Proceedings of the 6th International Conference on Biological Engineering and Medical Science
DOI: 10.54254/2753-8818/2026.37931

Bibliometric Analysis of Research on Traditional Chinese Medicine for Insomnia Treatment from 2016 to 2026: Inflammatory Mechanisms, Comorbidity Characteristics, and Acupuncture Therapy

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Abstract. In order to clarify the research progress and future direction of the field of traditional Chinese medicine intervention for insomnia, explore the core concerns, main research groups, and target directions of current research, and provide empirical reference for subsequent basic research and clinical diagnosis and treatment, this study carried out a systematic review of the relevant achievements in this field from 2016 to 2026. Using PubMed as the literature source, the English original researches related to traditional Chinese medicine for insomnia published from September 2016 to September 2026 were retrieved, and 432 valid literatures were finally included. Bibliometric analysis method was adopted, relying on the data analysis function of the citexs platform, combined with the BioBERT pre-trained model to carry out medical entity recognition and quantitative statistics on the abstract texts of the literatures, and an overall analysis was carried out from multiple dimensions such as the annual publication change law, the distribution pattern of countries and regions, the composition of research institutions, the core author group, the characteristics of published journals, the keyword hotspots and evolution paths, and the associated target genes and comorbidities. The results show that the annual publication volume in this field shows an overall rapid growth trend, reaching a publication peak of 97 papers in 2025; China occupies an absolutely dominant position in this field with 385 publications. Among the existing studies, Beijing University of Chinese Medicine is the core research subject in this field; the current academic hotspots focus on three types of directions: acupuncture intervention schemes, network pharmacology analysis methods, and randomized controlled trial designs; the inflammation-related regulatory genes IL6 and TNF are the core targets generally concerned by the academic community; the comorbidity mechanism and intervention research of insomnia with depression and anxiety have become key exploration areas. Overall, the related research on traditional Chinese medicine for insomnia is in a period of rapid development, and the research focus has gradually shifted from the induction of traditional clinical experience to the analysis of action mechanisms and the construction of evidence-based evidence, and the regulation of inflammatory signaling pathways and the comorbidity of insomnia and emotional disorders are the core research starting points at the present stage. Subsequent research needs to further promote international collaboration and multi-center large-sample clinical validation, deeply explore the inflammation-related action mechanisms, and at the same time rely on multi-omics technology to improve the research evidence level, so as to provide support for the

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DOI: 10.54254/2753-8818/2026.37931

international promotion and standardized application of traditional Chinese medicine insomnia treatment schemes.

Keywords: insomnia, traditional Chinese medicine, bibliometrics, inflammatory mechanisms, insomnia comorbidity

1. Introduction

Insomnia is the most common type of sleep disorder in clinical practice, and its core manifestations are prolonged sleep latency, interrupted sleep continuity, or advanced morning awakening time, which will cause significant negative impacts on the patient's daytime social function and daily quality of life. At present, the prevalence of insomnia among the global adult population is between 10% and 30%, and the risk of onset is higher in the older population [1]. In addition to causing the decline of individual cognitive ability and work output, insomnia is also clearly associated with the onset of cardiovascular diseases, metabolic disorders, and various mental disorders, which not only damages the personal health level of patients, but also causes considerable pressure on the public health system and social economy. At the present stage, the clinical routine intervention schemes for insomnia mainly include two types: cognitive behavioral therapy and drug treatment, but cognitive behavioral therapy has the problems of insufficient resource supply and high treatment cost, and long-term medication is easy to cause increased tolerance, drug addiction, and various adverse reactions [2]. In view of this, the development of new insomnia intervention schemes with more safety and effectiveness is a clinical demand that urgently needs to be responded to in the current field of sleep medicine, and has important practical application value.

The history of traditional Chinese medicine used for insomnia treatment is long-standing, and the clinical application scenarios are very wide, specifically including multiple intervention means such as oral administration of traditional Chinese medicine compound, acupuncture, massage, and qigong guidance. Existing research results show that traditional Chinese medicine can improve sleep conditions through multi-target action pathways such as regulating neurotransmitter levels, inflammatory factor expression, and neuroendocrine network functions, and its characteristics of multi-pathway intervention and low treatment cost give it a unique advantage in the field of insomnia diagnosis and treatment [3]. Many clinical practices and basic experimental evidences all show that traditional Chinese medicine can play a positive role in reducing the clinical symptoms of insomnia patients, reducing the risk of disease recurrence, and improving the emotional abnormalities accompanied by patients [4]. However, even though the relevant research output in this field continues to increase at present, there is still a lack of systematic bibliometric research at the present stage, and it is difficult to form an overall clear presentation of the research progress, hotspot evolution context, and internal action mechanism of this direction.

