

Annual review of acupuncture research in 2024

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Author contributions

She YF and Wang XS conceived and designed the study. Wang XS and Li HP developed the methodology and drafted the initial manuscript. Li BX, Fan GY, and Gao YB conducted the literature search and data screening. Li XX, Jiao JY, Chen H, Zuo G, and Fan XS contributed to data visualization and synthesis of the review content. Liu J, Zhang JC, and She YF critically revised the manuscript and approved the final version. All authors have read and approved the final manuscript.

Competing interests

The authors declare no conflicts of interest.

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Peer review information

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Abbreviations

AD, Alzheimer's disease; COPD, chronic obstructive pulmonary disease; CSU, chronic spontaneous urticaria; DOR, diminished ovarian reserve; DPN, diabetic peripheral neuropathy; FD, functional dyspepsia; fMRI, functional magnetic resonance imaging; IBS, irritable bowel syndrome; KOA, knee osteoarthritis; mTOR, mammalian target of rapamycin; NF-κB, nuclear factor kappa B; NLRP3, NOD-, LRR- and pyrin domain-containing protein 3; Nrf2, nuclear factor erythroid 2-related factor 2; OAB, overactive bladder; PCOS, polycystic ovary syndrome; PI3K, phosphatidylinositol 3-kinase; P2Y, purinergic receptor Y; Th1, T-helper cell type 1; TLR4, toll-like receptor 4; TCM, traditional Chinese medicine; UC, ulcerative colitis.

Citation

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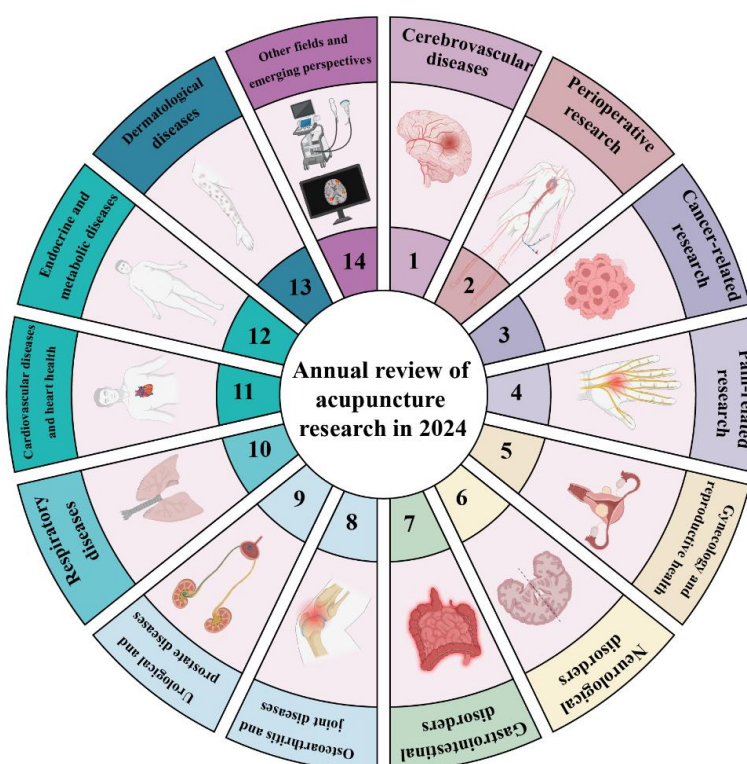
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Abstract

Acupuncture has been widely recognized for its significant therapeutic effects in treating a variety of conditions, including pain management, cerebrovascular diseases, cancer-related symptoms, respiratory disorders, and neurological diseases. A large body of clinical research demonstrates the substantial benefits of acupuncture, such as improving post-stroke recovery, alleviating chronic pain, reducing chemotherapy-induced symptoms, and promoting perioperative recovery. Mechanistic studies have shown that acupuncture influences multiple physiological systems, particularly the nervous, immune, and endocrine systems, providing insights into how acupuncture modulates neuroinflammation, neurotransmitter release, and immune responses. The role of acupuncture in integrative medicine is increasingly significant, with growing recognition of its therapeutic efficacy in regions outside China, particularly in Europe and the Americas. Acupuncture is expected to continue to expand its application, offering effective non-pharmacological treatment options in various fields, thereby consolidating its position in modern healthcare. Ongoing research holds the promise that acupuncture will play a key role in managing chronic diseases and supporting overall health. The 2024 acupuncture annual review will provide a comprehensive summary of the latest clinical applications and mechanistic research in acupuncture, with the aim of elucidating the current landscape and guiding future directions in the field.

Keywords: acupuncture; annual review; stroke; cerebrovascular diseases; cancer; pain



Highlights

This study performs a quantitative analysis of 2024 acupuncture literature using VOSviewer and R, identifying the latest trends and research hotspots. Key areas include cerebrovascular diseases, cancer, pain, gynecology, neurological and sleep disorders, and gastrointestinal issues. Research has expanded to include conditions such as exercise-induced fatigue, tinnitus, dry eye syndrome, allergic rhinitis, male infertility, temporomandibular joint disorders, osteopenia, spinal cord injury, and autism, with increased focus on diseases like hepatic regenerative failure and sickle cell disease. The integration of modern technologies such as acupuncture anesthesia, ultrasound guidance, virtual reality, EEG, and fMRI underscores acupuncture's growing role in both technological innovation and mechanistic exploration. Advances in understanding acupuncture's neurological mechanisms now emphasize neural circuit models. While acupuncture remains generally safe, rare adverse events highlight the importance of proper technique and effective risk communication.

Medical history of objective

Acupuncture, an essential component of traditional medicine, has a history spanning thousands of years. It is first comprehensively described in the “*Huangdi Neijing*” (*The Yellow Emperor's Inner Canon*), a foundational text written around the 2nd century B.C.E., traditionally attributed to the legendary Yellow Emperor. The “*Huangdi Neijing*” remains a seminal work in acupuncture study and continues to influence the development of traditional Chinese medicine (TCM). Initially, acupuncture was used to regulate bodily functions, balance internal systems, and alleviate pain. Today, it is widely practiced in China and has gained acceptance in regions like Europe and the Americas. Modern research shows acupuncture activates neural pathways, modulates the nervous and immune systems, and reduces inflammation, promoting health.

Background

Acupuncture, as an essential component of traditional Chinese medicine (TCM), has a long history and rich heritage. Its origins can be traced back to around 2000 B.C. in ancient China, with the earliest recorded references found in the “*Huangdi Neijing*” (*The Yellow Emperor's Inner Canon*). Over its several thousand years of development, acupuncture has evolved and improved as a treatment method, becoming widely used in the prevention, treatment, and rehabilitation of diseases. With the progress of globalization, acupuncture has not only gained popularity and development in China, but has also gradually spread to other countries, especially in Europe and the Americas, where it has become a widely accepted therapeutic approach [1]. By stimulating specific meridians and acupuncture points on the body, acupuncture helps regulate the flow of “Qi” (vital energy) and “Blood” (nourishment and vitality) balancing the “Yin” (cooling, passive, and nourishing) and “Yang” (active, warming, and stimulating), and restoring bodily equilibrium [2]. Traditional acupuncture methods include manual needling, electroacupuncture, and moxibustion, among others. In recent years, with the advancement of science and technology, modern acupuncture techniques such as transcutaneous electrical nerve stimulation [3], needle-knife acupuncture [4], and laser acupuncture have also gained widespread application [5].

With the development of evidence-based medicine, acupuncture's recognition within the international medical community has steadily increased. Modern acupuncture research not only focuses on the clinical validation of its therapeutic effects but also explores its biological, neurophysiological, and molecular mechanisms through basic research. An increasing number of systematic reviews,

meta-analyses, and randomized controlled trials have shown that acupuncture has significant effects in areas such as pain relief [6], immune regulation [7], and sleep improvement [8].

Research in modern medicine on acupuncture goes beyond the verification of its clinical efficacy, encompassing an in-depth exploration of its mechanisms of action. Researchers employ animal experiments, cell studies, and functional imaging technologies to reveal acupuncture's regulatory effects on various physiological systems, including the nervous system, immune system, and endocrine system. With ongoing research, acupuncture has been shown to positively influence autonomic nervous regulation, neurotransmitter secretion, immune functions, and anti-inflammatory responses by stimulating specific acupuncture points, activating particular neural pathways, and physiological mechanisms. The 2024 annual review will focus on presenting the latest evidence and research progress, particularly in the application of acupuncture in cancer, cardiovascular and cerebrovascular diseases, pain management, respiratory conditions, and women's health.

Methods

Search strategy

Given that most acupuncture-related literature is still published in Chinese, and high-quality Chinese literature is generally indexed by PubMed, this ensures a more comprehensive collection. Therefore, we chose to use PubMed to retrieve acupuncture-related literature for the entire year of 2024. The search was limited to articles published in 2024, utilizing a combination of medical terms and free words. The English search terms used for this study include: acupuncture [MeSH Terms], acupuncture points [MeSH Terms], meridians [MeSH Terms], acupuncture therapy [MeSH Terms], and a variety of related terms such as Acupuncture* [Title/Abstract], Acupuncture [Title/Abstract], Acupuncture Point [Title/Abstract], Acupoints [Title/Abstract], Acupoint [Title/Abstract], Electroacupuncture* [Title/Abstract], Electro-acupuncture [Title/Abstract], Acupoint Therapy [Title/Abstract], Acupuncture Treatment [Title/Abstract], Acupuncture Treatments [Title/Abstract], Needle Therapy [Title/Abstract], Needling [Title/Abstract], de qi [Title/Abstract], meridian [Title/Abstract], Needle Warming Therapy [Title/Abstract], scalp acupuncture [Title/Abstract], auricular acupuncture [Title/Abstract], ear acupuncture [Title/Abstract], and Acupoint Sensitization [Title/Abstract]. Additionally, moxibustion terms such as Moxibustion [MeSH Terms], Moxibustion [Title/Abstract], Moxibustion therapy [Title/Abstract], Moxa [Title/Abstract], and Moxibustion treatment [Title/Abstract] were also used. No restrictions were applied to the type of literature or other factors. The detailed search strategy can be found in Table 1.

Data analysis

The retrieved acupuncture-related literature published in 2024 was subjected to both qualitative and quantitative analysis using VOSviewer (version 1.6.18) and R software (bibliometrix package, version 3.2.1). VOSviewer software was used to analyze countries, institutions, journals, and authors, generating co-occurrence network maps. In these maps, a node represents an item such as a country, institution, journal, or author, and the thickness of the lines between the nodes reflects the degree of collaboration or co-citation. Endnote software (version X8) was used to manage the included literature. After carefully reading the titles and abstracts, the literature was categorized, and those with similar themes were grouped together for a summarized description. It is worth noting that literature related to dry needling was not excluded at this stage to allow for a more comprehensive assessment.

Following the bibliometric analysis, a comprehensive thematic classification was performed on all included publications. This process involved a systematic review of each study's title and abstract to preliminarily identify its research focus, including the targeted disease, clinical or mechanistic orientation, intervention modality, and methodological design. Studies addressing similar topics were

subsequently grouped into coherent categories. These thematic clusters were then ranked by publication frequency, and categories with the highest representation were selected for focused synthesis and critical appraisal. This methodology ensured both the breadth and depth of coverage, allowing for a structured and nuanced summary of prevailing research trends and focal areas in the field of acupuncture research in 2024 (Figure 1).

