

# A Bibliometric of Trends on Acupuncture Research About Migraine: Quantitative and Qualitative Analyses

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**Introduction:** Migraine is a common neurovascular disorder disease often characterized by episodic headaches that can develop chronic disorders. Acupuncture as a non-pharmacological therapy has been extensively used to manage migraine prevention and treatment in clinical practice. Many studies focused on acupuncture therapy for migraine, but none analyzed the publications quantitatively and qualitatively. The aim of this study is to show the recent researches and trend of advances in this field based on quantitative and qualitative analyses.

**Methods:** Publications related to acupuncture research about migraine were retrieved from the Web of Science (WoS) Core Collection and Scopus database. The quantitative data analysis was performed to show the recent researches and trend of advances from six perspectives: annual scientific production, countries, institutions, authors, journals, and keywords. For the qualitative analysis, acupuncture research about migraine was analyzed from the top twenty most highly cited articles.

**Results:** The number of annual scientific production steadily increased with some fluctuations over the years. The country and institutions contributing most to this field are China and Chengdu University of Traditional Chinese Medicine. Zhao Ling was the most relevant author in this field, Linde Klaus was the highly co-cited author. The leading journal regarding the number of selected articles was "Zhongguo Zhen Jiu". The top twenty most highly cited articles were divided into two categories: original articles and reviews. Among these two categories, original articles occupied the vast majority. Moreover, the real effectiveness of acupuncture for migraine prevention and treatment was the research frontier and hot spot.

**Conclusion:** Results of our analysis indicate that the number of publications showed an overall increasing trend, demonstrating that this research field still has a promising future. In addition, more researchers will probably focus their work on the difference between verum acupuncture and usual care for preventing and treating migraine.

**Keywords:** acupuncture, migraine, bibliometrics, quantitative analyses, qualitative analyses

## Introduction

Migraine is a common neurovascular disorder disease often characterized by episodic headache attacks that develop the chronic disorder.<sup>1,2</sup> According to statistics, migraine affects more than 10% of the world population.<sup>3</sup> In the Global Burden of Disease (GBD) study from 2016, migraine is the most common cause of disability in those aged 15–49 years, representing a significant increase from the previous year.<sup>4</sup> One epidemiological survey of migraine showed that 63% of respondents had one to four episodes per month.<sup>5</sup> As a result, migraine may have an adverse impact on the functional abilities of affected populations.<sup>6,7</sup> Normally, management of migraine includes the prevention and treatment of

migraine. However, migraines are very difficult to be cured successfully, and current therapeutic options have many undesirable side effects and may even intensify the headache pain in patients with chronic migraines.<sup>8</sup>

Acupuncture is the primary form of Traditional Chinese Medicine (TCM) that uses needles to puncture into acupoints. For a long time, acupuncture has been widely used as an essential and safest complementary or alternative treatment method against several diseases globally. A previous study indicated that chronic pain, especially migraine, is the most common clinical indication for acupuncture.<sup>9</sup> Indeed, acupuncture as a non-pharmacological therapy has been widely used to prevent and treat migraine in Asia and Western countries. Several clinical researches have indicated that acupuncture is a safe and effective treatment to prevent and treat migraine.<sup>10,11</sup> Therefore, considering the high incidence, recurrent migraine attacks, acupuncture still has a great application prospect in this field.

Bibliometric analysis of the literature using bibliometric tools can identify and visualize established fields of study. Based on mathematical and statistical tools, bibliometrics have been widely used to map the hot topics and trends in a specific research field. Recently, bibliometric analysis has been used to investigate the general trends in acupuncture researches.<sup>12,13</sup> The past decade have witnessed the rapid development of acupuncture research about migraine, and many high-quality papers have been published, especially after 2016.<sup>14,15</sup> Therefore, active bibliometric research related to acupuncture research about migraine may facilitate progress to the next stage. Currently, there has been no bibliometric analysis in acupuncture research about migraine by using both quantitative and qualitative bibliometric analysis. Hence, it is very necessary to carry out this research to analyze the hot topics and general trends of acupuncture research about migraine using both quantitative and qualitative bibliometric analyses. This systematic mapping of acupuncture researches of migraine will help identify research interests and provide insights into future research direction.

## Materials and Methods

### Data Sources, Search Strategies

Combining bibliometrics with qualitative analysis, acupuncture research about migraine field publication trends was evaluated. All literature were respectively collected from the Scopus and Web of Science (WoS) Core Collection database. Based on previous study protocol,<sup>16</sup> the following query sentence was applied to generate the initial search result: (“migraine” OR “migraine disorders” OR “migrain\*”) AND (“acupuncture” OR “electroacupuncture” OR “acupuncture therapy” OR “acupuncture treatment” OR “moxibustion acupuncture” OR “warming needle moxibustion” OR “fire needling” OR “fire needle” OR “fire acupuncture” OR “pharmaco-acupuncture treatment” OR “pharmaco-acupuncture therapy”), to search literatures with the keywords in their title, and both the queries were performed on January 15, 2022. The publication timespan considered was from 1965 to 2021.

