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Visualization Research on the Progress of Acupuncture Treatment for PCOS Based on Citespace

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Abstract: Background: Acupuncture in the treatment of polycystic ovary syndrome (PCOS) has attracted much attention in recent years. Acupuncture, as an adjunct therapy, provides a relatively safe and feasible treatment option for PCOS patients. Objective: To visually analyze the hot spots and trends of acupuncture and moxibustion in the treatment of polycystic ovary syndrome (PCOS) by bibliometrics, so as to provide some reference for the research in this field in China. Results and conclusions: (1) A total of 196 literatures were included, and the number of publications and citations showed an increasing trend in general; The discipline distribution involves integrated and complementary medicine, general internal medicine, endocrinology and metabolism, physiology and neuroscience, showing a trend of interdisciplinary integration. Stener-Victorin and Elisabet are the authors with the most publications, and the institution with the most publications is Heilongjiang University of China is the most prolific country for Chinese Medicine. (2) The keywords analysis found that the research focusses on the use of different acupuncture therapy to treat PCOS; Analysis of mechanism of acupuncture treatment for polycystic ovary syndrome; Analysis of curative effect of acupuncture and moxibustion on polycystic ovary syndrome. (3) The research hotspots in the field of acupuncture and moxibustion treatment of PCOS mainly focus on the use of different acupuncture and moxibustion treatment of PCOS as the theme, combined with the analysis of the mechanism of acupuncture and moxibustion treatment of PCOS and the analysis of efficacy.

Keywords: Bibliometrics; Visual Analysis; Acupuncture; Polycystic Ovary Syndrome; CiteSpace.

1. Introduction

Polycystic ovary syndrome (PCOS) is a common reproductive endocrine and metabolic disorder in adolescent and reproductive age women, mainly characterized by ovulation dysfunction, hyperandrogenemia and ovarian polycystic morphology. It often presents clinical manifestations such as infertility, oligomenorrhea or even amenorrhea, obesity, acne, and seborrheic alopecia[1][2][3]. According to investigation and research[4], the prevalence of infertility caused by ovulation disorder with PCOS is 15 times that of women of normal reproductive age.

Western approaches to the treatment of polycystic ovary syndrome (PCOS) include medication and surgery. Medications manage symptoms mainly by regulating the menstrual cycle and high androgens, improving metabolic disorders, and promoting fertility. However, western medicine treatment may cause some adverse reactions, such as nausea, vomiting, dizziness, fatigue, liver and kidney function damage, etc., and complications such as ovarian hyperstimulation and high ovulation rate and low pregnancy may occur after surgery[5]. In contrast, acupuncture treatment, as an alternative option, has many advantages. Acupuncture treatment has the characteristics of significant curative effect and few side effects, which can improve the reproductive function and endocrine disorders in patients with polycystic ovaries[6]. In addition, acupuncture can also promote blood circulation, adjust the neuroendocrine system, improve immune function, etc., and have a positive effect on the comprehensive adjustment of body balance.

In recent years, the research of acupuncture treatment of PCOS has been gradually deepened. Therefore, based on the core set database of Web of Science, this paper collected relevant literature on the application of acupuncture and moxibustion in the treatment of polycystic ovary syndrome, adopted bibliometrics and CiteSpace software to carry out visual analysis of research results in this field. Compared with the traditional manual reading of literature alone, CiteSpaces analysis combined with manual reading of literature can more accurately and clearly analyze research hotspots in this field[7].

Based on the core set database of Web of Science and the CiteSpaces software as the main analysis tool, this paper reveals the research hotspots of acupuncture in the treatment of polycystic ovary syndrome, thus providing a certain reference for the research in this field in China.

2. Data and Methods

2.1. Data Source and Retrieval Strategy

In order to ensure the authoritativeness and usability of the literature samples, the data of the literature are all from the Web of Science published by the American Institute of Scientific Information. The Core Collection database is the world's leading platform for the collection and related academic influence, providing the most influential and authoritative literature. Set as advanced search, the search formula is: TS = ("acupuncture" OR "acupoint" OR "moxibustion" OR " combination of acupuncture and medicine" OR " acupuncture method") AND TS = ("polycystic ovary syndrome" OR "PCOS" OR " patients with polycystic ovary syndrome" OR " polycystic ovary" OR " polycystic") in English. The document type was Article and the time span was 2000-01-01/2024-07-17. A total of 214 records were obtained.

2.2. Inclusion Criteria

2.2.1. Adoption Standard

It is consistent with the literature on the application of acupuncture in the field of polycystic therapy.

