RESEARCH PAPER

Treatment and Pathogenesis of Cervical and Lumbar Radiculopathy: An In-Depth Review

Devansh Upadhayay[1], Rohan Kumar[2], Md Estiac Jan[3], Jaismeen Kaur[4], Anagha K P[5], Muhammed Fairoos A[6*]

[1]Department of Pharmaceutical Sciences and Drug Research, Punjabi University, Patiala. 147002. ORCID ID: 0009-0008-2850-475X. Email: devanshupadhayay12@gmail.com

[2]Department of Pharmaceutical Sciences and Drug Research, Punjabi University, Patiala, Punjab, India – 147002. ORCID ID: 0009-0003-8801-4385. Email: gupta18rohan@gmail.com

[3]Department of Pharmaceutical Sciences and Drug Research, Punjabi University, Patiala. Urban estate phase 2, Patiala, Punjab India (147002). ORCID ID: 0009-0002-4010-5897. Email: estiac_pharmacy25@pbi.ac.in

[4]Department of Pharmaceutical Sciences and Drug Research affiliated to Punjabi University, Patiala – 147002. ORCID ID: https://orcid.org/0009-0009-6629-8069. Email: jaismeenkaur898@gmail.com

[5]Assistant Professor, Department of Pharmacology, Jkk Munirajah Institute of Health Sciences College of Pharmacy, T. N Palayam, Erode District, Tamil Nadu, 638506

[6*]College of Pharmaceutical Sciences, Govt. Medical College Kozhikode. Affiliated To Kerala University of Health Sciences. Medical College Junction, Mavoor Rd, Kozhikode, Kerala 673008, India. ORCID ID: 0009-0007-4133-2844. Email: muhammedfairoosa1@gmail.com

ABSTRACT

Background: Cervical and lumbar radiculopathy are prevalent neurological disorders caused by nerve root compression, leading to pain, sensory deficits, and functional impairment, significantly affecting patients' quality of life.

Objective: This review aims to summarize the pathogenesis, diagnostic approaches, and treatment strategies of cervical and lumbar radiculopathy, and to explore the possibility of their coexistence.

Methods: A narrative review of published literature was conducted, focusing on etiology, pathophysiology, clinical presentation, diagnostic modalities, and management options for both conditions.

Results: Cervical radiculopathy commonly results from disc herniation and cervical spondylosis, while lumbar radiculopathy is mainly associated with disc degeneration and structural changes affecting nerve roots. Diagnostic evaluation includes clinical assessment supported by imaging techniques such as MRI and CT, along with electrophysiological studies. Management primarily involves conservative approaches, including nonsteroidal anti-inflammatory drugs, muscle relaxants, physiotherapy, and lifestyle modifications. Interventional procedures such as epidural steroid injections and surgical options are considered in refractory cases. Both conditions share common inflammatory and mechanical mechanisms, and may coexist in some patients.

Conclusion: Early diagnosis and appropriate multidisciplinary management are essential to improve patient outcomes. Clinicians should consider the potential coexistence of cervical and lumbar radiculopathy in complex clinical presentations.

Keywords: Cervical radiculopathy, lumbar radiculopathy, nerve compression, diagnosis, treatment.

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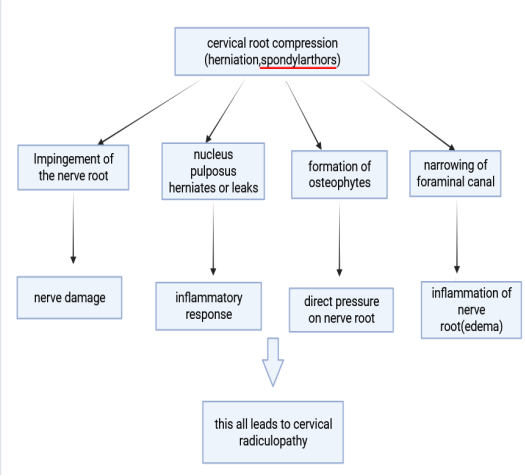
INTRODUCTION