2024 Acupuncture annual review

General information

A total of 3,086 relevant articles were retrieved. Based on the type of literature, the distribution was as follows: journal articles (1,391, 45.07%), clinical trials (419, 13.58%), reviews (396, 12.83%), meta-analyses and systematic reviews (378, 12.25%), case reports (171, 5.54%), research support (86, 2.79%), letters (69, 2.24%),

clinical trial protocols (65, 2.11%), editorials (22, 0.71%), published errata and retraction notices (19, 0.62%), historical articles (19, 0.62%), comments (12, 0.39%), practice guidelines (8, 0.26%), and others (31, 1.00%). In 2024, scientific research on acupuncture was predominantly produced by China. The data show that China leads significantly in publication volume, far surpassing other countries, which reflects the nation's strong focus and sustained investment in this field. The United States and South Korea follow, also demonstrating a high level of research activity. Overall, the top ten countries are primarily located in Asia and Western regions, indicating a geographically concentrated pattern of global research output in acupuncture (Table 2 and Figure 2). Using VOSviewer and R software (bibliometrix package, version 3.2.1), we identified the top five authors in terms of publication volume for 2024: Wang Yu, Li Jing, Wang Ying, Fang Jianqiao, and Li Bin (Table 3 and Figure 3). The top five institutions by publication count were the Chengdu University of

Table 1 Detailed search strategy for Web of Science Core Collection (WoSCC)

No.	Search item
#1	Acupuncture [MeSH Terms]
#2	acupuncture points [MeSH Terms]
#3	Meridians [MeSH Terms]
#4	acupuncture therapy [MeSH Terms]
#5	Acupuncture* [Title/Abstract] OR Acupuncture [Title/Abstract] OR Acupuncture Point [Title/Abstract] OR Acupoints [Title/Abstract] OR Acupoint [Title/Abstract] OR Electroacupuncture* [Title/Abstract] OR Electro-acupuncture [Title/Abstract] OR Acupoint Therapy [Title/Abstract] OR Acupuncture Treatment [Title/Abstract] OR Acupuncture Treatments [Title/Abstract] OR Needle Therapy [Title/Abstract] OR Needling [Title/Abstract] OR de qi [Title/Abstract] OR meridian [Title/Abstract] OR Needling [Title/Abstract] OR Needle Warming Therapy [Title/Abstract] OR scalp acupuncture [Title/Abstract] OR auricular acupuncture [Title/Abstract] OR ear acupuncture [Title/Abstract] OR Acupoint Sensitization [Title/Abstract]
#6	Moxibustion [MeSH Terms]
#7	Moxibustion [Title/Abstract] OR Moxibustion therapy [Title/Abstract] OR Moxa [Title/Abstract] OR Moxibustion treatment [Title/Abstract]
#8	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7
#9	2024 [dp]
#10	#8 AND #9

Table 2 Top 20 countries with the most publications

Rank	Country	Count	Rank	Country	Count
1	China	1,846	11	Germany	26
2	USA	171	12	Turkey	24
3	Korea	118	13	Poland	23
4	Iran	52	14	Canada	16
5	Brazil	36	15	France	16
6	Spain	35	16	Egypt	12
7	Australia	31	17	Saudi Arabia	10
8	India	30	18	Israel	9
9	Japan	30	19	Thailand	9
10	Italy	28	20	Switzerland	8

Table 3 The top 20 authors with the most publications

Rank	Author	Count	Rank	Author	Count
1	Wang Yu	25	11	Liu Lu	13
2	Li Jing	20	12	Liu Zhishun	13
3	Wang Ying	17	13	Shao Xiaomei	13
4	Fang Jianqiao	16	14	Wang Jing	13
5	Li Bin	15	15	Wang Zhen	13
6	Liang Fanrong	15	16	Xu Bin	13
7	Zhang Wei	15	17	Xu Nenggui	13
8	Zhao Ling	15	18	Ji Laixi	12
9	Guo Yi	13	19	Li Wei	12
10	Liu Cun-Zhi	13	20	Li Ying	12

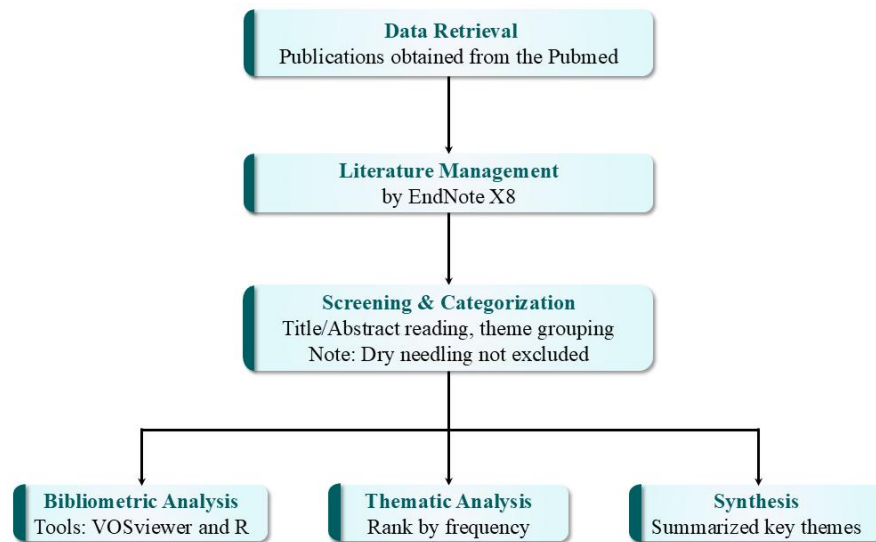


Figure 1 Workflow of bibliometric and thematic analysis for acupuncture-related publications (2024)

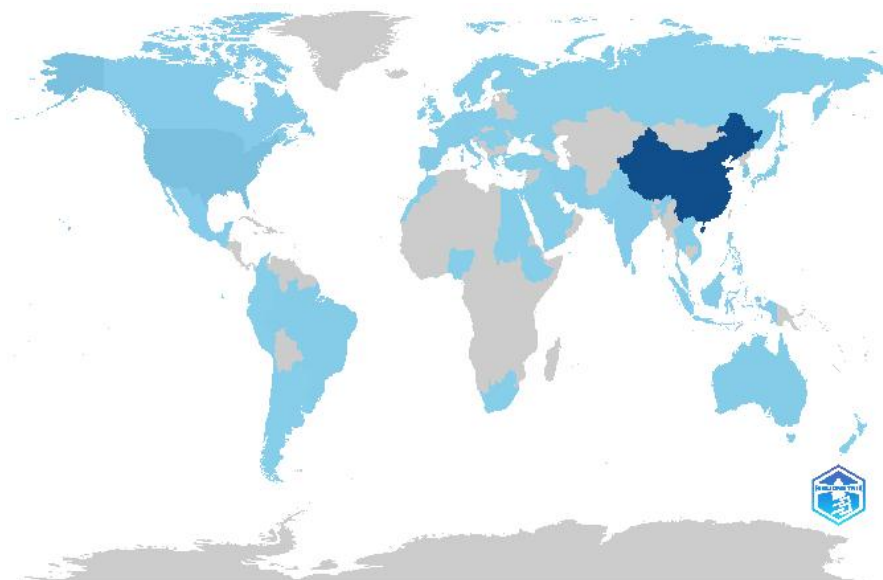


Figure 2 Global distribution of scientific publications

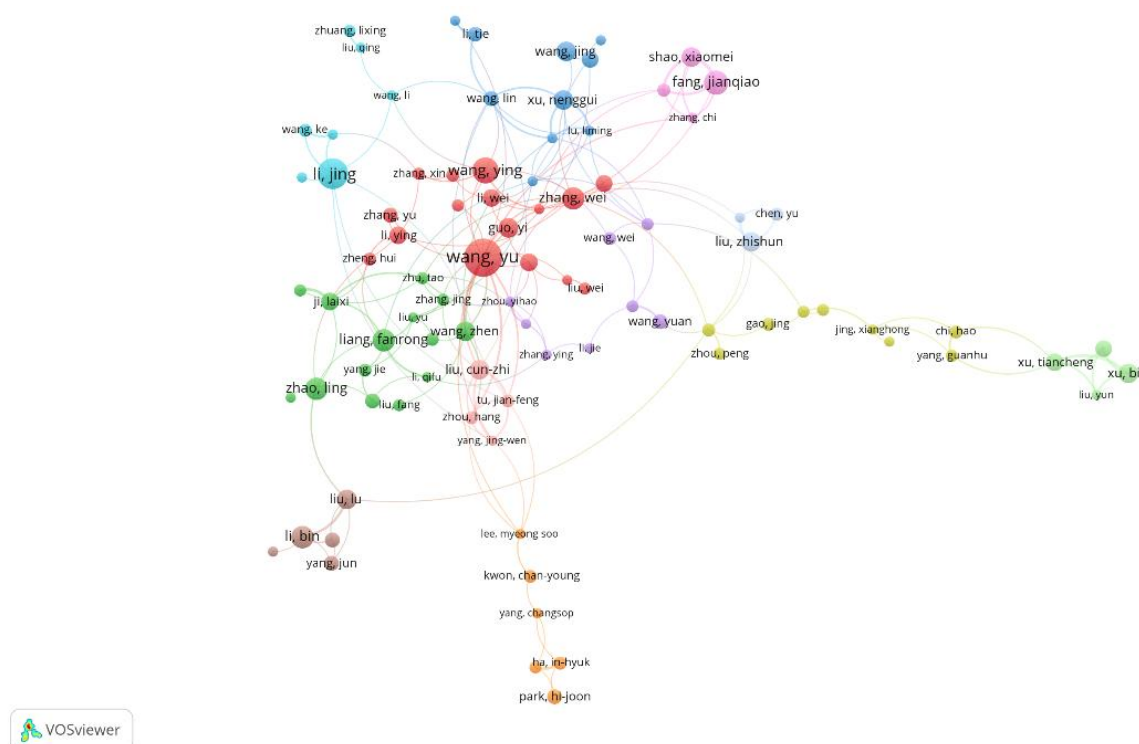


Figure 3 Author collaboration map

Traditional Chinese Medicine, Shanghai University of Traditional Chinese Medicine, Beijing University of Chinese Medicine, Guangzhou University of Chinese Medicine, Nanjing University of Chinese Medicine (Table 4). The top five journals publishing acupuncture-related research were *Zhongguo Zhen Jiu* (Chinese Acupuncture & Moxibustion), *Zhen Ci Yan Jiu* (Acupuncture Research), *Medicine*, *Frontiers in Neurology*, and *Heliyon* (Table 5).

The retrieved acupuncture-related research in 2024 covered a wide range of diseases and research directions, including cerebrovascular diseases (e.g., intracerebral hemorrhage, ischemic stroke, post-stroke symptoms), oncology-related studies (e.g., cancer-related fatigue, post-cancer urinary incontinence, cancer pain), pain-related conditions (e.g., chronic pain, lower back pain, sciatica), gynecological and reproductive health (e.g., pregnancy-related symptoms, diminished ovarian reserve (DOR), dysmenorrhea, endometriosis), neurological disorders (e.g., cognitive impairment, depression, anxiety, Parkinson's disease), and sleep disorders (e.g., insomnia). Additional research areas included gastrointestinal diseases (e.g., constipation, irritable bowel syndrome, functional dyspepsia (FD)), cardiovascular diseases (e.g., atrial fibrillation, heart rate variability (HRV), myocardial ischemia), metabolic diseases (e.g., diabetes, obesity), and others like dermatology (e.g., psoriasis, urticaria), musculoskeletal disorders (e.g., fibromyalgia, rotator cuff injuries), and research on visual health, tinnitus, and acupuncture anesthesia.

