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Knowledge domain and trends in acupuncture for stroke research based on bibliometric analysis

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Corresponding author:
Hai-Xin Liu

l-haixin@hotmail.com

Author Affiliation:
Shanxi University of Traditional Chinese Medicine.

Hao, H; Xing, Y; Chen, J; Wang, H; Dong, A; Liu, H-X.

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INTRODUCTION

Review question / Objective This bibliometric analysis aims to systematically explore the knowledge domain and research trends in the field of acupuncture for stroke rehabilitation by identifying key research hotspots, mapping the underlying knowledge structure, and examining developmental trends. The study seeks to determine how acupuncture contributes to stroke recovery, particularly in terms of neurological and motor function rehabilitation, and how research in this domain has evolved over time.

To define the research question systematically, we use the PICOS framework as follows:

Population (P):
Patients with stroke, including those with ischemic or hemorrhagic stroke, in various stages of rehabilitation.

Intervention (I):
Acupuncture and related modalities (e.g., scalp acupuncture, electroacupuncture, dry needling, and other traditional Chinese medicine-based needling techniques) applied for stroke treatment and rehabilitation.

Comparison (C):
Conventional rehabilitation strategies (e.g., physical therapy, occupational therapy, standard medical treatments) or no acupuncture intervention.

Outcomes (O):

Functional recovery: motor function improvement, cognitive recovery, language rehabilitation, and quality of life enhancements.
Mechanistic insights: neuroplasticity, neural repair, and the impact of acupuncture on brain function.

Research landscape: publication trends, collaboration networks, and emerging themes in acupuncture-based stroke research.
Study Design (S):
A bibliometric analysis based on Web of Science (WOS) and PubMed databases, utilizing CiteSpace and VOSviewer for data visualization and trend analysis.

This study aims to provide a comprehensive and systematic overview of the scientific literature on acupuncture for stroke, offering insights into its clinical application, evolving research priorities, and potential avenues for future investigation.

Condition being studied Stroke is a severe cerebrovascular disease characterized by sudden disruption of blood flow to the brain, leading to neuronal damage, neurological deficits, and functional impairments. It is a major global health concern, ranking among the leading causes of death and disability worldwide. Stroke is classified into two primary types:
Ischemic Stroke – Caused by a blockage in a cerebral artery, leading to reduced oxygen and nutrient supply to the brain.
Hemorrhagic Stroke – Occurs due to the rupture of a blood vessel, resulting in brain hemorrhage and tissue damage.
Stroke survivors often experience long-term impairments, including motor dysfunction, cognitive decline, language deficits, and reduced quality of life. Standard stroke treatment approaches include pharmacological therapy (e.g., thrombolytics like tissue plasminogen activator), surgical interventions, and rehabilitation therapies. However, these treatments have limitations such as bleeding risks, surgical complications, and slow recovery rates, leading to growing interest in complementary therapies like acupuncture to support stroke rehabilitation.

Acupuncture, a traditional Chinese medicine (TCM) practice, is widely used in stroke rehabilitation due to its potential to promote neuroplasticity, improve blood circulation, modulate inflammation, and enhance functional recovery. Various forms of acupuncture, including scalp acupuncture, electroacupuncture, and dry needling, have shown promising results in improving motor function, cognitive recovery, and overall patient outcomes.

This bibliometric study investigates the scientific literature on acupuncture for stroke rehabilitation, analyzing research trends, collaboration networks, and emerging hotspots to provide insights into its effectiveness and integration into modern stroke management strategies.

METHODS

Participant or population This review focuses on patients who have experienced a stroke, including both ischemic stroke (caused by arterial blockage) and hemorrhagic stroke (caused by brain hemorrhage). The study includes research addressing stroke patients across various stages of recovery, from acute to chronic phases, who have received acupuncture-based interventions for rehabilitation.
The population of interest includes:
Adults and elderly individuals diagnosed with stroke, typically aged 18 years and older, as stroke predominantly affects middle-aged and older adults.
Patients with post-stroke neurological deficits, including motor dysfunction, cognitive impairment, speech difficulties (aphasia), dysphagia (swallowing disorders), and sensory deficits.
Patients undergoing rehabilitation interventions, either in hospitals, rehabilitation centers, or home-based settings.
Individuals receiving acupuncture treatment, including various acupuncture techniques (scalp acupuncture, electroacupuncture, dry needling, and traditional body acupuncture) as part of their stroke recovery regimen.
Studies involving animal models, pediatric stroke patients, or non-stroke-related acupuncture applications are excluded. This review aims to analyze and map the research trends, effectiveness, and clinical applications of acupuncture in the recovery of stroke survivors, providing insights into its role in improving neurological function and rehabilitation outcomes.