A clinical disease called cervical radiculopathy is brought on by compression of the cervical nerve roots[1].Whereas Compression may arise from disc herniation, spondylosis, instability, trauma, or, infrequently, malignancies.[2] on other hand Lumbar radiculopathy, commonly known as sciatica, is a syndrome characterized by radiating pain in the distribution of a lumbar nerve root, which may also encompass motor weakness and sensory disturbances.[3] it is seen that cervical radiculopathy is less prevalent than lumbar radiculopathy, with an age-adjusted incidence of 83 per 100,000 persons.[4] Two pathogenic processes, either alone or in conjunction, can lead to cervical radiculopathy: 1) Disc herniation, with or without extruded pieces, and 2) degenerative cervical spondylosis.[5] whereas lumbar radiculopathy brought on by alterations to the typical anatomical

framework surrounding a nerve root. Ligaments, intervertebral discs, and the bones and articulations of the spinal vertebrae are among the surrounding structures. Any modifications or alterations to these tissues may result in lumbar radiculopathy by reducing the amount of room in the spinal canal for the nerve root to move.[6] on treatment perspective Nonsteroidal anti-inflammatory medicines (aspirin and naproxen) may help relieve acute symptoms. muscular relaxants, such as cyclobenzaprine (Flexeril) and tizanidine (Zanaflex), can assist relieve neck pain caused by increased muscular tension at the insertion sites. These drugs are also beneficial in the acute phase. Their long-term efficacy in the treatment of cervical radiculopathy is unknown.[7] In patients receiving conservative treatment for lumbar radiculopathy, the utilization of McKenzie exercises has been shown to offer temporary alleviation of symptoms.[8]a single intravenous infusion of gluco-corticosteroids can provide quick relief from lumbar radiculopathy.[9] This article provides a concise discussion on the pathogenesis of cervical and lumbar radiculopathy, as well as a comprehensive analysis of potential treatments.as well as provided a solution to the most essential question, which was whether or not a person might be affected by cervical and lumbar radiculopathy at the same time.

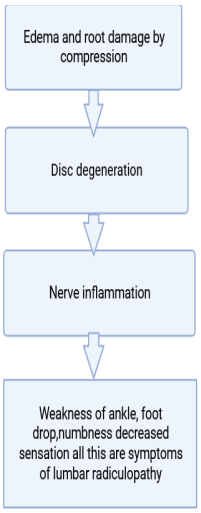
PATHOPHYSIOLOGY OF CERVICAL RADICULOPATHY

cervical radiculopathy is a somewhat common neurological condition arising from nerve root failure, which is often related to mechanical compression.[10] first step of pathogenesis involve Cervical root compression which is often caused by herniated or spondylarthrosed discs. [11]. Second step of pathogenesis involve Impingement of the nerve root by disc debris likely leads to nerve damage both by mechanical and chemical pathway.[12] Disc tissue, particularly the nucleus pulposus, initiates an inflammatory response and produces and releases pro-inflammatory cytokines[13] then in third step The intervertebral disc progressively diminishes in height, causing the posterior sections of the disc to protrude into the spinal canal and neuroforamina, while the ligamentum flavum and facet joint capsule invaginate, leading to the formation of osteophytes. This results in reductions in canal and foraminal dimensions[14] which ultimately led to direct pressure on nerve root and inflammation of nerve root(oedema). all this process result in cervical radiculopathy.



PATHOPHYSIOLOGY OF LUMBAR RADICULOPATHY

Lumbar radiculopathy is a distinct condition characterized by low back and lower extremities symptoms resulting from damage or stimulation of a lumbar nerve root.[15] The pathophysiologic processes can be categorized into two generally defined, but not mutually exclusive, mechanisms: mechanical deformation and inflammatory, immunological, and neurophysiologic mechanisms.[16] All those mechanisms may stem from a singular inciting factor, such as disc herniation[17] first step of pathophysiology, edema and root damage which get worse by accelerated and elevated compression levels.[18]second step is Disc degeneration which will transpire if the matrix is abnormal. Multiple factors have been identified as contributors to disc degeneration. Genetic predisposition, mechanical stress, and nutritional variables are considered significant contributors to the degenerative process.[19] Cells from herniated degenerative discs have been demonstrated to produce matrix metalloproteinases, nitric oxide, and prostaglandin E2. The production is augmented when the cells are activated by IL-1 . An elevated synthesis of collagenase (MMP-1) and antihuman stromelysin (MMP-3) linked to inflammatory cells in herniated discs, along with chondrocytes, so disc degeneration linked to inflammatory cell led to nerve inflammation [20].and inflammation led to Weakness of ankle inversion, plantar flexion, and foot drop are the main clinical manifestations of the sacral plexus lesion area. Numbness and decreased sensation [21].



