Multidisciplinary Reviews

CONFERENCE PAPER
Published Online: December 02, 2025
https://doi.org/10.31893/multirev.2025ss0230

Integrative Medicine: Incorporating Complementary Therapies into Clinical Practice

A comprehensive review of acupuncture in pain management: Insights from current research

S. Parthasarathy[a] | Uma Bhardwaj[b] | Parthkumar Devmurari[c] | Aniruddh Dash[d] | Vijay J. Upadhye[e]

[a]Department of anaesthesiology, Mahatma Gandhi Medical College and research Institute, Sri Balaji Vidyapeeth(deemed to be university) Pondicherry, India.
[b]Department of Biotechnology and Microbiology, Noida International University, Greater Noida, Uttar Pradesh, India.
[c]School of Physiotherapy RK University, India.
[d]Department of Orthopaedics, IMS and SUM Hospital, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, Odisha, India.
[e]Parul Institute of Applied Sciences, Parul University, PO Limda, Tal. Waghodia, District Vadodara, Gujarat, India.

Abstract Acupuncture has emerged as a significant therapeutic approach in pain management, particularly for patients suffering from chronic, acute, and neuropathic pain. Acupuncture treatments include inserting tiny needles into certain body parts to stimulate the nervous system and promote the body's natural healing processes. This review explores the historical background, mechanisms of action, and clinical evidence supporting acupuncture's efficacy in pain management. Mechanistically, acupuncture is thought to enhance the release of endorphins, modulate the nervous system, and improve blood circulation, contributing to pain relief. Clinical research suggests that acupuncture is particularly effective for conditions like osteoarthritis, back pain, fibromyalgia, and post-surgical pain. Electroacupuncture, a variation involving electrical stimulation of needles, has also shown promising results in enhancing therapeutic effects. Emerging neuroimaging studies have shed light on the brain's response to acupuncture, supporting its role in modulating pain perception. Moreover, advancements in laser acupuncture and dry needling techniques have expanded therapeutic options. Cross-cultural acceptance and integration into national healthcare systems have also improved its accessibility. These developments reflect acupuncture's growing role as both a complementary and alternative modality in multidisciplinary pain management protocols. Ongoing innovations continue to refine needle design, stimulation parameters, and individualized protocols to enhance treatment precision and patient outcomes. It further discusses acupuncture as a component of an all-encompassing pain treatment strategy, highlighting its integration with other modalities, such as physical therapy and pharmacological treatments. Despite its potential, challenges remain in the form of patient response variability and the placebo effect. This emphasizes the need for more rigorous clinical trials to better understand acupuncture's role and refine its applications in modern pain management practices.

Keywords: chronic pain relief, electroacupuncture, pain control, neuropathic pain, complementary treatment.

1. Introduction

Acupuncture is one of the most widely used therapies in the ancient healing practice, which is Traditional Medicine (TM), and it has been practiced to reduce pain and restore health for several thousand years (Wang et al., 2024). This technique entails piercing small needles that are placed at a particular location known as an acupoint for a certain degree of time to promote a natural cure from sickness. Acupuncture is an intervention found in the concept of maintaining uninterrupted energy pathways called meridians, which will be addressed through its practice. Incorporated into contemporary treatment procedures, acupuncture has become a part of the standard medical practice due to increasing proven benefits focused primarily on pain control (Gong & Thompson, 2024).

Acupuncture has been well appreciated as a complementary or alternative therapy for acute and chronic pains with musculoskeletal pain, migraine, postoperative pain, and neuropathic pains (Lin et al., 2021). Such results are achieved because it does not involve major invasive procedures, and the impact it has on the patient is not as dangerous as pharmacological treatments, which might lead to addictions as well as side effects. Acupuncture regulates pain sensation via the nervous system and distribution of endorphins as well as changing the areas of the cerebral cortex that are responsible for pain sensations (Su et al., 2023).

Although practices of acupuncture are gaining popularity in many countries, the issue provokes controversies among professionals (Miller et al., 2021). Due to questions concerning its action, the scientific approach to it, and the variation in its effectiveness, investigation activities abound. Clinical education and meta-analyses continue to explore its efficacy and safety across diverse populations and conditions (You et al., 2021). The impact of acupuncture on pain reduction, examining its historical roots, underlying mechanisms, and clinical applications (Birch et al., 2022). By bridging traditional wisdom with

scientific investigation, acupuncture offers a promising avenue for addressing the global burden of pain, enhancing patient well-being, and contributing to the evolving landscape of integrative medicine. Figure 1 shows the framework of ideas for incorporating acupuncture.