Intervention The primary intervention evaluated in this review is acupuncture and its related therapeutic modalities for stroke rehabilitation. Acupuncture, a core practice of Traditional Chinese Medicine (TCM), involves the insertion of fine needles at specific acupoints to stimulate neural pathways, promote circulation, and enhance recovery.

The review includes the following acupuncture-based interventions:

Traditional Body Acupuncture – Needle stimulation at acupoints along meridians associated with stroke recovery, such as Baihui (GV20), Hegu (LI4), and Zusanli (ST36).
Scalp Acupuncture – A specialized technique targeting acupuncture zones on the scalp, which has been widely used for post-stroke motor and cognitive recovery.

Electroacupuncture (EA) – A modern variation where a mild electrical current is applied to inserted needles, believed to enhance neural activation and accelerate functional recovery.
Dry Needling – A method similar to acupuncture but typically used for myofascial pain and neuromuscular recovery, which may aid in post-stroke rehabilitation.
Warm Acupuncture (Moxibustion-assisted Acupuncture) – The combination of acupuncture and moxibustion (burning of mugwort herb near acupoints) to enhance therapeutic effects on stroke recovery.
Combinations with Other Therapies – The integration of acupuncture with conventional stroke rehabilitation approaches, such as physical therapy, occupational therapy, or speech therapy.
This review evaluates the effectiveness of acupuncture interventions in improving neurological function, motor recovery, speech rehabilitation, cognitive function, and overall quality of life in stroke patients. By mapping trends and analyzing existing research, this study provides insights into the role of acupuncture in modern stroke management and its potential integration into evidence-based rehabilitation strategies.

Comparator The review evaluates acupuncture-based interventions for stroke rehabilitation in comparison to standard or alternative treatments, which serve as control groups in the analyzed studies. The primary comparators include:

Conventional Stroke Rehabilitation – Standard rehabilitation approaches used in clinical practice, including:

Physical therapy (PT) for motor function recovery.
Occupational therapy (OT) for daily functional improvements.
Speech therapy for post-stroke aphasia and communication impairments.
Pharmacological treatment (e.g., thrombolytics, neuroprotective agents, antiplatelets).
Sham Acupuncture / Placebo Control – Studies utilizing sham acupuncture (needles inserted at non-acupuncture points or without penetration) to evaluate the true therapeutic effect of acupuncture.

No Treatment / Usual Care – Patients receiving only standard supportive care without specific rehabilitation interventions.

Other Complementary Therapies – Acupuncture compared to or combined with other traditional Chinese medicine (TCM) modalities, such as:

Moxibustion (heat therapy with burning mugwort).
Herbal medicine.
Cupping therapy.
This bibliometric review investigates how acupuncture compares to conventional treatments and sham controls in stroke rehabilitation, assessing its effectiveness in neurological recovery, motor function improvement, cognitive rehabilitation, and overall patient outcomes.

Study designs to be included This review will include bibliometric studies analyzing research trends, knowledge structures, and scientific collaboration in acupuncture for stroke rehabilitation. The study incorporates:Original research articles (randomized controlled trials, cohort studies, case-control studies, and clinical trials)Systematic reviews and meta-analysesBibliometric analyses using tools like CiteSpace and VOSviewerNetwork analyses of citation patterns and keyword co-occurrencesExcluded: Case reports, conference abstracts, letters, dissertations, and non-peer-reviewed.

Eligibility criteria In addition to the inclusion and exclusion criteria defined in the PICOS framework, the following additional eligibility criteria will be applied:

Inclusion Criteria:
Publication Type – Peer-reviewed journal articles, systematic reviews, meta-analyses, and bibliometric studies.
Language – Studies published in English.
Publication Date – Studies published between 2020 and 2024.
Study Scope – Research focusing on acupuncture-based interventions for stroke rehabilitation, covering efficacy, mechanisms, and clinical applications.
Data Source – Studies indexed in the Web of Science (WOS) and PubMed databases.
Methodology – Studies utilizing bibliometric analysis, network visualization, citation analysis, or co-occurrence mapping using CiteSpace and VOSviewer.
Exclusion Criteria:
Non-Peer-Reviewed Literature – Conference abstracts, dissertations, editorials, letters, news articles, and commentary papers.
Irrelevant Studies – Articles that discuss stroke or acupuncture separately without exploring their combined application.
Animal Studies – Preclinical or animal model studies, as the review focuses on human stroke patients.

Pediatric Stroke Studies – Research involving stroke in children, as the review targets adult populations.
Duplicate Publications – Identified and removed through bibliometric software to avoid redundancy.
This set of eligibility criteria ensures that the included studies are high-quality, relevant, and contribute to a comprehensive bibliometric analysis of acupuncture in stroke rehabilitation.