DIAGNOSIS OR EVALUATION OF CERVICAL RADICULOPATHY

Diagnostic techniques for cervical radiculopathy include clinical assessment and electrophysiological evaluation. Magnetic resonance imaging (MRI) and computed tomography of the spine are fundamental basic assessments.[22] Cervical spine plain x-ray examinations are frequently requested for the assessment of neck and upper extremity pain. Lateral radiographs may reveal disc space narrowing. Oblique views may reveal foraminal constriction corresponding to radicular complaints. Open mouth radiographs are requisite solely when atlantoaxial joint dislocation is suspected.[23] CT myelography or MRI scans typically reveal the existence of a structural lesion compressing the nerve roots. It is essential to recognize that radiculopathy and polyradiculopathy can manifest in the absence of a structural lesion observable on MRI or CT myelogram.[24] Needle EMG may identify just the affected root or roots physiologically, but not the exact anatomical location of the pathology.[25] it has been seen MRI is contraindicated in patients with a pacemaker, defibrillator, or deep brain stimulator. Consequently, MRI is not universally suitable for standard screening. Conversely, ultrasonography yields superior spatial-resolution images that may be swiftly and effortlessly acquired in many settings, rendering it appropriate for screening purposes.[26]

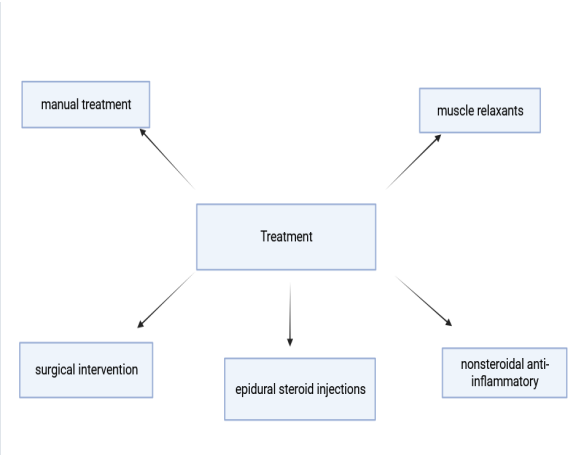
DIAGNOSIS OR EVALUATION OF LUMBAR RADICULOPATHY

Lumbar disc herniation and lumbar radiculopathy/sciatica are typically diagnosed using Magnetic Resonance Imaging (MRI). An MRI is beneficial as it offers superior imaging for identifying spinal infections and disc problems without subjecting the patient to ionizing radiation.[27] Computed tomography imaging modalities provide moderate to high sensitivity (0.6 to 1.0) and specificity (0.43 to 0.97) in identifying disc herniation in individuals with nerve root involvement [28] Diagnostic selective nerve root blocks (SNRBs) provide local anaesthetic or other agents around spinal nerves utilizing imaging guidance. Both provocative reactions (replicating symptoms after needle insertion) and analgesic responses (notable alleviation of symptoms) to SNRB may be diagnostically beneficial in confirming or excluding a specific nerve root as the origin of clinical symptoms or pain.[29] The FABER test (flexion, abduction, and external rotation) and the Gaenslen's test (extension of the affected leg by allowing it to hang off the examination table while applying a downward force and maintaining the contralateral hip in flexion) are primarily utilized to assess sacroiliac joint pain, while also indirectly aiding in the exclusion of lumbar radiculopathy.[30] Neurodynamic or orthopaedic tension tests, including the Straight Leg Raise Test (SLR) or Leg Elevation Test Extended, Bragard test (B), Fajersztajn test (F), Sicard test (S), Passive Neck Flexion test (PNFT), Kernig test (K), Slump Test (S), and Dejerine's triad (DT), are employed to assess the nerve roots of the patient for the diagnosis of lumbar radiculopathy.[31]