Furthermore, perioperative research, a field that has gained significant attention in recent years, also occupies an important position in this study. Acupuncture in the perioperative period involves preoperative and postoperative management, especially in relieving preoperative anxiety, managing postoperative pain, and accelerating recovery. The quantity of research on perioperative applications ranks high, and recent studies have shown that acupuncture positively influences the overall recovery process for patients. Thus, perioperative-related research is also a key focus of this study.

Cerebrovascular diseases

With the increasing aging population, the incidence of cerebrovascular diseases has been rising annually, placing a heavy

burden on public health systems and the socio-economic landscape. Cerebral hemorrhage and cerebral ischemia are the two most common types of cerebrovascular diseases, with cerebral ischemia (including ischemic stroke, transient ischemic attacks, etc.) being the most common form of stroke. According to the World Health Organization, stroke leads to over 9 million deaths each year, making it the second leading cause of death globally. After a stroke, patients may face varying degrees of functional impairment, including motor dysfunction, speech disorders, and cognitive impairment, which severely affect their quality of life. With continuous advancements in medical technology, significant progress has been made in the acute treatment and management of stroke during the acute phase; however, effectively helping patients recover and reducing post-stroke disabilities remains one of the challenges in the medical field. In recent years, acupuncture, as a TCM treatment, has shown unique advantages in the rehabilitation of cerebrovascular diseases. A review of the application of acupuncture in cerebrovascular diseases in 2024 is summarized as follows:

Clinical evidence shows that acupuncture has demonstrated significant efficacy in treating stroke and its sequelae, especially in restoring function, alleviating post-stroke complications, and relieving motor impairments. For post-stroke paralysis, electroacupuncture is widely used to improve motor function and reduce limb spasticity. Studies have shown that electroacupuncture significantly improves upper limb function in stroke patients, especially when combined with rehabilitation training, further enhancing functional recovery [9]. In shoulder joint function recovery, electroacupuncture combined with moist therapy has also shown excellent results, effectively alleviating post-stroke shoulder pain and promoting functional recovery [10]. Post-stroke speech disorders and swallowing difficulties are also common sequelae, and acupuncture has achieved positive results in this area as well. Studies have found that electroacupuncture combined with traditional acupuncture and rehabilitation training has a significant effect on improving swallowing function in post-stroke patients, enhancing their daily life quality [11]. In the treatment of speech disorders, acupuncture stimulates relevant brain areas, improving not only language function but also significantly enhancing patients' communication abilities [12]. Furthermore, acupuncture has shown positive effects in treating post-stroke depression.

Electroacupuncture and traditional acupuncture regulate brain function networks, alleviating emotional disorders and significantly improving post-stroke depression symptoms [13]. For post-stroke cognitive impairment, acupuncture also helps improve cognitive function through neural regulation, especially when combined with transcranial magnetic stimulation, significantly enhancing brain function and cognitive abilities [14].

Basic research evidence shows that electroacupuncture improves neurological damage after a stroke through various mechanisms, particularly in improving cognitive function, reducing brain damage, and promoting neural repair. Research has found that electroacupuncture regulates mitochondrial dynamics and activates the SIRT1/PGC-1 α pathway, effectively improving cognitive impairment in ischemic stroke [15]. In addition, electroacupuncture also reduces oxidative stress, regulates blood-brain barrier function, inhibits neuronal apoptosis, and reduces inflammation, thus protecting the nervous system [16]. By inhibiting ferroptosis and regulating the TLR4/NF- κ B/NLRP3 signaling pathway, electroacupuncture can improve post-stroke depressive behavior, providing an effective intervention for post-stroke emotional disorders [17]. For post-stroke dysphagia, electroacupuncture promotes swallowing function recovery by adjusting related brain neural

circuits, showing its broad application prospects in treating post-stroke complications [18]. Further research has revealed the neuroprotective mechanisms of electroacupuncture, where it alleviates stroke-induced neuroinflammation and cell death by regulating the P2X7/NLRP3/GSDMD pathway, thereby providing protection against brain damage [19]. Additionally, electroacupuncture has shown positive effects in promoting post-stroke angiogenesis, improving cognitive function, and facilitating neural repair [20]. These studies suggest that electroacupuncture not only improves neurological function after a stroke through neurobiological mechanisms but also exerts positive therapeutic effects by reducing inflammation and promoting neural regeneration.

In summary, acupuncture, by stimulating specific acupoints, can regulate cerebral blood circulation, neural function, and immune responses, aiding in functional recovery after a stroke. Especially in improving neural function recovery after cerebral ischemia, alleviating motor dysfunction, and relieving cognitive impairment, acupuncture has been proven by numerous clinical studies and practices to be a promising adjunctive therapy and has become an effective supplementary treatment in stroke and its sequelae management.

Table 4 The top 20 affiliation with the most publications

Rank	Affiliation	Count	Rank	Affiliation	Count
1	Chengdu University of Traditional Chinese Medicine	662	11	Heilongjiang University of Chinese Medicine	199
2	Shanghai University of Traditional Chinese Medicine	576	12	Kyung Hee University	195
3	Beijing University of Chinese Medicine	550	13	Changchun University of Chinese Medicine	190
4	Guangzhou University of Chinese Medicine	388	14	Fudan University	186
5	Nanjing University of Chinese Medicine	353	15	Anhui University of Chinese Medicine	166
6	Capital Medical University	284	16	China Medical University	151
7	Tianjin University of Traditional Chinese Medicine	269	17	Sichuan University	113
8	China Academy of Chinese Medical Sciences	262	18	Henan University of Chinese Medicine	112
9	Zhejiang Chinese Medical University	257	19	Fujian University of Traditional Chinese Medicine	110
10	Shandong University of Traditional Chinese Medicine	243	20	Tehran University of Medical Sciences	107

Table 5 Top 20 journals with the most publications

Rank	Journal	Count	Rank	Journal	Count
1	<i>Zhongguo Zhen Jiu (Chinese Acupuncture & Moxibustion)</i>	222	11	<i>Frontiers in Medicine</i>	40
2	<i>Zhen Ci Yan Jiu (Acupuncture Research)</i>	166	12	<i>Frontiers in Neuroscience</i>	40
3	<i>Medicine</i>	118	13	<i>BMC Complementary Medicine and Therapies</i>	37
4	<i>Frontiers in Neurology</i>	83	14	<i>Complementary Therapies in Medicine</i>	36
5	<i>Heliyon</i>	78	15	<i>PLoS One</i>	36
6	<i>Journal of Pain Research</i>	57	16	<i>Journal of Integrative and Complementary Medicine</i>	33
7	<i>Medical Acupuncture</i>	51	17	<i>Asian Journal of Surgery</i>	32
8	<i>Acupuncture in Medicine</i>	49	18	<i>Explore</i>	32
9	<i>Cureus</i>	47	19	<i>Journal of Traditional Chinese Medicine</i>	29
10	<i>BMJ Open</i>	45	20	<i>Journal of Acupuncture and Meridian Studies</i>	28

Perioperative research

The perioperative period (including preoperative, intraoperative, and postoperative stages) is a critical period in clinical medicine, involving various treatments and management strategies aimed at increasing the success rate of surgeries and shortening recovery time for patients. In recent years, acupuncture, as a TCM treatment, has become an important adjunctive therapy in perioperative management due to its significant effects in alleviating postoperative pain, improving postoperative functional recovery, and reducing preoperative anxiety. A review of acupuncture's application in the perioperative period in 2024 is summarized as follows:

Clinical evidence shows that acupuncture plays a significant role in the management of the perioperative period and surgery-related complications, especially in reducing postoperative pain, promoting gastrointestinal function recovery, decreasing the incidence of nausea and vomiting, and improving postoperative rehabilitation outcomes. Studies have shown that perioperative electroacupuncture treatment effectively alleviates preoperative anxiety and postoperative chronic pain by regulating the nervous and endocrine systems, helping to improve the overall recovery experience of patients [21]. Acupuncture also shows positive effects in accelerating postoperative gastrointestinal function recovery, particularly after abdominal and chest surgeries, where acupuncture and transcutaneous electrical acupoint stimulation can promote intestinal peristalsis and gastrointestinal venting, thus reducing the occurrence of postoperative ileus [22, 23]. In anesthesia and analgesia management, research has found that transcutaneous electrical acupoint stimulation significantly reduces the incidence of postoperative nausea and vomiting after general anesthesia while also alleviating hypotension during anesthesia induction and postoperative pain [24, 25]. Additionally, in cesarean section recovery, acupuncture combined with acupoint pressure therapy can accelerate anesthesia recovery and alleviate postoperative urinary retention and pain [26, 27]. In orthopedic surgery rehabilitation management, acupuncture also plays an important role. Studies show that electroacupuncture and acupoint embedding after knee joint replacement surgery promote muscle strength recovery, reduce postoperative edema, and improve joint function [28, 29]. Moreover, acupuncture has demonstrated good results in promoting postoperative neurological recovery, particularly after heart surgery, where early acupuncture application significantly improves neurological function recovery in ischemic stroke patients [30]. Research has also revealed that acupuncture promotes recovery after gastrointestinal surgeries by regulating the autonomic nervous and immune systems, with positive effects in reducing postoperative complications. For example, acupuncture can alleviate gastrointestinal dysfunction after pancreatoduodenectomy and promote recovery through endocrine regulation mechanisms [31]. In breast cancer surgery, electroacupuncture not only relieves pain but also reduces postoperative nausea, vomiting, and anesthesia-related adverse reactions [32]. Furthermore, acupuncture has been studied in the recovery after cardiac and neurosurgical procedures. Research shows that electroacupuncture aids in the rehabilitation after coronary artery bypass grafting, improving cardiac function and exercise endurance [33]. After spinal surgery, electroacupuncture promotes the recovery of urinary function and reduces the incidence of urinary retention [34].

Basic research evidence shows that acupuncture, particularly electroacupuncture, demonstrates significant efficacy in alleviating postoperative discomfort, improving recovery, and reducing complications. Studies indicate that electroacupuncture effectively promotes postoperative intestinal function recovery, especially in alleviating postoperative ileus. By inhibiting Th1 cell-mediated inflammatory responses, electroacupuncture acts via the vagus nerve, accelerating intestinal motility and reducing the occurrence of postoperative complications [35]. Moreover, electroacupuncture has shown positive effects in relieving postoperative pain, as animal model studies found that electroacupuncture reduces postoperative pain and regulates immune responses [36]. In research on

postoperative cognitive dysfunction, electroacupuncture also shows significant potential. Studies show that electroacupuncture pretreatment inhibits oxidative stress and neuroinflammation, improving postoperative cognitive function in aged mice, further proving its effectiveness in alleviating postoperative neurological damage [37]. Additionally, electroacupuncture significantly alleviates postoperative pain by regulating specific cellular signaling pathways, particularly after hemorrhoidectomy, where electroacupuncture reduces postoperative pain via the mAChRs/IP3-Ca²⁺-CaM signaling pathway [38].