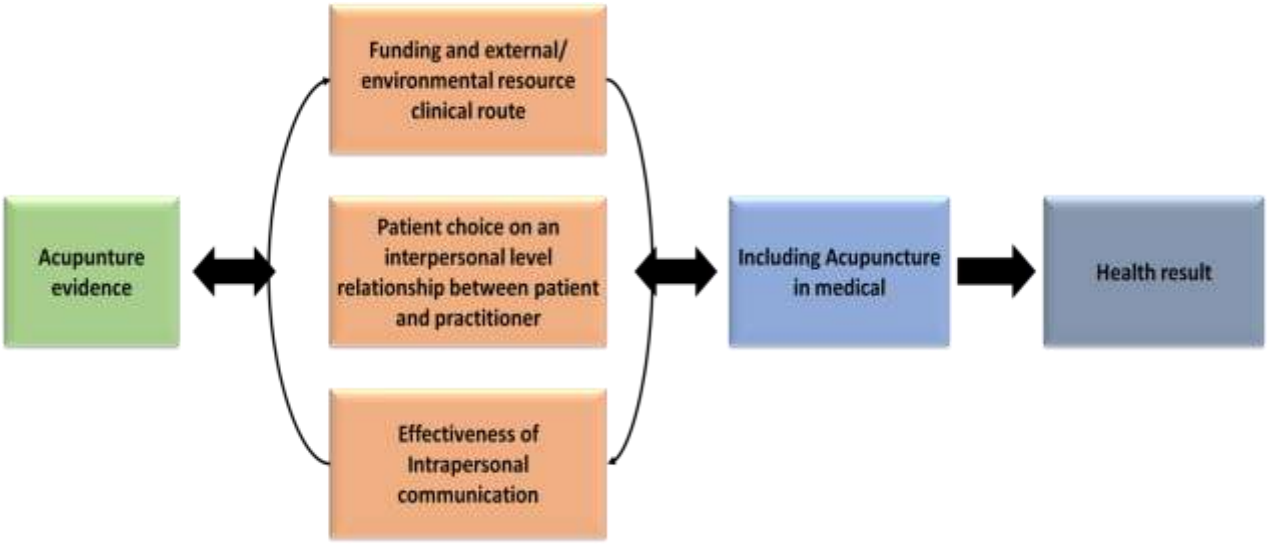

Figure 1 Framework for integrating acupuncture.

This paper is expected to examine the effects and physical processes underlying acupuncture treatment in pain management and how it might be used as a complementary treatment for acute and chronic pains.

2. Methodology

The current systematic review, which is based on PRISMA standards, assesses the effectiveness of acupuncture in managing chronic, neuropathic, and musculoskeletal pain. The publication of literature in the period between 2018 and 2024 was searched in the databases with specific terms. A total of 24 quality studies were analyzed by undergoing a four-phase selection process: identification, screening, eligibility, and inclusion. These were randomized controlled trials and systematic reviews. The studies were evaluated in accordance with relevance, methodological insightfulness, and clinical applicability to establish evidence-based expertise regarding the pain-relieving potential of acupuncture.

2.1. Purpose of the review

To evaluate the therapeutic efficacy of acupuncture in treating neuropathic, acute, chronic, and musculoskeletal aches, a comprehensive systematic review was carried out. The paper explains the mechanism of action of acupuncture, evaluates its clinical effects and its history, and explains how it can be combined with conventional medicine like pharmacotherapy and physical therapy. Results have shown both regulated therapeutic effects and inconsistent differences between various studies, especially across patients and pain types. It is also observed in the review that although the evidence is strong, it has various gaps in knowledge, some of which concern standardization, early and late effects, and placebo response. Not only do these findings reveal areas of concern in future research, but their findings also indicate potential models of optimal clinical practice.

2.2. Databases used

The selection of relevant research for the current systematic review was transparent and readily repeatable by adhering to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) standards. Finding high-quality research that evaluated acupuncture's effectiveness in treating a range of ailments, including neuropathic, chronic, and musculoskeletal problems, was the goal. The process was divided into four phases: identification, screening, eligibility evaluation, and final inclusion. Figure 2 illustrates the methodical progression of study selection from the initial classification of sources to the final inclusion of studies in the qualitative production.

