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REVIEW

Neuromodulation for chronic pain in neurological disorders: a scoping review protocol

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Background: Chronic pain is a frequent and debilitating symptom associated with various neurological disorders. Neuromodulation offers a promising alternative for managing chronic pain by modulating nervous system activity. Techniques include spinal cord stimulation, deep brain stimulation, transcranial magnetic stimulation, and vagus nerve stimulation, among others. While some systematic reviews have evaluated individual techniques, a comprehensive mapping of all neuromodulation approaches across diverse neurological disorders is lacking.

Objective: This scoping review aims to systematically map existing literature on the use of neuromodulation techniques for chronic pain in individuals with neurological disorders, with a focus on applications in low- and middle-income countries (LMICs). It seeks to identify the types of neuromodulation techniques used, their stimulation parameters, reported mechanisms of action, and pain outcome measures.

Methods: Following the Arksey and O'Malley framework and preferred reporting items for systematic reviews and meta-analysis extension for scoping reviews (PRISMA-ScR) guidelines, the review will include studies from 2005 to 2025. Databases such as PubMed, Embase, Scopus, CINAHL, Web of Science, and PsycINFO will be searched alongside grey literature. Inclusion criteria are based on the population, concept, and context framework, targeting adults with neurological conditions experiencing chronic pain managed by neuromodulation techniques. Data extraction and synthesis will involve descriptive statistics and thematic content analysis.

Conclusion: The review will provide a broad overview of neuromodulation practices for chronic pain in neurological disorders, highlight research gaps, and guide future clinical and research directions, particularly in LMIC contexts.

Keywords: neuromodulation, chronic pain, neuromodulation techniques, neurological disorders, deep brain stimulation

Research question

What is known from the existing literature about the use of neuromodulation techniques for the management of chronic pain in neurological disorders?

Background

Pain in neurological disorders is common, varying in pathophysiology and clinical presentation (1). Pain can be categorized into acute and chronic, with chronic pain defined as pain that persists beyond the normal healing time, typically lasting for months or even years. This type of pain is no longer considered a protective mechanism. It can significantly lead to reduced quality of life, affecting sleep, cognitive functions, mood, and overall mental health in neurological conditions (2–4). The management of chronic pain in neurological disorders has traditionally relied on pharmacological interventions, which often yield suboptimal outcomes, side effects, and risk of dependency (5). As a result, there is growing interest in alternative approaches such as neuromodulation techniques.

These techniques incorporate an array of invasive and non-invasive approaches (6). Invasive techniques encompass spinal cord stimulation (SCS), dorsal root ganglion (DRG) stimulation, deep brain stimulation (DBS), motor cortex stimulation (MCS), and peripheral nerve stimulation (PNS), and non-invasive techniques include transcranial magnetic stimulation (TMS), transcranial direct current stimulation (tDCS), vagus nerve stimulation (VNS), and transcutaneous electrical nerve stimulation (TENS) (7, 8). These approaches involve the use of electrical or chemical stimuli to alter nervous system activity, and they have shown promise in treating various neurological disorders, including chronic pain (9–12).

Given the expanding clinical interest and growing body of evidence, there is a clear need for a comprehensive mapping of neuromodulation approaches for managing chronic pain in individuals with neurological disorders. Previous reviews on neuromodulation have primarily focused on individual techniques or specific neurological conditions, limiting a comprehensive understanding of the field.

This scoping review aims to describe the existing literature on the use of neuromodulation in chronic pain management in various neurological disorders. Considering the contextual background, the review will seek to answer the following questions:

1. What are the neuromodulation approaches used to treat chronic pain in different neurological disorders?
2. What are the neuromodulation parameters used for the management of chronic pain in neurological disorders?
3. What are the pain outcome measures assessed, and how are they categorized?
4. What are the hypothesized and reported mechanisms of action for various neuromodulations in the context of management of chronic pain in neurological disorders?

Objectives

1. To identify and systematically map existing evidence of neuromodulation techniques used in low- and middle-income countries (LMICs) for chronic pain in neurological disorders.
2. To identify research gaps in shreds of evidence and provide future scope in this context

Methods

This scoping review will be conducted based on Arksey and O'Malley's framework for the methodological framework (13). The study is designed and will be reported per the preferred reporting items for systematic reviews and meta-analysis extension for scoping reviews (PRISMA-ScR) framework. The protocol is registered in the Open Science Framework (Registration DOI: https://doi.org/10.17605/OSF.IO/E9TFM)

Eligibility criteria

The eligibility criteria will be established using the population, concept, and context (PCC) framework. Studies will be selected per the following criteria (**Table 1**).

This scoping review will include all the relevant literature (published and ongoing).

Information sources and search

In lieu of the exploratory nature of this scoping review, no restrictions will be placed on the type of sources. The criteria of inclusion will be limited to the English language from the year 2005 to 2025 in electronic databases such as PubMed, Embase, Scopus, CINAHL, Web of Science, and PsycINFO, and grey literature sources such as clinical trial registries and Google Scholar will be included to explore the full breadth of available evidence.