2.2.2. Exclusion Criteria

Republished literature; The search terms have nothing to do with "acupuncture", "polycystic ovary syndrome", etc.; The bibliography is incomplete.

2.3. Literature Quality Evaluation

The literature retrieved from the Web of Science core set database was exported in "full records and cited references" and "plain text format", named "download_1-196.txt", and imported into the CiteSpace6.2. R4 software to de-duplicate. At the same time, input all the data into Excel2021 software for backup.

2.4. Software Parameter Setting

In the Citespace software, country, reference and keyword were selected respectively. The time span was from 2000 to 2024 (the search results showed that the earliest published literature was 2000). The time slice was 1 year, and Top N=50. Knowledge graphs such as country cooperation analysis, keyword burst and highly cited literature in-depth analysis were generated by Pathfinder and Pruningsliced networks and pruning the merged network, leaving all other Settings default.

3. Result

3.1. Literature Search Results

A total of 214 articles were retrieved, which were manually screened according to the exclusion criteria, and 196 eligible articles were finally selected, all of which were original articles.

3.2. The Trend of Acupuncture and Moxibustion in the Treatment of Polycystic Literature

Only two papers were published in this field in 2014, and the number of papers has increased significantly in a few years. On the whole, the number of published papers showed a slow upward trend, indicating that the attempts and explorations made by scholars in the field of acupuncture treatment of PCOS have gradually increased, and its research value has been attached importance by many researchers in the academic field, as shown in Fig 1.

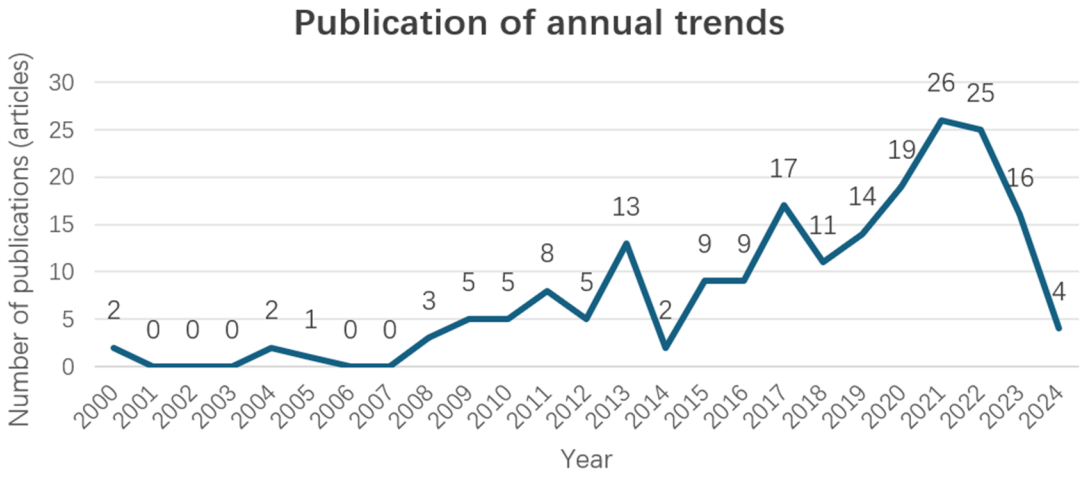

Fig 1. Annual trends of published literature on acupuncture in the field of treatment of polycystic ovary syndrome

3.3. Analysis of Cooperation Networks Between Countries

As can be seen from Table 1 and Fig 2, in the past 20 years, the international research enthusiasm for the use of acupuncture technology in the treatment of PCOS is high, among which China and Sweden have published the most papers. However, on the whole, the strength of the links between countries is relatively scattered, indicating that international cooperation still needs to be strengthened. In addition, China's publication accounts for 70.91%, accounting for the main position, which may be caused by cultural factors.

3.4. Author Cooperation Network Analysis

The authors who have published relevant articles were collected and the number of their published articles was sorted. It was found that the largest number of published articles was 34, and only Stener-victorin and Elisabet were one. Secondly, one author published eight papers, three authors published seven papers, and 165 authors published one paper, as shown in Table 2. Through the analysis of the cooperative network of authors with frequency greater than 1, the graph can be drawn (Fig 3): there are 256 nodes and 519 connections, the size of each node represents the number of its papers, and the number of nodes is the number of authors. The thickness of the connection between nodes corresponds to the strength of the cooperative relationship between them. According to Ripps' law, the minimum number of publications by the core author is $N=0.749\sqrt{M_{max}}$ (M_{max} is the number of publications by the most prolific author). M_{max} is 34, and N=5 is calculated. The core authors in this field are those with 5 or more published papers. Among the 256 authors, 8 authors published more than or equal to 5 articles, totaling 79 articles, accounting for 40.31% of the total number of articles. If the core authors account for more than 50% of the total number of papers, it indicates that the core author team has formed in this field, so no core author team has formed in this field.