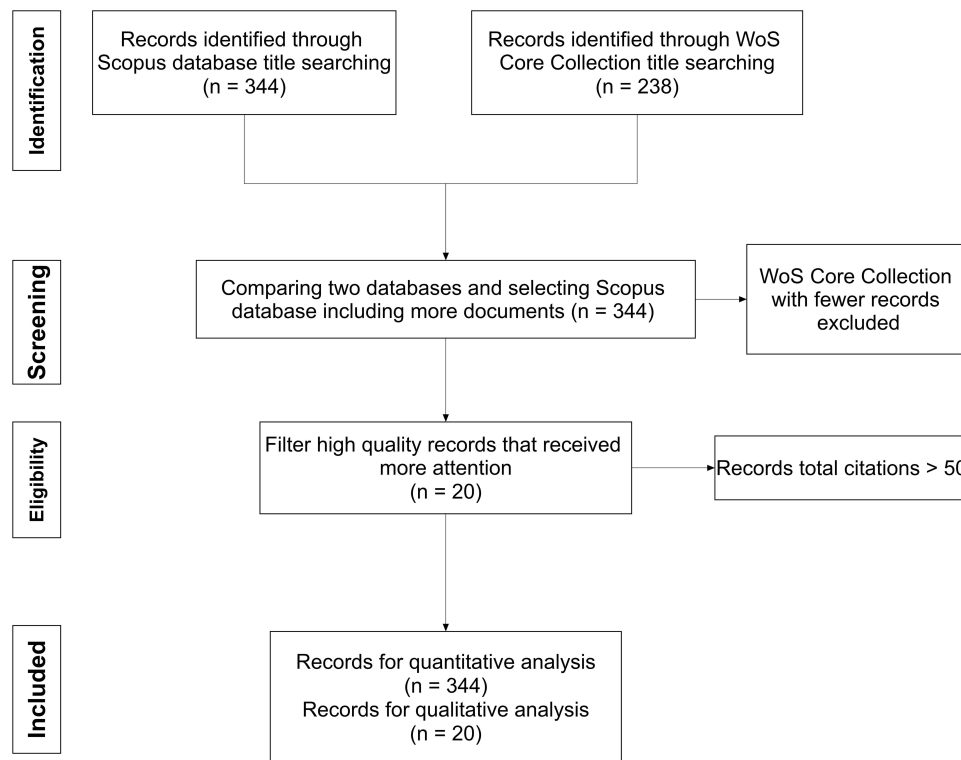
### Data Analysis

The papers were coded in the journal, study type, title, abstract, publication times, author names, and author affiliations. Data analysis was performed on the full search results using R software (R Project for Statistical Computing, <http://www.r-project.org/>, version 3.6.3) and the R packages “bibliometrix”.<sup>17</sup> Bibliographic data can be analyzed quantitatively using this tool. Moreover, the bibliometric results from the quantitative analysis are combined with qualitative analysis (content analysis) of publications.

## Results

### Data Collection and Filtering Process

Up to December 31th, 2021, a total of 344 records were retrieved from the Scopus database and 238 records from the WoS Core Collection database, respectively. In the light of previous researches, about 95% of publications in most research areas were included in the WoS and Scopus databases.<sup>18</sup> Thus, we performed a bibliometric analysis using the Scopus databases. Six perspectives, including annual publications, countries, institutions, authors, journals, and keywords, were analyzed. Among the 344 records, the top 20 publications with total citations more than 50 were filtered for qualitative analysis. The data collection and filtering process is based on “Preferred Reporting Items for Systematic Reviews and Meta-Analyses” (PRISMA)<sup>19</sup> flow diagram, as shown in Figure 1.



**Figure 1** The process of data collection and filtering process for the bibliometric analysis of acupuncture research about migraine.

## Quantitative Analysis

### Descriptive Analysis of the Bibliometric Data

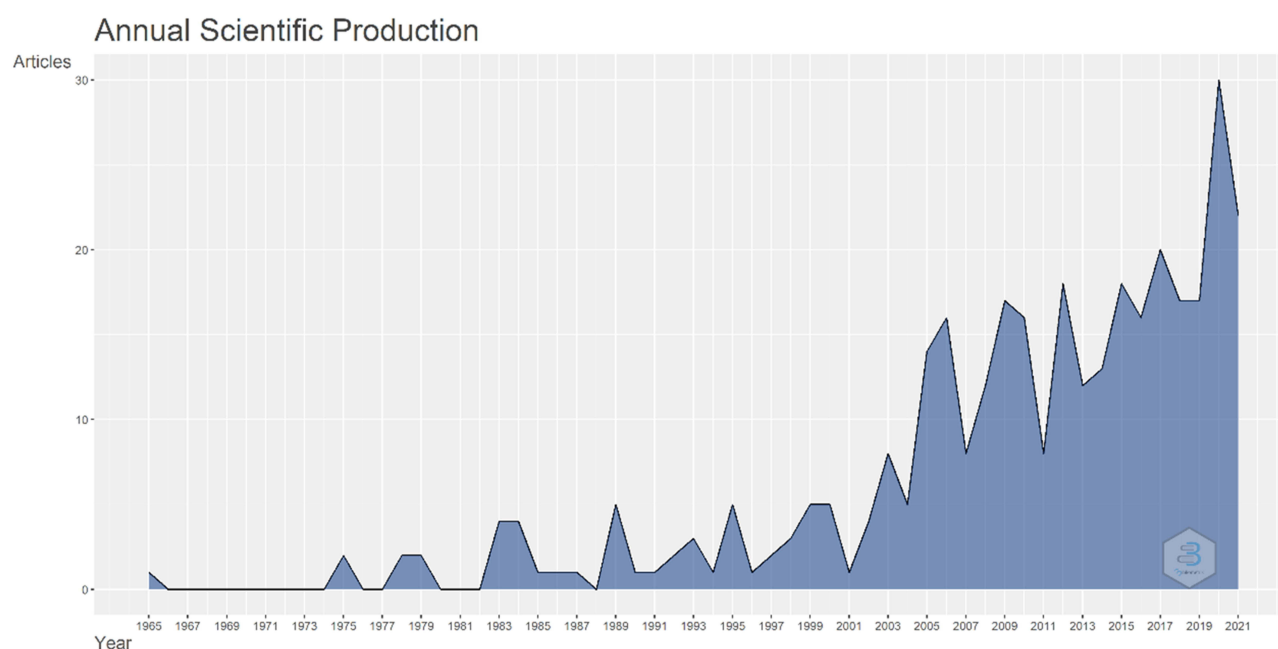
The descriptive analysis results for the Scopus database are presented in [Table 1](#). Briefly, 344 documents, 9 document types, and 945 authors were identified in this search. Among all of them, 863 were authors of multi-authored documents, and 82 were authors of single-authored documents. The author/documents ratio was 2.75, and the co-author/documents ratio 4.66.

