



## Research article

# Visual analysis of research hotspots and trends in traditional Chinese medicine for depression in the 21st century: A bibliometric study based on citespace and VOSviewer

Chengcheng Song, Kelong Chen, Yongxi Jin, Ling Chen, Zuxiu Huang\*

Department of Neurology, Wenzhou TCM Hospital of Zhejiang Chinese Medical University, Wenzhou, China

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## ABSTRACT

**Background and objectives:** Depression long been a key concern for scholars worldwide; however, the field of depression has not received sufficient attention in traditional Chinese medicine. It was not until the 21st century that research into depression gradually entered a period of rapid development, with an increasing number of academic studies published in major journals. However, one limitation of this field is that no scholars have yet summarised the development process and key research issues. Therefore, the present study aimed to summarise the research trends and progress in this field, providing relevant information and presenting potential future research directions for subsequent researchers.

**Methods:** Literature in this field was searched from January 1, 2000 to April 20, 2024 in the Web of Science Core Collection database, to analyse the current status of the literature and publication trends. Bibliographic information, including study authors, organisations, keywords, countries, references, citations, and co-citations, was extracted using CiteSpace and VOSviewer software for quantitative analysis, visual mapping, and scientific evaluation.

**Results:** A total of 921 papers were included, with a significant increase in the number of publications from 2017 to 2021, and a stable number of more than 140 publications between 2022 and 2023, with publications in these two years accounting for 31.38 % of the total. The Journal of Ethnopharmacology had the highest number of publications (97) and citations (2067), as well as the highest number of co-citations (1369). China (847 publications, 13256 citations), Beijing University of Chinese Medicine (90 publications, 1232 citations), and Qin Xuemei (30 publications, 759 citations) were the most prolific and influential countries, organisations, and authors in the field, respectively. Keyword clustering co-occurrence analysis revealed nine different clusters with good homogeneity. The top three clusters were randomised controlled trials, traditional Chinese medicine, and hippocampal neurogenesis. In the timeline analysis of keywords, from 2000 to 2010, keywords in this field were concentrated on hippocampal neurology and forced swimming test as clustering axes of Traditional Chinese Medicine. From 2010 to 2020, the research hotspots focused on randomised controlled trials and hippocampal neurogenesis. After 2020, keywords became more focused on network pharmacology. In addition, the occurrence time of explosive keywords were distributed before 2010 and after 2020. Before 2010, these keywords included the forced swimming test, Tail Suspension Test, Chronic Cold Stress, Neural

\* Corresponding author. Department of Neurology, Wenzhou TCM Hospital of Zhejiang Chinese Medical University, 9 Jiaowei Road, Wenzhou, China.

E-mail address: [15858878859@163.com](mailto:15858878859@163.com) (Z. Huang).

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Regeneration, and Banxia Houpu Decoction. Conversely, network Pharmacology and Molecular Docking arose as key buzzwords starting in 2020.

**Conclusions:** This study comprehensively analysed and summarised the research hotspots and trends in this field of research in the 21st century from a bibliometric perspective, further generating a series of visual graphs to help researchers understand the current research status, potential collaborators, collaborating institutions, and potential future research hotspots in this field.

## 1. Introduction

Depression is a common mental and psychological disorder, characterised by low emotions and mood, and often accompanied by changes in cognition and behaviour. It is the second leading cause of disease-related disability in China, resulting in a significant loss of healthy life expectancy [1]. According to the predictions of the World Health Organisation, depression represent a serious global public health challenge, and will arise as the greatest global disease burden by 2030 [2]. Since the 21st century, depression has been a primary focus of many scholars worldwide. In recent years, depression has gradually differentiated into different branches of research, including major depression [3], adolescent depression [4], elderly depression [5], maternal depression [6], and post-stroke depression [7]. Information regarding its pathogenesis (inflammation [8], gut microbiota [9], synaptic plasticity [10], monoamine neurotransmitters [11], and neuroimmunity [12]) and therapeutic concepts (mindfulness therapy [13] and drug therapy [14]) have been constantly updated in the face of challenges, and are widely used in clinical diagnosis and treatment.

Traditional Chinese Medicine (TCM), a unique and important component of the Chinese healthcare system, has a long history of treating depression [15], with many advantages, including actionable effects on multiple pathways and targets, with minimal side effects [16]. In recent years, TCM has become a common choice as a supplement or even as the main treatment for depression, and the treatment of depression using TCM has emerged as a research hotspot [17]. Since the beginning of the 21st century, an increasing number of high-quality studies on depression in TCM have been published in Web of Science (WOS) database journals, while an increasing number of scholars have paid attention to the key role of TCM in the field of depression, and have conducted further research accordingly. However, despite the progress in research in this field and the emergence of a large number of publications, several questions still need to be addressed, as follows.

- (1) What is the current status and trends of literature publications in this field since the 21st century?
- (2) What are the numbers of journal publications and citations on depression in TCM? Which authors, papers, institutions, and countries have experienced substantial and far-reaching impacts?
- (3) Is there a substantial collaborative relationship among authors, institutions, and countries in this field, and have mature collaborative networks and the corresponding core research institutions been formed?
- (4) What are the research trajectories, hotspots, and frontiers in this field since the 21st century, and what are the future research trends in this field?

Bibliometric analysis originated in the early 20th century and has been considered an independent discipline since 1969 [18]. Bibliometric techniques are widely used in the quantitative analysis of literature because of their ability to analyse a large amount of publication information, including authors, journals, countries, institutions, keywords, and references, at both the macro and micro levels [19,20]. Furthermore, it can show researchers' research dynamics, progress, and potential future research directions in the corresponding research field. Similarly, in recent years, bibliometrics has also been widely applied in the medical field, while the medical field is considered to be at the forefront of bibliometric knowledge development [21]. With the development of bibliometric techniques, scholars in this field have noted that the visualisation of quantitative analysis results can intuitively and conveniently explain the meaning of data, making the results more comprehensive and beneficial for researchers exploring the internal connections of information [22]. Therefore, VOSviewer and CiteSpace have been widely used in bibliometric research as effective tools for bibliometric and scientific mapping analyses [23,24].

