

# Research Trends of Moxibustion Therapy for Pain Treatment Over the Past Decade: A Bibliometric Analysis

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**Background:** Accumulate evidence indicated that moxibustion has a positive effect on pain treatment. However, the bibliometric analysis of moxibustion on pain remains uncertain. Herein, this study aimed to explore the current hotspots and the research trends over the past decade to bring a great panorama in this field.

**Methods:** Publications were retrieved from the database Web of Science Core Collection (WoSCC) related to moxibustion therapy for pain treatment from January 1, 2012, to December 31, 2021. CiteSpace and Excel were applied to analyze the volume of publications, journals, cited journals, dual-map analysis, countries, institutes, authors, references, and keywords with citation bursts.

**Results:** A total of 360 publications were retrieved from 2012 to 2021. The annual number of publications increased steadily with some fluctuations over the past 10 years. “The Evid Based Complement Alternat Med” and “the Gut” were the top-cited journals in frequency and centrality. *China* and *Shanghai University of Traditional Chinese Medicine* were the most prolific country and institutions, respectively. Among authors, Huang Wu was the most active author with the highest cited frequency. Jun Xiong, Fanrong Liang and Guixing Xu held the articles with higher centrality. In the ranking of frequency and centrality in cited references, the top one was the article published by Shamseer L and Deng HY, respectively. “Acupuncture” was the keyword with the highest frequency. Pain disease (including rheumatoid arthritis, knee osteoarthritis, herpes zoster), research method (including randomized controlled trial), and risk (including quality of life, economic burden, physical and psychological problems) were the hotspots and frontier trends in this field.

**Conclusion:** This bibliometric study reveals the current status and research trend in the treatment of pain with moxibustion. The formulation with bibliometric analysis further elicits hot spots and frontier issues in this field.

**Keywords:** moxibustion, pain, CiteSpace, bibliometric analysis

## Introduction

Pain is an unpleasant sensory and emotional perception associated with actual or underlying tissue pathology, which can bring major clinical, social, and economic problems in communities around the world. Notably, pain appears to have a greater negative effect on the quality of life than other diseases, and is also the greater cause of disability around the world.<sup>1</sup> It was estimated that more than 20% of the population visit the clinic with pain as the main complaint each year.<sup>2</sup> Additionally, pain also creates enormous economic pressure on society, with a total cost of about 3.0% of GDP.<sup>3</sup> Unfortunately, treatment options for pain are poorly targeted due to the complex etiology and recurring symptoms. As commonly identified, pain disease can be the classification by time (acute or chronic), etiology (traumatic, pathological, neurogenic, etc.), location (head and neck, spine and joint, etc.) and other methods. Pharmacological therapy options can relieve pain in a short time but the safety concerns of using muscle relaxants, non-steroidal anti-inflammatory drugs or other painkillers need to be fully evaluated. Thereby, effective complementary and alternative therapies attract both patients and practitioners.<sup>4</sup>

Moxibustion, a typical therapeutic procedure of traditional Chinese medicine (TCM), which restores the function of visceral organs and meridians by applying heat from burning herbs such as moxa to a certain area or acupoints, is widely sought after and used in the current healthcare system.<sup>5</sup> It cures disease by stimulating specific spots on the skin to treat many medical conditions such as asthma, colds and influenza, irritable bowel syndrome (IBS), cancer-related fatigue, disorders of the spinal column, pain, and others.<sup>6–10</sup> Accumulating evidence indicates that the combined effect of thermal effects and non-thermal radiation effects of pharmacological responses such as smoke and moxa extracts contribute significantly to the overall analgesic efficacy of moxibustion treatment.<sup>11</sup>

Preliminary studies were carried out to show the benefits of moxibustion in recent years. The current discussions show that moxibustion treatment was an efficient and safe option for the treatment of pain, including arthritis,<sup>9</sup> dysmenorrhea,<sup>10</sup> low back pain or neck pain,<sup>12</sup> and some other disorders. These trials had been shown that moxibustion can significantly relieve pain and improve function in patients. However, the kinds of literature in this field were diversified and had not been systematically classified and sorted out. Therefore, bibliometric analysis was needed to summarize the current research trend and elicit hotspots in this field. These dissertations seek to investigate the use of moxibustion in analgesia aiming to analyze the current status of moxibustion research for pain disease.

Bibliometrics is a quantitative analysis of published academic literature by using mathematical and statistical methods, and it is a statistical analysis and quantitative tool to study publications.<sup>13</sup> Based on mathematical and statistical tools, bibliometrics is used to measure established and emerging research areas through co-authorship, co-citation, and co-occurrence analyses in a certain research field.<sup>14</sup> CiteSpace software typically falls into bibliometric visualization tools that can visualize and analyze emerging trends and transition patterns in scientific literature widely.<sup>15</sup>

This study aims to explore the current status of year, countries, journals, research areas, authors, keywords, and explore hot topics and emerging trends in the field of moxibustion for pain treatment over the past 10 years by using bibliometric analysis.

## Methods

### Data Acquisition

All data in this study were collected from the core collection database for WoS via the Zhejiang Chinese Medical University Library website including Science Citation Index Expanded (SCI-Expanded), Social Sciences Citation Index (SSCI), Arts & Humanities Citation Index (A&HCI) and Emerging Sources Citation Index (ESCI) on April 3, 2022. The search strategy was TS=(moxibustion OR moxa OR Moxabustion) AND TS=(pain\* OR nocicep\* OR ache\* OR analg\* OR headache\* OR migraine\* OR stomach ache\* OR abdominal ache\* OR toothache\* OR neck painweek pain OR back pain OR musculoskeletal pain OR sciatic\* OR fibromyalg\* OR neuralgi\* OR hyperalg\* OR radiculalg\* OR arthralg\* OR causalg\* OR earache\* OR cancer pain OR osteoarthritis OR arthritis). The publications' timespan ranged from 2012 to 2021. A total of 360 records were retrieved in this study. In addition, the countries, categories and language of publications were not restricted. The specific search strategies and results are shown in [Table 1](#).