Overall, perioperative acupuncture has become an important treatment method for enhancing postoperative recovery quality, alleviating postoperative pain, and reducing postoperative nausea and vomiting. By influencing neurobiological mechanisms, immune system regulation, and inflammatory responses, acupuncture not only provides preoperative and postoperative pain relief but also accelerates overall patient recovery. With more in-depth clinical research, acupuncture will play an even greater role in perioperative care, particularly in reducing medication dependence and enhancing patient satisfaction, demonstrating its unique advantages.

Cancer-related research

With continuous advancements in cancer treatment, an increasing number of cancer patients survive throughout the treatment process. However, cancer treatment is still accompanied by numerous side effects, including cancer-related fatigue, cancer pain, chemotherapy-induced nausea and vomiting, and post-cancer urinary incontinence, all of which significantly impact patients' quality of life. Conventional pharmacological treatments often come with side effects and may lead to drug dependence. In recent years, acupuncture has emerged as a non-pharmacological therapy that provides unique advantages in alleviating pain, improving sleep, and reducing fatigue, gradually becoming an adjunctive therapy in cancer treatment. Therefore, exploring the clinical applications and mechanisms of acupuncture in cancer patients has become an important research direction at the intersection of oncology and TCM. As a traditional treatment method, acupuncture has gained increasing application in alleviating these symptoms and improving the overall well-being of cancer patients. Research conducted in 2024 further investigated the potential of acupuncture in managing cancer-related symptoms, providing more compelling evidence for clinical practice. A review of acupuncture's application in the oncology field in 2024 is summarized below:

Clinical evidence indicates that acupuncture has demonstrated significant efficacy in managing cancer treatment and its related complications, particularly in alleviating chemotherapy-induced symptoms and improving cancer patients' quality of life. Studies have shown that acupuncture effectively relieves chemotherapy-induced nausea, vomiting, peripheral neuropathy, fatigue, and joint pain. For example, acupuncture has shown significant effects in reducing nausea and vomiting caused by chemotherapy, particularly in breast cancer patients, where research has demonstrated that electroacupuncture combined with conventional treatment effectively mitigates chemotherapy-induced nausea and vomiting [39, 40]. Furthermore, acupuncture has been confirmed to alleviate post-chemotherapy fatigue in breast cancer survivors, enhancing their overall quality of life [41]. In cancer pain management, acupuncture also plays a positive role, particularly in alleviating cancer-related pain and postoperative complications. It has shown good efficacy in relieving post-surgical pain in breast cancer patients and in treating radiation-induced xerostomia [42, 43]. Moreover, acupuncture exhibits unique advantages in postoperative recovery, especially in functional rehabilitation after tumor resection. Studies have shown that acupuncture significantly improves overall health status by promoting postoperative gastrointestinal function recovery, reducing postoperative complications, and accelerating recovery speed [44, 45], as previously discussed. In cancer treatment, especially post-chemotherapy, acupuncture has been found to alleviate side effects such as leukopenia and nausea, thereby enhancing patients'

overall treatment tolerance and quality of life [46].

Basic research evidence indicates that acupuncture possesses multiple therapeutic potentials in cancer treatment and related complications, particularly in alleviating chemotherapy-induced side effects, enhancing treatment efficacy, and supporting immune function. Studies have found that electroacupuncture and traditional acupuncture can modulate various molecular pathways and cellular responses, effectively reducing cancer-related pain and other symptoms. For example, electroacupuncture regulates miR-124 expression in spinal neurons, inhibiting microglial activation and preventing chemotherapy-induced peripheral neuropathy [47]. Additionally, electroacupuncture, when combined with chemotherapeutic drugs (such as paclitaxel), has demonstrated anti-tumor effects in glioblastoma treatment, particularly in regulating the Hedgehog signaling pathway [48]. Acupuncture also modulates the tumor microenvironment by reducing angiogenesis and promoting vascular normalization, effectively inhibiting the growth of triple-negative breast cancer [49]. Further research has revealed that electroacupuncture and traditional acupuncture enhance immune responses, particularly in cancer immunotherapy. For instance, electroacupuncture combined with anti-PD-1 immunotherapy significantly enhances anti-tumor immune responses in microsatellite-stable colorectal cancer [50]. Acupuncture has also been shown to alleviate chemotherapy-induced liver damage by modulating the IRE-1 signaling pathway, thereby improving liver function in patients undergoing chemotherapy [51]. Additionally, acupuncture provides significant pain relief in cancer patients, particularly through electroacupuncture, which alleviates cancer-related pain symptoms and nociceptive responses [52].

Overall, acupuncture, as an adjunctive treatment, has demonstrated remarkable efficacy across various stages of cancer treatment. It not only alleviates pain, fatigue, and nausea in cancer patients but also enhances immune system recovery and accelerates postoperative rehabilitation. With further clinical and basic research advancements, the efficacy and mechanisms of acupuncture will continue to be validated, positioning it as an indispensable complementary therapy in cancer treatment in the future.

Pain-related research

Pain is a significant clinical issue in modern medicine, prevalent in a variety of diseases and injuries, especially chronic and acute pain, which pose major clinical challenges. Acupuncture, as a traditional Chinese medical therapy, has been widely applied in the management of various types of pain. Acupuncture has not only achieved significant results in alleviating chronic musculoskeletal pain but has also shown positive effects on neuropathic pain, postoperative pain, and pain related to various soft tissue injuries. Different types of pain not only affect the physical health of patients but also severely impact their psychological well-being and quality of life. Chronic pain, such as chronic low back pain, shoulder pain, and neuropathic pain, is often difficult to cure and persistently affects patients' daily lives. Postoperative pain, cancer-related pain, and acute pain often require comprehensive management through multiple methods, which have been discussed in detail earlier in this paper. In this context, acupuncture, a TCM therapy, has become an important adjunctive treatment for alleviating various types of pain due to its unique advantage of regulating body functions by stimulating specific acupoints. A review of acupuncture research in pain management in 2024 is summarized as follows:

Clinical evidence shows that acupuncture has been widely studied for pain management, covering various types of pain, including chronic pain, postoperative pain, low back pain, neck pain, shoulder joint pain, fibromyalgia, headaches, and other neuropathic and musculoskeletal pain. In 2024, high-quality clinical evidence continued to accumulate in the field of acupuncture research. Notably, a multicenter randomized controlled trial published in the *Annals of Internal Medicine* drew significant attention. The study employed a pressure pain threshold-based individualized point selection strategy to evaluate the efficacy of acupuncture for chronic neck pain. Results

indicated that this approach effectively alleviated pain and sustained its therapeutic effects over a 24-week follow-up period. Although the degree of improvement did not reach the threshold for minimal clinically important difference, the findings provide compelling empirical support for the concept of precision acupuncture and represent a significant advancement in the exploration of individualized acupuncture treatment strategies [53]. Studies have demonstrated that electroacupuncture and traditional acupuncture, by regulating the nervous system, promoting blood circulation, and improving autonomic nervous system function, significantly alleviate chronic pain, particularly in the treatment of knee osteoarthritis (KOA), osteoarthritis, and other chronic musculoskeletal diseases [54]. In managing postoperative pain, acupuncture has shown good efficacy, particularly in abdominal surgeries and post-partum pain. Acupuncture regulates the hypothalamic-pituitary-adrenal axis and the oxytocin system, effectively relieving pain and reducing anxiety [55]. For chronic low back pain, acupuncture significantly reduces pain and improves patients' quality of life by improving blood circulation and relaxing muscles [56]. Similarly, acupuncture effectively alleviates neck and shoulder joint pain, especially in the treatment of neck pain caused by cervical spondylosis and shoulder periarthritis, with electroacupuncture and traditional acupuncture helping to improve muscle tone and increase the range of motion [57, 58]. In the treatment of fibromyalgia (myofascial pain syndrome), a combination of dry needling therapy and electroacupuncture has shown excellent results in relieving muscle tension and reducing pain [59]. Headaches, especially migraines and tension-type headaches, have also been widely studied, with acupuncture significantly reducing the frequency and intensity of headaches by improving cerebral blood flow and regulating the nervous system [60]. Additionally, acupuncture has shown good efficacy in treating neuropathic pain, such as postherpetic neuralgia and sciatica [61]. Overall, acupuncture, as a non-pharmacological therapy, has demonstrated significant efficacy in treating various types of pain and is gradually becoming an important option in pain management.

In basic research, the analgesic mechanisms of acupuncture have been extensively explored, particularly its role in alleviating inflammatory and neuropathic pain. Studies have shown that acupuncture significantly reduces various types of pain by modulating different signaling pathways and cellular responses. Electroacupuncture and traditional acupuncture activate specific receptors and signaling pathways, such as P2Y receptors, TRPV1 channels, AMPK pathways, and IL-33/ST2 pathways, to alleviate inflammatory and neuropathic pain [62]. Additionally, electroacupuncture modulates the activity of the cerebral cortex, spinal cord, and ganglia, significantly alleviating pain associated with chronic nerve injury [63, 64]. In reducing fibromyalgia pain, acupuncture achieves effective analgesia by regulating TRPV1 signaling and microglial cell activity [65]. Moreover, acupuncture has shown significant effects in modulating neurotransmitters, inflammatory responses, and cell apoptosis. For instance, acupuncture regulates autophagy, cell apoptosis, and chronic inflammation to promote neural repair and functional recovery [66]. Furthermore, electroacupuncture's regulation of oxidative stress and immune cell responses in the brain has also been identified as a key mechanism behind its analgesic effects [67].

In conclusion, the mechanisms underlying acupuncture's analgesic effects are multifaceted. By activating and modulating various molecular pathways, including immune regulation, neurotransmitter release, and endocrine system modulation, acupuncture successfully alleviates a variety of pain types, including chronic inflammatory pain, neuropathic pain, and musculoskeletal pain. With ongoing research, acupuncture, as an effective non-pharmacological treatment, will have even broader applications in pain management and may become an important supplementary method in pain treatment.