At the present stage, the related research on traditional Chinese medicine intervention for insomnia mostly focuses on two major directions: clinical efficacy verification and action mechanism analysis, but the research resource layout characteristics, the evolution law of core research topics, and the screening and identification of core biomarkers in this field still need to be clarified. Taking the inflammatory pathway as an example, its regulatory role in the occurrence and development of insomnia has received wide attention from the academic community, but through which pathway traditional Chinese medicine regulates inflammation-related genes such as IL6 and TNF to exert the insomnia improvement effect, its specific action mechanism has not yet formed a unified understanding [5]. At the same time, insomnia patients generally have the characteristics of

DOI: 10.54254/2753-8818/2026.37931

comorbidity with mental disorders such as depression and anxiety, which also suggests that traditional Chinese medicine needs to take into account both the overall syndrome differentiation and treatment and the collaborative regulation of patients' emotional states in the treatment process [6]. However, most of the published research results are single-center small-sample clinical observations or basic experimental studies, and there is little macroscopic quantitative knowledge map analysis for this field, making it difficult to systematically sort out the development and evolution path of this field and predict the future research trend.

In order to fill the gaps in the above research, this study integrates bibliometric methods and natural language processing technology to carry out a systematic review of the existing research in the field of traditional Chinese medicine intervention for insomnia. Bibliometric analysis can objectively and efficiently present the research hotspots and knowledge structure of the field, and effectively overcome the subjective deviation existing in traditional reviews [7]. This study uses the PubMed database as the data source, retrieves the relevant English original researches published from September 2016 to September 2026, and finally includes 432 valid literatures. Relying on the citexs platform to carry out data mining work, and at the same time introducing the BioBERT biomedical language representation model to complete entity recognition and quantitative statistics on the abstract texts of the literatures, it intends to carry out an overall analysis from multiple dimensions such as the change trend of annual publication volume, the distribution of countries and regions, the distribution of research institutions, the core author group, the distribution of published journals, the keyword hotspots and evolution paths, and the associated genes and comorbidities.

This study intends to systematically sort out the overall picture and evolution trend of the research in the field of traditional Chinese medicine intervention for insomnia from 2016 to 2026, aiming to provide reference support for the subsequent related exploration in this field. By clarifying the research focus direction, the core research subject, and the internal logic of action in this field, this study expects to provide empirical reference for improving the allocation of research resources, promoting the transformation of scientific research results, and accelerating the internationalization process of traditional Chinese medicine, and finally provide assistance for the innovative iteration of clinical intervention schemes for insomnia.

2. Materials and methods

This study uses bibliometric analysis means to carry out a systematic review of the English research originals of traditional Chinese medicine intervention for insomnia included in the PubMed database from September 2016 to September 2026. The data retrieval adopts the retrieval formula " (traditional chinese medicine) AND (insomnia)", limits the literature type to journal papers and the language to English, and finally includes a total of 432 valid literatures that meet the standards.

In the selection of analysis tools, this study relies on the citexs data analysis platform to complete the literature big data mining work, and at the same time is equipped with the BioBERT biomedical language representation model to carry out entity recognition and frequency statistics on the abstract content of the included literatures, so as to achieve the goal of deep extraction of gene and disease association information.

This analysis is carried out systematically from multiple dimensions: for the dimension of annual publication trend, the total publication volume is counted year by year, and the average annual publication scale and annual growth rate are calculated at the same time, so as to determine the development stage of the field at present; for the dimension of country/region distribution, the publication number of different countries and regions is counted and its proportion in the total publication volume is calculated; for the dimension of research institution distribution, the main