An increasing number of scholars have attempted to conduct bibliometric studies on depression. For example, Wang used bibliometric methods to accurately and systematically present the hotspots, frontiers, and shortcomings of depression research from 2004 to 2019 [25]. In terms of mechanistic research, scholars have also used bibliometric analyses to investigate the epigenetic mechanisms of depression [26], as well as the roles of NMDA receptors [27], macrophages [28], and biomarkers [29] in the treatment of depression. In terms of clinical testing, Fu conducted a bibliometric analysis of the historical development, current status, and future trends of resting-state functional magnetic resonance imaging in one study on severe depression [30]. In terms of treatment decision-making, scholars have also recently used CiteSpace to evaluate the current status of medical decision-making research on adolescent depression [31], and further conducted bibliometric analysis of psychological interventions [32], virtual reality [33], clinical drugs [34], repetitive transcranial magnetic stimulation [35], and artificial intelligence [36] therapies in the field of depression. In terms of TCM therapy, scholars have previously applied bibliometric analysis to examine the application of acupuncture [37] and ear acupuncture therapy [38] in the field of depression. However, in the field of depression, although scholars have carried out a large number of bibliometric analysis of depression from different aspects, including individual research on acupuncture and moxibustion and other Chinese medicine non-drug therapies, as yet, there has been no bibliometric analysis with TCM and depression as the theme. As such,

the scientific problems in the field of TCM depression mentioned in this paper have not been solved.

Therefore, to address the scientific research issues in the field mentioned above, we conducted a bibliometric analysis using VOSviewer and CiteSpace to analyse research trends and progress in the field of depression in TCM since the 21st century (2000–2024). This study aimed to thereby provide relevant information and potential research directions for subsequent clinical practice and research.

## 2. Methods

### 2.1. Database selection and retrieval strategy

TCM is a unique medical resource and an important component of the Chinese medical industry. Although some research achievements in TCM in China have been published in databases such as the China National Knowledge Infrastructure, Wanfang Data Knowledge Service Platform, and China Science and Technology Journal Database, these databases have shortcomings, such as uneven literature quality, low authority, and poor international influence. Conversely, the WOS is an internationally recognised authoritative database covering multiple research fields, including the natural and biomedical sciences, and collecting highly influential journals and academic papers. Its citation format is compatible with CiteSpace and VOSviewer, and has been widely used in bibliometric research [39]. It has also been pointed out that to improve the accuracy and reproducibility of a literature study, articles should indicate the subdatasets of the WOS database used [40]. Therefore, this study set the literature search strategy for April 21, 2024 as follows.

- (1) The Science Citation Index EXPANDED and Social Sciences Citation Index subdatasets under the WOS Core Collection were searched.
- (2) A subject search was performed using the following search formula: "Chinese medicine" OR "Chinese herb" OR "Chinese formula" OR "Chinese materia medica" OR "decoction" (Topic) AND "depress\*" (Topic).
- (3) The qualifying document types were Articles and Reviews, the publication language was English, and the search time was 2000.1.1–2024.4.20.
- (4) The export method was set as a plain text file and the recorded content was set as "complete record and cited references".

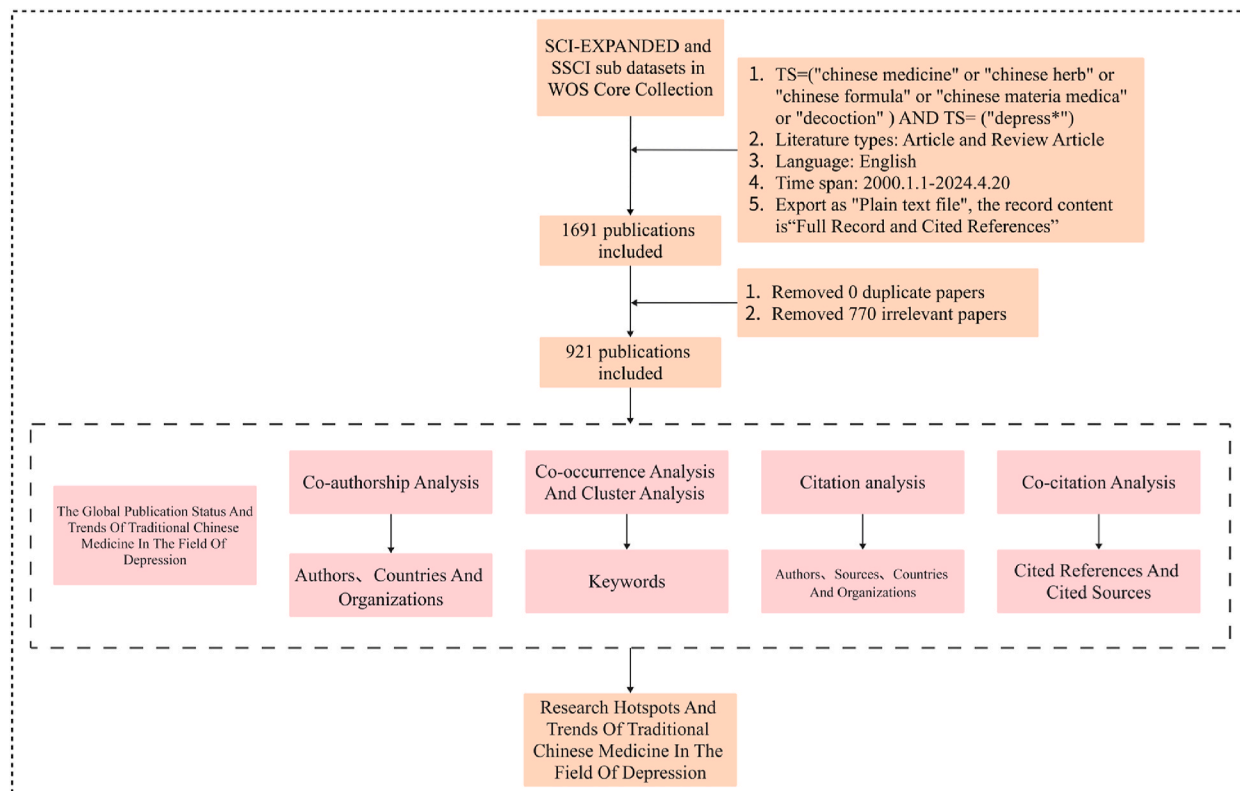


Fig. 1. Overview of the research process.