Gynecology and reproductive health

Gynecological and reproductive health issues are receiving increasing attention among modern women, particularly concerning fertility,

menstrual cycles, dysmenorrhea, diminished ovarian reserve, postpartum recovery, and breast health. These issues not only directly impact women's physical health but also have profound effects on their psychological well-being, social life, and overall quality of life. With changes in modern lifestyles and environmental factors, an increasing number of women are facing challenges such as menstrual irregularities, dysmenorrhea, ovarian insufficiency, and breast diseases. As research on the application of acupuncture in gynecology and reproductive health continues to expand, clinical evidence increasingly supports acupuncture's unique advantages and potential in regulating female health. A review of acupuncture research in women's health in 2024 is summarized as follows:

Clinical evidence shows that acupuncture has demonstrated extensive efficacy in female reproductive health, particularly in managing menstrual irregularities, polycystic ovary syndrome (PCOS), postpartum recovery, and infertility. Multiple studies have explored the therapeutic effects of acupuncture on menstrual disorders. For example, studies have shown that acupuncture effectively improves DOR, enhances pregnancy rates, and modifies brain functional networks as evaluated by functional magnetic resonance imaging (fMRI) [68]. Furthermore, auricular acupuncture and laser acupuncture have demonstrated positive effects on dysmenorrhea, particularly in autonomic nervous regulation and symptom relief [69]. The use of acupuncture before and after menstruation, especially through uterine artery blood flow regulation, has also been validated for its benefits in improving endocrine balance and fertility potential [70]. For PCOS patients, acupuncture has been shown to improve ovarian function and endometrial receptivity, thereby increasing pregnancy rates. Studies indicate that acupuncture combined with hormone-stimulated ovulation treatments significantly enhances endometrial receptivity and improves implantation success in patients with recurrent implantation failure [71]. Additionally, by regulating gut microbiota, acupuncture has played an important role in managing PCOS in obese patients [70]. In the treatment of pregnancy-related nausea and vomiting, a high-quality randomized controlled trial published in the 2024 *Annals of Internal Medicine* demonstrated the effectiveness of acupuncture as an adjunct therapy. The study found that acupuncture combined with conventional medication significantly reduced nausea and vomiting episodes, improving the quality of life for pregnant women [72]. This approach, compared to medication alone, reduced drug dependency and lowered the risk of side effects, particularly for patients who responded poorly to medication or sought non-pharmacological treatment options. This high-quality clinical study provided strong evidence supporting acupuncture as an adjunct therapy for managing pregnancy-related nausea and vomiting, highlighting its potential to reduce reliance on medications and offering a promising clinical application. In postpartum recovery, acupuncture has demonstrated significant efficacy. Studies have shown that acupuncture combined with transcutaneous electrical nerve stimulation helps alleviate postpartum pelvic floor dysfunction and improves abdominal muscle tone [73]. Additionally, acupuncture has been used to reduce postpartum urinary retention, with needling at specific acupoints significantly improving urodynamic function in postpartum women [74]. For pregnancy-related anxiety and insomnia, acupuncture has also been shown to be effective in alleviating prenatal anxiety disorders [75]. In infertility treatment, acupuncture has brought hope to patients with recurrent implantation failure by improving uterine blood flow and regulating hormone levels. Studies have indicated that acupuncture increases endometrial thickness and uterine blood flow, thereby significantly enhancing pregnancy rates [71]. Furthermore, acupuncture combined with herbal medicine has been found to effectively improve female fertility by regulating the uterine environment during treatment [76].

Basic research evidence indicates that acupuncture exhibits potential in regulating ovarian function and improving ovarian response. For instance, studies have shown that acupuncture improves ovarian function through the PI3K/AKT/FOXO3a pathway and promotes ovarian response in experimental models, demonstrating its

protective effects on ovarian health [77]. Electroacupuncture has also been found to facilitate ovarian function recovery, closely linked to the AMPK/ULK1 signaling pathway and mitochondrial autophagy processes [78]. Additionally, electroacupuncture is believed to improve endometrial fibrosis through the Wnt/ β -catenin pathway, effectively alleviating symptoms of intrauterine adhesions [79]. Further research has revealed the synergistic effects of acupuncture and Chinese herbal medicine in endometrial restoration [80]. In the treatment of menstrual-related disorders, acupuncture has also shown efficacy. Studies indicate that acupuncture alleviates dysmenorrhea by modulating the Rho/ROCK signaling pathway [81]. Acupuncture has also shown positive results in improving female pelvic floor function, particularly in postpartum recovery [73]. Research on conditions such as premature ovarian insufficiency and endometriosis has highlighted acupuncture's ability to regulate key signaling pathways (e.g., SIRT1/PGC-1 α /Nrf2) to enhance fertility potential [82].

Overall, acupuncture has shown remarkable applications in gynecology and reproductive health by modulating neuroendocrine functions, improving immune responses, and reducing inflammation. These findings provide theoretical support for its clinical applications, further validating acupuncture as a non-pharmacological treatment with unique advantages in gynecological disorders. Acupuncture has demonstrated great potential, particularly in treating DOR, dysmenorrhea, and endometriosis, making it a promising therapeutic approach in women's health.

Neurological disorders

Neurological disorders, particularly depression, anxiety, insomnia, cognitive dysfunction, Parkinson's disease, and facial paralysis, have become widespread and deeply impactful health concerns in modern society. These conditions not only affect patients' daily lives and social functioning but also pose long-term challenges to their psychological and physical health, as well as overall quality of life. Finding safe and effective treatment methods is therefore of paramount importance. Acupuncture, a TCM therapy, has demonstrated promising applications in the treatment of neurological disorders due to its ability to regulate the flow of "Qi" and blood and balance "Yin" and "Yang". A review of acupuncture research in neurological health in 2024 is summarized below:

Clinical evidence suggests that acupuncture can regulate nervous system activity, improve neurotransmitter function, promote blood circulation, reduce inflammation, and modulate the endocrine system. These mechanisms help alleviate symptoms, improve functionality, and enhance patients' quality of life. Acupuncture has been widely studied in the treatment of depression and anxiety. Studies have shown that electroacupuncture and acupuncture significantly relieve depressive symptoms by modulating the nervous system, enhancing autonomic nervous function, and improving HRV and coordination [83, 84]. Moreover, acupuncture interventions have been found to improve cognitive symptoms and emotional states in depression patients and further enhance treatment outcomes when combined with antidepressant medications such as fluoxetine [85]. In postpartum depression, acupuncture regulates the hypothalamic-pituitary-adrenal axis and the oxytocin system to improve mood and anxiety levels in new mothers [75]. Acupuncture has also shown remarkable efficacy in treating insomnia. Studies have demonstrated that acupuncture effectively improves sleep quality in patients with chronic insomnia by regulating emotional networks and enhancing brain functional connectivity [86]. Furthermore, combining electroacupuncture with cognitive behavioral therapy significantly improved short-term sleep quality and overall well-being [87]. In elderly patients, warm acupuncture therapy has been shown to yield positive results in treating insomnia, improving sleep quality by regulating the brain-gut peptide system [88]. Studies on facial paralysis indicate that acupuncture and electroacupuncture significantly improve facial muscle function. Research has found that electroacupuncture activates specific brain regions involved in facial movement and emotional regulation, promoting recovery in patients with facial paralysis [89]. Acupuncture at specific acupoints has been

shown to accelerate recovery in patients with acute-phase facial paralysis [90]. Furthermore, electroacupuncture combined with intermittent wave stimulation has been used as a rehabilitation therapy for chronic facial paralysis, effectively alleviating symptoms and restoring neurological function [91]. For Parkinson's disease, acupuncture has demonstrated significant benefits in improving motor symptoms and cognitive function. Studies have found that electroacupuncture and tongue acupuncture improve swallowing function, reduce muscle stiffness and tremors, and alleviate symptoms associated with Parkinson's disease [92]. Additionally, electroacupuncture stimulation of the stellate ganglion effectively relieves orthostatic hypotension in Parkinson's patients [93]. Fire acupuncture has also been studied as an effective method for alleviating chronic pain associated with Parkinson's disease, particularly in enhancing daily activity levels and quality of life [94]. Research on Alzheimer's disease (AD) has shown that acupuncture improves cognitive function and memory by modulating the default mode network and the brain-gut microbiota axis [95]. Additionally, electroacupuncture has demonstrated positive effects on cognition, motor abilities, and relevant neurological biomarkers (e.g., A β and tau protein levels) in AD patients [96]. These findings further validate acupuncture's potential in treating depression, insomnia, facial paralysis, Parkinson's disease, and AD, while also providing strong evidence for mechanistic studies of acupuncture therapy.

Basic research evidence indicates that electroacupuncture and acupuncture effectively improve depressive symptoms by modulating the nervous system, reducing neuroinflammation, alleviating oxidative stress, and promoting neuroplasticity. In chronic unpredictable mild stress rat models, electroacupuncture significantly alleviates depressive symptoms by regulating the cGAS-STING-NLRP3 signaling pathway [97]. Additionally, acupuncture has been shown to regulate microglial activity and inhibit inflammatory responses, demonstrating positive therapeutic effects in multiple animal models of depression [98]. Moreover, combined acupuncture treatment for anxiety and depression has been found to alleviate the interactive effects of these conditions [99]. For anxiety disorders, studies have found that electroacupuncture and moxibustion effectively alleviate anxiety symptoms by regulating autonomic nervous function and HRV. For example, electroacupuncture stimulates the vagus nerve and enhances cardiac rhythm coherence, effectively reducing symptoms of generalized anxiety disorder [84]. Other studies have shown that electroacupuncture can alleviate anxiety symptoms associated with post-traumatic stress disorder by modulating functional connectivity within brain neural networks [100]. These findings suggest that acupuncture holds promise as an adjunct therapy for anxiety disorders. In insomnia treatment, acupuncture and moxibustion have shown significant efficacy, particularly in improving sleep quality, adjusting sleep architecture, and alleviating anxiety and depression symptoms. Research indicates that electroacupuncture improves sleep quality and cognitive function in chronic insomnia patients by modulating emotional networks and brain functional connectivity [86]. Additionally, warm acupuncture therapy has proven effective in elderly patients, improving sleep quality through the regulation of the brain-gut peptide system [88].

Overall, acupuncture exhibits multiple mechanisms in the treatment of neurological disorders, including neurotransmission modulation, neuroinflammation reduction, oxidative stress inhibition, and neuroprotection. These mechanisms provide a strong theoretical foundation for its clinical applications and offer new treatment perspectives for managing neurological diseases. Acupuncture's expanding role in treating neurological disorders highlights its potential as a non-pharmacological, holistic therapeutic option with wide-ranging applications.

Gastrointestinal disorders

Gastrointestinal disorders, particularly irritable bowel syndrome (IBS), visceral hypersensitivity, constipation, and FD, have become increasingly prevalent worldwide in recent years, significantly impacting patients' quality of life. The use of acupuncture in

managing these conditions has been growing. A review of acupuncture research in gastrointestinal disorders in 2024 is summarized as follows:

Clinical evidence suggests that acupuncture has significant therapeutic effects on patients with diarrhea-predominant irritable bowel syndrome (IBS-D), particularly in alleviating diarrhea symptoms and pain. Studies combining electroacupuncture with TCM treatments have demonstrated that post-treatment, IBS-D patients experience marked reductions in diarrhea symptoms and improvements in intestinal function [101]. Additionally, research indicates that acupuncture promotes recovery in IBS-D patients by modulating neuroplasticity, particularly affecting white matter tracts [102]. Neuroimaging studies have shown that acupuncture alters cortical and spinal cord connectivity patterns, helping restore normal gastrointestinal function. Moreover, acupuncture improves gut microbiota balance, regulates intestinal microenvironment homeostasis, and alleviates IBS symptoms, especially by reducing microbiota-associated inflammation [103]. Clinical studies have also demonstrated that stimulating single or combined acupoints yields positive effects in IBS patients. Regarding gastric motility disorders, acupuncture and moxibustion play a vital role in treatment. For instance, in the management of gastroparesis, percutaneous electrical acupuncture has been found to improve autonomic nervous system regulation and gastrointestinal function [104]. Additionally, acupuncture and moxibustion interventions for FD improve symptoms by regulating gastric and duodenal motility [104]. Auricular acupuncture has also been found effective in managing functional constipation [105]. Acupuncture for gastroesophageal reflux disease has been shown to improve gastrointestinal hormone levels while effectively relieving gastroesophageal reflux disease symptoms [106]. Furthermore, sacral nerve stimulation therapy has demonstrated anti-inflammatory effects in ulcerative colitis (UC) patients, showing promising clinical applications [107].