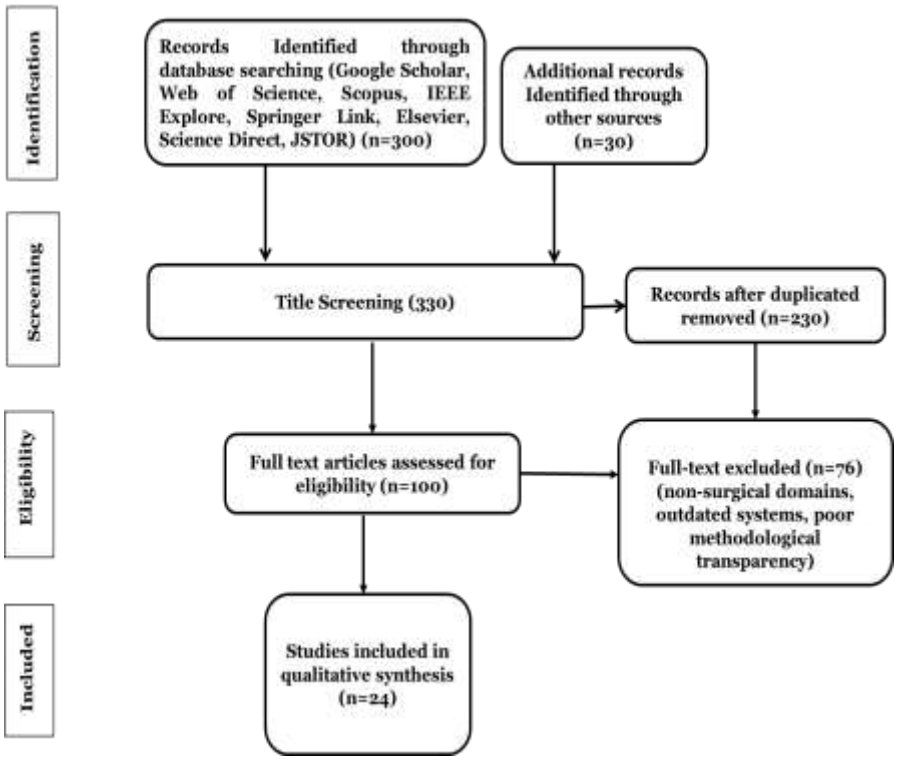

Figure 2 PRISMA flow diagram for the study selection process in acupuncture-based pain management research.

2.2.1. Identification

A detailed literature search has been conducted in several thematic academic databases such as Google Scholar, Findwise, Web of Science, Scopus, IEEE Xplore, Springer Link, Elsevier, ScienceDirect, and JSTOR. With the following keyword patterns: acupuncture, pain management, electroacupuncture, chronic pain, and neuropathic pain, 300 articles were preliminarily retrieved. Another 30 articles were retrieved using citation tracking and searching for relevant articles and reviews in journals.

2.2.2. Screening

The initial screening was done on 230 articles after eliminating duplicates. Titles and abstracts of these papers were reviewed to determine their congruence with the scope of the research. Articles that failed to analyze acupuncture as such or failed to have an outcome about pain were not included. The process produced 230 documents to be reviewed fully, and 70 articles were finally picked to be thoroughly assessed.

2.2.3. Eligibility

The systematic review, which was presented, provided an intensive eligibility assessment of 76 full-text articles by using inclusion criteria, which provide priority to clinical relevance, transparency of the methodology, appropriate sample size, and outcome measurement. Others that were excluded include publications reporting material not related to the research question, the quality of data being too low, or publications containing redundant events with previously published materials. Based on this, 46 articles were discarded at this stage, out of which 24 articles proceeded to the full assessment phase.

2.2.4. Inclusion

A total of twenty-four papers in all were used in the qualitative synthesis. These are the kinds of sources that include solid scientific evidence supporting the effectiveness of acupuncture in treating different kinds of pain conditions. The corpus includes randomized controlled trials, systematic reviews, and high-quality observational studies, giving a composite picture of the place of acupuncture in current pain-management paradigms.

2.3. Publication period covered

The review focused on literature published between 2018 and 2024. This time frame ensures the inclusion of both foundational evidence and the most recent clinical advancements and innovations related to acupuncture. Priority was given

to peer-reviewed journal articles that explored acupuncture's effectiveness, mechanisms, and applications across various pain conditions.

2.4. Quality assessment

To ensure methodological rigor, the included studies were screened for relevance, clarity of intervention, outcome reporting, and research design. Although a formal scoring tool (e.g., GRADE or PRISMA-A) was not applied, preference was given to randomized controlled trials, systematic reviews, and well-structured observational studies. Articles lacking clear methodology, with small sample sizes, or lacking control groups were excluded. The final selection reflects high-quality, clinically meaningful evidence suitable for informing both practitioners and researchers.

3. Results and Discussion

Numerous types of pain are there that can be categorized into distinct types: acute pain, a short-term response to injury or surgery, chronic pain, persistent and often linked to conditions like arthritis, neuropathic pain, resulting from nerve damage, and musculoskeletal pain, affecting muscles and bones. Acupuncture involves inserting and adjusting needles at specific bodily locations to treat symptoms, malfunctions, and illnesses (Nielsen et al., 2022). It treats organs, body locations, and channels. Acupuncture therapy involves patient evaluation, needle insertion, and supplemental therapies. According to tests, it has an 85% retention rate of therapeutic effect and considerably reduces pain compared to sham or normal therapy. Analgesic relief is immediate after a single dose. A multimodal strategy is used to treat chronic neck pain, using cervical traction, local injections, Nonsteroidal Anti-Inflammatory Drugs (NSAIDs), and physical therapy (Patel et al., 2020). Long-term remission can be achieved through the use of complementary health treatments.

