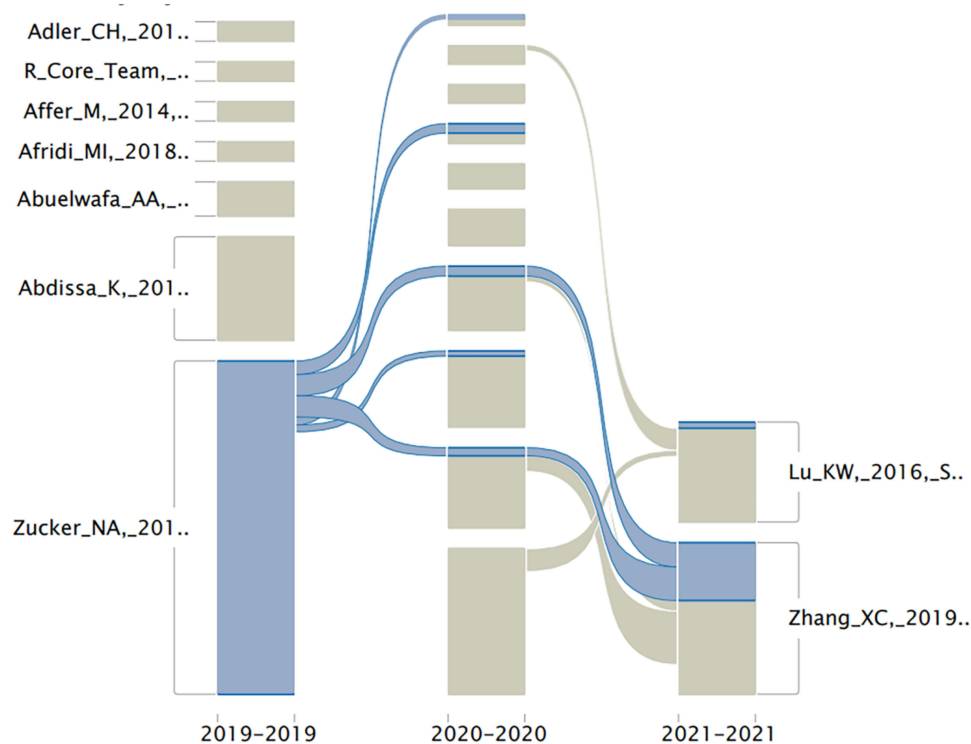


Figure 10 Alluvial flow map of acupuncture for fibromyalgia syndrome in the last 3 years. The blue portion of the Alluvial flow map indicates the evolution of the field of acupuncture for fibromyalgia over the last 3 years.

Analysis of Keywords

The central idea and research field of the article are reflected in the keywords, and the use of keyword analysis is beneficial to study the hotspots in the field of acupuncture in FMS. Therefore, we shaped three clusters of keywords by Vosviewer (Figure 11B), including therapeutic methods, clinical trials, and clinical symptoms

(Table 8). On the other hand, we create a keyword visualization graph to analyze the relationship between different subjects by CiteSpace (Figure 11A). Unsurprisingly, the most frequent occurrences involved acupuncture and FMS, while the other top 10 keywords were management, pain, therapy, randomized controlled trial, low back pain.