Basic research evidence indicates that acupuncture and moxibustion exhibit significant efficacy in treating gastrointestinal disorders, particularly in alleviating visceral hypersensitivity, reducing inflammation, and promoting gastrointestinal motility. For IBS, studies show that electroacupuncture reduces colonic inflammation by modulating the NLRP3 inflammasome pathway and enhances intestinal barrier function [108]. Additionally, electroacupuncture and moxibustion improve intestinal function through different mechanisms, particularly in modulating the nervous system and alleviating IBS-D symptoms [109, 110]. In the treatment of UC and FD, studies have shown that electroacupuncture regulates the gut microbiota, improves gastrointestinal function, reduces low-grade inflammation, and alleviates UC symptoms via the NF- κ B pathway [111, 112]. In terms of gastrointestinal barrier repair, moxibustion regulates long non-coding RNAs and Phf11 expression, significantly improving colonic inflammation in UC animal models [113]. Furthermore, high-frequency electroacupuncture at Zusanli (ST-36) has been found to enhance gastrointestinal motility and regulate macrophage secretion, further improving overall gastrointestinal function [114].

These studies highlight that acupuncture, electroacupuncture, and moxibustion regulate the immune system, nervous function, and gastrointestinal motility through multiple pathways, effectively relieving IBS, UC, and FD symptoms. Acupuncture provides new therapeutic strategies for gastrointestinal disorders and holds strong clinical application potential. Further exploration of these mechanisms not only expands the application of acupuncture in gastrointestinal treatments but also provides new directions for future therapeutic strategies.

Osteoarthritis and joint diseases

Osteoarthritis and joint diseases, especially KOA and rheumatoid arthritis, are the two most common joint diseases globally, particularly affecting the elderly population, severely impacting the quality of life of patients. KOA primarily presents as joint pain, limited movement, and joint dysfunction, typically related to degenerative

changes in the joint. Rheumatoid arthritis, on the other hand, is a chronic autoimmune disease that mainly affects the synovium of joints, leading to joint swelling, pain, morning stiffness, and functional loss. Acupuncture, as a traditional Chinese medical treatment, has shown significant efficacy in alleviating symptoms of joint diseases, improving patient function, and promoting rehabilitation in recent years. A review of acupuncture research in osteoarthritis and joint diseases in 2024 is summarized as follows:

Clinical research evidence shows that acupuncture has demonstrated significant clinical effects in the treatment of osteoarthritis and joint diseases. Relevant studies indicate that in the treatment of KOA, acupuncture combined with electroacupuncture has been found to be more effective, as this combination treatment improves the range of motion of the knee joint and reduces pain [115], and through the regulation of related signaling pathways such as p38 MAPK, enhances the body's repair functions [116]. Additionally, acupuncture can regulate immune functions, alleviate joint inflammation, and promote cartilage repair. Ultrasound-guided percutaneous needle knife treatment for KOA has been shown to precisely locate the lesions, alleviate joint pain, and improve function, with results significantly better than conventional treatments [117]. Moreover, long needles used for early- and mid-stage KOA patients significantly improve joint function, with sustained benefits observed over a longer treatment period [118]. For rheumatoid arthritis, studies have indicated that acupuncture treatment can significantly reduce joint inflammation, improve pain, and enhance joint function [119]. Moxibustion combined with acupuncture has been confirmed to be effective in improving pain and joint function [120].

Basic research evidence shows that electroacupuncture in the treatment of KOA demonstrates its potential by modulating immune function, reducing inflammation, and promoting cell repair. Studies have found that electroacupuncture can improve joint function and alleviate pain by regulating T-cell balance and inflammation [121]. Additionally, electroacupuncture can reduce cartilage degeneration in KOA rats by modulating fatty acid metabolism pathways and inhibiting the expression of ADAMTS5, thereby slowing the pathological process to some extent [122]. For rheumatoid arthritis (RA) models, studies indicate that acupuncture can modulate the immune system, particularly by reducing polarization of M1 macrophages and inhibiting the activation of NLRP3 inflammasomes, significantly reducing joint inflammation and pain [123]. Furthermore, acupuncture in RA rats has also been shown to regulate the gut microbiota, improving immune function and alleviating joint inflammation [124]. Further research suggests that electroacupuncture also has a positive effect in alleviating joint pain and improving joint function, particularly by modulating the P2Y12R receptor and microglial cell activation pathways to achieve pain relief [125]. In addition to arthritis, acupuncture plays a significant role in the treatment of osteoarthritis, with studies showing that acupuncture can effectively slow knee joint inflammation and promote joint repair by influencing cartilage metabolism and autophagy [126]. Electroacupuncture and moxibustion, by modulating joint microcirculation, oxidative stress, and cartilage hypoxia, further demonstrate their therapeutic potential in osteoarthritis treatment [127]. These studies indicate that acupuncture, as an effective intervention, can significantly improve the pathological process and clinical symptoms of osteoarthritis and joint diseases through multiple mechanisms such as modulating immunity, reducing inflammation, and promoting repair.

In conclusion, acupuncture works through multiple mechanisms such as regulating local blood circulation, reducing inflammation, and promoting soft tissue repair in the treatment of KOA and rheumatoid arthritis. It holds broad clinical application potential. These studies provide more theoretical support for acupuncture's application in osteoarthritis and joint diseases and demonstrate its effectiveness as a non-pharmacological treatment option.

Urological and prostate diseases

In the treatment of urological and prostate diseases, acupuncture, as a

traditional therapy, has received increasing attention in recent years, especially in the treatment of prostatitis, renal colic, urinary incontinence, and bladder dysfunction. Urological diseases are prevalent globally, particularly with the aging population and changes in lifestyle, leading to a rising incidence of prostate-related diseases and bladder dysfunction. A review of acupuncture in the treatment of urological and prostate diseases in 2024 is summarized as follows:

Clinical research evidence shows that in the treatment of enuresis, laser acupuncture has shown significant effects in treating monosymptomatic nocturnal enuresis in adolescent females. Studies have found that laser acupuncture significantly improves bladder capacity and maximum urinary volume, thereby reducing the frequency of nocturnal enuresis [128]; the Zhibian (BL54) along the "Bladder Meridian of Foot-Taiyang (a major meridian in Traditional Chinese Medicine that runs along the back of the body, starting from the inner corner of the eye, passing through the head, neck, and back, down the legs, and ending at the little toe, influencing the bladder, kidneys, and urinary system)" has been shown to effectively improve bladder control in women, increase blood flow velocity to the bladder, and increase bladder capacity [129]. For chronic pelvic pain syndrome (CP/CPPS), research indicates that acupuncture can significantly improve pain symptoms and quality of life in patients [130]. A study on chronic prostatitis found that acupuncture not only alleviates pain associated with the condition but also improves the NIH-CPSI score (Chronic Prostatitis Symptom Index), enhancing the patient's quality of life [131]. Additionally, acupuncture has shown significant efficacy in acute renal colic, shortening the time to complete pain relief and significantly improving the pain relief outcomes [132]. In the treatment of urinary incontinence, studies show that low-frequency electroacupuncture combined with pelvic floor muscle training has good therapeutic effects in post-surgical urinary incontinence (e.g., after prostatectomy) [133]. This combined treatment not only improves urinary control function but also significantly increases bladder capacity and urethral closure pressure, while reducing the frequency of using incontinence pads. For bladder stones, electroacupuncture combined with extracorporeal shock wave lithotripsy has significantly increased the stone expulsion rate and shortened the expulsion time [134]. In the treatment of neurogenic bladder following spinal cord injury, electroacupuncture at different acupoints has shown varying effects. Studies have found that electroacupuncture at Guanyuan (RN4), Zhongji (RN3), and Sanyinjiao (SP6) significantly increases bladder capacity and reduces the maximum pressure of the detrusor muscle, particularly in patients with overactive detrusor muscle, where Guanyuan (RN4) and Zhongji (RN3) were found to be especially effective [135].

Basic research evidence shows that moxibustion plays an important role in improving overactive bladder (OAB) in rat models by regulating ATP-sensitive potassium channels (K(ATP) channels). Moxibustion upregulates the protein and mRNA expression of K(ATP) channels, promotes potassium ion efflux, and inhibits calcium ion influx, thereby improving the stability of the detrusor muscle [136]. In the treatment of neurogenic bladder, research has shown that electroacupuncture can relieve excessive contraction of the detrusor muscle through the protein kinase A (PKA) signaling pathway. Electroacupuncture significantly increases PKA levels and enhances the protein expression of phosphorylated myosin light chain kinase (p-MLCK) and phosphorylated myosin light chain (p-MLC), thereby improving bladder function. Additionally, acupuncture has also achieved significant results in treating OAB, particularly through mechanisms that regulate brain neural activity. Studies show that acupuncture at Weizhong (BL40) significantly increases the inter-contraction intervals of the bladder and enhances low-frequency oscillation amplitude in areas such as the primary motor cortex (M1), periaqueductal gray, and pontine micturition center. This effect may be mediated by the regulation of mast cells and the tibial nerve, further influencing brain activation in these areas, thus improving bladder function [137]. These studies reveal acupuncture's potential in the treatment of urological diseases through various mechanisms, especially in regulating the nervous system, improving bladder

function, and alleviating OAB symptoms, providing new therapeutic approaches for clinical practice.

In conclusion, acupuncture has shown significant therapeutic effects in the treatment of urological and prostate diseases, working through multiple mechanisms, particularly in regulating bladder function, alleviating OAB, and promoting kidney stone expulsion. With further research, the application of acupuncture in urological diseases will become increasingly widespread, providing safer and more effective treatment options for patients.

Respiratory diseases

Respiratory diseases, including lung diseases, chronic obstructive pulmonary disease (COPD), and COVID-19, have become major challenges in global healthcare. Lung diseases not only affect patients' quality of life but also impose a heavy burden on public health systems. COPD is one of the leading causes of death and disability worldwide, characterized by a prolonged disease course, recurrent symptoms, and difficulty in achieving complete remission, resulting in persistent dyspnea and physical decline for patients. Since the outbreak of COVID-19, the disease has rapidly spread and become a global pandemic. Although the pandemic has ended, its long-term effects, particularly post-COVID syndrome (long COVID), have gained widespread attention. Long COVID symptoms include persistent respiratory issues such as shortness of breath, chronic cough, chest tightness, and fatigue, which can continue to affect patients' daily lives for months after recovery. As COVID-19 continues to affect patients beyond the acute infection phase, the challenge now extends to managing its long-term complications. Acupuncture is a TCM therapy that helps alleviate chronic and long-term symptoms, particularly by reducing pulmonary discomfort, improving respiratory function, and relieving chronic fatigue. By modulating the immune system, improving pulmonary circulation, promoting airway clearance, and reducing inflammatory responses, acupuncture provides a safe and effective non-pharmacological treatment option for respiratory diseases. With ongoing research into its mechanisms, acupuncture is increasingly being integrated into clinical practice for COVID-19 and long COVID patients, demonstrating broad application prospects. A summary of acupuncture research in respiratory diseases in 2024 is as follows:

Clinical research has demonstrated that acupuncture is effective in improving respiratory function and quality of life in COPD patients. Studies indicate that acupuncture enhances airway ventilation, alleviates dyspnea, and reduces fatigue associated with COPD [138, 139]. In clinical practice, various acupuncture modalities, including electroacupuncture, cupping, and bloodletting therapy, are frequently used to relieve COPD symptoms [140, 141]. For COVID-19 patients, acupuncture has also played a crucial role as an adjunct therapy. In cases of severe pneumonia and respiratory failure, studies have found that acupuncture improves lung function and facilitates weaning from mechanical ventilation [142]. Some studies suggest that acupuncture regulates immune responses, effectively reducing pulmonary inflammation and promoting the production of antiviral factors [141]. For example, acupuncture at Qihai (RN6) and Dazhui (DU14) has been shown to enhance immunity and improve respiratory function, aiding patients in recovering from severe COVID-19 symptoms [143]. Additionally, acupuncture has garnered attention for its role in treating chronic bronchitis, allergic asthma, lung injury, and other respiratory diseases [144–146]. Research indicates that acupuncture modulates the autonomic nervous system, relieves bronchospasm, and significantly improves airflow and respiratory conditions. For allergic asthma patients, acupuncture effectively reduces allergic reactions and bronchial constriction, decreasing the frequency of asthma attacks.