### Analysis of Year

[Figure 2](#) shows the annual scientific production of migraine research works on acupuncture. There were 344 publications, including 231 journal articles (67.15%), 44 reviews (12.79%), and other types of papers. Since the 1960s, the number of

**Table 1** Primary Information of Retrieved Data

Main Information About Data	Scopus Database
Documents	344
Document types	9
Total Authors	945
Average years from publication	12.2
Average citations per document	13.02
Average citations per year per documents	1.13
Authors of single-authored documents	82
Authors of multi-authored documents	863
Authors per Document	2.75
Co-Authors per Document	4.66

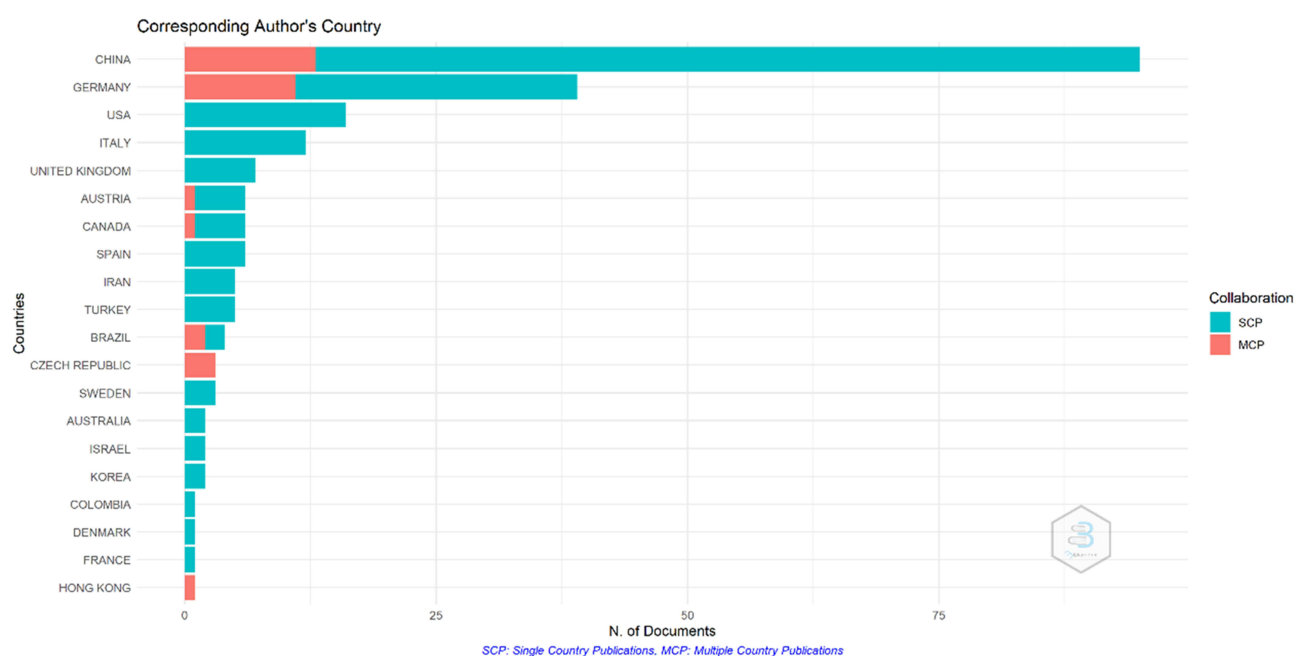


**Figure 2** The number of acupuncture research works on migraine for publications indexed by the Scopus database.

scientific publications relevant to acupuncture research about migraine had increased from 0 to 21 per year in 2021, showing a trend of rapid growth.