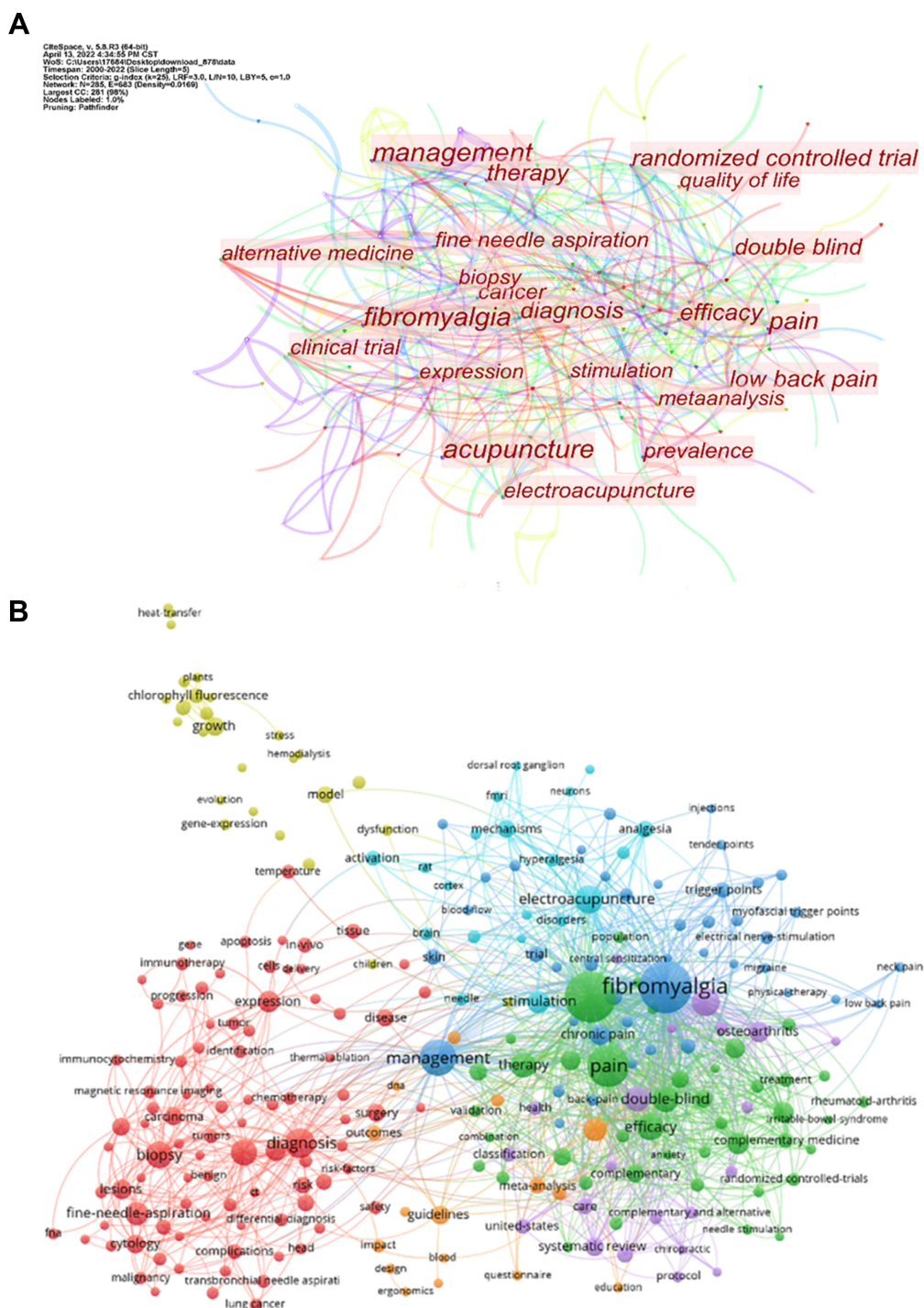


Figure 11 (A) Visualization graph of keywords of acupuncture for fibromyalgia Syndrome (CiteSpace). Keywords with larger font sizes in this figure indicate that those keywords appear more frequently in the field of acupuncture for fibromyalgia. **(B)** Visualization graph of keywords of acupuncture for fibromyalgia Syndrome (Vosviewer). Keywords with similar content in this chart will be marked with the same color for classification and analysis.

Table 8 Keywords in the Acupuncture Treaty on FMS

Category	Keyword	Centrality	Count
Therapeutic Method	Management	0.040	70
	Acupuncture	0.120	69
	Therapy	0.020	46
Clinical Trials	Diagnosis	0.070	42
	Efficacy	0.040	40
	Double Blind	0.080	38
	Randomized Controlled Trial	0.090	44
Clinical Symptoms	Fibromyalgia Syndrome	0.040	76
	Pain	0.050	64
	Low Back Pain	0.030	43

Abbreviations: FMS, Fibromyalgia Syndrome; WoS, Web of Science; SCI-Expanded, Science Citation Index Expanded; NSAIDs, Nonsteroidal Anti-inflammatory Drugs; EULAR, European League Against Rheumatism; the USA, the United State of America; UK, United Kingdom; NCI, National Cancer Institute; ACR, American College of Rheumatology.

