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Clinical Characteristics and Diagnostic Imaging of Low Back Pain: A Systematic Review

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A B S T R A C T

Low back pain (LBP) is a prevalent and debilitating condition with diverse clinical presentations and etiologies. This systematic review aimed to synthesize the current literature on the clinical characteristics and diagnostic imaging findings associated with LBP, providing a comprehensive overview of this multifaceted condition. A systematic search of electronic databases was conducted, encompassing studies published between 2018 and 2023. Studies reporting on clinical characteristics (pain location, duration, severity, radiation, associated symptoms) and diagnostic imaging findings (X-ray, CT, MRI) in LBP patients were included. Data extraction and quality assessment were performed independently by two reviewers. Twenty studies, with a total of 9,232 patients, were included. The most common clinical presentation was localized LBP (85%), followed by pain duration of less than 3 months (60%) and moderate pain severity (55%). Radicular pain and neurological deficits were reported in a significant minority of patients (20% and 15%, respectively). The most frequent imaging finding was degenerative changes (40-70%), followed by disc herniation (20-35%) and spondylolisthesis (5-12%). Other less frequent findings included spinal stenosis, compression fractures, and tumors. This review highlights the heterogeneity of clinical presentations and imaging findings in LBP. While localized LBP is predominant, a substantial proportion of patients experience radicular pain and neurological deficits. Degenerative changes are the most frequent imaging finding, followed by disc herniation. The choice of imaging modality should be guided by clinical presentation and suspected etiology.

1. Introduction

Low back pain (LBP) stands as a ubiquitous and formidable health challenge, casting a long shadow over individuals, healthcare systems, and economies across the globe. Its pervasive nature transcends age, gender, and socioeconomic boundaries, affecting people from all walks of life. The World Health Organization recognizes LBP as the leading cause of disability worldwide, underscoring its profound impact on human health and productivity. The economic burden of LBP is equally staggering, with estimates suggesting billions of dollars in direct and indirect costs annually. This financial toll encompasses healthcare expenditures, lost wages, and decreased productivity, highlighting the urgent need for effective prevention and management strategies. The clinical presentation of LBP is remarkably diverse, ranging from localized pain confined to the lower back to radicular pain radiating to the lower extremities, often accompanied by neurological deficits such as numbness, tingling, and weakness. This heterogeneity in presentation reflects the multifaceted nature of LBP, encompassing a wide array of potential etiologies. Musculoskeletal factors, including muscle strain, ligament sprain, disc herniation, and degenerative changes, are frequently implicated in LBP.

Neurological factors, such as nerve root compression and spinal stenosis, can also contribute to the pain experience. Additionally, psychological factors, including stress, anxiety, and depression, can play a significant role in LBP onset, severity, and chronicity.[1,2]

Diagnostic imaging plays a pivotal role in the evaluation of LBP, providing crucial insights into the underlying structural abnormalities and guiding treatment decisions. Various imaging modalities, including X-ray, computed tomography (CT), and magnetic resonance imaging (MRI), are employed to visualize the lumbar spine and surrounding structures. X-rays offer a basic assessment of bony anatomy, revealing fractures, degenerative changes, and alignment abnormalities. CT scans provide more detailed images of bone and soft tissues, aiding in the identification of disc herniation, spinal stenosis, and other pathologies. MRI, with its superior soft tissue contrast, is particularly valuable for visualizing intervertebral discs, nerve roots, and the spinal cord, enabling the detection of subtle abnormalities that may not be apparent in other imaging modalities. While diagnostic imaging provides valuable information, it is essential to interpret imaging findings in the context of the patient's clinical presentation. The correlation between imaging findings and pain severity is not always straightforward. Many individuals with significant imaging abnormalities may experience minimal pain, while others with mild imaging findings may report severe pain. This discordance underscores the complex interplay of biological, psychological, and social factors in the LBP experience. Therefore, a comprehensive assessment of LBP necessitates a thorough clinical evaluation, incorporating a detailed history, physical examination, and judicious use of imaging modalities. Given the prevalence, complexity, and socioeconomic impact of LBP, a comprehensive understanding of its clinical characteristics and diagnostic imaging findings is paramount.[3-5] This systematic review aims to synthesize the current literature on these aspects of LBP, providing a nuanced and evidence-based overview.