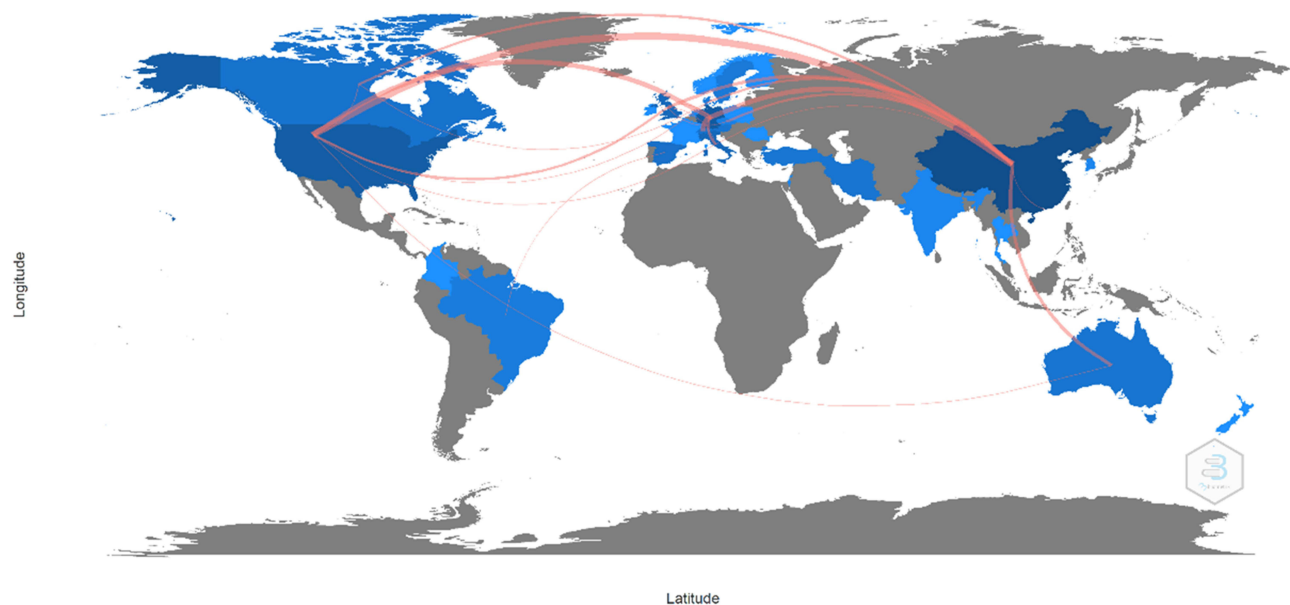
### Analysis of Country

This analysis is critical to understand which countries having a high implementation of acupuncture research on migraine. The results of the study are as follows. China had the most publications, followed by Germany and USA. As the [Figure 3](#) illustrates, China was at the top of single-country and multiple-country publications. In addition, the country or region's collaboration map in acupuncture research about migraine was also analyzed. As the [Figure 4](#)



**Figure 3** Most productive countries and regions in the field of acupuncture research about migraine.

## Country Collaboration Map



**Figure 4** World map showing the country/region collaboration in acupuncture research about migraine (Blue color: country/region with publications; grey color: country/region without publications; color intensity: the number of scientific publications; red lines' thickness: the number of co-published papers).

illustrates, China and the United States appeared to be the hub countries of publications. Notably, the collaboration between China and the United States had eleven co-published papers, taking a lead in the collaboration work.

### Analysis of Institution

The [Table 2](#) represents the results of the institution. Chengdu University of Traditional Chinese Medicine contributed the most significant number of papers, followed by Capital Medical University, Institute of acupuncture and moxibustion, China Academy of Chinese Medical Sciences, Beijing University of Chinese Medicine, and China Medical University.

### Analysis of Authors

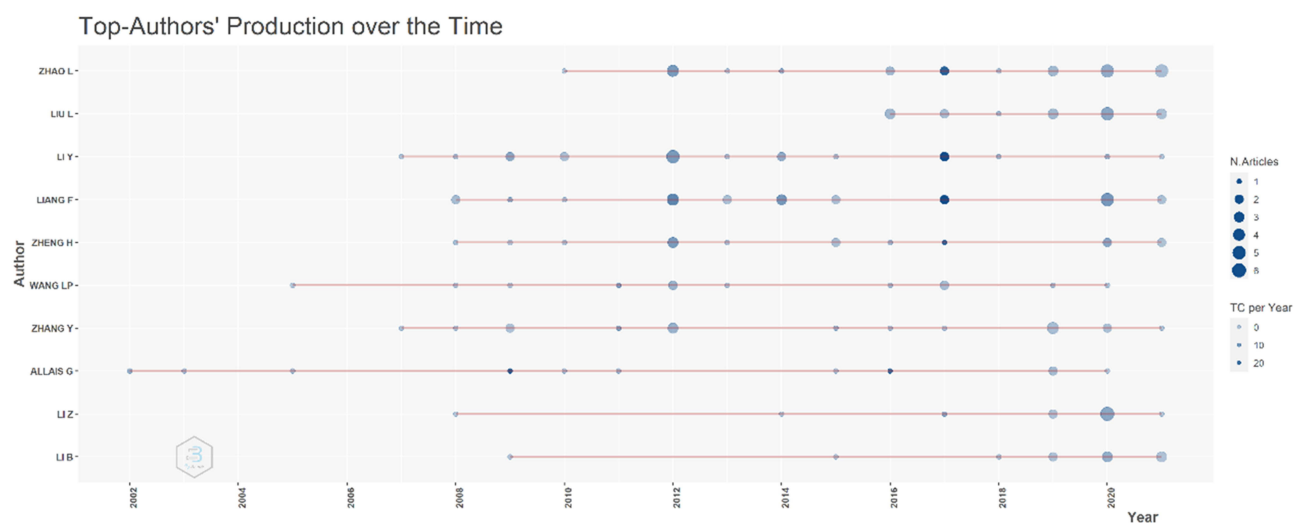
[Figure 5](#) shows the top ten authors with the most significant papers. Zhao Ling from Chengdu University of Traditional Chinese Medicine was the most relevant author. In addition, an increasing number of researchers had joined this research field after 2008.