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research institutions in the global scope are sorted out and identified, and the core research forces in the field are clarified; for the dimension of core author distribution, the publication number of each author is counted, and a list of prolific authors is formed; for the dimension of journal distribution, the total publication volume of each journal is counted, and the main publication platform of the research results in the field is determined. In addition, through the keyword hotspot analysis, the keywords with high occurrence frequency are extracted to reflect the mainstream research themes in the field; when carrying out the keyword time evolution analysis, the entire research time range is divided into 4 continuous time windows to track the heat ranking and change trend of keywords in different stages; the BioBERT pre-trained model is used to identify and mine the gene entities and disease entities in the literature abstracts, and the occurrence frequency of various related genes and diseases is counted respectively; finally, multiple indicators such as the citation times of literatures, publication time, and impact factor of the belonging journal are fully considered to screen out the recommended literatures and field classic literatures worthy of key attention. Through the above multi-dimensional data mining work and the supporting visualization analysis, the overall research pattern and complete development context of the field can be systematically and fully presented.

3. Results

3.1. General research overview

This study uses PubMed as the literature retrieval data source, and carries out a systematic review and analysis of the 432 English literatures on traditional Chinese medicine intervention for insomnia publicly published from September 2016 to September 2026. The results show that the field shows a relatively clear evolution path in the dimensions of research volume, core research subject, hotspot issues, and action mechanism exploration.

3.2. Annual publication trend

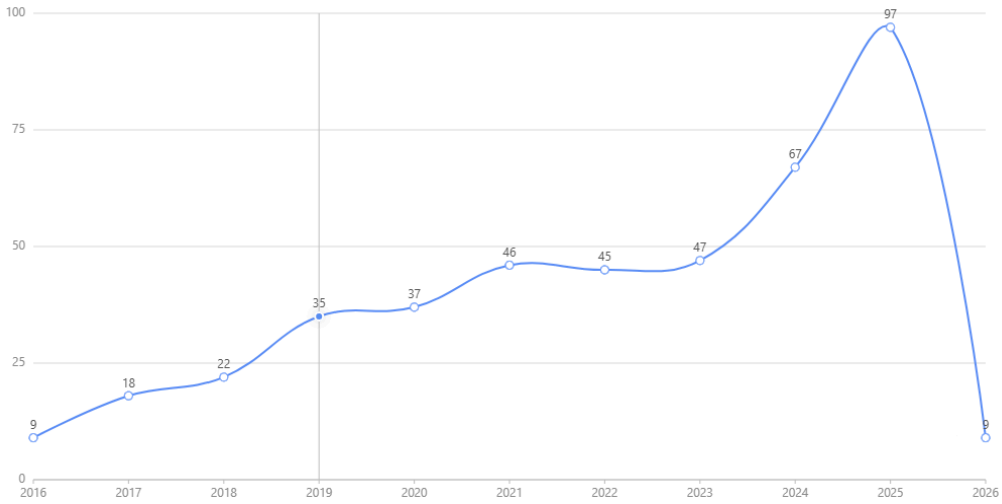

Figure 1. Annual publication trend of related literatures

note: The number of publications of related literatures in different years

By counting the change law of annual publication, it can be found that the research output of this field shows an overall rapid growth trend, and the average annual publication number reaches 39.3

DOI: 10.54254/2753-8818/2026.37931

papers. Combined with the data of Figure 1, the publication volume in 2017 achieved double growth compared with 2016, which is the year with the highest growth rate in the entire observation cycle; the publication scale in the subsequent years maintains a continuous upward trend, and reaches a peak of 97 papers in 2025. This change trend intuitively reflects that the attention of the related research on traditional Chinese medicine intervention for insomnia continues to increase, and the field has now entered a stage of rapid development.

3.3. Distribution of research forces

From the distribution of research forces presented in Figure 2, the mainland of China ranks first with a total publication volume of 385 papers, accounting for 89.12%, and occupies an absolutely dominant position in the research of this field; the Taiwan region of China ranks second with 13 papers and 3.01%, and the United States ranks third with 9 papers and 2.08%, and the overall participation of the rest of the countries and regions is relatively low (Figure 2a). This distribution characteristic shows that the current research in this field is highly focused on the mainland of China, and there is still a large room for improvement in the subsequent cross-national and cross-regional academic cooperation. From the dimension of participating institutions, the top three in publication volume are Beijing University of Chinese Medicine, Shanghai University of Traditional Chinese Medicine, and Chengdu University of Traditional Chinese Medicine, and various traditional Chinese medicine colleges and universities are the core subjects supporting the research in this field (Figure 2b). At the author contribution level, the scholar with the highest publication volume is Zhengzhong Yuan, followed by Bosai He, and another 10 authors each published 3 papers tied for the third place, and the achievement distribution of the overall author group is relatively scattered, and a core research team with high aggregation has not yet been formed.