We explored the keywords with strong citation bursts by CiteSpace, and identified the top 10 of them (Figure 12). Over the two decades, criteria ranked first (4.0896), followed by melanoma (3.9375) and core needle biopsy (3.7288). Among the top 10 keywords with the strongest citation bursts, we mainly pour attention to the keywords that began to burst after 2015 to understand the research hotspot. As Figure 12 shows, electroacupuncture is the newest keyword, followed by core needle biopsy, reliability, and prevalence. Electroacupuncture, as a product of traditional acupuncture therapy, mainstream medicine combined with modern technology, can play a standardized role in clinical trials or animal experiments of acupuncture for FMS, minimizing the problems of traditional acupuncture therapy to ensure the “double-blind” design. In addition, a study by John C Dearel³⁹ also demonstrated that electroacupuncture can provide better results compared to traditional acupuncture therapy. Notably, recent attention involves the modification of criteria and animal experimentation, indicating this is the research hotspot at present.

Top 10 Keywords with the Strongest Citation Bursts

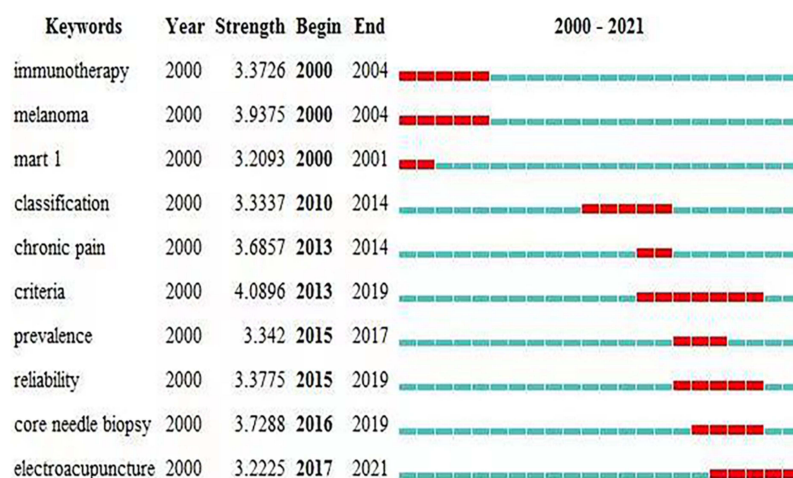


Figure 12 Keywords with the strongest citation bursts of Acupuncture in fibromyalgia Syndrome. In this figure, nodes with suddenness turn red, indicating that the keyword appears in large numbers in a certain period.

Discussion

FMS, the clinical diagnostic criterion and treatment first proposed by the American College of Rheumatology (ACR), is characterized by chronic widespread pain, persistent fatigue, depression and sleep disturbances, and cognitive dysfunction, and ultimately leads to impaired body function and decreased quality of life, often accompanied by complications such as migraine, bladder pain, and temporomandibular joint dysfunction.¹ However, the mechanism by which it arises is currently unknown. Although the commonly used treatments include medication, psychotherapy, and exercise, most of these methods suffer from high side effects and poor results, while the effectiveness of acupuncture in FMS has been proven.^{9,22,42} However, researchers currently do not grasp the research hotspots of acupuncture for FMS. Therefore, this study included 868 papers on acupuncture for FMS in the core database web of science from 2000 to 2021, using the visualization tools Vosviewer and CiteSpace used for analysis to further understand the current status of research and new research hotspots in this field.

General Information

This study analyzes 868 publications from 2000 to 2021 through bibliometrics methods, predominantly involving articles (74%), reviews (12%), and meeting abstracts (6%).