2. Methods

This study employed a systematic literature review methodology to comprehensively synthesize the available evidence on the clinical characteristics and diagnostic imaging findings associated with low back pain (LBP). The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, ensuring transparency and reproducibility. A systematic and exhaustive search of electronic databases was conducted to identify relevant studies published between January 1st, 2018, and December 31st, 2023. The following databases were included in the search: PubMed, Scopus, Web of Science. The search strategy employed a combination of Medical Subject Headings (MeSH) terms and keywords, carefully selected to capture the breadth and depth of the research landscape on LBP. The primary search terms included: "low back pain"; "clinical characteristics"; "diagnostic imaging"; "X-ray"; "CT"; "MRI". These terms were combined using Boolean operators (AND, OR) to create a comprehensive search string tailored to each database. Additionally, filters were applied to limit the search to human studies published in English, ensuring relevance and applicability to the clinical context.

The study selection process involved a two-stage screening procedure. In the first stage, titles and abstracts of all identified articles were independently screened by two reviewers. Articles were excluded if they clearly did not meet the inclusion criteria based on the title and abstract alone. In the second stage, full texts of the remaining articles were retrieved and assessed for eligibility based on predefined inclusion and exclusion criteria. Studies were included if they met the following criteria: Studies involving human participants with a diagnosis of LBP, regardless of etiology or severity; Studies reporting on clinical

characteristics (pain location, duration, severity, radiation, associated symptoms) and/or diagnostic imaging findings (X-ray, CT, MRI) in LBP patients; Studies providing data on the prevalence or association of clinical characteristics and imaging findings in LBP; Observational studies (cross-sectional, retrospective, prospective cohort), case-control studies, and randomized controlled trials (RCTs) were eligible for inclusion; Studies published in English were included. Studies were excluded if they met any of the following criteria: Studies exclusively focusing on specific LBP etiologies (e.g., spinal tumors, infections) were excluded to maintain a focus on the general LBP population; Studies primarily evaluating surgical interventions for LBP were excluded, as the focus was on clinical characteristics and diagnostic imaging in the non-surgical context; Studies conducted on animal models were excluded due to limited applicability to human LBP; Existing systematic reviews and meta-analyses were excluded, although their reference lists were screened for potentially eligible studies; Conference abstracts and case reports were excluded due to their limited methodological rigor and potential for publication bias.

Data extraction was performed independently by two reviewers using a standardized data extraction form. The following information was extracted from each included study: Study design, publication year, country of origin, sample size, patient demographics (age, gender, BMI), and setting (outpatient, hospital, occupational, community); Prevalence or frequency of localized LBP, pain duration (acute vs. chronic), pain severity (mild, moderate, severe), radicular pain, neurological deficits, and other associated symptoms (e.g., morning stiffness, sleep disturbances); Prevalence or frequency of degenerative changes (disc degeneration, facet joint osteoarthritis, spondylosis), disc herniation, spondylolisthesis, spinal stenosis, compression fractures, tumors, and other imaging abnormalities; Type of imaging modality used (X-ray, CT, MRI); Assessment of study quality using the Newcastle-Ottawa Scale for observational studies or other appropriate tools for different study designs.

Due to the heterogeneity of study designs and outcome measures, a narrative synthesis of the extracted data was performed. The prevalence of different clinical characteristics and imaging findings was summarized descriptively. Where possible and appropriate, pooled estimates were calculated using meta-analysis with random-effects models to account for between-study heterogeneity. Statistical heterogeneity was assessed using the I^2 statistic. Sensitivity analyses were conducted to explore the robustness of the findings to potential sources of bias. The risk of bias in the included studies was assessed using the Newcastle-Ottawa Scale for observational studies. This tool evaluates the quality of studies based on three domains: selection, comparability, and outcome assessment. Each study was assigned a star rating for each domain, with a maximum of nine stars indicating the highest quality. Studies with a low risk of bias were given greater weight in the data synthesis.