Table 1. The top five countries in the field of acupuncture treatment PCOS research from 2000 to 2024

Rank	Country	Number of publications	Publication ratio (%)	Centrality
1	PEOPLES R CHINA	139	70.91	0.41
2	SWEDEN	44	22.45	0.18
3	USA	20	10.20	0.08
4	AUSTRALIA	15	7.65	0.06
5	ENGLAND	14	7.14	0.25

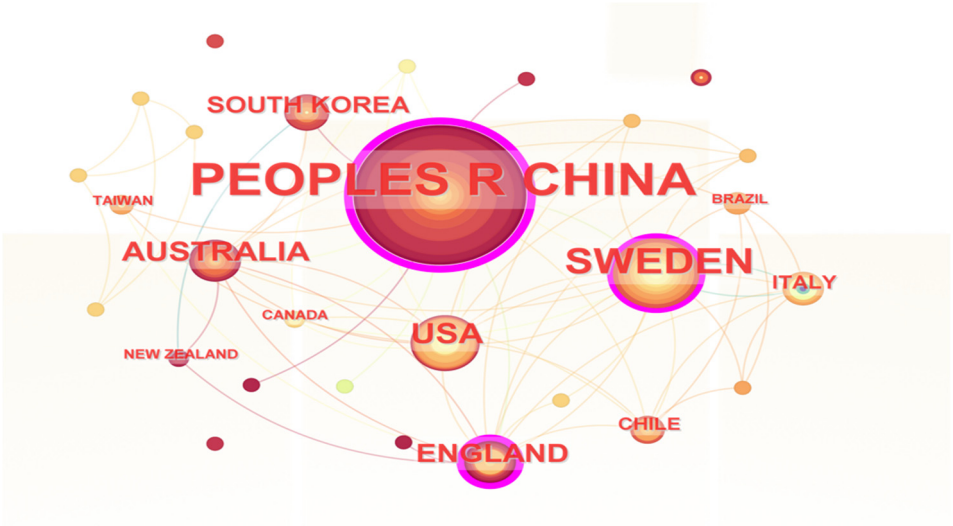

Fig 2. Map of national cooperation network in the field of acupuncture treatment PCOS research from 2000 to 2024

Table 2. The author of the top five publications in the field of acupuncture treatment PCOS from 2000 to 2024

Rank	Author	Number of publications	Publication ratio (%)
1	Stener-victorin, Elisabet	34	17.35
2	Feng, Yi	8	4.08
3	Wu, Xiaoke	7	3.58
4	Johansson, Julia	7	3.58
5	Benrick, Anna	7	3.58

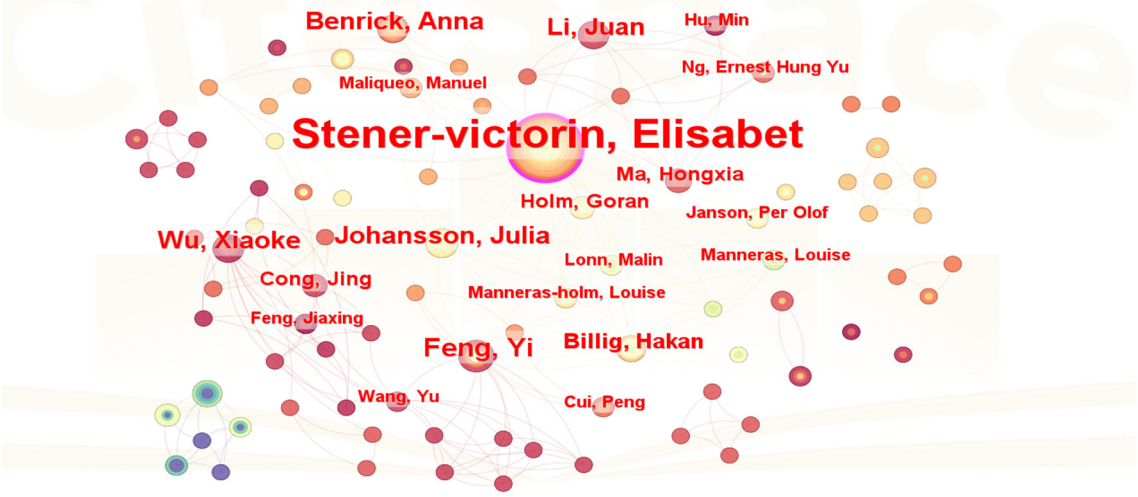

Fig 3. The authors of the research field of acupuncture treatment PCOS co-appeared on the network from 2000 to 2024