In the last two decades, the change in the number of publications has three distinctly different periods, as follows:

- Phase I (2000–2007): the early stage of development, during which research achievements on acupuncture for FMS increased slowly (as shown in Figure 1A). The average publication of this period is 22.6. As the reference timeline map (Figure 9) shows, the researchers are concerned about the mechanism of acupuncture analgesia and the role of alternative medicine at that time.
- Phase II (2008–2014): stationary period, the result section of this stage increased at a steady rate. The average publication of this period is 37. Figure 9 shows the research of “cupping therapy” and “controlled trial” was the mainstream at that date.
- Phase III (2015–2021): rapid development period, during which acupuncture for FMS research output increased rapidly. The average publication of this period is 61.1. According to the results of the reference timeline map, the researchers pay more attention to the “Open-label pragmatic study”, “Mouse model”, “Chronic pain”, “Myofascial pain syndrome”.

In terms of the number of papers contributing to acupuncture for FMS, the top 10 journals with the largest number of publications accounted for 13.59%. Evid-Based Compl Alt (IF2020 2.63,23 publications) was the most productive journal, followed by J Altern Complement Med (IF2020 2.582,18 publications), and Acupuncture in Medicine (IF2020 2.267,14 publications). In addition, the best part of the thesis was published in Medicine, Medical, and Clinical journals, while cited journals from Sports, Rehabilitation, and Sport in great measure. Therefore, we can conclude that high-level papers have markedly increased and most of them are published in the medical field. However, the research findings were applied in the rehabilitation field.

Among the top 10 countries, six were situated in Europe, two in North America, one in Asia, and one in South America. Consistently, the research of acupuncture in FMS has been prominent in advanced countries, such as the USA, Italy, Spain, etc. The results of the centrality assessment show that researchers in the USA have a potent effect on the field of acupuncture in FMS. Except for possible genetic differences, this circumstance is probably related to higher levels of medical care in developed countries. Therefore, with the development of the economy and technology, there is no doubt that acupuncture treatment for FMS will receive increasing emphasis from the research community in the future. Among the top 5 institutions, two were from the USA, two were from China, and one was from Brazil. Unfortunately, as the network visualization map of institutions (Figure 6A) shows, international cooperation is still lacking. The USA is the leading country in the field of acupuncture for FMS. On the other hand, although the research level is still low, the research trends in this field in developing countries have developed rapidly.

Among the 306 researchers in this field, Yiwen Lin is the most productive author, whereas Wolfe Frederick has the greatest influence in this field. The research areas of the former center on the physiological mechanism of acupuncture in the treatment of FMS while the latter is one of the framers of the criteria of FMS. However, according to Price's Law, the core author still has not demonstrated in this research area. Besides, the cooperation between researchers is relatively scattered.

Research Hotspots

According to the analysis of reference co-citation, the criteria of FMS, such as its classification and clinical criteria, as the physiological mechanism of treatment of acupuncture in FMS, will become the new research direction probably. Specifically speaking, as the reference timeline map shows, all of the clusters, such as #0 cupping therapy, #1 open-label pragmatic study, #2 complementary health approaches, #3 alternative medicine, #4 mouse model, #6 acupuncture analgesia, #7 alternative treatment, #8 controlled trial, #9 chronic pain, #10 rheumatic condition, #11 myofascial pain syndrome, the main focus involved the therapeutic methods of FMS, the analgesic mechanism of acupuncture in FMS, the development of clinical trial and animal experiment, etc. To grasp the research trend of this field, we should attach importance to the latest four clusters (#1 Open-label pragmatic study, #4 Mouse model, #9 Chronic pain, #11 Myofascial pain syndrome). All of them show that researchers pay more attention to the long-term treatment effects and the basic research of this field.