Information sources This review will gather data from the following electronic databases and bibliometric sources:

Web of Science (WOS) Core Collection – A primary database for citation analysis, covering high-impact scientific literature in stroke rehabilitation and acupuncture research.
PubMed – A widely used biomedical database that includes clinical studies, systematic reviews, and meta-analyses on acupuncture and stroke.
Additional Information Sources:
Bibliometric Tools: CiteSpace and VOSviewer will be used for network visualization, keyword co-occurrence mapping, citation analysis, and trend identification.
Reference Lists: Citation tracking of relevant articles to identify additional studies.
Exclusion:
Grey literature (conference abstracts, dissertations, preprints) and non-peer-reviewed sources will not be included.
These sources ensure a comprehensive and systematic bibliometric analysis of acupuncture for stroke rehabilitation.

Main outcome(s) This bibliometric review focuses on identifying research trends, key themes, and influential contributors in acupuncture for stroke rehabilitation. The main outcomes include:

Publication Trends:

Annual research output from 2020 to 2024.
Growth patterns and emerging research areas.
Keyword and Thematic Analysis:

High-frequency keywords (e.g., "electroacupuncture," "stroke rehabilitation," "motor function").
Keyword co-occurrence networks and evolution over time.
Citation and Collaboration Networks:

Most cited articles, influential authors, and leading institutions.
Country and institutional collaborations in acupuncture research.
Journal Impact and Dual-Map Overlay:

Top journals publishing acupuncture-stroke research.
Interdisciplinary influences (e.g., neuroscience, rehabilitation medicine).
Effectiveness of Acupuncture (Indirectly Assessed through Trends):

Focus areas such as neurological recovery, motor function improvement, and language rehabilitation.
Integration of acupuncture with other stroke treatments.
These outcomes will provide quantitative and visual insights into the knowledge structure and development trends in acupuncture for stroke recovery.

Additional outcome(s) In addition to the main bibliometric outcomes, this review will assess the following:

Research Impact and Global Influence:

Geographical distribution of research contributions.
International collaborations and country-level research influence.
Evolution of Research Focus Over Time:

Timeline visualization of key research clusters (e.g., electroacupuncture, functional MRI, randomized controlled trials).
Shifts in research priorities, including emerging techniques and mechanistic studies.
Interdisciplinary Integration:

How acupuncture research intersects with fields like neurology, rehabilitation, integrative medicine, and neuroscience.
Dual-map overlay analysis to track knowledge flow between disciplines.
Quality of Research Evidence:

Trends in study designs (e.g., increase in RCTs, systematic reviews, and network meta-analyses).
Methodological rigor and citation impact.
These additional outcomes will provide a comprehensive understanding of acupuncture's role in stroke rehabilitation research and its integration into modern medical practice.

Quality assessment / Risk of bias analysis Since this is a bibliometric review, the focus is on analyzing research trends rather than directly evaluating clinical outcomes. However, the quality of included studies will be assessed based on

research impact, citation metrics, and study design trends.

Quality Assessment Criteria:
Citation-Based Impact Analysis:

Highly cited papers and influential journals will be identified to assess the scientific impact of acupuncture-stroke research.
Dual-map overlay analysis will be used to track citation relationships and interdisciplinary influences.
Study Design Evaluation:

The proportion of randomized controlled trials (RCTs), systematic reviews, and meta-analyses will be assessed to determine methodological rigor.
The presence of high-quality clinical evidence (e.g., large-scale RCTs, well-structured observational studies) will be considered an indicator of research reliability.
Risk of Bias Considerations (Indirect Assessment):

A trend analysis of sham-controlled trials vs. uncontrolled observational studies will provide insight into the scientific rigor of acupuncture research.
The representation of placebo-controlled studies, blinding techniques, and objective outcome measures will be examined.
Geographical and Institutional Bias:

The dominance of certain countries or institutions will be assessed to determine whether research findings are globally representative or regionally concentrated.
Since this is not a systematic review of clinical outcomes, tools like Cochrane Risk of Bias (RoB 2) or Newcastle-Ottawa Scale (NOS) will not be applied. Instead, bibliometric techniques will be used to evaluate the credibility, reliability, and influence of research in this field.

Strategy of data synthesis This bibliometric review will utilize quantitative and visual data synthesis methods to analyze the research landscape of acupuncture for stroke rehabilitation. The data synthesis will be performed as follows:

1. Data Extraction and Processing:
Extracted data from Web of Science (WOS) and PubMed will include titles, authors, publication years, keywords, citations, institutions, and countries.
Duplicate records will be removed before analysis.
Data will be formatted and standardized for compatibility with bibliometric tools.