According to family physician's guidelines, acupuncture can help with persistent neck discomfort because it has been shown to enhance function but not pain. The treatment of neuropathic pain involves acupuncture, which targets local, regional, and distal sites (Ma et al., 2022). Patients with trigeminal neuralgia and radiculalgia experience the most severe pain at local locations. Regional points are identified by examining nerve distribution properties or by following meridians. Acupuncture is based on traditional medicine and integrates localized therapies with current anatomical understanding to treat pain in specific areas. Adult English-speaking participants in the trial had previously been diagnosed with cancer but did not exhibit any symptoms at the time of the trial (Mao et al., 2021). Patients who reported having moderate or higher pain at their worst and had musculoskeletal pain for at least three months and fifteen days during the previous 30 days are eligible. There might be concomitant non-musculoskeletal pain disorders. Individuals who had implanted medical devices, phantom limb discomfort, inflammatory arthritis, or pending disability claims are not included.

Acupuncture alleviates pain through multiple mechanisms: stimulating endorphin release, modulating neurotransmitters, and improving blood flow (Xu et al., 2020). It influences the nervous system, reducing inflammation and blocking pain signals. By targeting specific points along energy meridians, acupuncture balances the body and enhances natural pain-relief pathways for effective management. The release of neurotransmitters after acupuncture and Gamma-Aminobutyric Acid (GABA). Cross-sectional data is present at baseline after the subjects are randomized for five weeks to receive either sham or verum acupuncture (Wang et al., 2024). Before beginning treatment, a practitioner with more than 15 years of clinical experience used techniques like palpation, hearing, and observation to get a TM diagnosis.

The patients are divided into three groups based on TM Syndrome: Equal Stagnation and Deficiency, Deficiency greater than Stagnation, and Stagnation greater than Deficiency. Diagnoses are blindly confirmed by a second practitioner. Acupuncture has been shown to increase neural stem cells' growth and differentiation in the brain (Chen et al., 2020). Combining acupuncture with stem cell implantation might have a stronger effect. Electroacupuncture and embryonic stem cell implantation can partially recover function in paralyzed hind limbs in a rat model with spinal cord injury. Additionally, electroacupuncture increases the development of mesenchymal stem cells. A preferred method is the combination of stem cell implantation and acupuncture. Acupuncture is frequently associated with the placebo effect, an endorphin-mediated effect, like many other complementary and alternative medical procedures (Seca et al., 2019). Acupuncture rituals can intensify this impact, with significant therapeutic implications. Reproducible biological processes are triggered by acupuncture, which also provides psychological benefits, including increased touch and patient-healer time. However, to verify its scientific usefulness, conventional therapy models are individually modified to exclude components that can materially affect the intervention's efficacy.

Acupuncture is often used as standard therapy for chronic pain, often seen as a last resort due to inconclusive evidence (Anjos et al., 2024). Patients who don't react to other approaches can use it, which leads to an undesirable selection bias. Where Rostral Ventromedial Medulla (RVM), Periaqueductal Gray (PAG), and Anterior Cingulate Cortex (ACC). According to the clinical rationales for acupuncture referrals, the respondents consider that acupuncture therapy is effective in managing pain:

- Increase in function
- Decrease in pain score
- Reduction in the use of painkillers

- No increase in the dosage of painkillers
- No worsening of the pain state
- A reduction in the adverse effects of traditional pain management
- Fewer visits to the doctor.

A fair amount of foundational training is required before veterinarians can use acupuncture in their practice (Gong & Thompson, 2024). Clients whose pets experience chronic pain should be able to get acupuncture. Acupuncture is often used to decrease the amount of medicine needed to maintain a patient's comfort. For other cases, it can mean the difference between the owner trying to decide whether to euthanize their pet due to pain-induced incapacitation or believing the pet has a reasonable quality of life. From a public relations and financial standpoint, a practice might benefit from using acupuncture to treat acute, chronic, and surgically associated pain.

A minimum of two of the three doctors had to perform all operations in the patient's ward within 20 minutes of the cesarean delivery, according to the trial's design, immediately following randomization. One of the doctors gave the patient structured information about the following topics throughout the intervention:

- possible acupuncture benefits
- possible acupuncture mechanisms
- probable acupuncture side effects
- postoperative management

A doctor used a neural pen to simulate the feeling of needle insertion while attaching placebo needles to patients close to acupuncture spots (Usichenko et al., 2022). The narrow tip of the pen feels like a needle piercing the skin when pressure is applied. The patient is told by the doctor that the pen is not used to apply pressure but rather to locate the acupuncture point. Patients who used complementary health treatments, such as acupuncture, experienced less discomfort and disability from back pain (Urits et al., 2021). However, a high level use of complementary health treatments is necessary for these beneficial results. Low or non-utilization leads to little or no improvement in chronic low back pain for patients who are older and less educated. The impact explores the possibility of better patient outcomes by examining the efficacy of exercise training, spinal manipulation, and acupuncture in treating chronic pain in the lower back.