Burst detection is an effective method to find the focus of research increasing abruptly in a specific realm. Our analysis revealed that the keyword "criteria", was the current hotspot in this field. After years of development, the criteria of FMS were improved constantly. In fact, since the ACR guidelines for fibromyalgia were established in 1990, relevant clinical trials have increased constantly, and now the diagnostic criteria have gradually become clearer. Researchers still do not recommend first-line drug treatment but have gradually begun to recognize the role played by alternative medicines in treatment, such as acupuncture. In recent years, Sarzi-Puttini,⁴⁷ Wolfe,⁴⁸ Maffei,⁴⁹ and Galvez-Sánchez⁵⁰ have published their opinions and relevant research results on the revision of diagnostic and therapeutic criteria for FMS, and researchers believe that a combination of protocols should be used to develop individualized treatment. The burst intensity of melanoma and core needle biopsy is second only to the criteria, demonstrating that accompanying symptoms related to FMS, such as, tumors, also have the potential to become a hot spot for new research in recent years. In 2019, a study has proved that fibromyalgia syndrome is associated with increased mortality from cancer.⁵¹

The results suggest that the improvement of treatment criteria and efficacy assessment criteria for acupuncture in the treatment of FMS, especially for individualized treatment protocols, has been a hot topic of research in this field for a long time, indicating that researchers have long been concerned about this area. In addition, alternative therapies such as acupuncture and individualized treatment protocols have been mentioned in recent revisions of guidelines related to FMS. At the same time, the physiological mechanisms of acupuncture in the treatment of FMS and related animal studies have also become a hot topic of research. In recent years, the role of electroacupuncture in the treatment of FMS has begun to emerge as a new research topic.

Limitation

However, given the research status of acupuncture in FMS, we believe that there are still many limitations: (1) Research design: At present, the field is mostly clinical trials, lacks basic research and animal experiments, and due to the particularity of acupuncture therapy itself, most clinical trials have not reached the "double-blind" design, and there is a lack of multi-center clinical trials. (2) Institutional cooperation: On the one hand, the lack of transnational cooperation. Institutional cooperation between Europe and North America is close, but there is less cross-border cooperation on other continents, mostly domestic cooperation; on the other hand, regional development is uneven. At present, most of the research institutions and achievements are concentrated in developed countries while only a few developing countries, such as China, Brazil, and Egypt, carry out relevant research. Therefore, researchers should analyze relevant clinical experience and research results with each other to strengthen multinational cooperation. (3) The limitations of the bibliometric software: it is impossible to deal with multiple language databases at the same time, the algorithm problem of the software itself, etc., which may have a certain impact on the research results, and the software can only be used to analyze keywords, references, authors and institutions, countries, etc., instead of the entire content of the 868 documents included, which may cause some information omissions.

Conclusion

The specific mechanism of action of acupuncture in the treatment of FMS is still unclear, but its clinical efficacy has been confirmed by several relevant clinical trials, and a review¹⁸ also pointed out that nearly a quarter of patients with FMS currently choose acupuncture as their treatment option. However, the current research results in the field of acupuncture for FMS are scattered, making it difficult for researchers and clinicians to keep abreast of the research results and new research trends in this field, increasing unnecessary time and economic costs. Therefore, in this paper, we use the bibliometric software CiteSpace and Vosviewer to visualize and analyze the research results of acupuncture in the treatment of FMS, so that researchers can save time and improve efficiency.

The results of this paper show that (1) concerning the current status of research: the number of relevant publications has grown rapidly in recent years and the level of published journals is high, indicating that the quantity and quality of research results on acupuncture for FMS are improving. In addition, from a geographical perspective, the country distribution of acupuncture for FMS is relatively broad, showing a diverse international layout. However, in terms of the number of high-level research institutions as well as researchers, the high-level output in this field is still concentrated in the USA and China. (2) Research hotspots: Through the analysis of bibliometric software CiteSpace and Vosviewer, we can conclude that new research trends in acupuncture for fibromyalgia will focus on the long-term efficacy of acupuncture on FMS, animal experiments, and the role of other alternative medicine will also be increasingly emphasized. In addition, electroacupuncture, as a combination of traditional Chinese medicine and modern technology, is playing an increasingly important role in clinical as well as experimental design because it can work at a stable frequency during use and reduce the impact of the acupuncturist on the patient during manipulation.

This study visualizes the current state of research and scientific hotspots in the field of acupuncture for FMS, which will help researchers to accurately grasp research trends promptly and find suitable research collaborators, thus increasing efficiency, reducing unnecessary costs, and ultimately promoting future development of the field, thereby alleviating patient pain.

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Disclosure

The authors report no conflicts of interest in this work.

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