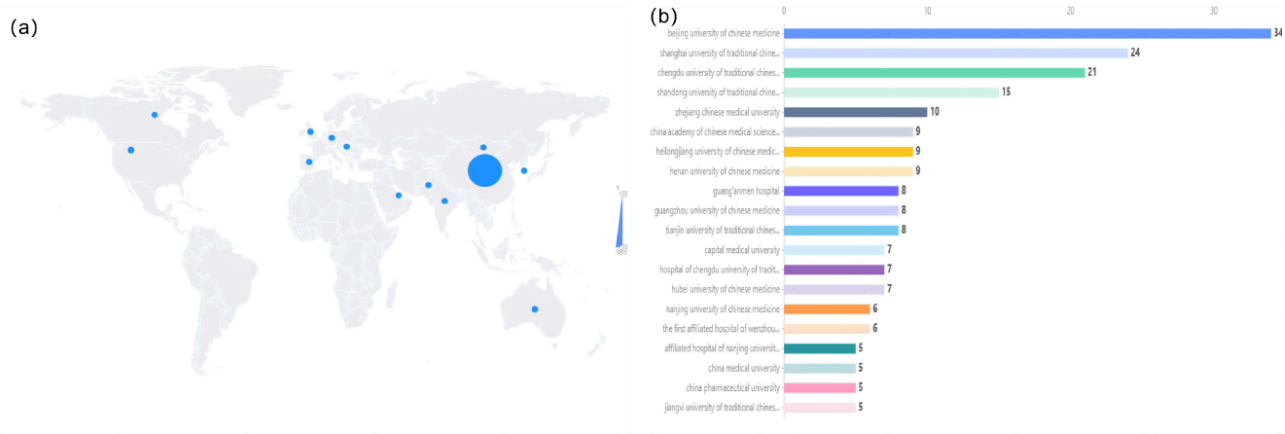

Figure 2. Analysis of countries/regions and research institutions

note: (a) indicates the distribution difference of countries and regions, (b) indicates the quantity difference of research institutions

3.4. Journal distribution and keyword hotspots

From the perspective of journal distribution characteristics, combined with the statistical results of Figure 3, the top three journals in publication volume are the *Journal of Ethnopharmacology*, *Medicine (Baltimore)*, and *China Journal of Chinese Materia Medica*, covering multiple research fields such as ethnopharmacology, clinical medicine, and Chinese materia medica (Figure 3a). The keyword hotspot analysis results show that insomnia, traditional Chinese medicine, acupuncture,

DOI: 10.54254/2753-8818/2026.37931

network pharmacology, and randomized controlled trial rank in the top five of the high-frequency keywords, reflecting that acupuncture intervention, network pharmacology method, and randomized controlled trial design are the core methodological hotspots of the research in this field at the present stage (Figure 3b). Through the keyword time evolution analysis, it can be further found that the attention of keywords such as network pharmacology and acupuncture continues to rise, while the heat of some early research hotspots gradually declines (Figure 3c), and the overall research theme is steadily transforming from the traditional empirical induction to the direction of mechanism interpretation and evidence-based evaluation.