**Table 1** The Topic Search Query

Set	Results	Search Query
#1	1043	((TS=(moxibustion)) OR TS=(moxa)) OR TS=(Moxabustion) Indexes = SCI-EXPANDED,SSCI,A&HCI,ESCI Timespan = 2012–2021
#2	597,422	(((((TS=(pain*) OR TS=(nocicep*) OR TS=(ache*) OR TS=(analg*) OR TS=(headache*) OR TS=(migraine*)) OR TS=(stomach ache*) OR TS=(abdominal ache*) OR TS=(toothache*) OR TS=(neck painweek pain)) OR TS=(back pain)) OR TS=(musculoskeletal pain)) OR TS=(sciatic*) OR TS=(fibromyalg*) OR TS=(neuralgi*) OR TS=(hyperalg*) OR TS=(radiculalg*) OR TS=(arthralg*) OR TS=(causalg*) OR TS=(earache*) OR TS=(cancer pain)) OR TS=(osteoarthritis)) OR TS=(arthritis) Indexes = SCI-EXPANDED,SSCI,A&HCI,ESCI Timespan = 2012–2021
#3	360	#1 AND #2

## Analysis Tool

Descriptive statistical analysis, co-occurrence analysis and cluster analysis were executed by using CiteSpace 5.8 and Excel 2016, the former mainly to achieve analysis of journals, cited journals, dual-map of cited journals, countries, institutions, authors, references, and keywords; while the latter was mainly applied to depict the annual publications. The parameters of CiteSpace were set as below: (1) time slicing: from January 2012 to December 2021, per slice represent 1 year; (2) term source: all options were selected; (3) selecting criteria: factor  $k = 25$ ; (4) pruning: pathfinder, pruning sliced networks and pruning merged network were chosen. In this multivariate, time-sharing, dynamic visualization knowledge graph, each node represented an element. The size of the circle represented the frequency of items and the width of lines served as the connection between items. The large size and warm color of a node implied that it has recently exploded with high frequency. The thick links between nodes meant a strong co-leading relationship. Additionally, the nodes with wide purple around them often represented the literature with higher centrality.

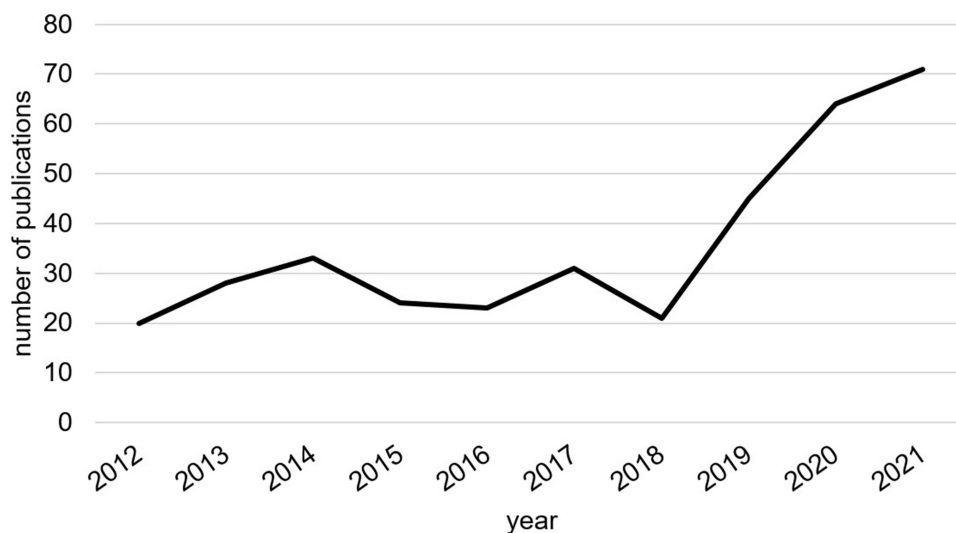
## Results

### Analysis of Annual Publications

A total of 360 publications were included in this study. As shown in Figure 1, the number of publications increased obviously from 20 in 2012 to 71 in 2021. From 2012 to 2018, the number of publications fluctuated at a low level, with the lowest number of publications being in 2012 (with only 20 publications). However, the number of publications increased rapidly in 2019. Furthermore, the number of publications increased continually is reach 71 from 2019 to 2021. The trend of publications indicated that moxibustion, as a complementary treatment, has received more attention, and more studies have been carried out to observe the efficacy of moxibustion on pain in recent years.

### Analysis of Journals and Cited Journals

Results of our statistical analysis revealed that the total number of journals that published articles on moxibustion treatment for pain was 97. The top 10 journals of moxibustion therapy for pain treatment are shown in Table 2 and the publishers of these journals were mostly located in the United States or England. *Evidence-Based Complementary and Alternative Medicine (Evid-based Compl Alt)* was the most productive journal (with 62 publications, 17.22% of 360), followed by *Medicine* (60, 16.67% of 360), and *Journal of Traditional Chinese Medicine* (20, 5.56% of 360). Furthermore, *Lancet Gastroenterology & Hepatology* the journal with the highest impact factor (IF), with an IF of 18.486.