## 2.2. Data analysis and processes

Considering the potential drawbacks of repetitive content, inconsistent keywords, and paper content in the preliminary literature, this study removed duplicates from the 1691 articles obtained by the author, institution, and keywords, and further screened them by title, topic words, abstract, and article content to exclude literature not directly related to depression. Subsequently, this study used VOSviewer 1.6.20 to analyse the exported files from the WOS database, extracting bibliographic information such as research authors, organisations, keywords, countries, references, citations, and co-citations, and creating a visual network graph. The co-occurrence and clustering information of the keywords were analysed using CiteSpace 6.3. R1 and the timeline and explosive words of the keywords were processed and visualised. The research process is illustrated in Fig. 1.

VOSviewer and CiteSpace are effective tools for bibliometric analysis used to perform general bibliometric, performance, and scientific mapping analyses [23]. VOSviewer, developed by van Eck and Waltman, can directly analyse information imported from the WOS database and export journals, authors, countries, organisations, and co-citation information according to user goals. Further, it extracts and draws bibliographic networks, such as Co-Authorship, Co-citation Analysis. The advantage of VOSviewer lies in its excellent visualisation of networks [41]. In the graph drawn using VOSviewer, the larger the node and label, the more important the prompt. The colour of the node indicates the cluster to which it belongs, while the lines between nodes indicate the connection between two elements, with thicker connecting lines indicating higher correlations.

CiteSpace, developed by Professor Chen Chaomei, is a software used to visualise and qualitatively evaluate keyword co-occurrence and clustering, as well as visually present research hotspots from different periods to determine their research trends [42]. In the keyword timeline drawn by CiteSpace, each node represents a keyword, while the size of the node and font are positively correlated with the frequency. The position of the keyword on each clustering axis corresponds to its first appearance time, and the colour that reflects the time node is cited. The warmer the colour, the closer the time. As this study did not involve a comparative analysis, it was not necessary to conduct hypothesis testing and set p-values. Finally, appropriate adjustments were made to the graphic content drawn by the two software programs to improve data visualisation.

## 2.3. Research ethics

The data retrieved and downloaded from the WOS database are publicly available, and do not directly involve human or animal research. As such, there were no ethical issues when using these data, and approval from the ethics committee was not required. In addition, the software used in this study is cited to express gratitude to the authors.

## 3. Results

### 3.1. Global publication status and trends of the use of TCM in the field of depression

A total of 1691 documents were retrieved from the WOS database, of which 921 were included after screening. These papers were

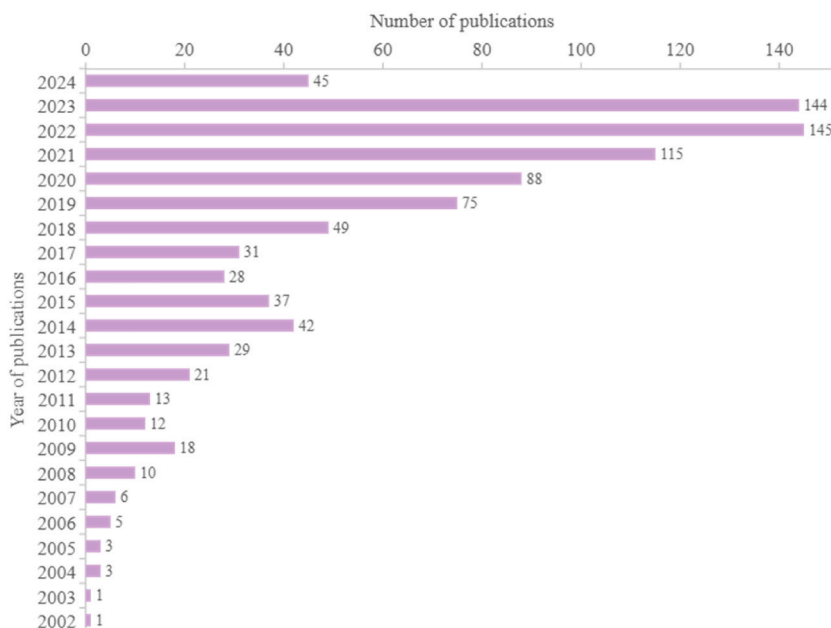


Fig. 2. The annual publication trend of papers.

published by 4898 authors from 894 institutions in 37 countries and included 3779 keywords. In total, 36682 articles from 7464 journals were cited, with 25570 cited authors. The distribution of the published annual papers is shown in Fig. 2. Overall, there were relatively few publications on depression in TCM between 2002 and 2011, indicating that the research in this field was still in its early stages. However, the number of publications significantly increased after 2017, with stable publications of over 140 in 2022 and 2023, with the publications in these two years accounting for 31.38 % of the total. This indicates that in recent years, an increasing number of scholars have begun to focus on the potential of TCM in the field of depression.

### 3.2. Visualisation analysis of authors and co-authorship

We analysed the authors of the extracted papers to understand the representative scholars and core research forces in the field of depression in TCM. Statistical analyses revealed that 921 papers were published by 4898 authors, with an average of six authors per paper. In a prior study, Price pointed out that, on the same topic, half of all scientific papers are written using the square root of the total number of authors, with the lowest number of publications among core authors equal to 0.749 times the square root of the number of publications by the highest producing authors [43]. In the present study, the most productive author published 30 papers, and the lowest number of publications by the core author was 4. Therefore, the present study identified authors with more than five articles as core authors in the field, resulting in a total of 98 authors with 728 articles, accounting for 79.04 % of the total number of publications. Among these authors, Qin Xuemei had the highest number of publications, with 30 articles and 759 citations, yielding an average of 25.3 citations per publication, while Du Guanhua had the highest average of 37.4. Table 1 lists the six authors with the most publications. In addition, we visualised the collaboration network of the core authors using VOSviewer, the results of which are shown in Fig. 3. The co-authorship network of authors not only displays the connections between important researchers in the field, but also provides information on influential research groups and potential collaborators, which helps to further establish collaboration between research teams in the future. The network diagram consists of nine clusters represented by different colours, among which Qin Xuemei, Zhang Yi, Zhang Zhangjin, Chen Gang, Li Yunfeng, Zhu Yue, Kong Lingdong, Li Yan, and Zou Zhongmei are the core authors of each cluster.