Basic research has found that electroacupuncture alleviates pathological changes and reduces ventilator-induced lung injury by modulating the Nrf2/HO-1 signaling pathway [147]. Another study revealed that electroacupuncture significantly reduces airway inflammation in allergic asthma models by activating the somatosensory-sympathetic neural pathway [144]. In the treatment of

acute asthma, electroacupuncture effectively relieves symptoms during acute exacerbations by promoting airway smooth muscle relaxation [145]. Moreover, electroacupuncture preconditioning has shown protective effects against endotoxin-induced acute lung injury. Research indicates that electroacupuncture maintains mitochondrial quality control and activates the HO-1/MIC60 signaling pathway, thereby reducing pulmonary damage [146]. Another study on COPD found that electroacupuncture reduces pulmonary inflammation and improves lung function by inhibiting miR-19b-3p and modulating the SOCS3/JAK1/STAT3 signaling pathway [148]. These studies provide scientific evidence supporting the application of electroacupuncture in respiratory diseases, highlighting its potential in improving lung function, reducing inflammation, and protecting lung tissue.

In summary, acupuncture plays a vital role in treating respiratory diseases by improving lung function, alleviating airway inflammation, and relieving respiratory distress. As research continues to deepen, acupuncture's therapeutic mechanisms in respiratory diseases will be further elucidated, driving its clinical application and establishing it as an important complementary therapy in combating respiratory conditions.

Cardiovascular diseases and heart health

Cardiovascular diseases significantly impact human quality of life and longevity and have become one of the major global health concerns. Heart diseases, particularly chronic heart failure and coronary artery disease, have long imposed a heavy burden on patients, often associated with high recurrence and mortality rates. Atrial fibrillation, one of the most common arrhythmias, not only affects the heart's pumping function but also increases the risk of stroke. Reduced HRV is considered a marker of autonomic nervous system imbalance and is closely linked to the incidence and mortality of heart disease. Additionally, myocardial ischemia, which directly affects the heart's blood supply and oxygenation, is a key clinical manifestation in patients with coronary artery disease. A review of acupuncture research in cardiovascular diseases in 2024 is summarized as follows:

Clinical research evidence suggests that numerous studies have explored the therapeutic effects of acupuncture on various cardiovascular diseases, yielding promising clinical results. For example, in the treatment of orthostatic hypotension due to yang deficiency in the elderly, a randomized controlled trial of heat-sensitive moxibustion combined with medication showed that acupuncture significantly improved blood pressure levels and symptoms of orthostatic hypotension in elderly patients [149]. Similarly, in the treatment of chronic heart failure with coexisting chronic kidney disease, acupuncture demonstrated favorable clinical effects by regulating cardiac function and renal blood flow, thereby improving symptoms and enhancing quality of life [149]. Another study indicated that acupuncture is effective in alleviating dyspnea and other symptoms associated with heart failure. A comprehensive review of trial data confirmed that acupuncture improves respiratory function and effectively relieves symptoms caused by heart failure [150]. In the treatment of carotid atherosclerosis, results from randomized controlled clinical trials indicated that acupuncture improved carotid blood flow, slowed the progression of atherosclerosis, and helped prevent cardiovascular events [151]. Further research has also focused on the effect of acupuncture on HRV, particularly in on-call workers, demonstrating its potential in improving HRV and providing theoretical support for acupuncture's role in autonomic nervous system regulation [152]. Additionally, a study comparing hemodynamic changes in supine and seated positions during acupuncture stimulation found that different positions influence treatment effects, offering valuable insights for optimizing clinical protocols [153]. In the treatment of unstable angina, acupuncture was found to significantly reduce depression and anxiety in patients. Regarding the immediate and short-term effects after coronary intervention, studies have shown that acupuncture not only improves angina symptoms but also effectively alleviates psychological burdens associated with heart disease [154]. Lastly, a study on vagal nerve modulation to regulate HRV found that auricular

acupuncture effectively increased HRV, thereby improving cardiac function and autonomic balance [155].

Basic research evidence suggests that acupuncture plays a crucial role in cardiovascular treatment through multiple mechanisms, including autonomic nervous system regulation, myocardial function improvement, and inhibition of myocardial injury. In studies on myocardial ischemia, acupuncture was found to regulate the AMPK/KLF2 signaling pathway, promoting angiogenesis in the heart and reducing myocardial ischemia and reperfusion injury [156]. Research demonstrated that electroacupuncture enhances local cardiac blood flow, reduces oxidative stress responses, and significantly improves ejection fraction and cardiac function. Additionally, electroacupuncture treatment modulates VEGF expression, promoting myocardial vascular regeneration and improving oxygen supply to the heart [157]. In studies on atrial fibrillation, acupuncture was shown to regulate autonomic nervous balance, particularly by enhancing vagal nerve activity, which helps restore stable heart rhythms. Research found that acupuncture's effect on atrial fibrillation is primarily due to its ability to reduce excessive sympathetic nervous activity while enhancing vagal tone, thereby preventing the initiation and maintenance of atrial fibrillation. This mechanism is achieved through acupuncture stimulation of specific points such as Neiguan (PC6), which modulates neural activity and improves cardiac rhythm [158]. For myocardial infarction models, acupuncture also demonstrated significant protective effects. Studies showed that acupuncture modulates β 1-adrenergic receptors and the downstream PKA signaling pathway, reducing myocardial ischemia and cardiac injury. Particularly in acute myocardial infarction, acupuncture was found to improve cardiac electrical activity, reduce infarct size, and increase left ventricular ejection fraction [159]. Additionally, acupuncture improves cardiac electrophysiological characteristics and alleviates myocardial hypertrophy by modulating potassium channels and calcium ion overload. In HRV studies, acupuncture was found to improve autonomic nervous system balance, particularly by enhancing vagal nerve activity, which effectively increases HRV and reduces cardiovascular mortality. The regulatory effect of acupuncture on HRV may be attributed to its influence on both sympathetic and parasympathetic nervous activity, reducing excessive cardiac load and promoting overall heart health [160].

In conclusion, these research findings provide strong theoretical support for acupuncture's application in cardiovascular disease treatment. Acupuncture has demonstrated efficacy in managing various cardiovascular conditions through multiple mechanisms, highlighting its unique advantages as a non-pharmacological therapy and offering additional treatment options for cardiovascular patients.

Endocrine and metabolic diseases

With the continuous improvement in living standards and changes in modern lifestyles, endocrine and metabolic diseases, represented by obesity and diabetes, have become major public health issues globally. The incidence of obesity and diabetes continues to rise, particularly among the elderly and subhealthy populations. These diseases not only increase the risk of complications such as cardiovascular diseases, kidney diseases, and nerve damage, but also severely affect the quality of life of patients. Obesity is a significant risk factor for diabetes, and the two conditions are closely related. As the prevalence of diabetes increases, how to effectively prevent and treat these complications has become an urgent medical challenge. Diabetic peripheral neuropathy (DPN), insulin resistance, and diabetic cognitive dysfunction are common complications of diabetes, leading to symptoms such as pain, sensory loss, and motor dysfunction, significantly affecting quality of life. A review of acupuncture research in the field of endocrine and metabolic diseases in 2024 is summarized as follows:

Clinical research evidence shows that acupuncture has demonstrated the ability to regulate appetite and reduce fat accumulation in the treatment of obesity. For example, one study found that electroacupuncture at specific acupoints significantly reduced waist circumference, body weight, and body fat percentage

[161]. Additionally, auricular acupuncture and acupuncture with embedded needles have also been widely used in treating obesity [162–164]. For diabetes and its complications, acupuncture has been shown to effectively reduce blood glucose levels in early diabetic nephropathy patients and protect renal function [165], as well as reduce serum inflammation markers, especially in improving peripheral neuropathy [166], promoting wound healing in diabetic foot ulcers, and improving microcirculation [167]. For example, one study indicated that acupuncture combined with auricular magnet therapy significantly reduced blood glucose levels and improved blood flow and healing ability in tissues [168]. Recent bibliometric studies also show favorable trends for non-pharmacological therapies [169, 170].

Basic research evidence shows that in obesity studies, acupuncture regulates intestinal barrier function and the TLR4/NF- κ B signaling pathway, reducing intestinal inflammation and effectively lowering fat accumulation. For instance, electroacupuncture at specific acupoints can improve intestinal dysbiosis, promote fat metabolism, and enhance insulin sensitivity. Studies also indicate that acupuncture can regulate the function of adipocytes through the AMPK/mTOR signaling pathway, alleviating fat accumulation and achieving weight loss [171]. In the treatment of diabetes and its complications, acupuncture has a more diversified mechanism, particularly in the case of DPN. Acupuncture improves nerve function, alleviates mechanical hyperalgesia and inflammation caused by diabetes, and significantly relieves neuropathic pain. Studies have found that electroacupuncture reduces the expression of the BR1 receptor, regulating the CaMKII/CREB signaling pathway, effectively alleviating DPN symptoms [172]. Additionally, electroacupuncture also reduces the inflammation caused by diabetes by regulating the activation of the NLRP3 inflammasome, helping to repair damaged nerves [173]. In the treatment of diabetic cognitive dysfunction and diabetic nephropathy, acupuncture has also shown positive therapeutic effects. Research indicates that acupuncture can improve cognitive function in diabetic mice by inhibiting autophagy-related ferroptosis [174]. Moreover, acupuncture modulates the Sirt1/PGC-1 α /TFAM signaling pathway, effectively reducing DPN [175]. In the treatment of diabetic nephropathy, electroacupuncture reduces epithelial-to-mesenchymal transition, slowing the progression of renal fibrosis and improving kidney function [176].

In summary, acupuncture improves obesity, diabetes, and their complications through multiple mechanisms, particularly in regulating metabolism, reducing inflammation, and repairing nerve damage, showcasing its unique advantages in metabolic disease management. With further research, acupuncture is expected to become an important adjunct in the treatment of obesity, diabetes, and their associated complications, offering patients safer and more effective treatment options.