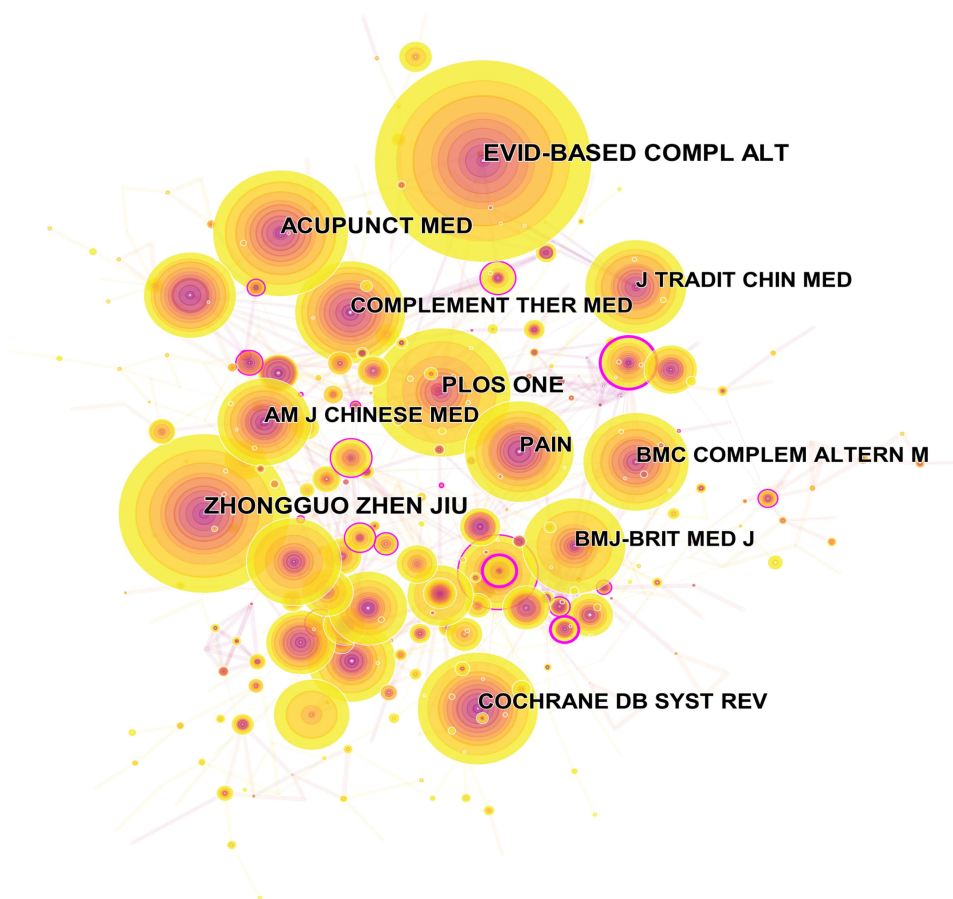
**Figure 1** The number of moxibustion therapy for pain treatment publications from 2012 to 2021.

**Table 2** Top 10 Journals Related to Moxibustion Therapy for Pain Treatment

Rank	Publications	Journal	IF	Country
1	62	Evidence-Based Complementary and Alternative Medicine	2.629	England
2	60	Medicine	1.889	United States
3	20	Journal of Traditional Chinese Medicine	0.848	China
4	11	Acupuncture in Medicine	2.257	England
5	11	European Journal of Integrative Medicine	1.314	Germany
6	10	Neural Regeneration Research	5.135	China
7	9	Trials	2.279	England
8	9	International Journal of Clinical and Experimental Medicine	0.000	United States
9	8	American journal of Chinese Medicine	4.667	United States
10	7	Chinese Journal of Integrative Medicine	1.978	China

The analysis of the co-citation of journals indicated a distribution of significant knowledge sources in a particular field. Cited journal map consists of a total of 430 references (as shown in Figure 2 and Table 3). In terms of centrality, the top 5 journals were *Gut*, *Journal of clinical epidemiology*, *JAMS Journal of Acupuncture and Meridian Studies*, *BMC Complementary and Alternative Medicine*, and *BMC Research Notes*, respectively.

A dual-map overlay with citing and cited matrices of journals was generated by using CiteSpace 5.8 software (Figure 3). The left side of the map represents citing journals while the right is cited journals which are linked with four citation paths in this illustration. The green paths illustrate that studies published in “medicine, medical, clinical” journals tended to cite journals primarily in the domains of “Molecular, Biology, Genetics” and “health, nursing,

**Figure 2** Cited journal maps related to moxibustion therapy for pain treatment from 2012 to 2021.

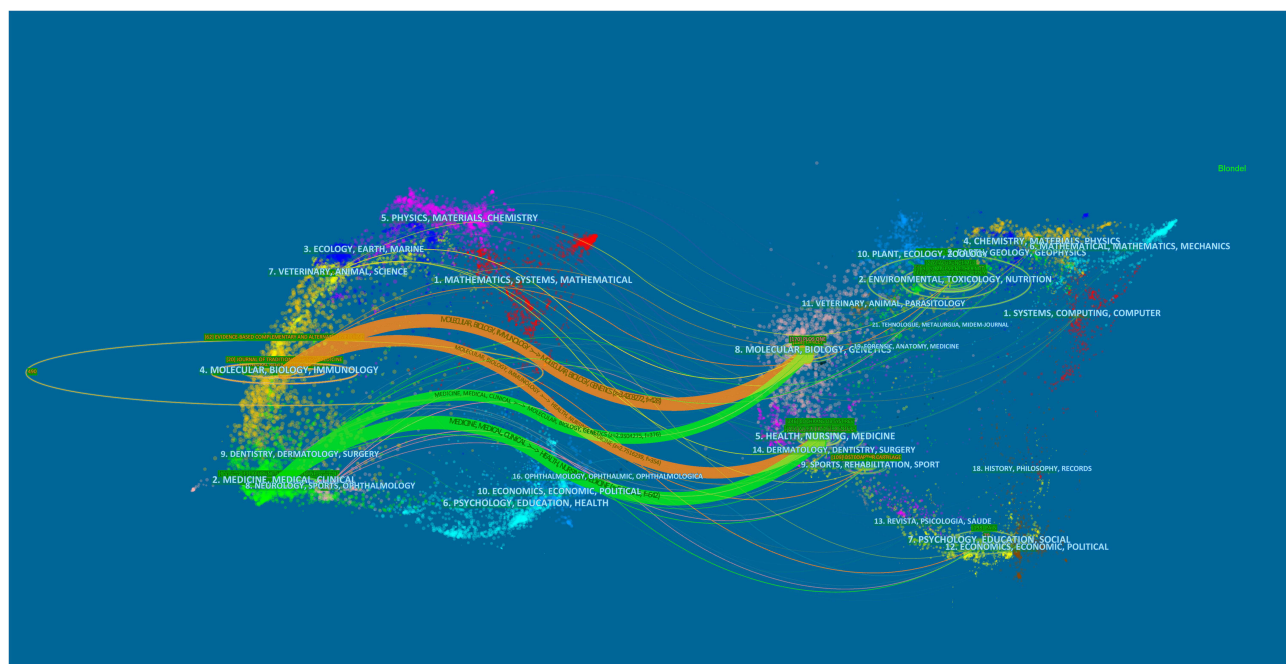
**Table 3** Cited Journals and Centrality Related to Moxibustion Therapy for Pain Treatment