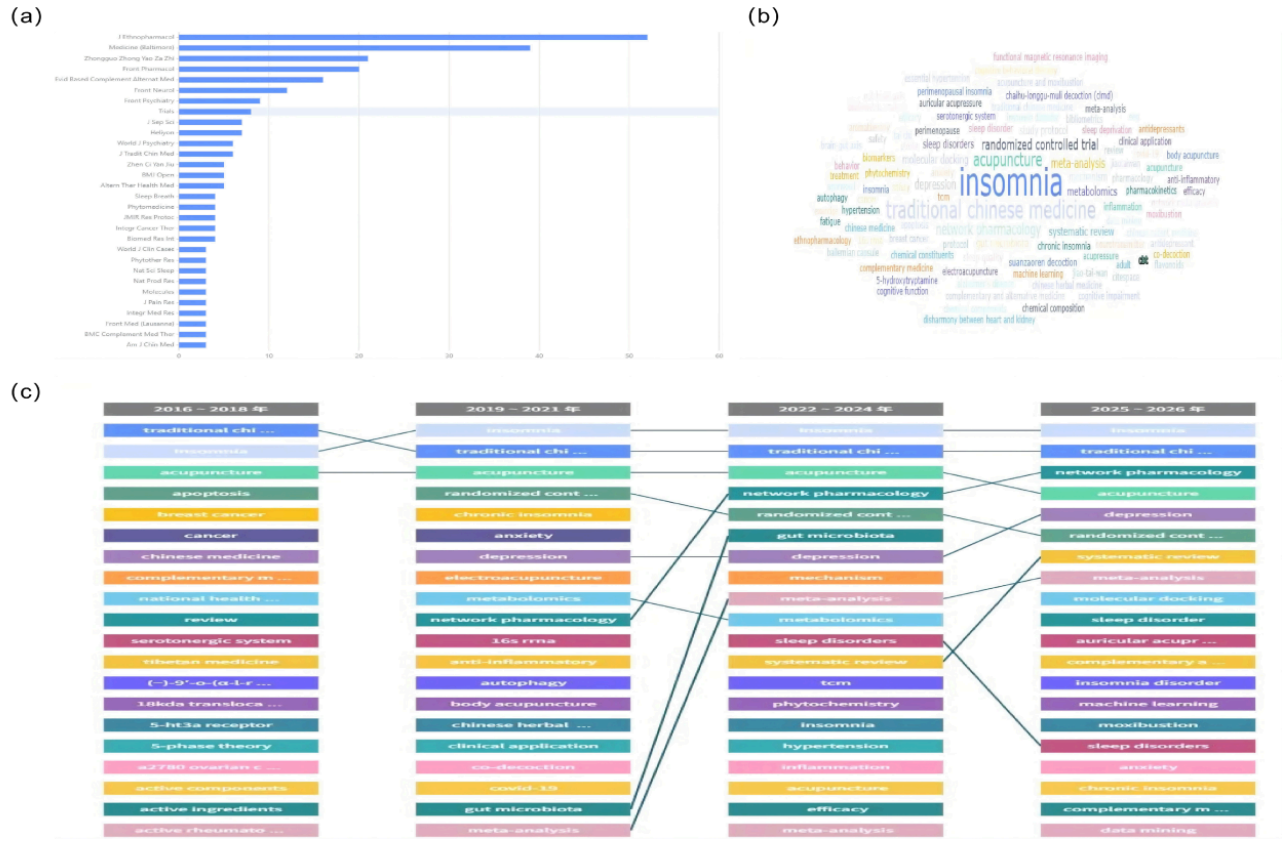

Figure 3. Frequency analysis of publishing journals and keyword hotspots

note: (a) indicates the publication ranking of different journals, (b) indicates the hotspot map of high-frequency publications, (c) the keyword time evolution analysis steadily transforms from the traditional empirical induction to the direction of mechanism interpretation and evidence-based evaluation.

3.5. Associated genes, comorbid diseases, and representative literature

The mining results for the action mechanism are shown in Figure 4. After using the BioBERT model to carry out gene entity recognition, it is found that the mention frequency of inflammation-related genes is much higher than that of other categories. Among them, IL6 is reported in 26 literatures, TNF is discussed in 23 studies, and the occurrence frequency of RATTNF also reaches 18 times. This result shows that the inflammatory pathway is the core action target of traditional Chinese medicine in the treatment of insomnia (Figure 4a). The co-occurrence disease statistics show that the related literatures of insomnia disorder itself account for the highest proportion, reaching 420 papers cumulatively, followed by depression with 178 papers and anxiety with 150 papers, reflecting that the comorbidity mechanism research of insomnia with depression and anxiety is a hotspot direction

DOI: 10.54254/2753-8818/2026.37931

in the current field. In addition, this study integrates multiple dimensions such as literature citation frequency, publication year, and journal impact factor to screen out 30 representative literatures in the field, and at the same time combines co-citation network analysis to obtain 30 high-value classic literatures (Figure 4b), which can provide basic literature support for subsequent related research.