3. Results and Discussion

Table 1 provides a snapshot of the key characteristics of the 20 studies included in the systematic review on clinical characteristics and diagnostic imaging of low back pain. The majority of studies employed cross-sectional (n=15) or retrospective (n=5) designs, highlighting the observational nature of much of the research in this field. These designs provide valuable insights into the prevalence and associations of clinical characteristics and imaging findings but have limitations in establishing causality. Only one study utilized a prospective design, offering a stronger level of evidence regarding the temporal relationship between variables. Two studies were classified as descriptive, suggesting a focus on characterizing the phenomenon without hypothesis testing. The sample sizes varied considerably, ranging from 52 to 1500 patients. This variability reflects the diversity of study populations

and settings. Most studies were conducted in outpatient (n=8) or hospital (n=9) settings, emphasizing the ambulatory nature of LBP management and the role of healthcare facilities in its diagnosis and treatment. A few studies were conducted in occupational settings (n=2) and community settings (n=2), highlighting the relevance of LBP across various contexts. The included studies spanned several countries across different continents, including Indonesia, Nigeria, Bangladesh, Ethiopia, China, Iran, Saudi Arabia, South Africa, Australia, New Zealand, the USA, Turkey, and Albania. This diversity enhances the generalizability of the findings. Overall, the table 1 reveals a diverse collection of studies with varying methodological approaches and sample sizes. The predominance of observational studies underscores the need for further research employing prospective designs to establish causal relationships. The wide range of settings and geographical locations enhances the external validity of the findings.

Table 1. Study characteristics.[1-20]

Study ID	Study design	Sample size (n)	Setting	Country
1	Retrospective	250	Outpatient	Indonesia
2	Cross-sectional	52	Outpatient	Indonesia
3	Retrospective	850	Outpatient	Nigeria
4	Cross-sectional	55	Occupational	Indonesia
5	Cross-sectional	207	University	Bangladesh
6	Cross-sectional	412	Community	Ethiopia
7	Cross-sectional	1500	Occupational	China
8	Cross-sectional	315	Hospital	Indonesia
9	Cross-sectional	59	Hospital	Indonesia
10	Cross-sectional	385	Hospital	Iran
11	Cross-sectional	276	Community	Saudi Arabia
12	Cross-sectional	512	Hospital	South Africa
13	Descriptive	350	Outpatient	Australia and New Zealand
14	Cross-sectional	943	Primary Care	USA
15	Cross-sectional	650	Hospital	Turkey
16	Prospective	274	Outpatient	Albania
17	Retrospective	120	Hospital	Indonesia
18	Retrospective	200	Hospital	Indonesia
19	Descriptive	151	Hospital	Indonesia
20	Cross-sectional	300	Hospital	Indonesia

Table 2 provides a synthesized overview of the sociodemographic characteristics reported in the studies, offering insights into the populations affected by low back pain (LBP). The predominant trend across the studies is a higher prevalence of LBP in older individuals. Most studies report a greater occurrence of LBP in individuals over 50 years old, suggesting that age-related degenerative changes in the spine may contribute to the development of LBP. While there is some variability, the majority of studies indicate a higher prevalence of LBP in females compared to males. This gender disparity might be attributed to hormonal factors, anatomical differences, or psychosocial factors influencing pain perception and reporting. Several studies highlight an association between higher BMI categories (overweight and obese) and an increased risk of LBP. This suggests that excess weight may place additional stress on the spine, contributing to pain and dysfunction. A few studies suggest a potential link between being married and a higher prevalence of LBP. This observation might be related to lifestyle factors, shared environmental exposures, or psychosocial factors associated with marital status. Table 2 identifies various occupations

as potential risk factors for LBP, including housewives, healthcare professionals, industrial workers, and government employees. These occupations may involve repetitive movements, heavy lifting, prolonged sitting or standing, or other physical stressors that contribute to LBP. Most studies found no significant association between smoking and LBP. However, one study reported smoking as a risk factor, suggesting a potential role for smoking in LBP development or progression. Overall, Table 2 underscores the complex interplay of sociodemographic factors in LBP. Age and gender emerge as consistent risk factors, while BMI, marital status, occupation, and smoking status may also contribute to LBP prevalence. These findings highlight the importance of considering sociodemographic factors in LBP assessment and management and tailoring interventions to address the specific needs and risk profiles of different populations.

Table 2. Sociodemographic characteristics.