2. Bibliometric Analysis Using CiteSpace and VOSviewer:
Publication Trends: Annual publication volume and growth rates will be analyzed.
Co-Authorship Analysis: Identifies leading authors, influential research groups, and institutional collaborations.
Keyword Co-Occurrence Analysis: Maps research hotspots and emerging trends over time.
Citation Network Analysis: Identifies highly cited papers, influential studies, and key references shaping the field.
Country and Institutional Analysis: Assesses global research contributions and collaboration networks.
Journal Impact and Dual-Map Overlay: Evaluates academic impact, knowledge flow, and interdisciplinary integration.
3. Visualization Techniques:
Network diagrams (co-authorship, keyword clustering, and citation networks).
Heatmaps and trend graphs to highlight research evolution.
Timeline visualizations for keyword development over time.
4. Interpretation and Reporting:
Key findings will be interpreted within the context of stroke rehabilitation and acupuncture.
Research gaps, emerging trends, and potential future directions will be discussed.
Limitations and biases (e.g., regional concentration of studies) will be acknowledged.
This approach ensures a comprehensive and systematic synthesis of the research landscape, providing quantitative insights and visual interpretations of acupuncture's role in stroke recovery.

Subgroup analysis Subgroup analysis will be conducted to identify differences and trends within specific aspects of acupuncture research for stroke rehabilitation. The following subgroups will be analyzed:

1. Study Timeframe
Research trends will be examined year by year (2020–2024) to observe publication growth, keyword evolution, and shifts in research focus.
2. Acupuncture Techniques
Studies will be categorized based on the type of acupuncture used, including:
Traditional body acupuncture
Scalp acupuncture
Electroacupuncture
Dry needling
Moxibustion-assisted acupuncture
This analysis will determine which methods are most researched and emerging trends in technique preference.

3. Research Discipline and Journal Categories
Studies will be grouped based on publication disciplines (e.g., Neurosciences, Clinical Neurology, General Internal Medicine, Rehabilitation Medicine) to assess disciplinary contributions.
Journal impact factor and citation rates will be analyzed to identify high-impact publication sources.
4. Country and Institutional Contributions
Research contributions will be analyzed by country and institution to assess global trends and collaboration networks.
Citation analysis will reveal which regions produce the most influential research.
5. Study Design Trends
Categorization of studies based on methodology:
Randomized controlled trials (RCTs) vs. observational studies.
Systematic reviews and meta-analyses vs. individual clinical studies.
Bibliometric studies evaluating different citation metrics and knowledge structures.
6. Clinical Focus Areas
Research will be grouped based on clinical outcomes studied, such as:
Motor function recovery
Cognitive rehabilitation
Speech and language improvement
Quality of life and patient-centered outcomes
These subgroup analyses will provide detailed insights into acupuncture's role in stroke rehabilitation and highlight key variations in research trends and impact.

Sensitivity analysis Sensitivity analysis will be conducted to assess the robustness and reliability of the bibliometric findings. The following strategies will be applied:

1. Exclusion of Low-Cited or Low-Quality Studies
Studies with low citation counts (e.g., below a specific threshold) will be excluded to determine if highly cited papers disproportionately influence research trends.
This will help assess whether the findings remain consistent when only high-impact studies are considered.
2. Comparison of Different Timeframes
The dataset will be analyzed for different time windows (e.g., 2020–2022 vs. 2023–2024) to identify potential publication biases or short-term trends.
If significant shifts in research focus occur in recent years, they will be highlighted and discussed.
3. Alternative Search Strategies
The analysis will compare results using broader vs. more restrictive search criteria (e.g., including vs. excluding "needle" as a keyword).
This ensures that search term selection does not overly bias the included studies.
4. Country-Level Sensitivity Analysis
The study will examine whether excluding dominant countries (e.g., China, which contributes the highest number of publications) significantly affects research trends.
This will help determine whether the global research landscape is balanced or regionally skewed.
5. Sensitivity to Study Type
Separate analyses will be conducted for randomized controlled trials (RCTs), systematic reviews, and bibliometric studies to see if specific study designs disproportionately impact the overall trends.
By conducting these sensitivity analyses, the study ensures that its bibliometric findings remain valid, reliable, and free from major biases, strengthening the interpretation of acupuncture research trends in stroke rehabilitation.

Country(ies) involved China.

Keywords Acupuncture; Stroke; Bibliometric Analysis; CiteSpace; VOSviewer; Rehabilitation; Electroacupuncture; Scalp Acupuncture; Traditional Chinese Medicine; Neuroplasticity; Motor Recovery; Citation Network; Keyword Co-occurrence.

Contributions of each author

Author 1 - Hongdong Hao.
Email: 2948666666@qq.com
Author 2 - Yifang Xing.
Email: 1929777978@qq.com
Author 3 - Ji Chen.
Email: 790944757@qq.com
Author 4 - Haijun Wang.
Author 5 - ai Dong.
Email: dongaiai@sxtcm.edu.cn
Author 6 - Hai-Xin Liu.
Email: l-haixin@hotmail.com