### Analysis of Journals

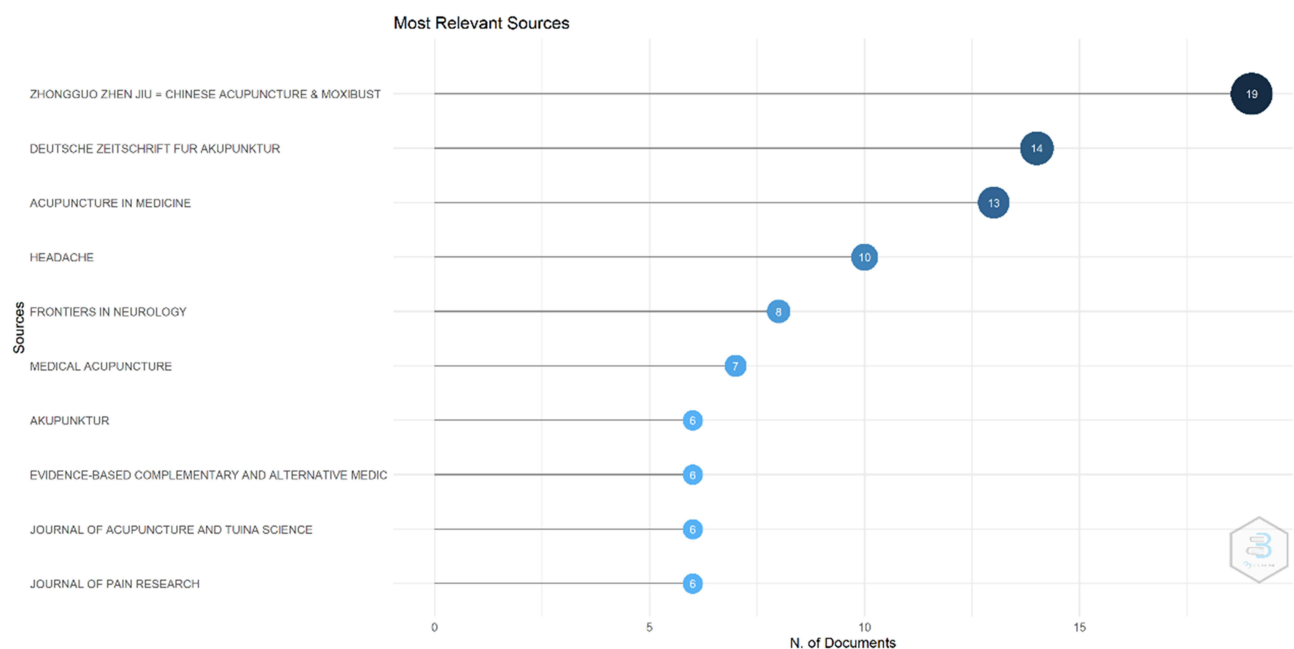
[Figure 6](#) shows the number of publications in the field of acupuncture research about migraine. Among the top ten publication journals, “Zhongguo Zhen Jiu” had published the most papers, followed by “Deutsche Zeitschrift fur Akupunktur” and “Acupuncture in medicine”.

**Table 2** Top Five Institutions Which Performing Acupuncture Research About Migraine

Ranking	Affiliations	Counts
1	Chengdu University of Traditional Chinese Medicine	32
2	Capital Medical University	25
3	Institute of acupuncture and moxibustion, China Academy of Chinese Medical Sciences	13
4	Beijing University of Chinese Medicine	11
5	China Medical University	9



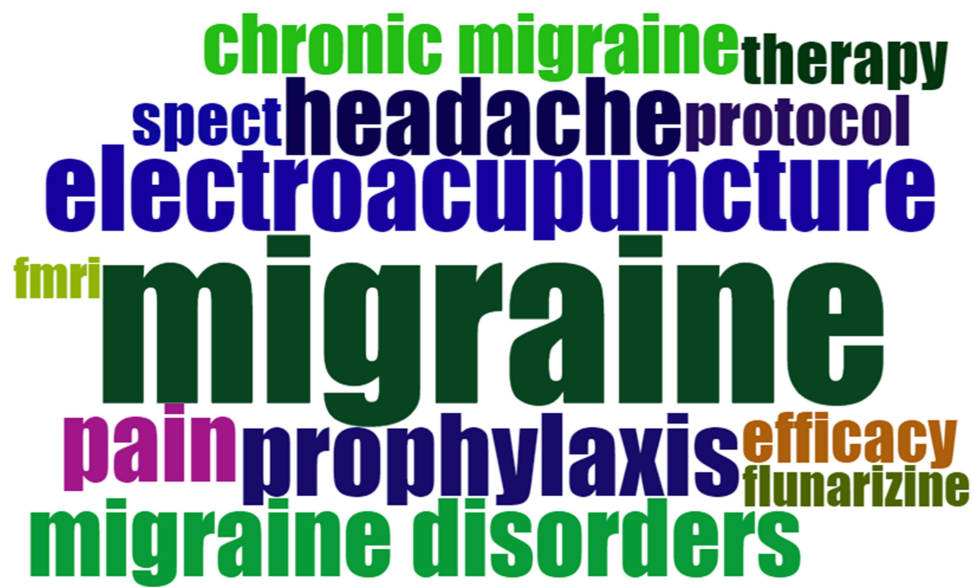
**Figure 5** Top ten most relevant authors' production (Redline: start and end time; bubble size: number of publications; color intensity: number of publications citation in that year).



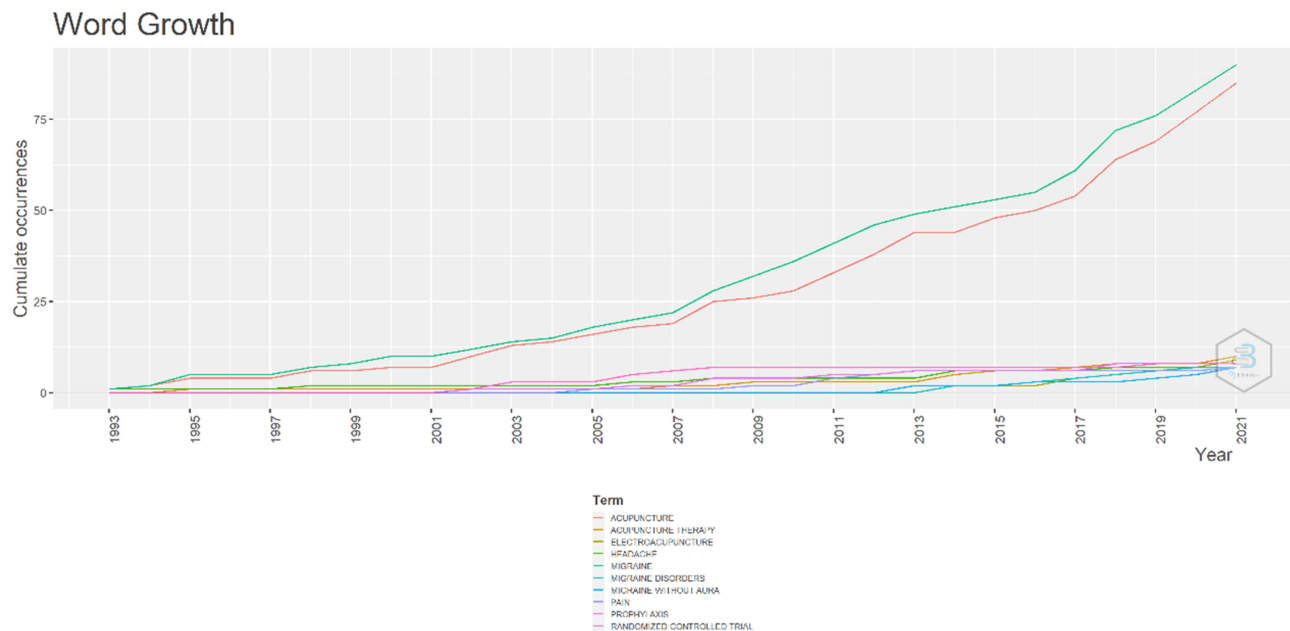
**Figure 6** The number of literature sources.