Dermatological diseases

Dermatological diseases, especially chronic inflammatory skin conditions such as psoriasis and urticaria, have become common and significant health issues that affect the quality of life of individuals worldwide. These diseases not only severely impact the patient's appearance but can also lead to persistent pain, itching, and discomfort, which negatively affects the psychological and social aspects of their life. Although modern medicine has made some progress in treating skin diseases, many treatments still face issues such as unstable efficacy, long treatment durations, and significant side effects. Therefore, finding safer and more effective treatments, especially non-pharmacological therapies, is crucial. Acupuncture, as a TCM therapy, has demonstrated significant efficacy in treating dermatological diseases in recent years. By modulating the immune system, reducing inflammation, and improving skin barrier function, acupuncture can alleviate symptoms of chronic skin conditions and improve the quality of life for patients. Especially in the treatment of persistent skin diseases like psoriasis and urticaria, acupuncture not only helps alleviate skin lesions but also improves overall immune function, providing effective long-term therapeutic options for

patients. With the continuous research into acupuncture in the dermatological field, it has gradually become a popular adjunctive therapy, gaining more attention from patients. A summary of acupuncture research in dermatology in 2024 is as follows:

Clinical research evidence shows that acupuncture, as an adjunct therapy, has gradually demonstrated its potential in the treatment of various skin diseases, particularly in relieving chronic urticaria, psoriasis, and eczema. Regarding chronic spontaneous urticaria (CSU), a high-level randomized controlled trial published in 2024 in the *Annals of Internal Medicine* focused on acupuncture for treating CSU. This study showed that acupuncture, as an adjunct therapy, effectively alleviated itching, reduced skin inflammation, and significantly improved the patient's overall quality of life [177]. The study included 31 patients with CSU, who received four weeks of acupuncture treatment. The results indicated that acupuncture significantly lowered the Urticaria Activity Score and improved the Urticaria Control Test score, showing effective symptom control. Furthermore, acupuncture also positively affected sleep quality, alleviated anxiety and pain, and regulated skin immune responses, reducing the activity of inflammatory cells and mitigating the skin reactions caused by urticaria. A comparison of scores before and after acupuncture further confirmed acupuncture's significant efficacy in treating CSU. This study emphasized acupuncture as a safe and effective non-pharmacological treatment for CSU and provided new ideas and practical guidance for clinicians treating such conditions. Other studies on CSU have shown that acupuncture not only effectively improves skin itching but also enhances the patient's quality of life. Combined treatment with acupuncture and omalizumab showed that acupuncture significantly improved the total disease score and symptom control in CSU patients, particularly in reducing symptoms and improving quality of life [178, 179]. Additionally, another study confirmed acupuncture's effectiveness in treating CSU by comparing Urticaria Activity Scores before and after acupuncture, finding significant improvements and reduced overall scores [179]. In the treatment of plaque psoriasis, fire needle therapy has demonstrated significant clinical efficacy. Studies have shown that fire needle therapy effectively controls the development of skin lesions, alleviates symptoms, and significantly improves the size and severity of lesions during a 2–4 week treatment period [180]. Similarly, traditional acupuncture has also achieved good results in improving skin symptoms, relieving itching, and preventing recurrence. These studies indicate that acupuncture and its variations, such as fire needle therapy, are clinically significant in the treatment of psoriasis, particularly in alleviating symptoms and promoting skin lesion recovery. In eczema studies, acupuncture and its combination with other traditional therapies, such as moxibustion, have been proven effective in relieving skin inflammation and itching caused by chronic eczema. For example, acupuncture can regulate immune responses, reduce the effects of external inflammatory factors, and thus alleviate skin symptoms and improve the quality of life for eczema patients [181]. Besides the aforementioned conditions, acupuncture has also been used to treat other skin issues, such as chronic eczema and multiple plantar warts, with proven efficacy. Studies have found that the combination of fire needle therapy and herbal baths using an improved fire needle technique effectively reduces the symptoms of multiple plantar warts and significantly enhances the quality of life [182]. These studies provide strong evidence for the use of acupuncture in dermatological treatments, further confirming its potential as an adjunctive therapy for skin diseases.

Basic research evidence shows that electroacupuncture reduces the frequency of scratching, skin inflammation, and mast cell degranulation in experimental rats with urticaria, thus alleviating symptoms. This effect is associated with inhibiting the NLRP3 inflammasome and pyroptosis mechanisms. Electroacupuncture also regulates the substance P-NK1R signaling pathway, alleviating inflammation, keratinocyte hyperplasia, and T-cell infiltration in psoriasis mice [183]. Additionally, autohemotherapy in the treatment of atopic dermatitis has shown efficacy, potentially by activating regulatory T cells to modulate immune responses and alleviate skin

lesions [184]. Furthermore, acupuncture also improves intestinal barrier function and modulates the gut microbiota to reduce symptoms of atopic dermatitis, providing a novel non-pharmacological treatment approach [185].

In conclusion, acupuncture may improve clinical symptoms by regulating immune responses, reducing inflammation, and improving blood circulation, but its specific mechanisms require further in-depth research in the future.

Other fields and emerging perspectives

Beyond the major disease categories with high publication volume discussed earlier in this yearbook, acupuncture research in 2024 has demonstrated continued expansion into a wide range of additional clinical conditions, reflecting its growing applicability across multiple bodily systems. Specifically, recent studies have addressed diverse conditions including exercise-induced fatigue and spasms [186], tinnitus and hearing loss [187], dry eye syndrome [188], muscle weakness and biomechanical changes in muscle hardness [189], allergic rhinitis [190], myopia [191], male infertility [192], temporomandibular joint disorders [193], ankylosing spondylitis [194], carpal tunnel syndrome [195], osteopenia and osteoporosis [196], restless leg syndrome [197], spinal cord injury [198], impaired liver regeneration [199], autism spectrum disorder [200], thyroid dysfunction [201], acrophobia [202], and sickle cell disease [203], some of these studies explored relatively rare or previously underrepresented conditions, such as hepatic regenerative failure [199] and sickle cell disease [203], underscoring the expanding scope of acupuncture's clinical application.

At the methodological level, 2024 has also seen a trend toward “new perspectives, new methods, and new paradigms.” Traditional acupuncture techniques are increasingly being integrated with modern medical technologies. Research involving acupuncture anesthesia [204], visualization-assisted technologies [205] (such as ultrasound guidance [206] and virtual reality-based operation systems [207]), electroencephalography (EEG) [208], and functional magnetic resonance imaging has been steadily increasing [209], reflecting the continuous expansion of acupuncture interventions in both technological integration and mechanistic exploration.

Of particular note, significant progress was made in 2024 in elucidating the neurological mechanisms underlying acupuncture [210]. A paradigm shift is underway, moving from traditional meridian-viscera theories to modern models based on neural circuit modulation. Research has focused on key neurocircuits such as the periaqueductal gray-pro-opiomelanocortin-endorphin axis [211], the medial prefrontal cortex-habenula-ventral tegmental area reward pathway [212], the spinal cord-thalamus transmission circuit [213], and the cortex-basal ganglia-brainstem regulatory axis [214]. For instance, stimulation at Shenmen (HT7) was shown to suppress self-administration behavior in alcohol addiction models via modulation of the medial prefrontal cortex-habenula-ventral tegmental area pathway [212]. Moreover, studies on exercise-induced fatigue and brain injury rehabilitation have highlighted the plasticity and clinical value of acupuncture in modulating cortical motor networks.

Additionally, while acupuncture is generally considered safe, 2024 also saw several reports of adverse events. Although rare, documented complications such as pneumothorax [215], hemothorax [216], broken acupuncture needle [217], localized infection [218–220], and nerve injury underscore the importance of strict adherence to aseptic technique [221], accurate anatomical localization, and clear risk communication with patients to ensure safety in clinical practice.

In summary, acupuncture research in 2024 not only demonstrated a broadening scope in disease intervention but also advanced significantly in methodological innovation and mechanistic understanding. As a core component of traditional medicine, acupuncture is increasingly aligning with contemporary biomedical paradigms through interdisciplinary integration, revealing transformative potential in both academic and clinical contexts.

Summary and future outlook

Compared to the 2021 and 2022 Acupuncture Yearbooks [222, 223], the 2024 Yearbook adopts bibliometric methods, using tools such as VOSviewer and R software for qualitative and quantitative analysis of acupuncture-related literature. This method provides a more systematic presentation of research hotspots and trends, offering readers a clearer understanding of the research context. Additionally, the literature has been categorized in more detail, systematically organizing papers based on different research types, and including a broader selection of studies across various fields. These fields include research on cerebrovascular diseases, perioperative care, pain management, cancer-related studies, gynecology and reproductive health, neurological diseases, gastrointestinal and digestive health, musculoskeletal diseases, urology and prostate diseases, respiratory diseases, cardiovascular diseases, endocrine and metabolic diseases, and dermatological diseases. The comprehensiveness and systematization of the literature enhance the scientific quality and depth of the yearbook, with more thorough and comprehensive summaries of both clinical and mechanistic research. These improvements not only enhance the quality of acupuncture research but also provide a more solid theoretical foundation and clearer research directions for future studies.

In 2024, significant progress was made in acupuncture research in clinical treatments, mechanistic exploration, and technological applications. As an ancient Chinese medical therapy, acupuncture is becoming more widely applied in modern medicine, demonstrating strong efficacy, particularly in areas such as pain management, cerebrovascular diseases, cancer-related symptoms, neurological diseases, and perioperative care. In basic research, with advances in neuroscience, the mechanisms behind acupuncture are gradually being unveiled, particularly in areas such as neural circuits, imaging techniques, and neurotransmitter regulation, offering scientific support for understanding acupuncture's therapeutic mechanisms.

Looking ahead, clinical acupuncture research needs to further improve, especially in the standardization of clinical trials. It is critical to strictly adhere to the reporting guidelines for acupuncture randomized controlled trials and promote the implementation of multi-center, large-sample quality control. As acupuncture research deepens, the execution of sham acupuncture reporting guidelines will become crucial in ensuring research fairness and reliability. There is also a need to improve the quality of RCT reports, particularly in terms of transparency and reproducibility in acupuncture clinical studies. Following reporting guidelines such as STRICTA and SHARE Checklist will help improve the quality of acupuncture research and ensure the reliability of study designs and results [224, 225]. Specifically, reinforcing blinding methods, transparently reporting sham acupuncture, and promoting multi-center, large-sample quality control will greatly enhance the evidence quality in acupuncture research, driving high-quality RCT reports and further improving reproducibility and reliability.

Basic research in 2024 has made significant strides, and neural circuit studies will continue to provide breakthroughs in understanding acupuncture mechanisms [210]. Advanced methods such as two-photon imaging, optogenetics, patch-clamp techniques, and microdialysis are enabling researchers to observe more precisely how acupuncture affects the nervous and immune systems. These technologies will help uncover the specific mechanisms by which acupuncture regulates brain neural circuits, alleviates pain, modulates emotions, and promotes recovery. Moving forward, neural circuit studies will be a key focus for basic research and will offer deeper theoretical support for clinical applications. With technological advancements, acupuncture research will increasingly incorporate new techniques such as infrared thermography [226], laser speckle imaging [227], musculoskeletal ultrasound [228, 229], and functional magnetic resonance imaging [230]. These imaging methods will allow more precise insights into how acupuncture impacts local tissues, neural networks, and the whole body, further enhancing understanding of acupuncture's mechanisms. Moreover, the study of

acupuncture point anatomy will continue to refine acupuncture treatments, providing the foundation for more scientifically accurate and precise acupuncture therapies. The use of artificial intelligence [231], virtual reality [207], and new computational models will also support the growth of acupuncture [232, 233].

In summary, future acupuncture research will increasingly emphasize the quality of evidence and interdisciplinary collaboration. Through continued advancements in both clinical and basic research, acupuncture will play a more significant role in the global medical field, becoming a more scientific, precise, and effective therapeutic method.

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