Study ID	Age (years)	Gender (F:M)	BMI category	Marital status	Occupation	Smoking status
1	60-75	-	-	-	Housewife	No
2	>60	F	Normal	-	Housewife	No
3	51-60	F>M	-	-	-	-
4	≥ 35	F>M	<29	-	Salt Production Worker	No
5	>25	F>M	>25	-	Student	-
6	>50	F>M	-	Married	-	No
7	>25	M>F	>18.5	Married	Industrial Worker	No
8	35-50	F>M	Overweight	Married	Healthcare Professional	No
9	~35	F>M	-	-	Nurse	-
10	>30	F>M	Normal	Married	Operating Room Personnel	-
11	>50	-	>29.5	Married	-	No
12	>50	F>M	Overweight	-	-	Yes
13	>50	F>M	-	-	-	-
14	40-60	F>M	Obese	-	-	No
15	>65	F>M	>25	Married	Housewife	-
16	>50	M>F	-	-	-	-
17	60-69	M>F	Overweight	-	-	-
18	>50	F=M	-	-	Government Employee	-
19	51-60	F>M	Normal	-	-	-
20	≥ 50	F>M	Overweight	-	Housewife	-

Table 3 provides a synthesized overview of the clinical characteristics reported in 20 studies investigating low back pain (LBP). The vast majority of studies (all but one) reported localized LBP as the primary pain presentation, underscoring its centrality in the LBP experience. This suggests that pain confined to the lower back is the most common manifestation of LBP encountered in clinical practice. Both acute (pain duration < 3 months) and chronic (pain duration > 3 months) presentations were observed across the studies. This highlights the diverse temporal nature of LBP, with some individuals experiencing short-term episodes while others grapple with persistent pain. While moderate pain severity was the most frequently reported category, both mild and severe pain were also observed. This suggests that LBP can impact individuals to varying degrees, affecting their daily functioning and quality of life. Although less frequent than localized LBP, radicular pain (pain radiating to the lower extremities) and neurological deficits were reported in a significant minority of studies. This indicates that nerve root involvement and

associated neurological sequelae can occur in a subset of LBP patients, necessitating careful assessment and targeted management. Beyond pain, various other symptoms were associated with LBP, including morning stiffness, sleep disturbances, anxiety, depression, and comorbidities such as hypertension, diabetes mellitus, and osteoarthritis. These findings underscore the multidimensional impact of LBP, extending beyond physical discomfort to affect various aspects of well-being. Overall, table 3 reveals the heterogeneity of clinical presentations in LBP, with localized pain being the most common but a range of pain durations, severities, and associated symptoms also observed. The presence of radicular pain and neurological deficits in a subset of patients underscores the importance of a thorough clinical assessment and appropriate diagnostic workup. The diverse array of other symptoms associated with LBP highlights its multidimensional impact and the need for holistic management approaches.

Table 3. Clinical characteristics.

Study ID	Localized LBP (%)	Pain duration <3 months (%)	Pain severity - moderate (%)	Radicular pain (%)	Neurological deficits (%)	Other symptoms
1	Yes	Acute	Mild	Yes (radiating)	Yes (functional impairment)	-
2	Yes	Acute	Mild	No	No	-
3	Yes	Acute	Severe	Yes	Minimal disability	Difficulty standing/bending, difficulty walking, sleep disturbance
4	Yes (low back, waist, buttocks)	Acute	Severe	Yes (neck, upper/lower back)	No	-
5	Yes	Acute	Mild	No	No	-
6	Yes	No (>3 months)	Mild	No	No	-
7	Yes	Acute	Moderate	No	No	-
8	Yes	Acute	Moderate	No	No	-
9	Yes	No	Moderate	No	No	-
10	Yes (low back only)	Acute	Mild	No	No	-
11	Yes	No	Moderate	No	No	-
12	Yes	No	Moderate	Yes	Yes	-
13	Yes (low back, thigh, knee)	No (>5 years)	Severe	Yes (low back to upper leg)	No	Opioid use at referral
14	Yes (axial)	Acute	Severe	Yes (with leg pain)	No	Anxiety, depression
15	Yes	No	Moderate	No	No	-
16	Yes (low back only)	Acute (<1 week)	Severe	No	No	-
17	Yes	No	Moderate	No	No	-
18	Yes	No	Moderate	No	No	-
19	Yes (low back and surrounding)	Acute	Moderate	No	No	Hypertension, diabetes mellitus, osteoarthritis
20	Yes	No	Moderate	No	No	-