TREATMENT OF CERVICAL RADICULOPATHY

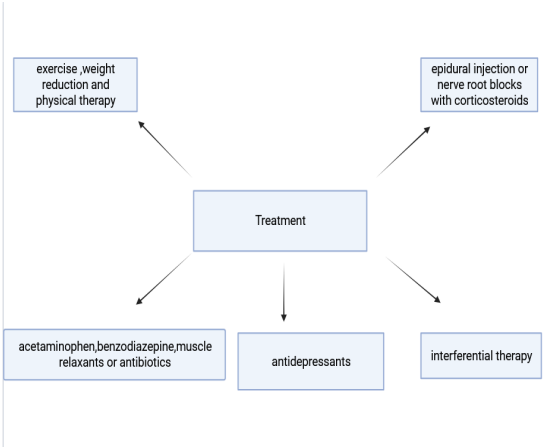
Manual treatment (cervical manipulation and mobilisation, thoracic manipulation or mobilisation, spinal mobilisation, and motor control exercises) is frequently employed for people experiencing neck pain, with or without radicular symptoms.[32] Posterior Lamin foraminotomy is advised as a surgical intervention for symptomatic cervical radiculopathy.[33] Nonsteroidal anti-inflammatory medications and muscle relaxants are frequently used for the management of acute cervical radiculopathy. A Cochrane review determined that evidence supporting the use of these medicines for acute neck pain is inadequate, however it did not specifically examine radiculopathy.[34] Level IV data suggests that transforaminal epidural steroid injections may alleviate symptoms in 60% of patients, while approximately 25% of those assigned with definitive surgical grounds may have at least temporary pain relief, potentially obviating the necessity for surgery.[35] Epidural injections(comprising a combination of steroids and anaesthetics) are typically employed for axial neck pain, where as doctors may opt for either blocks or

epidurals for radicular pain, based on their preference[36].



TREATMENT OF LUMBAR RADICULOPATHY

Current management for people with low back pain and radiculopathy typically commences with conservative interventions, including exercise, weight reduction, and physical therapy. When conservative treatments are ineffective or when pain significantly restricts daily activities, epidural injections or nerve root blocks with corticosteroids are typically the subsequent therapy approach for these patients.[37] whereas the predominant class of medications advised by the clinical practice guidelines for lumbar radiculopathy was antidepressants. No clinical practice guidelines endorse the prescription of acetaminophen, benzodiazepines, muscle relaxants, or antibiotics.[38] another treatment for lumbar radiculopathy is Interferential therapy which was implemented via an electrotherapy apparatus. The interferential therapy was administered to the lumbosacral area using an amplitude-modulated constant frequency of 100 Hz and a pulse duration of 125 μs for its analgesic properties (to relief lower back pain). A 20-minute interferential session is commonly endorsed by physiotherapy professionals.[39] according to study conducted Lumbar translaminar epidural injection with Dexamethasone seems helpful in the short term for treating chronic lumbar radiculopathy, exhibiting fewer major side effects than Methylprednisolone use for long term.[40]



OUTCOME MEASURES FOR DETERMINING QUALITY OF LIFE

Once pain is reduced, a treatment is considered unsuccessful if the patient continues to be psychologically upset, functionally impaired, or dependent on additional medical treatments. Hence the additional disability and distress need to be addressed separately.[41] Outcome measures are required to be assessed for functional disability and psychological distress along with pain for determining treatment efficacy.

Outcome Measures for Cervical Radiculopathy	Outcome Measures for Lumbar Radiculopathy
Neck Disability Index (NDI)	Roland Morris Disability Questionnaire
Patient Specific Functional Scale (PSFS)	Quebec Back Pain Disability Scale
Neck Pain and Disability Scale (NPAD)	Fear Avoidance Belief Questionnaire
Cervical Radiculopathy Impact Scale (CRIS)	Oswestry Disability Index

Table 1. Outcome measure assessment scales for Radiculopathy

NECK DISABILITY INDEX

Howard Vernon created the Neck Disability Index (NDI), which is the most established and popular tool for self-reporting neck pain-related disability.[42] The questionnaire comprises ten items, consisting of four pertaining to subjective symptoms and six related to everyday activities. The questionnaire is parted into 10 sections. Statements on the severity of pain are included in the first section. The second segment focuses on challenges with personal care tasks including clothing, cleaning, and so forth. Reading challenges are covered in the fourth part, while lifting issues are covered in the third. Questions about the frequency and severity of headaches, which are more prevalent during neck discomfort, are included in

Section five. The sixth section addresses the condition's impact on concentration. Statements on work-related challenges are included in the condition's next section. Section eight evaluates driving difficulty. The nineth section evaluates sleep issues brought on by neck pain. Recreational activities are included in the final section. Responses for each item range from no disability (0) to a significant disability (5). The total score is computed by summing all components. The scale has a maximum score of 50. A score below 4 signifies no disability, a score between 5 and 14 denotes mild disability, a score ranging from 15 to 24 reflects moderate disability, a score from 25 to 34 shows severe disability, and a score over 35 represents complete disability.[43]