The new Medicare regulation increases the ability of Medicare workers to provide acupuncture to combat the opioid crisis. To meet veterans' pain care needs, the Acupuncture Training Across Clinical Settings (ATACS) program was developed by the Department of Defense (Liou et al., 2021). A standardized acupuncture procedure is taught to more than 2700 clinicians, and a randomized controlled trial is in progress. Brief educational programs can be required for practitioners who lack the time or inclination to fill in knowledge gaps and guide effective patient counseling. About half of medical schools do not provide acupuncture courses. Adult patients aged 18 and older with a verified diagnosis of painful diabetic peripheral neuropathy, any form of warm needling acupuncture, all comparators, and at least one outcome indicator associated with diabetic peripheral neuropathy pain are included in the randomized controlled trials on the use of combining acupuncture with warm needling to reduce pain in patients with diabetic peripheral neuropathy in acupuncture (Wang et al., 2020). Nonpenetrating needles, electro-acupuncture, acupuncture, moxibustion, comparators utilizing warm needling acupuncture, outcome markers without pain assessment, duplicate or overlapping publications, and nonclinical trials are all eliminated (Berger et al., 2021).

Table 1 offers an intellectual view of the models involved in the use of acupuncture for pain control and includes Decision Trees (DT), Support Vector Machine (SVM), Fine-tuned GPT-3.5, and ACUBERT (a BERT classifying model). These models are used to forecast the effects of the treatment on patients and determine how pain might be effectively treated. Compared with other algorithms, Decision Trees and SVM are superior in predictive accuracy and classification problems, and ACUBERT helps to understand acupuncture-related patterns by using natural language processing techniques. Further, there are YoloAcuPatient and PRONTO software that help visualize the patients' responses and calculate the neuroimaging analysis. Both methods have their advantages and limitations in incorporating the foundation of traditional acupuncture into modern pain control. Pain management utilizing acupuncture practices involves the use of past and present innovations in the mechanics of acupuncture to anticipate, measure, and enhance the amount of alleviation for the patients' pain.

Table 1 Comparison of acupuncture in pain management.

ML Algorithm	Applications in Medical Sciences	Significant Findings	Drawbacks	Result
SVM-based predictive modeling (Yin et al., 2022)	Predicting acupuncture response in chronic low back pain using resting-state fMRI.	Achieved ~81%–84% accuracy by using baseline functional connectivity (PAG–amygdala, DMN–SMN networks) to predict responders	Small sample sizes (<100), needs external validation; requires costly fMRI limiting wider clinical application	Successfully predicted responders to real and sham acupuncture with ~81% accuracy and correlated rsFC patterns with pain reduction

DT (Dong et al., 2022)	Used to build models for forecasting acupuncture's effectiveness in methadone maintenance therapy (MMT) based on patient data.	Provides clear, interpretable decision rules for treatment efficacy based on various factors.	Can overfit with small datasets or noisy data.	Identified acupuncture, years of opioid use, and other factors as key predictors for the effectiveness of MMT. The decision tree has an accuracy of 0.74.
Traditional acupuncture philosophies (Tsai et al., 2020)	Pain management for children with sickle cell disease	Provides a non-opioid therapy for pain relief	Limited by the subjective nature of pain and variability in responses	Decreased pain in 65.5% of treatments; Significant pain reduction in a subset of patients ($p < 0.0001$)
SVM (Yin et al., 2023)	Predicting responsiveness of FD patients to acupuncture based on functional brain MRI data	Identifies critical predictive biomarkers, achieves high accuracy in prediction (0.76 ± 0.03), and provides insights into brain networks related to treatment efficacy	Requires a large dataset for training; might not generalize well to all populations	Obtained a prediction accuracy of 0.76 ± 0.03 for acupuncture responders vs non-responders, identified 38 critical brain features for prediction, R^2 of 0.24 ± 0.02 in predicting symptom relief
MeSH-DistantRE (Tran & Kavuluru, 2019)	Extracting treatment-related relations from biomedical text using distant supervision and MeSH subheadings	Reduces manual annotation by leveraging structured MeSHmetadata; scalable to large corpora	Sensitive to noise from distant supervision; relies on accuracy of MeSH-basedlabeling	Achieved F1-score up to 0.84 on treatment relation extraction tasks
YoloAcuPatient (Zhao et al., 2024)	Proposed method for automatic patient in-position detection during acupuncture treatment	Fast, accurate, and one-stage detection with improvements in architecture and loss functions	Requires a large annotated dataset and careful fine-tuning	YoloAcuPatient achieves high accuracy with mAP (IoU=0.5): 0.981, mAP (IoU=0.75): 0.902, F1 Score: 0.865.
Pronto Software (Lu et al., 2023)	Classifying minimum clinically significant differences (MCID) for motor improvement after a stroke	Identifies acupuncture mechanisms and brain functional remodeling.	Requires accurate neuroimaging data	It obtained a 75.51% balance accuracy rate.
Fine-tuned GPT-3.5 (Li et al., 2024)	A fine-tuned version of GPT-3.5 applied to acupoint relation extraction, improving task-specific performance.	Requires large labeled data for fine-tuning, and training can be computationally expensive.	It faces challenges with overfitting or generalizing across different types of tasks.	Best performing model, highest F1 score (0.92).