## Analysis of Keyword

It is well known that literature reviews collect data from original research articles. Thus, there is a great deal of overlap about keywords and topics. Of course, duplicate data affects the final statistical results. Therefore, 44 publications (literature reviews) were removed from the data set. Eventually, the analysis of keyword was performed based on the remaining publications. Finally, 322 keywords were extracted from the included publications. The word cloud of the author's keyword in acupuncture research about migraine is shown in the Figure 7. As showcased in the Figure 8, the most apparent trend is that two curves represent "migraine" and "acupuncture", respectively. With the aid of the multidimensional scaling method, the clustered topics form two categories, as shown in the Figure 9. Overall, the conceptual structure map of acupuncture research about migraine can be split into two main clusters. One cluster



**Figure 7** A word cloud of the most common keywords in acupuncture research about migraine papers (Font size: frequency of occurrence).



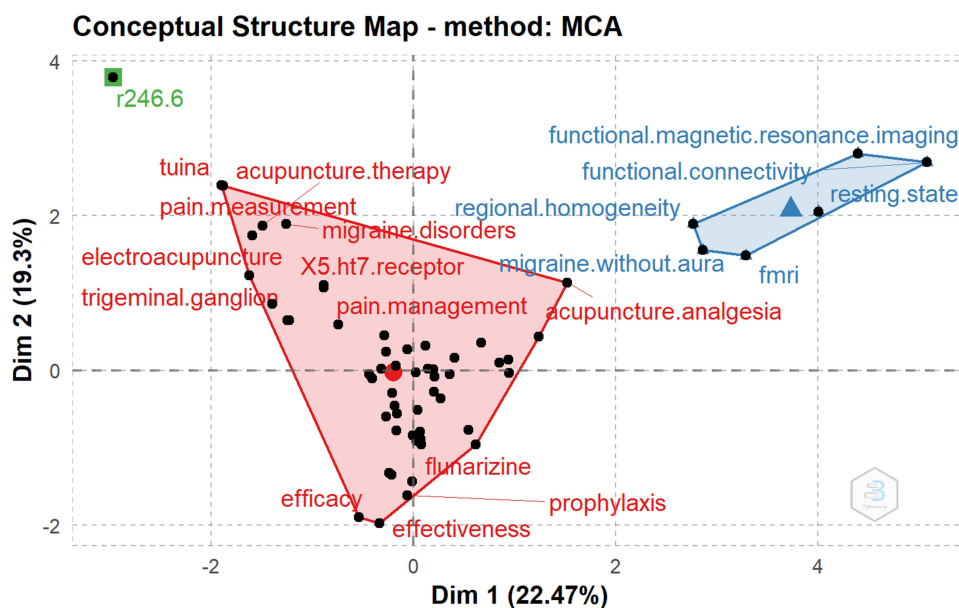
**Figure 8** The variation trend (with Loess Smoothing): top ten keywords in the field of acupuncture research about migraine.

demonstrated the effectiveness of acupuncture on migraine, while another cluster represented functional changes in the brain for acupuncture research about migraine.

## Qualitative Analysis

Qualitative analysis of these top citation publications' content can help researchers identify the most concerning research topics in this field. To extract the most value from the data set of high-quality publications, all publications are in a descending order of total citations. Finally, 20 publications with more than 50 were filtered. In addition, the method of taxonomy was used to classify these papers into two categories (clinical trial and review) and several subcategories, as showcased in Table 3 and Figure 10.





**Figure 9** The conceptual structure map of acupuncture research about migraine (Map dimensions: the average position of the publication; map midpoint: center of the research field).

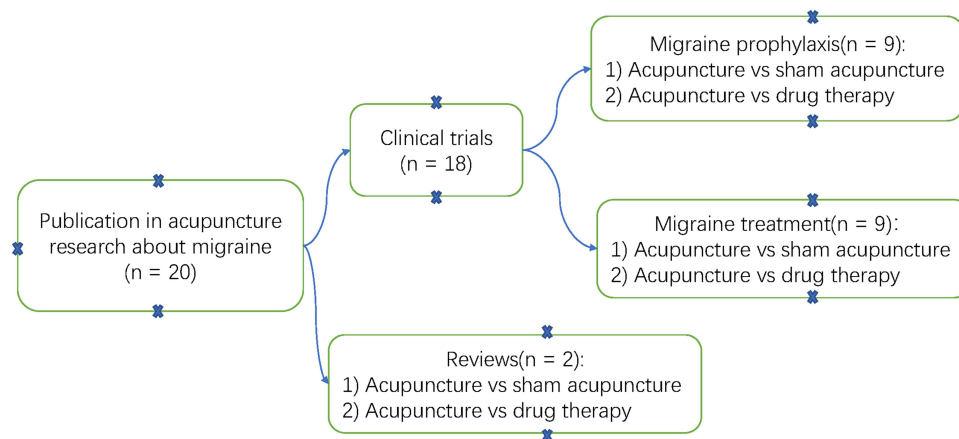
## Discussion

Overall, the major findings from the present study with a total of 344 selected publications are that we can identify the general trends in the field of acupuncture research about migraine using quantitative and qualitative analyses. At the first quantitative stage, the number of publications has been growing steadily in recent years, but there are some fluctuations. In addition, the most productive authors, institutions, and countries were Zhao Ling, Chengdu University of Traditional Chinese Medicine, and China, respectively. In the second stage of qualitative analysis, our study has produced an exciting