3.5. Institutional Document Analysis

Scientific research institutions play an irreplaceable role in the improvement of a country's scientific research level and scientific research ability. By analyzing relevant papers published by different scientific research institutions, we can understand the development of the research field of acupuncture treatment of PCOS and the distribution of resources and power. CiteSpace was used to visually analyze the research institutions of the 196 literatures included, and the co-occurrence view of the research institutions was obtained (fig 4).

The results show that 21 research institutions have published more than 5 papers, and the top 5 institutions are shown in Table 3. Step by step analysis of the relevant literature published by the top research institutions, the results show that: The research of Heilongjiang University of Chinese Medicine, University of Gothenburg, Karolinska Institutet and other institutions involved in physical exercise, whole-body glucose uptake, systematic review, clomiphene citrate, international multicenter pilot, etc.

Table 3. The institution of the top five publications in the field of acupuncture treatment PCOS from 2000 to 2024

Rank	Institution	Number of publications	Publication ratio (%)
1	Heilongjiang University of Chinese Medicine	43	21.94
2	University of Gothenburg	30	15.31
3	Karolinska Institute	23	11.73
4	Guangzhou Medical University	13	6.63
5	Beijing University of Chinese Medicine	13	6.63

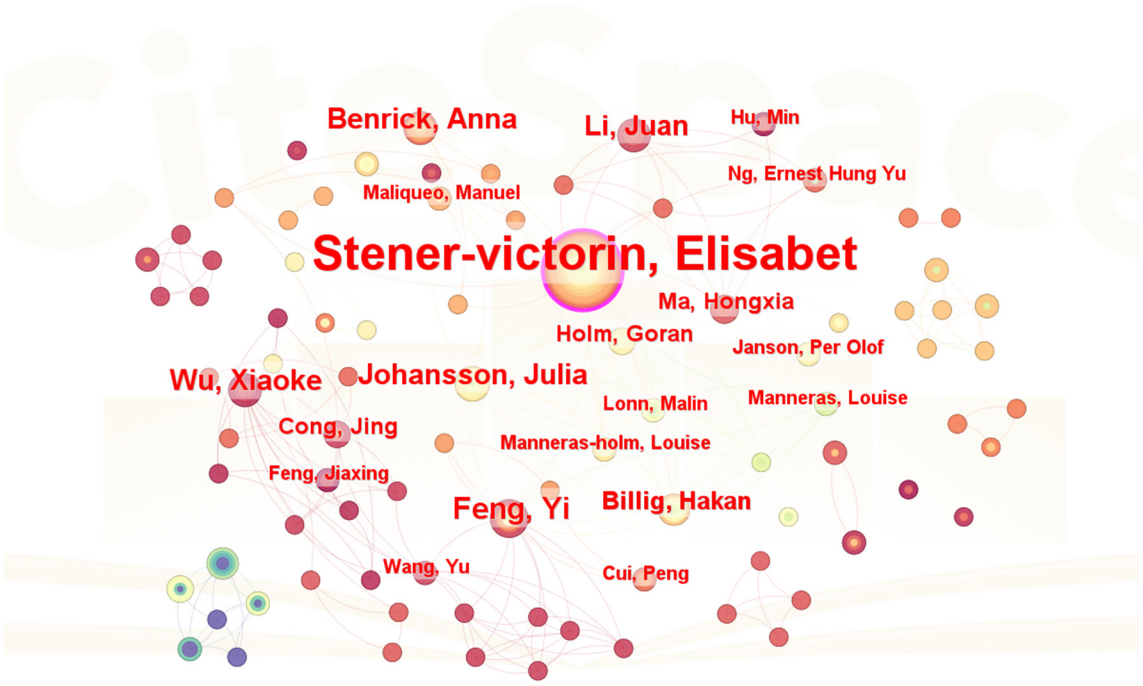

Fig 4. The authors of the research field of acupuncture treatment PCOS co-appeared on the network from 2000 to 2024