### 3.3. Journal and citation analysis

Analysis of the journals and citation status of the literature revealed 269 publishing journals. Table 2 presents the top ten journals with the highest publication volumes. These top ten journals accounted for 35.72 % (329/921) of the total number of publications, with the top three journals being the Journal of Ethnopharmacology (97 articles), Frontiers in Pharmacy (68 articles), and Evidence-Based Comprehensive and Alternative Medicine (63 articles). After analysing the citation status of journal articles, it was found that the journals with the highest citation counts were the Journal of Ethnopharmacology (21.31) and Biomedicine & Pharmacotherapy (20.91), indicating that the literature published in these journals has received considerable attention from scholars in this field.

### 3.4. Distribution and co-authorship of countries and organisations

To better understand the contributions of different countries and organisations to the field of depression in TCM, this study analysed 37 countries and 894 organisations and displayed the top five countries and organisations with the highest publication volumes, as presented in Tables 3 and 4. Analysis of the distribution of countries can help promote global cooperation in this field. As shown in Table 3, among the 37 countries conducting research on TCM for depression, China, the birthplace of TCM, had the highest productivity (847/921), followed by the USA (54/921), and Australia (17/921). It should be noted that the number of publications from China greatly exceeds the total number from all other countries, accounting for 91.97 % of the total, which indirectly indicates that the field of depression in TCM requires more attention from global scholars. We visualised and analysed the co-authorship networks of various countries using VOSviewer and Scimago Graphica [44], as presented in Fig. 4. In this figure, the larger the number of circular nodes in the figure, the more publications there are; the node connections indicate an association between countries. The node colour represents the average citations, with a deeper red colour indicating a higher average number of citations. Overall, China and the United States play a connecting role in the national co-authorship network (Fig. 4). However, many of the research achievements of these two countries have not been seriously valued, and their average number of citations is relatively low. In contrast, although Poland has only published three papers, the citation count for these articles was high, with a maximum of 372 and an average 124, which has received attention from scholars around the world. Analysis of organisations (Table 4) further showed that the top five

**Table 1**

Top 6 authors with the most published papers.

Rank	Author	Documents	Citations	Average Citation/Publication
1	Qin, Xuemei	30	759	25.3
2	Zhang, Yi	18	247	13.72
3	Zhou, Yuzhi	16	552	34.5
4	Du, Guanhua	15	561	37.4
5	Liu, Ping	15	206	13.73
6	Ma, Qingyu	15	364	24.27

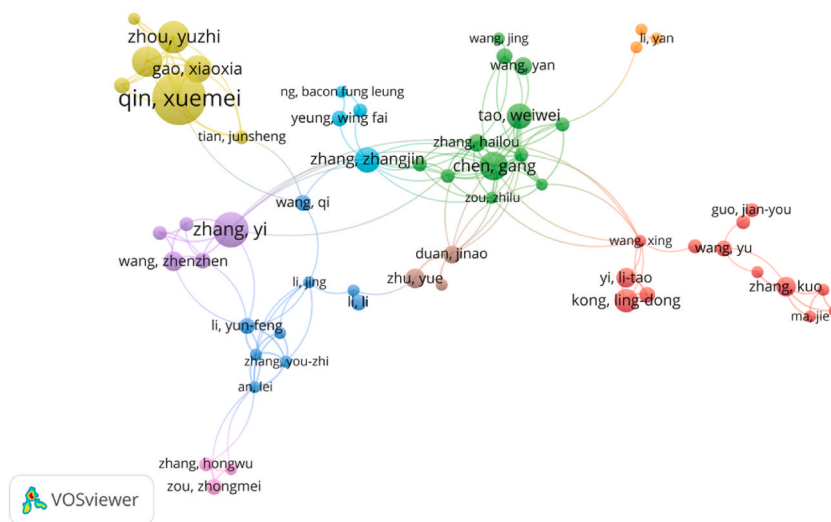


Fig. 3. The co-authorship network of authors.

Table 2

Top 10 journals with the most published papers.

Rank	Source	Documents	Citations	Average Citation/Publication
1	Journal of Ethnopharmacology	97	2067	21.31
2	Frontiers in Pharmacology	68	742	10.91
3	Evidence-Based Complementary and Alternative Medicine	63	771	12.24
4	Medicine	35	84	2.4
5	Phytomedicine	24	361	15.04
6	Biomedicine & Pharmacotherapy	23	481	20.91
7	Frontiers in Psychiatry	19	184	9.68
8	Chinese Journal of Integrative Medicine	19	150	7.89
9	Neural Regeneration Research	18	166	9.22
10	Journal of Traditional Chinese Medicine	16	172	10.75

Table 3

Top 5 countries with the most published papers.

Rank	Country	Documents	Citations	Average Citation/Publication
1	China	847	13256	15.65
2	The United States of America	54	1339	24.80
3	Australia	17	381	22.41
4	United Kingdom	14	362	25.86
5	South Korea	14	185	13.21

Table 4

Top 5 organisations with the Most Published Papers.