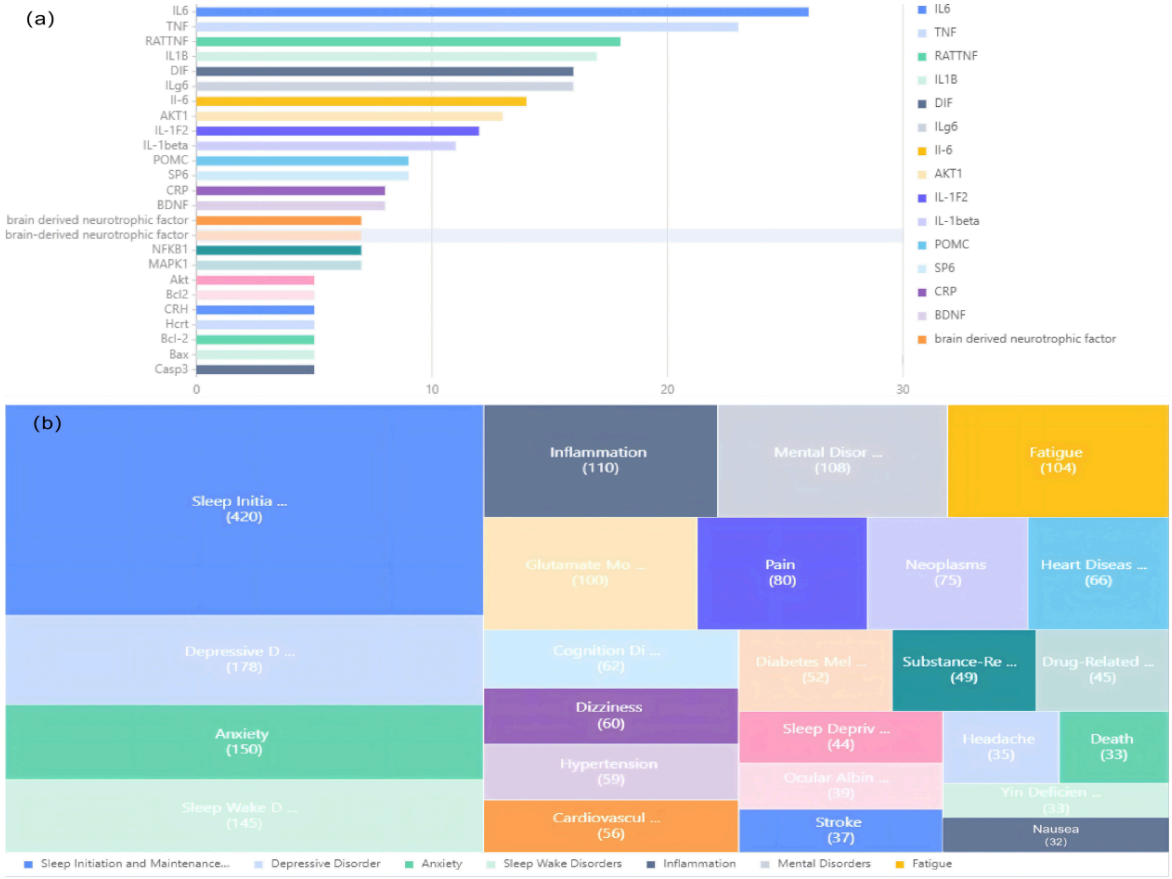

Figure 4. Analysis of hotspot frequency of associated genes, associated diseases, and representative literature

note: (a) indicates the hotspot frequency of different associated genes and associated diseases, (b) indicates the co-occurrence disease keywords and the quantity analysis of representative literatures.

4. Discussion

Insomnia is a common type of sleep disorder in clinical practice. Its core manifestations are prolonged sleep latency, frequent awakening during sleep, or morning early awakening. At present, 10% to 30% of adults worldwide are suffering from this disease, and the prevalence rate is positively correlated with age growth [1]. In addition to causing the decline of cognitive ability and work efficiency of patients, the disease is also closely related to the occurrence and development of cardiovascular diseases, metabolic syndrome, and various mental disorders, and has brought a heavy public health and economic burden to the society and patients' families [2]. Among the first-line intervention means of insomnia at the present stage, cognitive behavioral therapy has the problems of insufficient resource supply and high diagnosis and treatment cost, and drug treatment is easy to cause tolerance, dependence, and various adverse reactions [2, 3]. Therefore, it is urgent to explore new intervention schemes with both safety and effectiveness.