Acupuncture has gradually found clinical acceptance as an effective intervention in the management of diverse pain conditions such as chronic, acute, and neuropathic pain. Its clinical effectiveness, according to both traditional Chinese medicine and modern neurophysiology, supports the fact that it is a very effective treatment method. Many studies have established that acupuncture had statistically significant pain reduction compared with placebo or sham procedures, especially in osteoarthritis, fibromyalgia, and post-surgical pain. Vickers et al. (2018) concluded through meta-analysis that acupuncture outperforms both placebo acupuncture and the absence of treatment. Thus, the effect caused by acupuncture is not merely placebo-related.

Acupuncture intends to identify endogenous neurochemicals affected by stimulation, such as endorphins and enkephalins, which interact with central and peripheral neurons to alter pain perception. Modern neuroimaging studies show that acupuncture activates pain matrix nodes like the anterior cingulate cortex, hypothalamus, and periaqueductal gray. Electroacupuncture, which uses low-frequency current, enhances these neurochemical responses, causing increased analgesia in specific patient groups. These findings provide a biomedical construct explaining acupuncture's efficacy and warrant inclusion

in an integrative approach to pain management. Acupuncture has seen significant growth in multimodal therapeutic applications, with empirical evidence showing it can weaken opioid dependence and improve functional outcomes when combined with pharmacological regimens or physical rehabilitation. This is crucial as the world focuses on opioid dependency.

Acupuncture is effective in pain management programs for musculoskeletal diseases, cancer pain, and post-surgery. Research by Mao et al. (2021) supports its role in reducing pain and minimizing medication load, thereby improving overall quality of life. Acupuncture, despite its effectiveness in treatment, faces challenges in everyday clinical practice and policymaking due to patient responsiveness, personal physiological conditions, belief systems, and practitioner qualifications (Nielsen et al., 2022). The placebo effect and varied study designs complicate the applicability of existing findings. Future research should aim for high methodological quality, including large-scale, blinded, randomized controlled trials piloting identical treatment issues and follow-ups. This empirical rigor will provide a clear picture of the clinical usefulness of acupuncture and its role in modern integrative pain management. The study designs, treatment guidelines, and reporting practices also need to be improved to ensure the applicability of acupuncture.

4. Conclusion

Acupuncture is a helpful modality in pain relief therapy since it is a harmless, holistic action for both acute and chronic pains. Effectively, acupuncture not only suppresses pathological pain but also enhances endorphin secretion, neurochemical influences, and blood circulation. It is most useful in osteoarthritis, chronic low back pain, migraines, and fibromyalgia since it helps reduce the amount of pain and effectively improves the quality of the patient's life. Acupuncture is a natural complement to this perspective; despite its widespread use for pain relief, it represents a safe approach that allows for a natural pain treatment method without the use of drugs. Acupuncture is effective in alleviating pain, despite the ongoing debate over its effectiveness. Applying acupuncture might serve as an effective means of employing an integrative, tailored approach to pain management; therefore, it should be of pivotal importance to healthcare providers with goal-setting skills towards creating the best experience for involving clients.

4.1 Limitation and future scope

Limited large-scale education, placebo effect concerns, and variability in practitioner techniques hinder definitive assumptions. Expanding randomized controlled trials, integrating with modern medicine, and exploring mechanisms through neuroimaging can enhance acceptance and efficacy in diverse pain conditions.

Ethical Considerations

Not applicable.

Conflict of Interest

The authors declare no conflicts of interest.

Funding

The authors acknowledge Lembaga Pengelola Dana Pendidikan (LPDP), from which the article project commenced.

References

Anjos, A., Corten, L., Goncalves, N., & Maart, S. (2024). Exploring Pedagogical Dissonance in including Acupuncture Treatment Approach into A Western Biomedical Evidence-based Physiotherapy Curriculum. *New Emirates Medical Journal*, *5*(1), e040923220676. https://doi.org/10.2174/0250688205666230904104357

Berger, A. A., Liu, Y., Mosel, L., Champagne, K. A., Ruoff, M. T., Cornett, E. M., ... & Urits, I. (2021). Efficacy of dry needling and acupuncture in the treatment of neck pain. *Anesthesiology and pain medicine*, 11(2), e113627. https://doi.org/10.5812/aapm.113627

Birch, S., Lee, M. S., Kim, T. H., & Alraek, T. (2022). Historical perspectives on using sham acupuncture in acupuncture clinical trials. *Integrative Medicine Research*, 11(1), 100725. https://doi.org/10.1016/j.imr.2021.100725.