Rank	Organisation	Documents	Citations	Average Citation/Publication
1	Beijing University of Chinese Medicine	90	1232	13.69
2	Nanjing University of Chinese Medicine	64	994	15.53
3	Shandong University of Traditional Chinese Medicine	41	436	10.63
4	China Academy of Chinese Medical Sciences	39	479	12.28
5	Guangzhou University of Chinese Medicine	37	423	11.43

research organisations with the highest publication volumes were all from Chinese universities, among which Beijing University of Chinese Medicine, Nanjing University of Chinese Medicine, and Shandong University of Traditional Chinese Medicine were the most dynamic institutional groups in this field. We visualised and analysed the co-authorship network of the top 50 organisations with the highest publication volumes using VOSviewer, as presented in Fig. 5. Overall, the institutional cooperation network mainly included seven different clusters, among which Beijing University of Chinese Medicine and Nanjing University of Chinese Medicine had the



Fig. 4. The co-authorship network of countries.

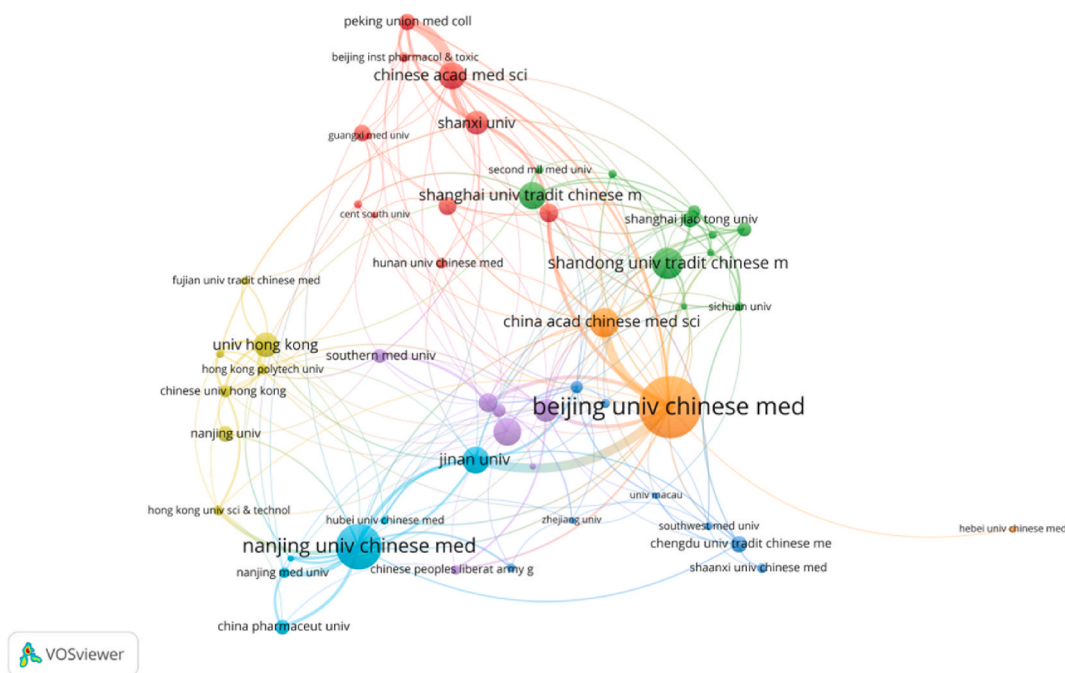


Fig. 5. The co-authorship network of organisations.

largest nodes and were closely connected with other organisations. These institutions presented important contributions and influence in the research of TCM on depression, and may produce more important academic achievements in the future. Simultaneously, Shandong University of Traditional Chinese Medicine, China Academy of Chinese Medical Sciences, Guangzhou University of Chinese Medicine, and the University of Hong Kong have also conducted in-depth research and have become core research organisations in the local area.

### 3.5. Keyword analysis

Keywords are an important component of scientific publications, reflecting both the core ideas and the research hotspots in the field. Keyword analysis can thus predict changes in the research frontier. This study analysed 3779 keywords from 921 papers using VOSviewer, and presented the top 10 high-frequency keywords in Table 5. The top 50 keywords were visualised for co-occurrence, as presented in Fig. 6; the larger the node in the figure, the more frequently the keywords appeared. From keyword analysis, it can be seen that the high-frequency words and representative terms in this field were depression, Traditional Chinese medicine, anxiety, stress, and antidepressants. In addition, we conducted co-occurrence clustering analysis on keywords using CiteSpace software (two years per slice, g-index  $K = 17$ ) and obtained a co-occurrence clustering graph for keywords ( $N = 294$ ,  $E = 1025$ , density = 0.0238), as presented in Fig. 7. As shown in this figure, nine keyword clusters were generated with good homogeneity. The lower the value of the cluster label, the higher the frequency of keywords and the more important the cluster, which is also more likely to be a research hotspot in this field.

In addition, to emphasise the interaction of keywords in the temporal dimension and demonstrate the phased development trajectory and characteristics of research hotspots in this field, we further designed a co-occurrence timeline for keywords based on CiteSpace software, as presented in Fig. 8, in which the keywords in this field were divided into nine clustering timelines. The position of the keywords on each clustering axis corresponds to their first appearance, while the size of the nodes reflects the frequency of the keywords, and the colour reflects the citation time. This figure thus vividly presents the research hotspots for different periods. Overall, the research hotspots in this field could be divided into three different periods: 2000–2010, 2010–2020, and after 2020, with keywords concentrated in traditional Chinese medicine, forced swimming test, hippocampal neurology, randomised controlled trial, and network pharmacy clustering axes. At the same time, the frequency of keyword citations significantly increased after 2020, which may be related to the increase in publications after 2020 and reflects the increasing attention of scholars in the field of depression in TCM.

To further investigate the research hotspots of sudden outbreaks in the field of depression in TCM, we further applied the burst analysis function of CiteSpace software to analyse and visualise the top 10 outbreak keywords in this field, as presented in Fig. 9. This analysis showed that the occurrence time of explosive keywords were distributed before 2010 and after 2020. The explosive words that appeared prior 2010 include the main theme word "depression", as well as the keyword "complexity" of TCM as a complementary therapy in the field, in addition to commonly used keywords in animal experimental research, including "mice", "forced swimming test", "tail suspension test", and "chronic cold stress", and the keyword "neural regeneration" in mechanism research. It should be noted that "banxia houpu prescription" appeared as the only explosive term in TCM formulas in 2005, continuing until 2015. After 2020, the keywords "network pharmacology" and "molecular docking" arose as new outbreak keywords. Changes in explosive words at different times indicate changes in the research hotspots in this field and provide potential future research directions for scholars in the field of depression in TCM.