**Table 3** TOP 20 Total Citation Publications and Their Categories (1: Clinical Trials; 2: Reviews)

Rank	Paper	DOI	Total Citations	Category
1	LINDE K, 2005, J AM MED ASSOC	10.1001/jama.293.17.2118	483	1
2	LINDE K, 2009, COCHRANE DATABASE SYST REV	10.1002/14651858.CD001218.pub2	337	2
3	DIENER HC, 2006, LANCET NEUROL	10.1016/S1474-4422(06)70382-9	299	1
4	LINDE K, 2016, COCHRANE DATABASE SYST REV	10.1002/14651858.CD001218.pub3	143	2
5	ZHAO L, 2017, JAMA INTERN MED	10.1001/jamainternmed.2016.9378	126	1
6	VINCENT CA, 1989, CLIN J PAIN	10.1097/00002508-198912000-00006	123	1
7	PINTOV S, 1997, PEDIATR NEUROL	10.1016/S0887-8994(97)00086-6	112	1
8	HESSE J, 1994, J INTERN MED (GBR)	10.1111/j.1365-2796.1994.tb01102.x	104	1
9	ALLAIS G, 2002, HEADACHE	10.1046/j.1526-4610.2002.02203.x	99	1
10	LI Y, 2012, CMAJ	10.1503/cmaj.110551	98	1
11	WANG LP, 2011, PAIN	10.1016/j.pain.2011.04.006	82	1
12	YANG CP, 2011, CEPHALALGIA	10.1177/0333102411420585	79	1
13	LOH L, 1984, J NEUROL NEUROSURG PSYCHIATRY	10.1136/jnnp.47.4.333	78	1
14	FACCO E, 2008, HEADACHE	10.1111/j.1526-4610.2007.00916.x	70	1
15	LI Y, 2009, HEADACHE	10.1111/j.1526-4610.2009.01424.x	69	1
16	STRENG A, 2006, HEADACHE	10.1111/j.1526-4610.2006.00598.x	64	1
17	BCKER M, 2008, CLIN J PAIN	10.1097/AJP.0b013e318159f95e	63	1
18	ALECRIM-ANDRADE J, 2006, CEPHALALGIA	10.1111/j.1468-2982.2006.01062.x	60	1
19	MELCHART D, 2003, J INTERN MED (GBR)	10.1046/j.1365-2796.2003.01081.x	52	1
20	YANG J, 2012, BMC COMPLEMENT ALTERN MED	10.1186/1472-6882-12-123	51	1





**Figure 10** Top 20 total citation publications in the acupuncture research about migraine field.

new view that the real effectiveness of acupuncture for migraine prevention and treatment is the main direction of this research in the field. It indicates that our study is precious and has offered a novel perspective in the field of acupuncture research about migraine.

Migraine is not only difficult to treat but also adds to the existing morbidity of patients suffering from asthma,<sup>20</sup> epilepsy,<sup>21</sup> gastrointestinal disorders,<sup>22</sup> hypercoagulability.<sup>23</sup> Thus, the treatment of migraine still has a significant medical need. It has been known that acupuncture has clinical effects on analgesia.<sup>24–27</sup> As is well-known, the analgesic effect of acupuncture can reduce the dosage of drugs and side effects.<sup>28</sup> To date, many studies have explored the impact of acupuncture on migraine. However, studies based on quantitative and qualitative analyses are very few. In this study, bibliometric analysis has been carried out with the R software and bibliometrix package. Based on the quantitative analysis result, acupuncture research about migraine is still a hot spot. It is still noteworthy that paralleling the significant increases in the field of acupuncture research about migraine has been a trend towards strict study designs. The possible reason is that they follow the Standards for Reporting Interventions in Clinical Trials of Acupuncture (STRICTA) guideline.<sup>29–31</sup> It is a reporting guideline consistent with the characteristics of the clinical research on acupuncture. In addition, Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) is also an important reporting guideline.<sup>32–35</sup> According to the PRSRMA guideline, many meta-analysis studies in acupuncture research about migraine have been carried out.<sup>16,36–40</sup> Moreover, many experimental studies were conducted. Through these studies, the molecular mechanism of acupuncture on migraine included modulation of the brainstem descending pathways,<sup>41</sup> inhibiting the activation of 5-HT receptors in the descending pain pathway,<sup>42</sup> achieving analgesic effect via modulating A $\delta$ -fibers, not C-fibers,<sup>43</sup> CB1 receptors mediated anti-inflammatory effects,<sup>44</sup> the activation of MLCK in the middle meningeal artery.<sup>45</sup> There are, of course, other mechanisms of action of acupuncture on migraine that have not been fully described yet. Hence, continued research into the role of acupuncture research about migraine is worthy of further exploration.