Rank	Frequency	Cited Journal	IF	Country	Rank	Centrality	Cited Journal	IF	Country
1	197	Evidence-Based Complementary and Alternative Medicine	2.629	England	1	0.36	Gut	23.06	England
2	157	Zhongguo Zhen Jiu		China	2	0.21	Journal of clinical epidemiology	6.437	England
3	128	Acupuncture in Medicine	2.257	England	3	0.20	JAMS Journal of Acupuncture and Meridian Studies	1.463	Netherlands
4	127	Plos One	3.240	United States	4	0.19	BMC Complementary and Alternative Medicine	3.659	England
5	114	Cochrane Database of Systematic Reviews	9.266	England	5	0.16	BMC Research Notes	1.66	England

medicine”. The paths colored with an orange showcase that research published in “Molecular, Biology, Immunology” journals preferred to quote journals mostly in the domains of “Molecular, Biology, Genetics” and “health, nursing, medicine”.

### Distribution of Countries and Institutions

The distribution of the countries map consists of 24 nodes and 30 links (Figure 4). The 360 references were published by researchers from 24 countries, indicating that 24 countries participated in the study of moxibustion therapy for pain. As a result, China (267) had the most publications, followed by South America (37), Korea (36) and England (13) (Table 4). Considering the country centrality, England (0.83) ranked first among the countries, followed by Germany (0.7) and China (0.48).



**Figure 3** A dual-map overlay of journals related to moxibustion therapy for pain treatment from 2012 to 2021.



**Figure 4** A country cooperation map related to moxibustion therapy for pain treatment from 2012 to 2021.

CiteSpace was applied to estimate the 238 institutions that have made significant contributions in this field (Figure 5). *Shanghai University of Traditional Chinese Medicine* (44) ranked first for publications, followed by *Chengdu University of Traditional Chinese Medicine* (43), and *Jiangxi University of Traditional Chinese Medicine* (27). Besides, the top 3 institutions with higher centrality were *Chengdu University of Traditional Chinese Medicine*, *the University of Hong Kong*, and *Shanghai University of Traditional Chinese Medicine* (Table 5). Therefore, based on the publications and centrality, we found that the institutions from China paid more concerned with the research of moxibustion treatment in pain currently, and *Shanghai University of Traditional Chinese Medicine* and *Chengdu University of Traditional Chinese Medicine* was the strongest cooperation institutions.

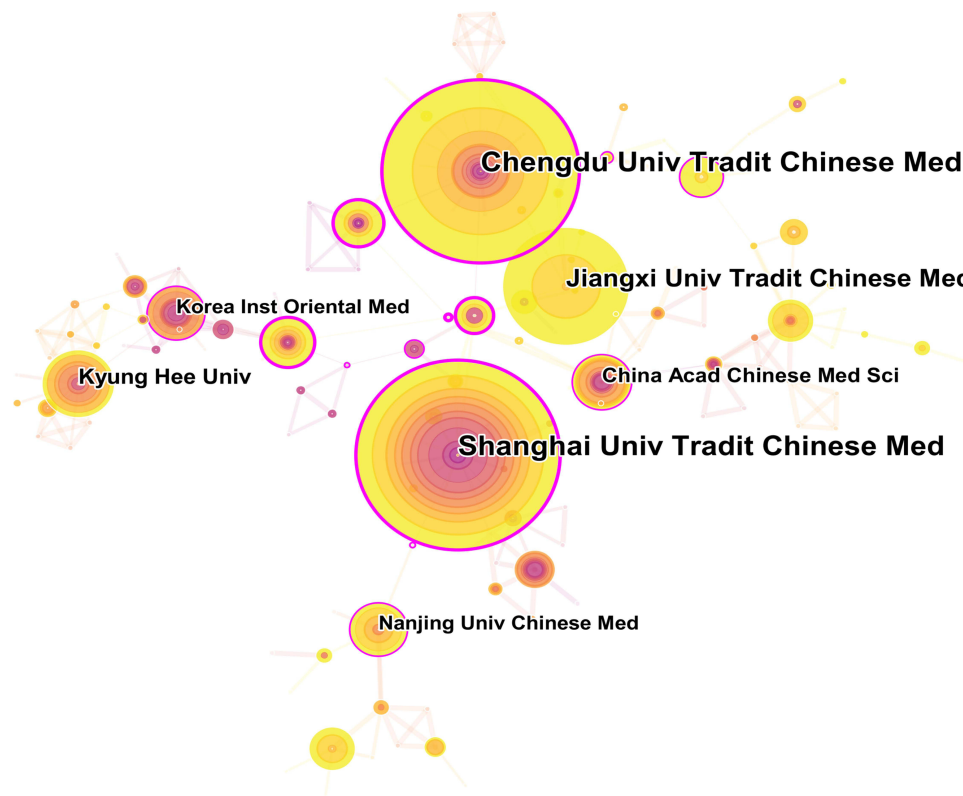
## Analysis of Authors

Co-authors map consists of 315 nodes and 418 links using CiteSpace software (Figure 6), indicating that the total eligible publications in this study were published by 315 authors. The map of authors was designed to reveal the most prolific author or co-author, as well as demonstrate the closeness of collaboration among the authors, which could provide information on influential research groups and potential collaborators, and help researchers establish cooperative relationships. The top 3 productive authors were Huangan Wu (19), Jun Xiong (18), Luyi Wu (12) (Table 6). Among them, the most prolific author was Huangan Wu, from the *Shanghai University of Traditional Chinese Medicine* in China, with 19 articles. In terms of centrality, the top 4 authors were Jun Xiong (0.06), Fanrong Liang (0.06), Guixing Xu (0.05) and Adi Wirawan Tjahjono (0.05). From the network, few links between these top authors suggest an urgent need to strengthen the collaboration between these researchers.