3.6. Keywords Cluster Analysis

Under normal circumstances, keywords are highly summarized and refined the content of the literature, reflecting the core content and value of the whole article, and also reacting to the hot spots and research frontiers. The use of CiteSpace to draw the keyword co-occurrence knowledge map is convenient for scholars to analyze the research hotspots. Cluster analysis, on the other hand, is a statistical method that classifies data with multiple indicators according to their similarity[8]. Keyword co-occurrence analysis is the core part of a literature study, and it is an important method to identify research hotspots in the field of acupuncture and moxibustion in the field of polycystic therapy. It can be used to analyze the distribution of hot spots in the research field. The mechanism is to identify the importance of keywords by counting the number of repeated occurrences of keywords in the titles and abstracts of all literatures[9]. The keyword information was counted and sorted, and the co-occurrence map of all keywords was drawn. The co-occurrence map of keywords with 260 nodes and 1337 connections was obtained in CiteSpace.

Table 4. Information table of the top 10 high-frequency keywords in the application of acupuncture treatment polycystic research from 2000 to 2024

Rank	Frequency	Centrality	Year	Keyword
1	110	0.46	2000	polycystic ovary syndrome
2	78	0.29	2000	women
3	45	0.17	2004	acupuncture
4	39	0.3	2000	electroacupuncture
5	34	0.1	2008	insulin resistance
6	21	0.09	2012	physical exercise
7	19	0.13	2009	adipose tissue
8	19	0.04	2011	prevalence
9	18	0.11	2008	blood flow responses
10	15	0.03	2004	ovulation

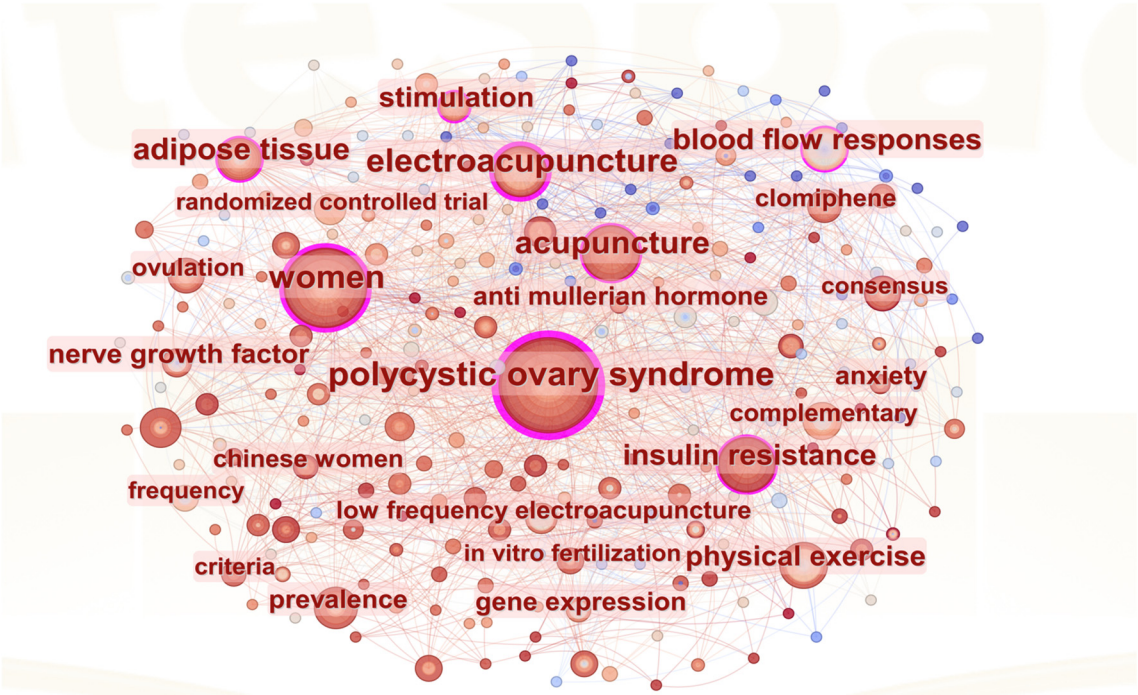

Fig 5. Keyword co-occurrence map in the field of acupuncture treatment PCOS from 2000 to 2024

According to the ranking of keyword occurrence frequency, the top 5 words were polycystic ovary syndrome 110 times, women 78 times, acupuncture 45 times, electroacupuncture 39 times and insulin resistance 34 times. According to the centrality, polycystic ovary syndrome 0.46, electroacupuncture 0.3, women 0.29, acupuncture 0.17, adipose tissue 0.13 were the top 5. The hot keywords in comprehensive analysis were polycystic ovary syndrome, electroacupuncture, women and acupuncture, as shown in Table 4.