Besides the above qualitative analyses, quantitative analyses were performed to get more accurate and reliable results.<sup>46</sup> Based on the previous studies, the total citation number is an important indicator of publications' academic influence.<sup>47</sup> Therefore, the same approach was used in the present study. The ordering of the total citations of articles was sorted from high to low values, providing a qualitative measure. Finally, we identified that the literature met the requirements for further exploration. It is worth noting that the most studied types of highly cited articles were original studies. Interestingly, those high-quality original studies published so far belong to clinical trials. It is well known that acupuncture is an ancient medical technology and comes from clinical practice. However, definitive proof is still lacking for evidence-based practice guidelines. Therefore, there is a critical need to conduct clinical trials. Hence, we attempted to investigate the effect of acupuncture on clinical outcomes using the taxonomy method. Surprisingly, we found a migraine treatment frequency of 50% and prevention frequency of 50%. The current state of literature demonstrates that the management of migraine prevention and treatment is often unsatisfactory because available acute and prophylactic treatments for migraines are either ineffective or poorly tolerated.<sup>48</sup> Immediately afterward, we reviewed those clinical

trials that investigated whether acupuncture is effective in preventing and treating migraine. First, we address the effect of acupuncture in preventing migraine. A trial by Hesse et al (1994)<sup>49</sup> showed that acupuncture (vs metoprolol) was a highly valued supplement to the list of prophylactic migraine tools. A trial by Allais et al (2002)<sup>50</sup> found that acupuncture (vs flunarizine) proved adequate for migraine prevention in female patients. A trial by Diener et al (2006)<sup>51</sup> found that acupuncture (vs sham acupuncture or standard therapy) for preventing migraine did not differ among the three. A trial published by Alecrim-Andrade et al (2006)<sup>52</sup> found that acupuncture (vs sham acupuncture) for preventing migraine attacks differed between semi-standardized and sham acupuncture. A trial by Li et al (2012)<sup>53</sup> found that acupuncture (vs sham acupuncture) tested appeared to have a clinically minor effect on migraine prevention. A trial published by Wang et al (2011)<sup>54</sup> found that verum acupuncture (vs sham acupuncture plus flunarizine) could be adopted for migraine prevention. A trial published by Yang et al (2011)<sup>55</sup> found that acupuncture (vs topiramate) could be considered a treatment option for chronic migraine patients. A trial published by Streng et al (2006)<sup>56</sup> found that acupuncture (vs metoprolol) might be an effective and safe treatment option for migraine prevention. A trial published by Zhao Ling et al (2017)<sup>11</sup> showed that acupuncture (vs sham acupuncture or waiting-list) might be related to a long-term reduction in migraine recurrence. Overall, the role of acupuncture for preventing migraine is effective. Controversies have mainly focused on verum and sham acupuncture. Second, we discuss the effect of acupuncture in treating migraine. A study by Loh et al (1984)<sup>57</sup> found that acupuncture (vs standard medical treatment) was beneficial for migraine. A study by Vincent (1989)<sup>58</sup> found that true acupuncture (vs sham acupuncture) effectively reduced the pain of migraine headaches. A study by Pintov et al (1997)<sup>59</sup> showed that acupuncture (vs sham acupuncture) might be an effective treatment in children with migraine headaches. A study by Facco et al (2008)<sup>60</sup> found that acupuncture (vs sham acupuncture plus rizatriptan) was a beneficial treatment for migraine. A study by Li et al (2009)<sup>61</sup> found that verum acupuncture treatment (vs sham acupuncture) effectively treated acute migraine. A study by Bäcker et al (2008)<sup>62</sup> found that verum and sham acupuncture might have a beneficial influence on the autonomic nervous system in migraineurs. A study by Melchart et al (2003)<sup>63</sup> found that acupuncture (vs placebo acupuncture) was effective in treating an acute migraine attack at an early stage. However, acupuncture was not superior to sumatriptan. A study by Linde et al (2005)<sup>64</sup> showed a statistical difference in the efficacy of acupuncture compared to the waiting list for migraine treatment. However, there was no statistical difference between true acupuncture and sham acupuncture. A PET-CT study by Yang et al (2012)<sup>65</sup> found acupuncture stimulation reduced pain in migraine patients, and the mechanisms were inconsistent with cerebral glucose metabolism. Overall, the role of acupuncture in treating migraine is effective. Controversies have still focused on verum acupuncture and sham acupuncture. In addition, many meta-analyses have investigated the efficacy of acupuncture. In 2009, a meta-analysis by Linde et al<sup>66</sup> indicated that acupuncture was used with better therapeutic efficacy and fewer adverse effects. However, there is no evidence for a result of true acupuncture over sham interventions. In 2016, an updated meta-analysis by Linde et al<sup>67</sup> suggested that acupuncture treatment reduced the frequency of headaches. Importantly, this study generated new evidence that there is a small effect between verum and sham acupuncture. From the above results, as long as verum acupuncture is compared to sham acupuncture, results are not very reliable. However, sham acupuncture is not an inert technique. Thus, verum acupuncture must necessarily be compared to usual care to understand its real effectiveness.

## Limitations

Nevertheless, there are some limitations to this study. First, qualitative analysis is subjective by nature. It is well known that the results of qualitative analysis from different perspectives are quite different. Hence, we cannot guarantee that a different team would have reached the same conclusion. Second, this study is limited by the number of databases, although the Scopus database is trusted and contains a widely representative collection. Third, the findings from this study only reflect the academic trend of the current studies, which is the aim of this bibliometric analyses.

## Conclusion

Our analysis suggests that the number of publications shows an overall increasing trend, demonstrating that this research field still has a promising future. The real effectiveness of acupuncture for migraine prevention and treatment is the main

direction in this field. We could expect more research about the difference between verum acupuncture and usual care for preventing and treating migraine in the future.

## Data Sharing Statement

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

## Ethical Review

There is no involvement of patients or animals in this study; therefore, the ethical review was not required.

## Acknowledgments

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## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

## Disclosure

The authors declared no potential conflicts of interest with respect to this work, nor the research, authorship, and publication of this article.

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