NECK PAIN AND DISABILITY SCALE (NPAD)

The Visual Analogue Scale (VAS) was used as a basis to create the Neck Pain and Disability Scale (NPAD). The severity of pain and how it affects social, emotional, recreational, occupational, and functional facets of life are measured by NPAD. Each of the twenty items in the NPAD has a VAS of 100 mm.[44] The first three items of the scale deal with current pain intensity and pain intensity on an average and at its worst. The following items of the scale assess the extent to which pain disrupts standing, sleeping, driving, walking, social interactions, occupational tasks, recreational pursuits, personal hygiene, interpersonal relationships, overall outlook on life and the future, emotional state, concentration, neck stiffness, difficulties in neck movement, challenges in upward and downward gazes, issues with overhead activities, and the efficacy of analgesics.[45] Item values range from 0, indicating no pain or activity limitation, to 5 representing maximal limitation or the highest level of discomfort. The cumulative NPAD score ranges between 0 and 100 points. Elevated scores indicate greater impairment.

PATIENT-SPECIFIC FUNCTIONAL SCALE (PSFS)

The Patient-Specific Functional Scale (PSFS), developed by Stratford and colleagues, is a self-reported, patient-specific outcome measure utilized to assess changes in functional status resulting from musculoskeletal issues, especially in instances of cervical radiculopathy. Patients are requested to identify up to five activities that their condition renders challenging. Subsequently, they assess their difficulty using an 11-point rating scale, with 0 indicating an inability to perform an action and 10 signifying the capacity to execute it at the same level as before.[46] Patients are asked to score these same activities that during the follow-up period following an intervention.

CERVICAL RADICULOPATHY IMPACT SCALE (CRIS)

This scale is a disease-specific questionnaire that consists of questions relating to the complaints of the arm and possible limitations that the patient may experience as a result of these complaints. The questionnaire consists of 21 items with three subscales-complaints, pain and limitations to activities, posture, and actions.[47] Each item in the questionnaire contains varying responses with scores ranging from none/never/not limited to very severe/always/very severely limited. This scale is considered as one of the best ways to assess the functional quality of life in patients with cervical radiculopathy

OSWESTRY DISABILITY INDEX (ODI)

The Oswestry Disability Index, also referred to as the Oswestry Low Back Pain Disability questionnaire, is regarded as a gold standard evaluation instrument that may be applied to lumbosacral radiculopathy of various severity. It was developed by Fairbank JCT. The questionnaire comprises 10 sections: pain intensity, personal care, lifting, walking, sitting, standing, sleeping, sexual life, social life, and travel. Each section has 6 varying responses. Every response is evaluated on a scale from 0 to 5. A maximum score of 50 is achievable. According to ratings, severity can be categorized as bedridden or having exaggerated symptoms (81–100%), having debilitating back pain (61–80%), having a severe disability (41–60%), having a moderate impairment (21–40%) and minimal impairment (0-20%).[48]

ROLAND MORRIS DISABILITY QUESTIONNAIRE (RMDQ)

The Roland Morris Disability Questionnaire is a self-claimed outcome measure used to determine how disabled someone is with low back pain. There are 24 statements about how the individual views their back pain and related limitations, including physical activity, sleep/rest, psychological, managing household affairs, eating, and the frequency of pain.[49] The number of items ticked are added up and 0 refers to no disability and 24 being maximal disability.

QUEBEC BACK PAIN DISABILITY SCALE (QBPDS)

The Quebec Back Pain Disability Scale (QBPDS) is a questionnaire specifically designed to assess the degree of functional impairment related to low back pain. The scale includes 20 items which the patient may find difficult to perform due to back pain. Every item has varying answers, with 0 denoting no difficulty to 5

denoting inability. Scores vary between an initial score of 20 to up to a maximum of 100. Greater disability is indicated by higher scores.[50]

FEAR AVOIDANCE BELIEF QUESTIONNAIRE (FABQ)

The Fear Avoidance Belief Questionnaire was specifically designed to assess the functional quality of life in people with low back pain. In addition to measuring fear-avoidance attitudes, this questionnaire is used to identify individuals who are potentially vulnerable for long-term disability.[51] Each of the 16 statements on the test can be evaluated using a 7-point Likert scale, with 0 indicating total disagreement and 6 indicating total agreement. The work subscale (FABQw) and the physical activity subscale (FABQpa) are its two subscales. Stronger fear avoidance beliefs are indicated by a higher score.[52]