Lin Zhao has published many articles in this field recently, and the content of his articles is comparatively original. One of the studies suggested that moxibustion is an effective and safe approach for pain relief in osteoarthritis of the knee.<sup>16</sup> System reviews and meta-analysis had proved the effectiveness of moxibustion therapy; nonetheless, there was still a lack of high-quality articles.<sup>17</sup> Those scholars with high attainments in this field could create more cooperation and exchanges so as to complete more high-quality articles and scientific research achievements.

**Table 4** The Top 5 Publications and Centrality of Countries Related to Moxibustion Therapy for Pain Treatment

Rank	Publications	Country	Centrality	Country
1	267	China	0.83	England
2	37	USA	0.70	Germany
3	36	South Korea	0.48	China
4	13	England	0.26	USA
5	8	Australia	0.25	Singapore



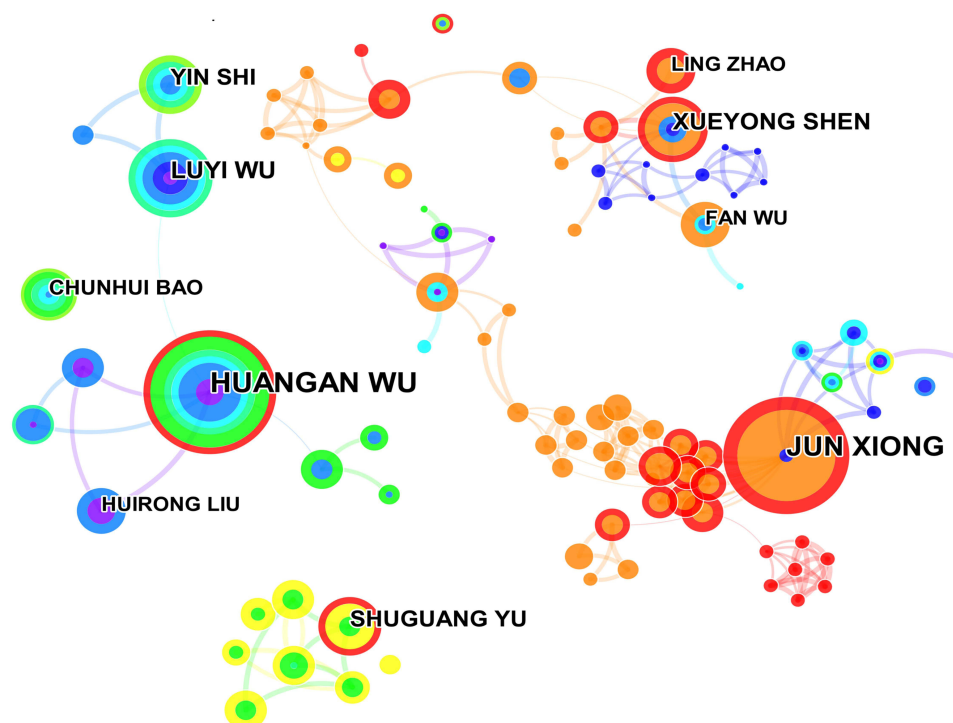
**Figure 5** An institution cooperation map related to moxibustion therapy for pain treatment from 2012 to 2021.

## Analysis of Cited-Reference

Co-citation implies that two articles appear together in the reference list of a third cited article thus the two articles form a co-citation relationship. Co-citation suggests that the cited literature and corresponding research are related in content, and the literature usually contains high-quality content which has significant influence in a particular field of research. By analyzing the literature with high co-citation frequency and centrality, the knowledge foundation of the subject could be obtained. Moreover, the relationship between literature co-citation is likely to change with time. A total of 403 references were generated from 360 records to analyze cited-references. The top 5 cited-references were shown in [Figure 7](#), [Table 7](#). The study published by Shamseer L in 2015 had the highest co-citation counts, followed by Li A (2016) and Song GM (2016), intending to clarify the clinical effect of moxibustion treatment for Knee Osteoarthritis (KOA) through a systematic Review and Meta-Analysis. The review published by Li A concluded that moxibustion can mitigate the

**Table 5** The Top 10 Publication and Centrality of Institutions Related to Moxibustion Therapy for Pain Treatment

Rank	Publications	Institution	Rank	Centrality	Institution
1	44	Shanghai Univ Tradit Chinese Med	1	0.37	Chengdu Univ Tradit Chinese Med
2	43	Chengdu Univ Tradit Chinese Med	2	0.33	Univ Hong Kong
3	27	Jiangxi Univ Tradit Chinese Med	3	0.30	Shanghai Univ Tradit Chinese Med
4	16	Kyung Hee Univ	4	0.24	Beth Israel Deaconess Med Ctr
5	14	China Acad Chinese Med Sci	5	0.23	Beijing Univ Chinese Med
6	13	Korea Inst Oriental Med	6	0.21	Capital Med Univ
7	13	Nanjing Univ Chinese Med	7	0.18	China Acad Chinese Med Sci
8	12	Beijing Univ Chinese Med	8	0.17	Korea Inst Oriental Med
9	11	Capital Med Univ	9	0.13	Nanjing Univ Chinese Med
10	11	Guangzhou Univ Chinese Med	10	0.13	Chinese Acad Sci



**Figure 6** Map of cited author related to moxibustion therapy for pain treatment from 2012 to 2021.

symptoms of KOA to some extent.<sup>18</sup> Yang MX conducted a randomized controlled trial to identify the synergy between moxibustion therapy and conventional drug.<sup>10</sup> With respect to centrality, the first was the article published in 2013 by Deng HY who reviewed on the mechanism of moxibustion effects, among which the most acceptable view is adjusting the nerve-endocrine-immune network and circulatory system to achieve the effects of preventing and curing diseases.<sup>19</sup>

To investigate the clusters of a cited-references, the logarithmic likelihood ratio (LLR) algorithm was used to assess nominal terms extracted from the keyword list of articles to the naming of clusters to explore research models and emerging trends in knowledge systems, and to obtain key information from cited references. Seventy-one clusters were generated with a modularity value of 0.86777, indicating that clustering results were highly reliable (Figure 7B). As the figure showed the silhouette was 0.8785, which demonstrated that the resulting network community structure was significant and our cluster was acceptable concurrently. The top 5 clusters were “osteoarthritis”, “primary osteoporosis”, “clinical research”, “knee osteoarthritis” and “metabolomics”. Among these groups, the largest one was “osteoarthritis”, which consisted of 38 reference articles. Cluster #53 angina pectoris was depicted in most vivid yellow which indicated a new research direction that had recently emerged.