Named log-likelihoodratio, 9 cluster groups are obtained by keyword aggregation (as shown in Fig 6). The smaller the number of cluster label #, the larger the cluster scale. The lines between nodes represent two keywords used in the same literature, and the more lines the more times. CiteSpace also provides modularity and silhouette indicators, namely module value (Q value) and average contour value (S value), based on the network structure and the clarity of clustering, which will be the basis for judging the drawing effect of the atlas[10]. In Fig 6, the clustering module value Q=0.4455, and the average contour value S=0.7617. Generally speaking, a Q value greater than 0.3 means that the community structure is significant; When S value is above 0.5, clustering is generally considered reasonable and reliable[11], and when S value is 0.7, the result is convincing. In this study, the value of the 0-8 cluster is 0.7617, which indicates high confidence.

Keyword clustering labels can reflect the research hotspots and frontiers in this field. The more nodes, the higher the popularity of clustering research, and the higher the shear value, the higher the critical degree of clustering in this field[12]. We rank them according to how critical the clustering tags are, Research focus in the field can be summarized as roughly: neuroendocrine function, systematic review, developing clinical practice guideline, ovarian morphology, qualitative.

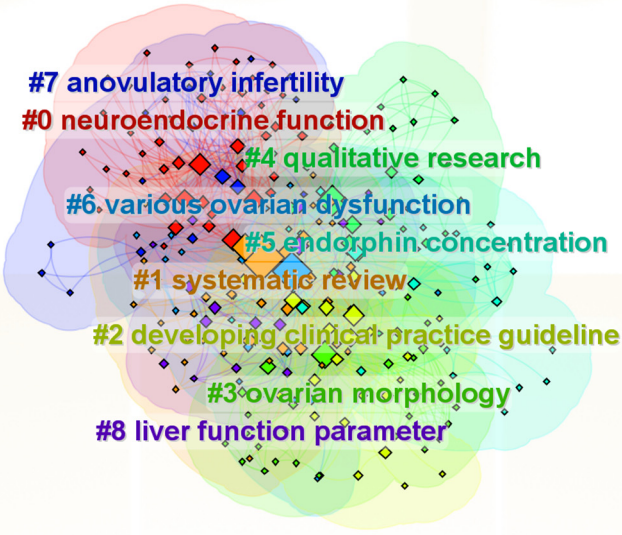

Fig 6. Cluster map of key words in the research field of acupuncture treatment PCOS from 2000 to 2024

Each cluster tag has its own line, and the timeline indicates the year in which the keyword first appeared. Figure 7 is a Timeline diagram of keyword clustering, which shows the changes of high-frequency keywords in different periods. The timeline diagram of keyword clustering (fig 7) shows the changes of high-realization keywords in each period along with the research year, so as to grasp the mainstream and trend in the research field of acupuncture treatment polycystic.