DIFFERENCE BETWEEN CERVICAL AND LUMBAR RADICULOPATHY

Cervical radiculopathy	Lumbar radiculopathy
cervical radiculopathy is brought on by compression of the cervical nerve roots.	Lumbar radiculopathy, commonly known as sciatica, is a syndrome characterized by radiating pain in the distribution of a lumbar nerve root.
Arise from disc herniation, spondylosis, instability, trauma, or, infrequently, malignancies.	lumbar radiculopathy brought on by alterations to the typical anatomical framework surrounding a nerve root. Ligaments, intervertebral discs, and the bones and articulations of the spinal vertebrae are among the surrounding structures.
Diagnostic techniques for cervical radiculopathy include: MRI, computed tomography of the spine, Cervical spine plain x-ray, ultrasonography.	Diagnostic techniques for lumbar radiculopathy include: MRI, computed tomography, Diagnostic selective nerve root blocks (SNRBs), FABER test, Gaenslen test, orthopedic tension tests.
Treatment include: Manual treatment surgical intervention, Epidural steroid injections, Nonsteroidal anti-inflammatory, muscle relaxants.	Treatment include: Exercise, Weight reduction, and Physical therapy, Epidural injections or Nerve root blocks with Corticosteroids, Acetaminophen, Benzodiazepines, Muscle relaxants, or Antibiotics, Antidepressants, Interferential therapy
cervical radiculopathy is less prevalent than lumbar radiculopathy.	Lumbar radiculopathy is more prevalent than cervical radiculopathy.

SUMMARY

The cervical and lumbar radiculopathy are discussed in length in this review article, along with the pathogenies, diagnosis, and therapy options. People with cervical radiculopathy have pain in their neck, arms and shoulder because their nerve roots are squished. On the other hand, people with lumbar radiculopathy have pain in their lower back and legs because a lumbar nerve root is damaged or stimulated. Herniation of the discs and spondolysis are the most common causes of compression of the cervical nerve branch. Both magnetic resonance imaging (MRI) and computed tomography (CT) are often used as diagnostic tools for radiculopathy. Epidural injections, nonsteroidal anti-inflammatory drugs (NSAIDs), muscle relaxants, and antidepressants are all part of the treatment. New and improved methods of diagnosing and treating cervical and lumbar radiculopathy are now in the works. When considering the entirety of the article, it is possible to draw the conclusion that a person can be affected by cervical and lumbar radiculopathy at the same time.

CONCLUSION

Cervical and lumbar radiculopathy are significant causes of pain and functional impairment, arising

primarily from nerve root compression due to disc pathology. Early diagnosis using appropriate imaging and a combination of conservative and interventional treatments can improve patient outcomes. Importantly, both conditions may coexist, highlighting the need for comprehensive clinical evaluation.

LIST OF ABBREVIATIONS

MRI – Magnetic Resonance Imaging
CT – Computed Tomography
NSAIDs – Nonsteroidal Anti-Inflammatory Drugs
EMG – Electromyography
SNRB – Selective Nerve Root Block
NDI – Neck Disability Index
NPAD – Neck Pain and Disability Scale
PSFS – Patient-Specific Functional Scale
CRIS – Cervical Radiculopathy Impact Scale
ODI – Oswestry Disability Index
RMDQ – Roland Morris Disability Questionnaire
QBPDS – Quebec Back Pain Disability Scale
FABQ – Fear Avoidance Belief Questionnaire

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AUTHOR CONTRIBUTIONS

Devansh Upadhayay: Conceptualization, literature review, and original draft preparation.
Rohan Kumar: Literature search, data collection, and organization of content.
Md Estiac Jan: Literature review, content development, and interpretation of findings.
Jaismeen Kaur: Methodology (review approach), data compilation, and drafting support.
Anagha K. P.: Critical review, validation of content, and supervision.
Muhammed Fairoos A.: Literature review, manuscript formatting, drafting support, and final proofreading.
All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

ETHICAL APPROVAL

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

HUMAN AND ANIMAL ETHICAL RIGHT

Not applicable.

CONFLICT OF INTEREST

The authors declare no conflict of interest, and no funding was required to conduct these review data.

AVAILABILITY OF DATA AND MATERIALS

The data supporting this study's findings will be available in the cited references

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