The search strategy will use MeSH terms and keywords related to neuromodulation and neurological disorders ("Neuromodulation" [MeSH] OR "Neurostimulation Techniques" [MeSH] OR "Transcranial Magnetic Stimulation" [MeSH] OR "Deep Brain Stimulation"

TABLE 1 | Population, Concept, Context (PCC) framework outlining the inclusion and exclusion criteria used for study selection in the review of neuromodulation interventions for chronic pain in adults with neurological conditions in low- and middle-income countries.

PCC framework	Population	Concept	Context
Inclusion	Adults (≥18 years of age) with neurological conditions (such as Stroke, spinal cord injury [SCI], multiple sclerosis [MS], Parkinson disease [PD], neuropathies, motor neuron disease [MND], Guillain-Barré syndrome [GBS]) experiencing chronic pain	Invasive [Deep Brain Stimulation (DBS), Spinal Cord Stimulation (SCS), Vagus Nerve stimulation (VNS), Motor Cortex Stimulation (MCS), Intrathecal drug delivery system (IDDS)] and non-invasive Neuromodulation techniques [Transcranial Magnetic Stimulation (TMS), Transcranial Direct Current Stimulation (tDCS), Transcutaneous Electrical Nerve Stimulation (TENS), Transcutaneous Vagus Nerve Stimulation (tVNS), Repetitive TMS (rTMS), Functional Electrical Stimulation (FES)] for managing chronic pain (>3 months)	In any healthcare setting, low- and middle-income countries (LMICs) Studies that are either conducted in LMICs (based on the World Bank classification) or explicitly report data from LMIC settings
Exclusion	Non-neurological pain conditions (e.g., orthopedic pain) or pain in populations other than neurological disorders	Pharmacological and other surgical interventions	Non-clinical animal studies, case studies, case reports, editorials, opinions

[MeSH] OR "Vagus Nerve Stimulation" [MeSH]) AND ("Chronic Pain" [MeSH] OR "Neuropathic Pain" [MeSH]) AND ("Nervous System Diseases" [MeSH] OR "Multiple Sclerosis" [MeSH] OR "Parkinson Disease" [MeSH]). Boolean operators ("OR" and "AND") will be used to combine and refine search terms and concepts.

Selection of sources of evidence

After the search, all identified records will be collated and exported in Rayyan software, a web-based application for data management of reviews. It will be used for the screening and duplicate removal process. The research team will screen the first 10 citations of the initial search to assess the inclusion and exclusion criteria and researcher agreement. Any discrepancies will be discussed and resolved collectively among the research team.

The titles and abstracts of the remaining articles will be screened by two independent researchers. Screening differences will be resolved by the third reviewer. Researchers will categorize the studies as "include" or "exclude" to identify articles for full-text screening. Potentially relevant papers will be retrieved in full text and screened by a group of two researchers. Any disagreements between researchers regarding the inclusion and exclusion criteria will be resolved through discussion and debate; if a consensus is not reached, a senior researcher will be consulted. If full-text articles are not available, the corresponding author will be contacted and requested to share the full-text article via email. Reasons for the exclusion of full-text papers that do not meet the inclusion criteria will be recorded and reported in the scoping review. For any missing information, an email will be sent to the corresponding author of each paper. The screening processes will be documented using the PRISMA flow diagram.

Data extraction

Data extraction will be completed by groups of two researchers using a data extraction tool developed by the research team. To ensure accurate data collection, the extracted data will be compared; discrepancies will be resolved through consensus, or a third researcher will serve as an arbitrator. The data extracted will include specific details about the author(s), year, country, study design, study population (adults with neurological disorders), neuromodulation technique, pain outcome measures, and key findings relevant to the research questions. Also, a dedicated column can be included in the data charting form to indicate whether the study is LMIC-specific, the name(s) of the LMIC(s) involved, and whether data from LMICs are reported separately in multicounty studies.

Critical appraisal of individual sources of evidence

Depending on the study design, appropriate tools will be used, including Joanna Briggs Institute (JBI) Critical Appraisal Checklists, CASP tools for randomized controlled trials (RCTs), cohort studies, case series, and cross-sectional studies, risk of bias in non-randomized studies of interventions (ROBINS-I) for non-randomized interventional studies, and the Mixed Methods Appraisal Tool (MMAT) will be used for evaluation of qualitative, quantitative, and mixed methods.

Data presentation & synthesis of results

The collected data will be presented in a tabular or graphical format that aligns with the scoping review's proposed research questions. A summary and synthesis of the findings and discussion of the review will accompany the tabulated or charted data. The collated results will be presented in a scoping review publication. The findings will be synthesized to provide a mapping overview of neuromodulation techniques used for neurological disorders and pain outcome measures through content analysis. Descriptive statistics (frequencies, proportions) and thematic analysis (techniques, outcomes, trends) will be done.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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