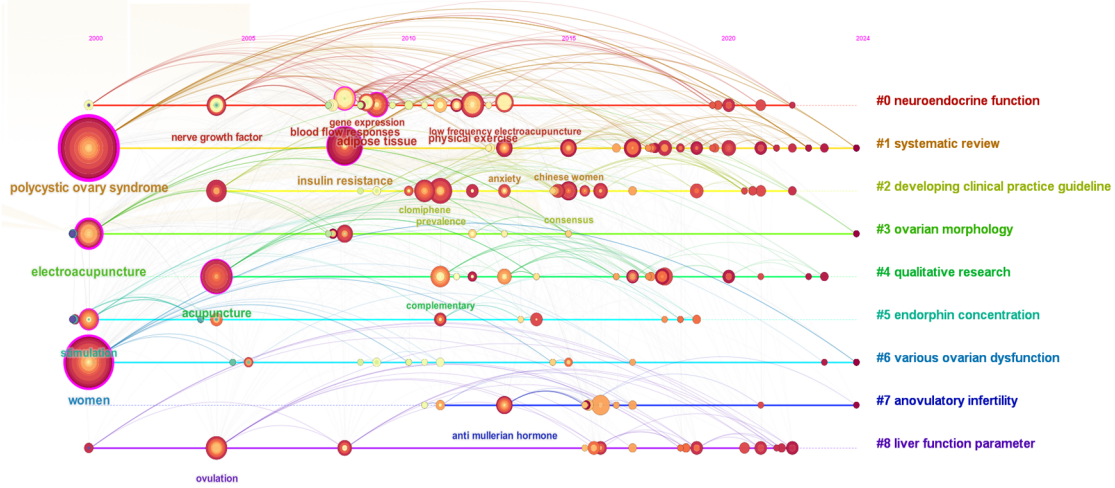

Fig 7. Keyword clustering timeline based on LLR algorithm

3.7. Keyword Emergence Analysis

Emergent words are high-frequency keywords in a specific period of time, which can reflect the popularity and cutting-edge views of a certain research direction in the field to some extent. Keyword emergence refers to the significant increase in the use frequency of some keywords in a short period of time, so it usually represents the research hotspot in this period [13]. Mutagenicity detection was conducted for keywords from 2000 to 2024, and a total of 11 mutated words were obtained (see fig 8), which can be used to assist in judging the research frontier and trend of acupuncture and moxibustion in the treatment of ovulation disorder infertility.

Top 11 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2000 - 2024
nerve growth factor	2004	3.47	2004	2013	
blood flow responses	2008	6.46	2008	2013	
sympathetic nerve activity	2011	3.42	2011	2013	
complementary	2011	3.33	2011	2019	
physical exercise	2012	5.95	2012	2016	
low frequency electroacupuncture	2013	4.1	2013	2014	
electroacupuncture	2000	4.3	2015	2017	
randomized controlled trial	2016	4.95	2016	2017	
management	2018	2.94	2018	2021	
acupuncture	2004	2.95	2019	2020	
insulin resistance	2008	4.57	2020	2024	

Fig 8. keywords emerged in the research field of acupuncture treatment PCOS from 2000 to 2024

4. Conclusion

In this paper, CiteSpace software is used to visualize the literature on acupuncture treatment of PCOS, so as to explore the research hotspot in this field. By exploring high-frequency keywords and clustering the distribution of time lines, the research hotspots in this field are sorted out. At the same time, the relevant literature is read and evaluated, and the research hotspots in this field are summarized.

4.1. Research Status

From the analysis of the number of articles published, the number of citations and the distribution characteristics of disciplines, it can be seen that the research of acupuncture in the field of polycystic treatment has received greater attention in the past 20 years. The distribution characteristics of disciplines show a trend of cross-fusion. The interdisciplinary direction of integrating complementary medicine, general internal medicine, endocrinology, metabolism, physiology and neuroscience promotes the exploration of research frontiers, and also points out the direction for the treatment of infertility in acupuncture and moxibustion. The analysis of high-yield authors, institutions and countries shows that a core group of authors has been formed in this field. China's

research in this field occupies a dominant position. Although China ranks first in the number of publications, there are still few countries studying this field. Therefore, China should pay more attention to and research in this field, strengthen international exchanges and cooperation, and lead the international trend and pace.

4.2. Hot Spot Analysis

From the results of keyword clustering and application analysis, it can be seen that acupuncture and moxibustion in the treatment of polycystic ovary syndrome has three research hotspots, including different acupuncture and moxibustion treatment of polycystic ovary syndrome, analysis of the mechanism of acupuncture and moxibustion treatment of polycystic ovary syndrome, and analysis of the effect of acupuncture and moxibustion treatment of polycystic ovary syndrome.

In the study of acupuncture therapy for the treatment of polycystic ovary syndrome, the effect of moxibustion on the treatment of polycystic ovary syndrome was investigated by establishing a rat model of DHEA-induced polycystic ovary syndrome. The results showed that moxibustion could alleviate DHEA-induced polycystic ovary syndrome by regulating metabolic level, restoring the balance of intestinal microbiota and regulating the interaction between intestinal microecota and host metabolites[14]. Studies have found that acupuncture combined with metformin has positive effects on pregnancy rate, ovulation rate and insulin resistance compared with metformin alone[15]. Another scholar has studied the application of moxibustion combined with electric acupuncture for polycystic ovary syndrome in patients with kidney deficiency and sputum dampness syndrome. Moxibustion combined with electric acupuncture can inhibit the overexpression of AMH, increase the expression level of ovarian granulosa cells, thus reestablishing the dependence of hair follicle development on hormone stimulation, and finally improve the abnormal development of ovary and androgenemia. Thus, relevant clinical symptoms of patients can be improved[16].