### 3.6. Co-citation analysis of journals and references

The 921 articles included in this study cited a total of 36682 references from 7464 journals. To understand the frequently cited journals and papers in this field, we analysed and drew a co-citation map using VOSviewer. The top 10 cited journals are presented in Table 6, while a network visualisation of the top 100 cited journals is shown in Fig. 10. As shown in Table 6, the top three journals with the highest number of citations are the Journal of Ethnopharmacology, Evidence-Based Comprehensive and Alternative Medicine, and the Journal of Effective Disorders. Fig. 10 shows that the co-citation network of journals consists of four clusters of different colours, including journals in the fields of neuropsychology, pharmacology, and Chinese medicine, etc. These journals can analyse and review existing research and current hot topics and provide research support.

Further analysis of the cited literature was performed to list the top 5 frequently cited articles and draw a graph of the 34 cited articles cited more than 20 times, as presented in Table 7 and Fig. 11, respectively. Among the five highly cited articles in Table 7, one is a review from the top journal The Lancet, one is an introduction to network pharmacology databases, two discuss the application and evaluation of animal models of depression, and one discusses the behavioural methods of depression in animals. As presented in Fig. 11, the network graph of highly cited literature could be divided into four clusters corresponding to the four colours in the graph. The red, green, blue, and yellow clusters contained 13, 9, 8, and 4 papers, respectively. Quoting these papers mainly provides existing theoretical and technical methodological support for the research.

**Table 5**  
List of the high-frequency keywords.

Keyword	Occurrences	Total link strength	Keyword	Occurrences	Total link strength
Depression	466	508	Traditional Chinese medicine	188	246
Anxiety	131	184	stress	112	179
Antidepressant	101	158	model	91	148
Expression	84	159	brain	82	127
Major depression	80	142	mice	77	133





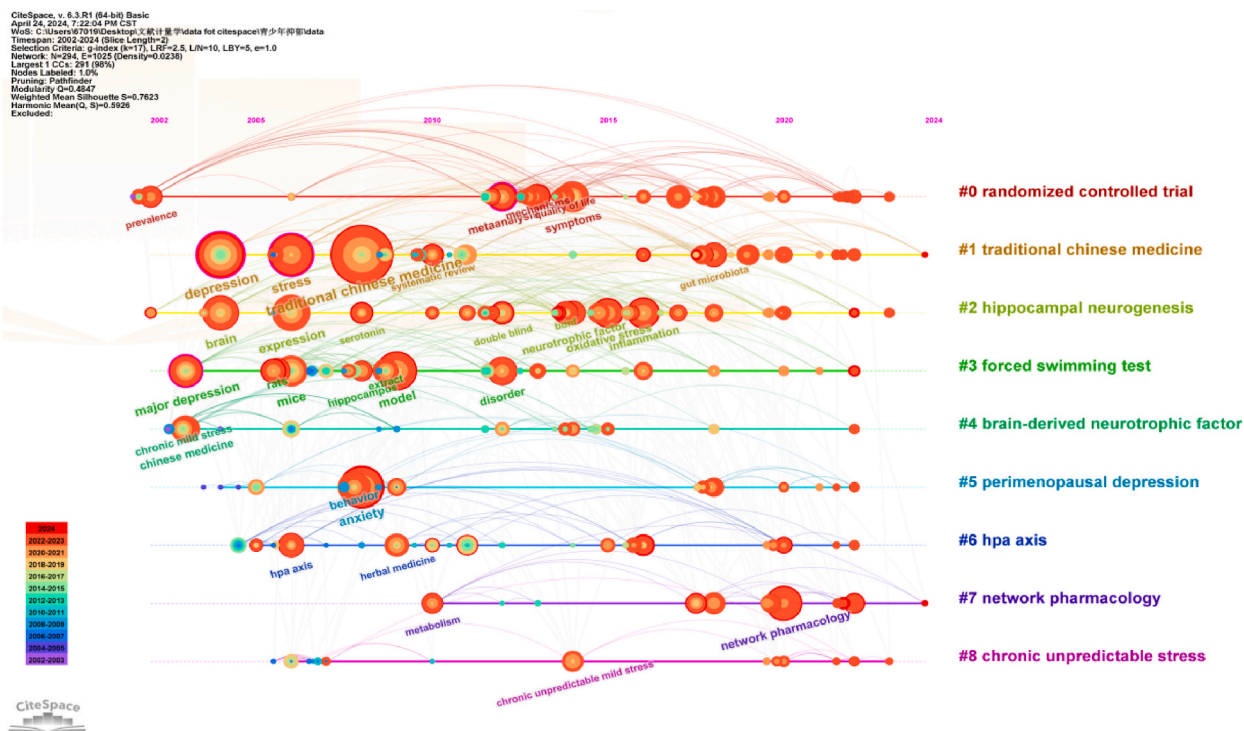


Fig. 8. Co-occurrence timeline of Keywords.