Chen, T., Zhang, W.W., Chu, Y.X. and Wang, Y.Q., 2020. Acupuncture for pain management: molecular mechanisms of action. *The American journal of Chinese medicine*, *48*(04), pp.793-811. https://doi.org/10.3390/jcm10122568

Dong, Y., Fan, B., Yan, E., Chen, R., Wei, X., Zhan, J., ... & Lu, L. (2022). Decision tree model-based prediction of the efficacy of acupuncture in methadone maintenance treatment. *Frontiers in Neurology*, 13, 956255. https://doi.org/10.3389/fneur.2022.956255.

Gong, J., & Thompson, M. F. (2024). Assessing the efficacy of acupuncture as the sole analgesic for canine chronic pain. *Veterinary Evidence*, 9(1) 2396-9776). https://doi.org/10.18849/ve.v9i1.681.

Li, Y., Peng, X., Li, J., Zuo, X., Peng, S., Pei, D., ... & Hong, N. (2024). Relation extraction using large language models: a case study on acupuncture point locations. *Journal of the American Medical Informatics Association*, *31*(11), 2622-2631.https://doi.org/10.48550/arXiv.2404.05415

Lin, L. L., Li, H. P., Yang, J. W., Hao, X. W., Yan, S. Y., Wang, L. Q., ... & Liu, C. Z. (2021). Acupuncture for psychological disorders caused by chronic pain: a review and future directions. *Frontiers in Neuroscience*, 14, 626497. https://doi.org/10.3389/fnins.2020.626497.

Liou, K. T., Korenstein, D., & Mao, J. J. (2021). Medicare coverage of acupuncture for chronic low back pain: does it move the needle on the opioid crisis?. *Journal of general internal medicine*, 36(2), 527-529. https://doi.org/10.1007/s11606-020-05871-6.

Lu, M., Du, Z., Zhao, J., Jiang, L., Liu, R., Zhang, M., ... & Zou, Y. (2023). Neuroimaging mechanisms of acupuncture on functional reorganization for post-stroke motor improvement: a machine learning-based functional magnetic resonance imaging study. *Frontiers in Neuroscience*, 17, 1143239. https://doi.org/10.3389/fnins.2023.1143239 .

Ma, X., Chen, W., Yang, N. N., Wang, L., Hao, X. W., Tan, C. X., ... & Liu, C. Z. (2022). Potential mechanisms of acupuncture for neuropathic pain based on somatosensory system. *Frontiers in neuroscience*, 16, 940343. https://doi.org/10.3389/fnins.2022.940343

Mao, J. J., Liou, K. T., Baser, R. E., Bao, T., Panageas, K. S., Romero, S. A., ... & Kantoff, P. W. (2021). Effectiveness of electroacupuncture or auricular acupuncture vs usual care for chronic musculoskeletal pain among cancer survivors: the PEACE randomized clinical trial. *JAMA oncology*, 7(5), 720-727.https://doi.org/10.1001/jamaoncol.2021.0310

Miller, D. W., Roseen, E. J., Stone, J. A., Gardiner, P., Olson, J., Rosen, S., ... & PCORI-SAR Stakeholder Group. (2021). Incorporating acupuncture into American healthcare: initiating a discussion on implementation science, the status of the field, and stakeholder considerations. *Global Advances in Health and Medicine*, 10(2):216495612110425. https://doi.org/10.1177/21649561211042574.

Nielsen, A., Dusek, J. A., Taylor-Swanson, L., & Tick, H. (2022). Acupuncture therapy as an evidence-based nonpharmacologic strategy for comprehensive acute pain care: the academic consortium pain task force white paper update. *Pain Medicine*, 23(9), 1582-1612. https://doi.org/10.1093/pm/pnac056.

Patel, M., Urits, I., Kaye, A. D., & Viswanath, O. (2020). The role of acupuncture in the treatment of chronic pain. *Best Practice & Research Clinical Anaesthesiology*, 34(3), 603-616. https://doi.org /10.1016/j.bpa.2020.08.005.

Seca, S., Patrício, M., Kirch, S., Franconi, G., Cabrita, A. S., & Greten, H. J. (2019). Effectiveness of acupuncture on pain, functional disability, and quality of life in rheumatoid arthritis of the hand: results of a double-blind randomized clinical trial. The Journal of Alternative and Complementary Medicine, 25(1), 86-97. https://doi.org/10.1089/acm.2018.0297

Su, N., Cai, P., Dou, Z., Yin, X., Xu, H., He, J., ... & Li, C. (2023). Brain nuclei and neural circuits in neuropathic pain and brain modulation mechanisms of acupuncture: a review on animal-based experimental research. *Frontiers in Neuroscience*, 17, 1243231. https://doi.org/10.3389/fnins.2023.1243231.