In the study of the mechanism of acupuncture treatment of polycystic ovary syndrome, some scholars have found that acupuncture can improve the endocrine disorder and ovulation function of patients with polycystic ovary by adjusting the balance of the hypothalamic-pituitary-ovarian axis and the sympathetic nerve - adrenal axis. Some scholars have found that EA intervention can improve IR, mitochondrial dysfunction and oxidative stress by regulating lipid metabolism regulatory factor SREBP1, thus alleviating PCOS-like symptoms[17] Studies have found that acupuncture can increase the number of cell processes and endometrial thickness of hyperovulatory mice, and promote HOXA10 and vascular endothelial growth[18] Other studies have shown that, Electroacupuncture in PCOS rats may regulate the KISspeptin-GNRH /LH circuit through the attenuation of androgen activity, and the study results suggest that the potential mechanism of acupuncture regulating HPO axis in PCOS rats may be related to the decreased expression of Kisspeptin protein in hypothalamus. Acupuncture may regulate the expression of Kisspeptin protein, and then control the pulse frequency of GnRH, thereby regulating the secretion of LH, etc[19].

In an analysis of the efficacy of acupuncture for the treatment of PCOS, 84 women aged 18-37 years with PCOS were randomly assigned to 16 weeks of low-frequency electroacupuncture, physical exercise, or no intervention. Changes in total testosterone (T) concentration at week 16 were analyzed by gas chromatography and liquid chromatography-mass spectrometry. The study found that low-frequency EA and physical exercise were more effective in improving hyperandrogen and menstrual frequency in women than no intervention. At the same time, low-frequency EA is superior to physical exercise and may help treat hyperandrogen and hypohidrosis/menstruation[20]. The study found that acupuncture could not only improve the mood changes of SF-36 score and ChiQOL score, but also improve lipid metabolism, suggesting that mood changes may be related to lipid compensation. In addition, acupuncture can also regulate the changes of serum calcium, potassium and chlorine[21]. Other scholars have found that in patients with PCOS, the use of acupuncture combined with moxibustion as a supplementary therapy for basic treatment can improve the pregnancy rate, ovulation rate and abortion rate, the level of certain sex hormones and metabolic indicators, with good safety[22].

Future studies may further explore the pathogenesis of acupuncture in the treatment of polycystic ovaries, as well as the synergistic mechanism of acupuncture and drugs. On the one hand, modern scientific and technological means such as molecular biology and genetics can be combined to study the influence of acupuncture on gene expression in patients with polycystic ovary, so as to reveal the regulatory mechanism of acupuncture on polycystic ovary. On the other hand, more clinical trials could be conducted to explore whether acupuncture combined with drugs has a synergistic effect and how the two interact in the treatment of polycystic ovaries.

4.3. Limitations of the Article

The search object was only based on WebofScience core set database, excluding other databases such as PubMed and Scopus, and the number of included literatures was limited. However, WebofScience core set database, as a commonly used and most suitable platform for bibliometrics, makes the evaluation more accurate by screening literatures in related fields. Therefore, the literature data obtained based on WebofScience core set database can fully reflect the domestic and foreign research status of finite element in the field of concussion.

The retrieval time is from 2000 to 2024, which may be a large time period. Through analyzing the number of published papers and article contents before 2010 in WebofScience core set database, the research finds that although the number of published papers before 2010 is small, the research contents are still closely related to current research hotspots. Therefore, literatures from 2000 to 2024 can be selected to better analyze current research hotspots. Therefore, the conclusion of the article has a high reference value.

4.4. Summary and Prospect

The research on the application of acupuncture and moxibustion in the treatment of polycystic ovary syndrome shows a slow upward trend on the whole, and a certain core author cooperation group has not been formed, so there is a lot of space for exploration, and China occupies a dominant position in this field. In recent years, the research focus is mainly on different acupuncture therapy to treat PCOS. Analysis of mechanism of acupuncture treatment for polycystic ovary syndrome; Analysis of curative effect of acupuncture and moxibustion on polycystic ovary syndrome.

In general, acupuncture, as a safe and effective treatment, has potential therapeutic effects for infertility in patients with PCOS. With the deepening of acupuncture research, more and more evidence supports the efficacy and mechanism of acupuncture in the treatment of polycystic ovaries. Future studies should further strengthen high-quality clinical trials and systematic reviews to further study the mechanism of acupuncture treatment of polycystic ovaries to provide more reliable evidence support and provide more effective treatment strategies for clinical practice. At the same time, it is also necessary to strengthen the standardization and standardization of acupuncture therapy, improve the consistency and repeatability of treatment, to ensure that acupuncture plays a greater role in the treatment of patients with PCOS.

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