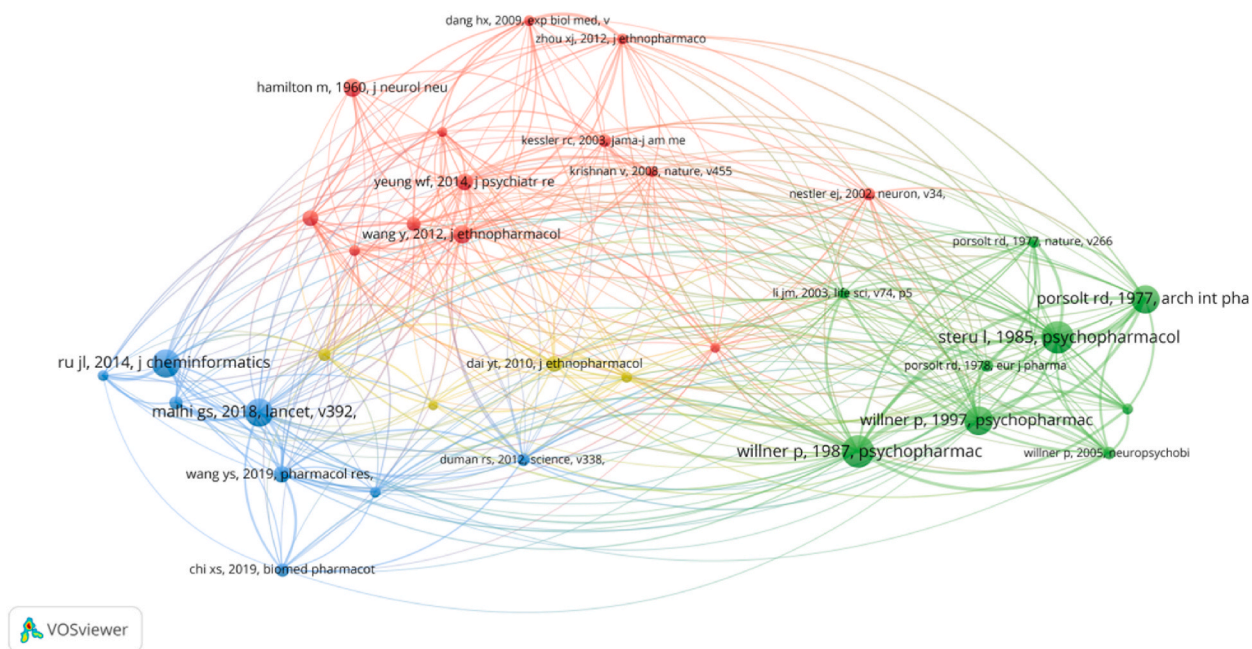
### Top 10 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2002 - 2024
depression	2004	9.41	2004	2015	[Timeline bar from 2004 to 2015]
complementary	2005	6.63	2005	2015	[Timeline bar from 2005 to 2015]
banxia houpu decoction	2005	6.09	2005	2015	[Timeline bar from 2005 to 2015]
forced swimming test	2007	7.58	2007	2013	[Timeline bar from 2007 to 2013]
mice	2006	6.52	2006	2015	[Timeline bar from 2006 to 2015]
tail suspension test	2008	8.73	2008	2017	[Timeline bar from 2008 to 2017]
chronic mild stress	2003	4.91	2008	2017	[Timeline bar from 2008 to 2017]
neural regeneration	2010	6.21	2010	2013	[Timeline bar from 2010 to 2013]
network pharmacology	2020	5.76	2020	2024	[Timeline bar from 2020 to 2024]
molecular docking	2022	4.96	2022	2024	[Timeline bar from 2022 to 2024]

Fig. 9. Explosive keywords.

from China exceeds the total number of publications from other countries (847/921), accounting for 91.97 % of the total, followed by the United States (54/921). These two regions are the core countries in this field, and play a connecting role in the national cooperation network. However, although this field has gradually attracted the attention of scholars worldwide, it is still far from sufficient, as shown in Fig. 4. This may be related to the lack of standardisation in TCM, insufficient theoretical education on TCM, complex composition of TCM formulas, low international recognition of research results on formulas, and potential toxicity of TCM. Although Poland published only three papers, its average number of citations reached as high as 124. Analysis of the papers showed that its highly cited papers were published in Neuroscience and Biobehavioral Reviews, a meta-analysis on the reliability of animal models of chronic unpredictable mild stress depression [45] providing empirical evidence for animal modelling and basic research of depression,





**Fig. 11.** Co-citation analysis of the references.

Evidence-Based Complexity and Alternative Medicine are both open-source journals, indirectly indicating that the development of open-source journals in recent years has, to some extent, promoted the development of depression in TCM. The journals with the highest number of citations per article were the Journal of Ethnopharmacology (21.31) and Biomedicine & Pharmacotherapy (20.91), indicating that the literature published in these journals has received much attention from scholars in the field of TCM depression. Further analysis of the literature revealed that papers in the Journal of Ethnopharmacology mainly focused on reviewing the antidepressant effects of TCM [47,48] and a series of mechanistic studies, such as adjusting the gut microbiota [49] and anti-inflammatory effects [50]. In addition to relevant reviews [51] and mechanism studies [52], papers in Biomedicine & Pharmacotherapy have mainly published a series of studies on the classic antidepressant TCM formulas Chaihu Shugan San [53] and Xiaoyao San [54]. Overall, both scholars and journal editors attach great importance to the mechanism and clinical research of TCM classic formulas for the prevention and treatment of depression.

The analysis of keywords can help to understand and predict the dynamics, hotspots, and cutting-edge changes in a field of research. We therefore conducted keyword analysis using VOSviewer and CiteSpace, finding that the research keywords in this field ultimately generated nine different clusters with good homogeneity, as presented in Fig. 7. The top three clusters were randomised controlled trials, Traditional Chinese Medicine, and hippocampal neurology. Cluster 1(#0) mainly studied the randomised controlled trials and meta-analyses of TCM methods in the field of depression, emphasising and validating the efficacy and safety of TCM in diagnosing and treating depression [55–57]. Cluster 2(#1) focuses on exploring the applications and mechanisms of different TCM therapies in the field of depression [58,59]. Cluster 3(#2) focused on the mechanism of TCM in treating depression, with hippocampal nerve injury and repair being considered important implications for the occurrence and development of depression and the treatment of depression with TCM [53,60]. Therefore, we have reason to believe that clinical and mechanistic research on the treatment of depression with TCM remains an important direction for future development in this field. In particular, considering the potential toxicity of TCM, conducting high-quality clinical studies with large sample sizes and multicentre collaborations, as well as in-depth basic research, could provide reliable evidence for the effectiveness and safety of TCM in the treatment of depression, and is also an important step towards the internationalisation of TCM.