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This study retrieved 432 English original research literatures on traditional Chinese medicine intervention for insomnia from 2016 to 2026 through the PubMed database, and completed the literature data mining and biological entity recognition work with the help of the citexs analysis platform and the BioBERT pre-trained model [8]. The analysis results show that the annual publication volume in this field shows a rapid growth trend, and it is expected to reach the publication peak in 2025; China is the core research output country, and traditional Chinese medicine colleges and universities are the core subjects of publication; acupuncture therapy, network pharmacology research, and randomized controlled trial design are the current research hotspots; inflammation-related genes such as IL-6 and TNF are the biomarkers of key attention; the comorbidity mechanism and intervention research of insomnia with depression and anxiety are important development directions in the future [9, 6]. This bibliometric analysis result effectively makes up for the inherent defect that traditional review research relies on the subjective judgment of researchers [7].

The core innovation of this study lies in the first systematic combination of bibliometrics and natural language processing technology, and its application to the analysis of the overall pattern of research in the field of traditional Chinese medicine intervention for insomnia. The existing related research generally focuses on the discussion of the effect of a single therapy. For example, the evaluation study carried out by scholar Ye et al. on the traditional Chinese medicine related recommendation content in the global clinical guidelines for insomnia [2], and the characteristic analysis of the acupuncture combined with Chinese herbal medicine intervention scheme for the perimenopausal insomnia population by Li et al. [4], both lack the systematic quantitative review of the overall development trend, knowledge system structure, and action mechanism of this field. This study includes 432 related literatures, and carries out an integrated analysis from four dimensions: annual publication trend, national distribution of research subjects, keyword evolution path, and gene-disease association characteristics, clarifying that this field is transforming from the traditional experience summary stage to the stage combining mechanism exploration and evidence-based evaluation, and at the same time determining that interleukin-6, tumor necrosis factor, and the comorbidity of insomnia with depression/anxiety are the current core research hotspots. This conclusion forms a mutual confirmation with the review research conclusion of scholar He et al. who sorted out the regulation of neurotransmitter, hypothalamic-pituitary-adrenal axis, and gut microbiota by traditional Chinese medicine [3], and also further verifies the core role of the inflammatory pathway in the mechanism of traditional Chinese medicine intervention for insomnia through the method of data mining.

The conclusions of this study can provide important reference basis for clinical diagnosis and treatment practice and related scientific research policy formulation. At present, the total annual publication volume in this field shows a rapid growth trend, reaching a peak of 97 papers in 2025, among which the year-on-year growth rate in 2017 is as high as 100%. This growth trend is not only closely related to the release and implementation of the Outline of the Healthy China 2030 Plan and the continuous promotion of the internationalization strategy of traditional Chinese medicine, but also the significant increase in the prevalence of insomnia among the global population after the COVID-19 pandemic [10] directly drives the investment of related research resources. It is suggested that the subsequent scientific research projects should take the exploration of inflammatory action mechanism, the implementation of multi-center randomized controlled trials, and the optimization of comorbidity intervention schemes as the key support directions. Among the existing literatures, Chinese scholars produced 385 papers, accounting for 89.12% of the total, occupying an absolutely dominant position, while American scholars published only 9 papers,

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accounting for 2.08%, which reflects the low degree of internationalization of the research in this field from the side. This distribution characteristic is consistent with the related research conclusion published by Feng et al. with the research results of Chinese research teams as the main review object [5]. In the follow-up, it is necessary to establish a unified efficacy evaluation standard with the Pittsburgh Sleep Quality Index as the core, accelerate the promotion of cross-cultural multi-center clinical research, and the intervention scheme of acupuncture combined with Chinese medicine proposed by Wang et al. can be referred to for related exploration [11].

The keyword review results of the existing research show that acupuncture intervention, network pharmacology method, and randomized controlled trial have become the core research means in this field, reflecting that the current research paradigm is gradually transforming from the traditional empirical description to the direction of internal mechanism interpretation and evidence-based evidence verification. The Meta-analysis results for the efficacy of acupuncture show that its intervention effect is significantly better than that of sham acupuncture or placebo control [9], but such studies still have difficulties to break through at the level of double-blind design and placebo control setting; although network pharmacology can realize the prediction of multi-target action mechanism, it generally lacks the verification support of subsequent experimental research [12]. Indicators such as interleukin-6 and tumor necrosis factor provide a clear action target basis for the intervention means such as Suanzaoren Decoction and acupuncture to regulate the inflammatory pathway, and the related conclusions are complementary to the research results of Bao et al. around Zhumian Granules regulating neurotransmitters and inhibiting neuronal apoptosis [13]. The high comorbidity characteristics of insomnia with depression and anxiety in clinical practice suggest that the intervention process can follow the TCM treatment principle of "treating different diseases with the same method", and at present the intervention effect of Xiaoyao San on such comorbidities has been supported by the evidence of Meta-analysis [6].