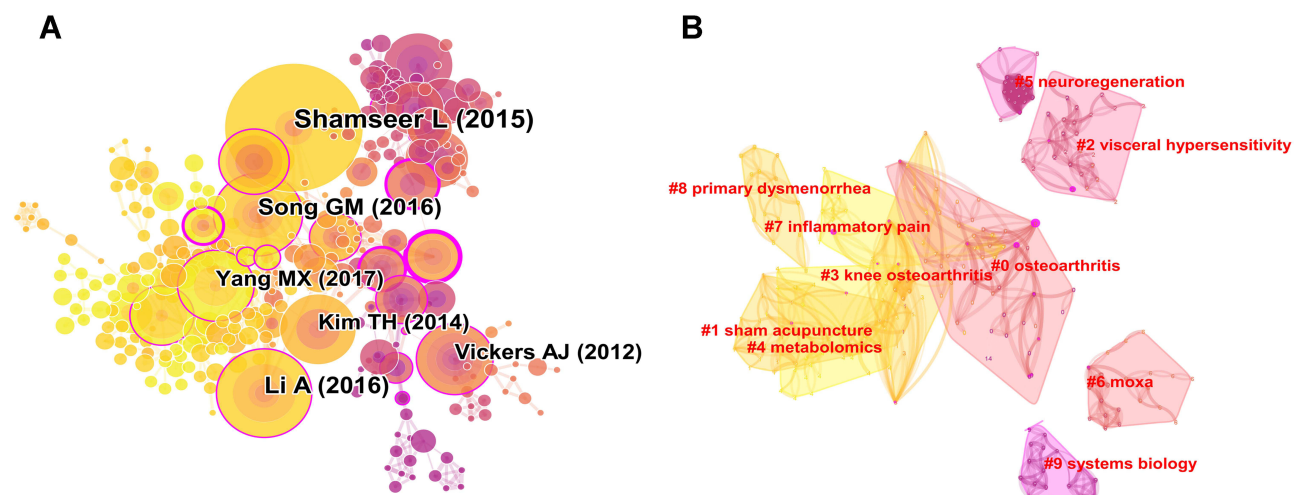
## Analysis of Keywords

The research trend in this field is often represented by analyzing keywords, the increase in occurrence and citation frequency is considered to predict the research frontier in this field. A keyword co-occurrence network containing 302 nodes and 538 links

**Table 6** The Top 5 Publication and Centrality of Authors Related to Moxibustion Therapy for Pain Treatment

RANK	Publications	Author	Centrality	Author
1	21	Huangan Wu	0.05	Jun Xiong
2	18	Jun Xiong	0.05	Fanrong Liang
3	12	Luyi Wu	0.05	Guixing Xu
4	10	Xueyong Shen	0.04	Yuan Li
5	9	Yin Shi	0.02	Xueyong Shen



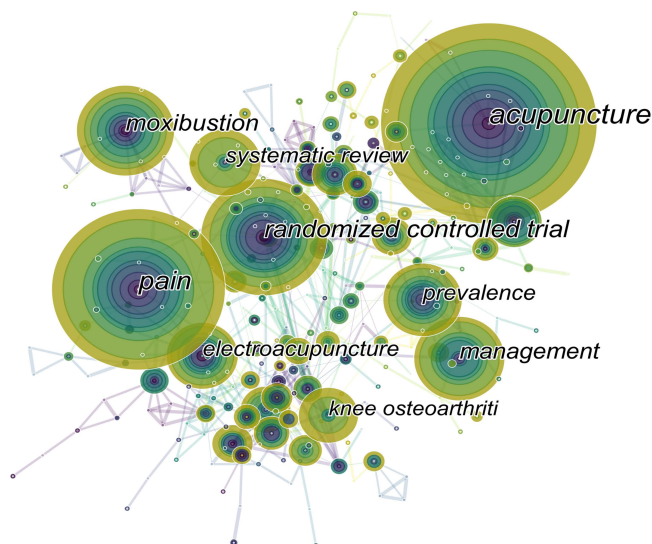


**Figure 7** (A) Map of cited references related to moxibustion therapy for pain treatment from 2012 to 2021. (B) The top 10 clusters of cited reference related to moxibustion therapy for pain treatment from 2012 to 2021.

(Figure 8). “Acupuncture”, “pain”, “randomized controlled trial”, “moxibustion”, and “management” were the top 5 keywords with the highest frequencies; while “meta-analysis”, “acupuncture treatment”, “randomized controlled trial”, “irritable bowel syndrome”, and “ankylosing spondylitis” were the top 5 keywords with the highest centrality (Table 8). Interestingly,

**Table 7** The Top 5 Frequency and Centrality of Citation Related to Moxibustion Therapy for Pain Treatment

Rank	Frequency	Reference	Representative Author (Publication Year)	Centrality	Reference	Representative Author (Publication Year)
1	22	Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation	Shamseer L (2015) <sup>38</sup>	0.49	The mechanism of moxibustion: ancient theory and modern research	Deng HY (2013) <sup>19</sup>
2	15	Moxibustion Treatment for Knee Osteoarthritis: A Systematic Review and Meta-Analysis	Li A (2016) <sup>18</sup>	0.35	Moxibustion for the treatment of osteoarthritis: a systematic review and meta-analysis	Choi TY(2012) <sup>41</sup>
3	14	Moxibustion is an Alternative in Treating Knee Osteoarthritis: The Evidence From Systematic Review and Meta-Analysis	Song GM (2016) <sup>39</sup>	0.34	Acupuncture-Induced Analgesia: A Neurobiological Basis in Purinergic Signaling	Tang Y (2016) <sup>42</sup>
4	12	Acupuncture for chronic pain: individual patient data meta-analysis	Vickers AJ (2012) <sup>40</sup>	0.28	How does moxibustion possibly work?	Chiu JH(2013) <sup>11</sup>
5	12	Moxibustion for pain relief in patients with primary dysmenorrhea: A randomized controlled trial	Yang MX (2017) <sup>10</sup>	0.19	Moxibustion inhibits apoptosis and tumor necrosis factor-alpha /tumor necrosis factor receptor I in the colonic epithelium of Crohn's disease model rats	Bao CH(2012) <sup>43</sup>