To emphasise the development trajectory and characteristics of research hotspots in this field at different time stages, we analysed the timeline, finding that the research hotspots in this field could be divided into three different time periods (2000–2010, 2010–2020, and after 2020), as shown in Fig. 8. Between 2000 and 2010, keywords in this field were concentrated in the three clustering axes of Traditional Chinese Medicine, hippocampal neurology, and forced swimming test. The first two have already been introduced, while the forced swimming test is a standard behavioural methods in animal basic research [61], indicating that the hot research direction at that time involved the investigation of mechanism of action of TCM antidepressant through animal experiments. From 2010 to 2020, research hotspots focused on randomised controlled trials and hippocampal neurology, indicating that, in addition to conducting animal experiments, scholars in this field have begun to focus on the clinical efficacy and safety evaluation of TCM in the field of depression, thus providing high-quality evidence-based evidence for the development of TCM. After 2020, network pharmacology [62] began to appear in the sight of scholars and has become a new hotspot in this field. In addition, in the analysis of keyword citation time, it was found that the frequency of keyword citations significantly increased after 2020, which may be related to the increase in

publications after 2020, and reflects the increasing attention of scholars in this field. Analysis of the explosive keywords in this field showed explosive keywords were temporally distributed before 2010 and after 2020. The explosive words before 2010 focused on animal experimental research, consistent with the research trajectory indicated by the timeline, including behavioural methods, such as the forced swimming test and tail suspension test, and animal modelling methods, such as chronic cold stress. Neural regeneration was a hot topic in animal mechanism research from 2010 to 2013, consistent with the clustering of hippocampal neurogenesis mentioned above. From 2005 to 2015, the TCM Banxia Houpu decoction was a popular research formula in the field of depression, and its research content included randomised clinical trials [63], animal trials [64], and metabolomics studies [65]. Since 2020, network pharmacology and molecular docking have become explosive keywords, indicating that network pharmacology has become a new ongoing research hotspot in this field. This indicates that researchers may hope to make this a future research direction in the field of depression in TCM. Network pharmacology research has promoted the development of TCM for depression. As a new research hotspot that emerged after 2020, it not only provides new directions for the study of the compound mechanism of TCM in treating depression but also promotes scholars' attention to this field.

Analysis of the frequently cited journals and papers in this field showed that the *Journal of Ethnopharmacology*, *Evidence-Based Comprehensive and Alternative Medicine*, and the *Journal of Effective Disorders* were among the top three cited journals. The *Journal of Ethnopharmacology* and *Journal of Affective Disorders* are excellent journals in the JCR1 region. The former focuses on studying the mechanisms of action in pharmacology and toxicology, whereas the latter focuses on emotional disorders. *Evidence-Based Complementary and Alternative Medicine* is an open-source journal that has a wide range of published papers. To some extent, open-source journals can promote the development of emerging fields. Analysis of the cited literature showed that out of the top five highly co-cited articles, two were from scholar Willner, who mainly evaluated the effectiveness, reliability, and practicality of the Chronic Mild Stress model for depression [66,67]. Steru et al. previously designed a tail suspension test that is widely used in behavioural tests for depression [68]. The academic achievements of the above two scholars provide high-quality and scientific methodologies for animal experimental research in the field of depression. The TCMSp database mentioned by Ru laid the foundation for network pharmacology research on depression in TCM [69], which has arisen as a current research hotspot in this field. In addition, a review paper on depression from The Lancet provided scholars with the current research status on depression [70]. The network graph of highly cited literature generated in this study was divided into four clusters corresponding to four colours. The red cluster contained 13 articles, focusing on randomised controlled studies, meta-analyses, and basic experimental studies of TCM in the field of depression. The nine articles in the green cluster mainly studied methodologies such as animal modelling and behavioural testing for depression. The blue cluster consisted of eight articles that mainly focused on the methodology of network pharmacology and related reviews in the field of depression. Four papers in the yellow cluster conducted a series of studies on the antidepressant effects of the TCM Xiaoyao San on intestinal microbiota and metabolic regulation. From this, it can be seen that papers are primarily cited to provide existing theoretical support and technical methodological support for research.

Although this study employed a relatively comprehensive and objective bibliometric approach to demonstrate research dynamics and progress in the field of depression in TCM, it is inevitable that there are some limitations and problems similar to those of previous studies [71,72]. The most common issue was that the search database used in this study only selected articles included in the WOS. Even though the WOS is an authoritative and reliable database, it is highly likely that high-quality research results published in other databases in this field may have been overlooked, affecting the results of the study. Classic bibliometric research may face many challenges, such as providing subjective judgements and unreliable results when non-experts in the reporting research field manually analyse literature, and requiring a significant amount of time and human effort for manual citation analysis and classification throughout the entire text [73]. In recent years, with the development of artificial intelligence, natural language processing based on computer science has been applied to bibliometrics. This can overcome the shortcomings of classical bibliometric research to a certain extent, bring new perspectives for an accurate and systematic understanding of the nature of citations and scientific papers and their internal structures, and provide a general overview of the research. This may be a limitation of this study.

Overall, while our research may not fully represent all the results of this research field; however, it can be said that the results of this study have greatly demonstrated the research trends and hotspots in this field to scholars, which are of positive significance for its development.

## 5. Conclusion

To the best of our knowledge, this study is the first to present a comprehensive analysis and summary of research hotspots and trends in the field of depression in TCM since the 21st century from a bibliometric perspective, as well as the first to generate a series of visualisation maps that could provide relevant information for researchers in their clinical practice and research, and help them understand the potential collaborators, collaborating organisations, and possible future research hotspots in this field. Overall, our research showed that depression in TCM requires further attention from scholars worldwide. Conducting high-quality clinical research with large samples and multicentre cooperation as well as in-depth basic research are important directions for future development in this field. Since 2020, network pharmacology research has not only promoted scholars' attention to this field, but has also provided new directions for research on the mechanism of TCM compound therapy for depression, which may still be the research trend in this field in the coming period.

## CRedit authorship contribution statement

**Chengcheng Song:** Writing – original draft. **Kelong Chen:** Data curation. **Yongxi Jin:** Visualization. **Ling Chen:** Formal analysis.

**Zuxiu Huang:** Writing – review & editing, Project administration.

## Data and code availability statement

Data will be made available on request.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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