This study still has certain limitations: first, the research data only come from the PubMed database, and non-English literatures and other database resources are not included, so there may be regional selection bias; second, the association conclusion of genes and diseases is mainly obtained by relying on the text mining results of the BioBERT model, and has not been verified by wet experiments or clinical research, so the causal association between the two cannot be clarified; in addition, the keyword analysis results are disturbed by the annotation habits of the original literature authors to a certain extent, the relevant data in 2026 have the problem of incomplete collection, and the study did not carry out the cross-validation of multiple methods. The follow-up research can further expand the scope of data sources, supplement the experimental verification link, and optimize and improve the existing research process.

In summary, this study sorts out and presents the overall pattern of research in the field of traditional Chinese medicine intervention for insomnia from 2016 to 2026: the publication volume in this field shows a rapid growth trend, and the research forces are highly concentrated in our country, and traditional Chinese medicine colleges and universities are the core research subjects; interleukin-6, tumor necrosis factor, and the comorbidity of insomnia with depression/anxiety are the core concerns of the current research, and the application of acupuncture related research and network pharmacology methods promotes the research paradigm of the field to gradually transform to deep mechanism analysis and evidence-based evidence verification. However, at present, the field still has two prominent bottlenecks: insufficient international influence and lack of empirical verification of basic mechanism research. The follow-up research can focus on promoting multi-center international collaboration projects, integrated analysis of multi-omics technology, and the implementation of high-quality randomized controlled trials, so as to help the standardized

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construction and global promotion of traditional Chinese medicine intervention schemes for insomnia.

5. Conclusion

This study uses the PubMed database as the retrieval source, and carries out a systematic bibliometric analysis of 432 English literatures in the field of traditional Chinese medicine intervention for insomnia from 2016 to 2026. The results show that the related research on traditional Chinese medicine for insomnia has entered a period of rapid development, the total annual publication volume shows a steady upward trend, and the publication volume reaches a peak of 97 papers in 2025, and the research heat of the field continues to rise. China has published 398 papers cumulatively, accounting for 92.13% of the total, occupying an absolutely leading position in the research of this field. The core research institutions are represented by Beijing University of Chinese Medicine, Shanghai University of Traditional Chinese Medicine, and Chengdu University of Traditional Chinese Medicine, and traditional Chinese medicine colleges and universities are the core research subjects in this field; however, the distribution of researchers is relatively scattered, and a core author group with high aggregation has not yet been formed. Acupuncture therapy, network pharmacology analysis, and randomized controlled trial are the methodological research hotspots at the present stage, and the research paradigm is gradually transforming from the traditional experience summary to the direction of internal mechanism mining and evidence-based evidence construction. The inflammation-related genes IL6 and TNF are the core action targets of traditional Chinese medicine in regulating insomnia, suggesting that the inflammatory signaling pathway is the key breakthrough point to explain the action mechanism of traditional Chinese medicine treatment. The comorbidity intervention research of insomnia with depression and anxiety has become an important academic exploration direction, fully demonstrating the diagnosis and treatment advantages of the overall syndrome differentiation and the treatment of different diseases with the same method of traditional Chinese medicine.

Overall, the related research output scale of traditional Chinese medicine intervention for insomnia is growing rapidly at present, and the development potential of the field is sufficient, but the cross-national scientific research collaboration network has not yet been formed, and the insufficient systematic verification of the action mechanism is still the core bottleneck restricting its development. The follow-up research can focus on promoting multi-center cross-border cooperation projects, further explore the regulatory mechanism of the inflammatory pathway in traditional Chinese medicine for insomnia, and at the same time rely on multi-omics technical means and large-sample high-quality clinical trials to consolidate the evidence-based medical evidence, so as to provide support for the standardized construction and international promotion of traditional Chinese medicine insomnia treatment schemes.

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