Tran, T., & Kavuluru, R. (2020). Social media surveillance for perceived therapeutic effects of cannabidiol (CBD) products. *International Journal of Drug Policy*, *77*, 102688. https://doi.org/10.1016/j.drugpo.2020.102688

Tsai, S. L., Bombacie, M., Licursi, M., Qian, Y., Stiles, G. M., & Lee, M. T. (2020). Acupuncture for pediatric sickle cell pain management: A promising non-opioid therapy. *Complementary therapies in medicine*, 49(4):102314. https://doi.org/10.1016/j.ctim.2020.102314.

Urits, I., Wang, J. K., Yancey, K., Mousa, M., Jung, J. W., Berger, A. A., ... & Viswanath, O. (2021). Acupuncture for the management of low back pain. *Current Pain and Headache Reports*, 25 (1), 1-10. https://doi.org/10.1007/s11916-020-00919-y.

Usichenko, T. I., Henkel, B. J., Klausenitz, C., Hesse, T., Pierdant, G., Cummings, M., & Hahnenkamp, K. (2022). Effectiveness of acupuncture for pain control after cesarean delivery: a randomized clinical trial. *JAMA networkopen*, 5(2), e220517-e220517. https://dx.doi.org/10.1001/jamanetworkopen.2022.0517.

Vickers, E.D., Clark, C., Osypenko, D., Fratzl, A., Kochubey, O., Bettler, B. and Schneggenburger, R., 2018. Parvalbumin-interneuron output synapses show spike-timing-dependent plasticity that contributes to auditory map remodeling. *Neuron*, *99*(4), pp.720-735. https://doi.org/10.1016/j.neuron.2018.07.018

Wang, L. Q., Wang, F., & Wang, X. H. (2020). Effectiveness of warm needling acupuncture for pain relief in patients with diabetic peripheral neuropathy: a protocol of systematic review. *Medicine*, 99(45), e23077. https://doi.org/10.1097/MD.0000000000023077.

Wang, S., Fang, R., Huang, L., Zhou, L., Liu, H., Cai, M., ... & Akkaif, M. A. (2024). Acupuncture in traditional Chinese medicine: a complementary approach for cardiovascular health. *Journal of Multidisciplinary Healthcare*, 17, 3459-3473. https://doi.org/10.2147/JMDH.S476319

Wang, Y., Wang, D. D., Pucka, A. Q., O'Brien, A. R., Harte, S. E., & Harris, R. E. (2024). Differential clinical characteristics across traditional Chinese medicine (TCM) Syndromes in patients with sickle cell disease. *Frontiers in Pain Research*, 4, 1233293. https://doi.org/10.3389/fpain.2023.1233293

Xu, Z. F., Hong, S. H., Wang, S. J., Zhao, X., Liu, Y. Y., Ding, S. S., ... & Guo, Y. (2020). Neuroendocrine-immune regulating mechanisms for the anti-inflammatory and analgesic actions of acupuncture. *World Journal of Traditional Chinese Medicine*, 6(4), 384-392. https://doi.org/10.4103/wjtcm.wjtcm_41_20.

Yin, T., He, Z., Chen, Y., Sun, R., Yin, S., Lu, J., ... & Zeng, F. (2023). Predicting acupuncture efficacy for functional dyspepsia based on functional brain network features: a machine learning study. *Cerebral Cortex*, 33(7), 3511-3522. https://doi.org/10.1093/cercor/bhac288.

Yin, T., Zheng, H., Ma, T., Tian, X., Xu, J., Li, Y., ... & Zeng, F. (2022). Predicting acupuncture efficacy for functional dyspepsia based on routine clinical features: a machine learning study in the framework of predictive, preventive, and personalized medicine. *EPMA Journal*, *13*(1), 137-147.

You, J., Li, H., Xie, D., Chen, R., & Chen, M. (2021). Acupuncture for Chronic Pain-Related Depression: A Systematic Review and Meta-Analysis. *Pain Research and Management*, 2021(1), 6617075. https://doi.org/10.1155/2021/6617075.

Zhang, M., Shi, L., Deng, S., Sang, B., Chen, J., Zhuo, B., ... & Meng, Z. (2022). Effective oriental magic for analgesia: acupuncture. *Evidence-Based Complementary and Alternative Medicine*, *2022*(1), 1451342. https://doi.org/10.1155/2022/1451342

Zhao, P., Pang, L., Cao, S., & Cao, Z. (2024). Deep learning-based patient in-position detection for acupuncture treatment. *Computational Optical Imaging and Artificial Intelligence in Biomedical Sciences*, 12857, 157-165. *SPIE*. https://doi.org/10.1117/12.3023364.