**Figure 8** Map of keywords related to moxibustion therapy for pain treatment from 2012 to 2021.

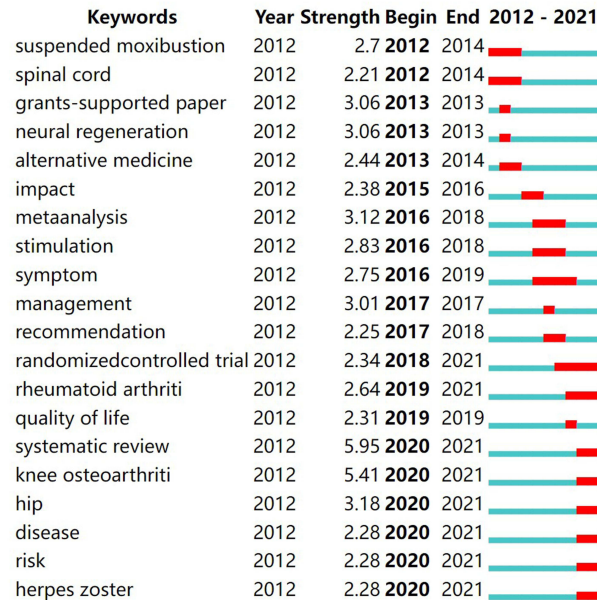
“randomized controlled trial” is of high position both in frequency and centrality. RCT was essential for evaluating the efficiency of a certain therapeutic method, but inadequate reporting and design elicited a high level of concern to formulate proper ethical standards. Hence, developing the Consolidated Standards of Reporting Trial (CONSORT) statement is employed promising to improve the quality of reporting of RCTs.<sup>20</sup> As double-blind is difficult to meet in clinical trials, single-blind trials were chosen to deploy. The findings suggested that one possible explanation for relieving the joint swelling and pain symptoms in rheumatoid arthritis patients was that moxibustion restricts inflammatory factor release.<sup>21</sup> Another trial delivered the consequence that the effectiveness of moxibustion has been implicated in the quantity of stimulus. Experiments displayed that penetrating stimulation could gain yet more moxibustion sensation in analgesia and enhance the quality of life of patients with migraine without aura.<sup>22</sup> Management and prevalence are in the front position in the ranking list of frequency which indicates moxibustion is one of the complementary therapies in prophylaxis and treatment. KOA is the only specific disease in the ranking list that demonstrates a relatively mature research trend in this field. IBS ranks highly in the list of centrality makes us investigate the interconnection between moxibustion therapy and chronic visceral hyperalgesia. Moxibustion has its advantages in treating chronic pain in the spine and joints such as ankylosing spondylitis and arthritis. Additionally, the moxibustion method needs to manipulate by following the specific acupuncture point. As different acupuncture points are selected in studies, more attention should be paid to assessing the therapeutic effect of distinct acupuncture points.

The top 20 keywords with the strongest citation burst from 2012 to 2021 are shown in [Figure 9](#). “Systematic review” and “knee osteoarthritis” were ranked at the top, while “herpes zoster” has burst recently. Research progress of

**Table 8** Top 10 Keywords Related to Moxibustion Therapy for Pain Treatment

Rank	Frequency	Keywords	Centrality	Keywords
1	91	Acupuncture	0.38	Metaanalysis
2	73	Pain	0.38	Acupuncture treatment
3	53	Randomized controlled trial	0.24	Randomized controlled trial
4	41	Moxibustion	0.22	Irritable bowel syndrome
5	38	Management	0.17	Ankylosing spondylitis
6	33	Prevalence	0.17	Arthritis
7	30	Electroacupuncture	0.17	Acupuncture point
8	30	Systematic review	0.16	Bias
9	25	Knee osteoarthritis	0.15	Symptom
10	23	Metaanalysis	0.15	Chronic visceral hyperalgesia

## Top 20 Keywords with the Strongest Citation Bursts



**Figure 9** Top 20 keywords with the strongest citation bursts. The red color represents the keyword was cited in high frequency and the green color represents in low frequency.

moxibustion treatment of pain can be drawn from the strongest citation bursts of keywords evolution. “Suspended moxibustion” and “spinal cord” exerted their influences earlier, while “herpes zoster” and “knee osteoarthritis” were lucubrated in 2020 and arouse wide public concern hitherto. Particular attention in this area of research has been given to moxibustion therapy in treating certain pain diseases. These keywords will be further discussed in the following section.

## Discussion

### General Information

To the best of our knowledge, this is the first bibliometric study of moxibustion therapy for pain management. The general information concluded from the results is listed as follows: (1) The annual number of publications boosted steadily over the past 10 years and the output was expected to grow swiftly which indicates a promising direction in this research field. (2) “The Evid Based Complement Alternat Med” and “the Gut” were the top-cited journals in frequency and centrality. (3) The most prolific country is China, which successfully provided crucial research foundation trends. Given that the other top countries were of poor yield, efforts should be paid to strengthen collaboration between countries to potentiate their output. *Shanghai University of Traditional Chinese Medicine* and *Chengdu University of Traditional Chinese Medicine* have profound academic backgrounds, and the institutions can achieve more high-quality results by cooperative closely. (4) Huangan Wu was the most active author with the highest cited frequency. (5) The top cited reference in frequency and centrality was the article published by Shamseer L and Deng HY respectively. (6) Pain disease (eg, arthritis, ankylosing spondylitis, herpes zoster, IBS), research method (eg, RCT), and risk assessment (eg, quality of life, economic burden, physical and psychological problems) were the hotspots and frontier trends in this field according to the analysis of the keyword.

### Research Hotspots

The results of co-citation demonstrated the fact that literature usually contains high-quality and strong impacts in this research field. Moreover, it may represent the research foundation of a certain field. The current research type relies on meta-analysis and RCTs, and the content involves mechanism and clinical. One of the frontier research hotspots is osteoarthritis which provides novel perspectives on moxibustion therapy indications. Osteoarthritis is a prevalent pain

disease that affects people all over the world. Moxibustion, because of the thermal effect on the local area, often has a therapeutic efficacy to analgesia. Recent research has shown that it directly promotes knee cartilage repair, in the meanwhile regulates the composition of the intestinal flora to prohibit inflammatory factor release.<sup>23</sup> Some RCTs have suggested that moxibustion therapy is a safe choice for treatment.<sup>9,24,25</sup> However, the top-cited were the standard of meta-analysis, indicating that the number of RCTs in this field is relatively limited and the quality needs to be improved. Therefore, researchers should strengthen the study on efficacy evaluation, to promote the view of moxibustion in the treatment of pain and push forward further research in this field.

Interestingly, as we searched publications related to moxibustion and pain, we found that IBS ranked forward in the list with high centrality as an important research spot. IBS is a functional gastrointestinal (GI) disorder that manifests as abdominal pain and a change in bowel habit.<sup>26</sup> The research found abundance and diversity of intestinal microflora in the GI were risks of IBS.<sup>27</sup> Alteration of intestinal microbiota activated the immune system to foster the formation of inflammatory cytokines to induce intestinal inflammation. However, a recent study found moxibustion treatment can reverse the changes in microbiota profiles and balance GI function.<sup>28</sup> Besides, the NOD-like receptor family pyrin domain containing 6 (NLRP6) inflammasome signaling is considered a medium for regulating gut microbiota and intestinal homeostasis.<sup>29</sup> Another research indicated that mild moxibustion can control NLRP6 inflammasome signaling to alleviate inflammation to achieve analgesia.<sup>30</sup> These results discussed how moxibustion contributes to pain relief.

## Keywords as Indicators of Emerging Trends

Recent emerging trends in moxibustion therapy on pain disease were identified according to the keyword bursts from 2012 to 2021, as follows:

(1) Rheumatoid arthritis (RA): Studies have shown that inhibition of relevant cytokines can reduce joint neovascularization to alleviate pain and dysfunction caused by RA.<sup>31</sup> Interestingly, moxibustion can regulate inflammatory cytokines released in RA at the molecular level. Downregulated hypoxia-inducible factor-1 $\alpha$ /vascular endothelial growth factor level can effectively relieve pain intensity in rheumatoid arthritis.<sup>32</sup> In addition, moxibustion may diminish the level of inflammatory factors to improve the symptoms of swelling and pain.<sup>21</sup> Further technologies in the specific mechanism of moxibustion to RA are urgently warranted.

(2) KOA: Moxibustion therapy is an efficient intervention without pharmacological and surgical for KOA. Current studies have proved that moxibustion is effective in the treatment of KOA. However, it is notable that the smoke of bursting moxa is harmful to one's health. Therefore, it is necessary to find a moxibustion method with less influence of smoke. The study found that maybe smokeless moxibustion can achieve the same therapeutic effect. This will become a new research direction. One exciting recently discovered is that CO<sub>2</sub> laser moxibustion is a device as a convenient and environmental substitution that simulates the traditional moxibustion but without smoke or smell.<sup>33</sup> Another trial evaluated the effect of the laser moxibustion device with the thermal effect but no smoke is promising for KOA symptoms.<sup>9</sup> More smokeless moxibustion therapies are expected to be developed in the future.

(3) Risk: In recent years, the risk of pain diseases attracted more attention from researchers. In particular, suffering from pain disease could raise the occurrence of diverse physical and psychological problems. The high cost of treatment also increases the burden on society.<sup>34</sup> Besides, it has an adverse impact on quality of life and physical function. Thus, much more attention should be paid to being aware of the risks of diseases and focusing on prevention and treatment.

(4) Herpes zoster: Herpes zoster can bring health burdens for people of all ages. Complications usually manifest as pain, fever, and itching. The most common is postherpetic neuralgia, which affects one in five people suffering from this disease.<sup>35</sup> Moreover, these uncomfortable feelings caused by herpes zoster bring a heavy economic burden from individuals to society.<sup>36</sup> Recently, a systematic review and meta-analysis have shown that moxibustion can alleviate postherpetic neuralgia to some extent, which highlights the great potential of moxibustion therapy.<sup>37</sup> This review provides a new perspective on interventions for herpes zoster.

In this review, we discuss current adaptable indications of moxibustion therapy, for instance, AS, arthritis, KOA, RA, herpes zoster, IBS and other pain conditions. Most of them are a class of chronic inflammatory conditions affecting the spine or joints and typically fall into musculoskeletal disease. Additionally, our results provide a novel perspective on the

therapeutic efficacy and potential of moxibustion therapy in neuralgia and chronic visceral hyperalgesia. These findings provide future possibilities for moxibustion therapy as a complement and alternative to pain management.

## Strengths and Limitations

This study has used bibliometrics for the first time to perform a visual analysis of literature related to moxibustion for pain treatment, summarized research status and key research forces in this field, and predicted the research trend. In addition, we have used a variety of methods to analyze data, which is suitable for multi-angle interpretation of conclusions. However, this study has limitations that need to be addressed. This study only analyzed the core collection database for Web of Science, because CiteSpace is currently unable to analyze cited references for other databases. It is anticipated that the improvement of this software will enable the expansion of the selection range for databases in the future.

## Conclusion

In conclusion, this study reveals hot spots and frontier issues in the field of moxibustion therapy for pain treatment. The findings presented here are expected to promote the optimization of treatment options.

## Data Sharing Statement

The following information was supplied regarding data availability: the raw data can be directly obtained from the WoSCC of Thomson Reuters.

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## Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work.

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## Disclosure

The authors declare that they have no conflicts of interest in this work.

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