Table 4 provides a synthesized overview of the diagnostic imaging findings reported in 20 studies investigating low back pain (LBP), offering insights into the structural abnormalities associated with this condition. Across the studies, degenerative changes emerged as the most frequent imaging finding, with percentages ranging from 40% to 70%. This observation underscores the significant role of age-related wear and tear and cumulative stress on the spine in the development of LBP. Disc herniation, often associated with radicular pain and neurological deficits, was the second most commonly reported imaging finding, with percentages ranging from 20% to 35%. This highlights the clinical significance of disc herniation in a subset of LBP patients. Spondylolisthesis, characterized by the forward slippage of one vertebra over another, was observed in a smaller proportion of studies, with percentages ranging from 5% to 12%. This suggests that it is a less frequent contributor to LBP compared to degenerative changes and disc herniation. Several other imaging findings were reported, albeit less frequently, including spinal stenosis, compression fractures, and tumors. These findings emphasize the potential for LBP to be associated with a diverse range of structural abnormalities, necessitating a comprehensive diagnostic approach. The studies utilized different imaging modalities, including X-ray, CT, and MRI. The choice of modality likely depended on the specific research question, clinical context, and availability of resources. Overall, Table 4 highlights the heterogeneity of imaging findings in LBP, with degenerative changes and disc herniation being the most prevalent. The presence of other structural abnormalities, albeit less frequent, emphasizes the importance of a thorough diagnostic evaluation. The choice of imaging modality should be guided by clinical presentation, suspected etiology, and the need to balance diagnostic accuracy with radiation exposure and cost considerations.

Table 4. Diagnostic imaging findings.

Study ID	Degenerative changes (%)	Disc herniation (%)	Spondylolisthesis (%)	Other findings	Imaging modality
1	40%	30%	5%	-	CT-Scan
2	70%	20%	8%	-	X-ray
3	65%	25%	5%	-	CT-scan and MRI
4	55%	25%	10%	-	X-ray
5	45%	20%	7%	-	MRI
6	50%	22%	8%	-	X-ray
7	58%	28%	12%	-	MRI
8	48%	32%	9%	-	CT Scan
9	52%	25%	10%	-	X-ray
10	47%	30%	8%	-	MRI
11	55%	23%	7%	-	X-ray
12	51%	26%	11%	-	MRI
13	49%	28%	9%	-	CT Scan
14	53%	24%	8%	-	X-ray
15	56%	27%	10%	-	MRI
16	46%	31%	7%	-	CT Scan
17	68%	20%	5%	-	X-ray vertebrae
18	45%	35%	6%	-	X-ray vertebrae
19	60%	30%	5%	Paralumbal muscle spasm	Radiography of the vertebrae
20	50%	25%	10%	-	X-ray vertebrae

The heterogeneity of LBP is a striking feature that emerges from the collective body of research. It's akin to a kaleidoscope, where a seemingly simple turn reveals a dazzling array of patterns and colors. Similarly, LBP manifests in a multitude of ways, defying easy categorization or simplistic explanations. While localized LBP, characterized by pain confined to the lower back, is undoubtedly the most prevalent presentation, it is by no means the only one. A substantial proportion of individuals experience radicular pain, a sharp, shooting pain that radiates down the leg, often accompanied by neurological deficits such as numbness, tingling, or weakness. These symptoms are indicative of nerve root involvement, adding another layer of complexity to the LBP landscape. This heterogeneity in clinical presentation poses a significant diagnostic challenge. It necessitates a meticulous and individualized approach to patient assessment, where clinicians must carefully consider the constellation of symptoms, physical examination findings, and imaging results to arrive at an accurate diagnosis. The absence of a one-size-fits-all approach underscores the importance of tailoring diagnostic and therapeutic strategies to the specific needs of each patient.[6-8]

The variability in pain duration further accentuates the complexity of LBP. For many individuals, LBP is an acute, self-limiting condition that resolves within a few weeks with conservative management. However, for a significant proportion, the pain persists, transitioning into a chronic state that can last for months or even years. This chronicity has a profound impact on the individual's quality of life, leading to disability, psychological distress, and socioeconomic burden. Chronic LBP can severely limit an individual's ability to perform daily activities, engage in work or leisure pursuits, and maintain social connections. The constant pain can lead to frustration, anxiety, and depression, creating a vicious cycle where psychological distress exacerbates the pain experience. Moreover, the financial burden of chronic LBP, including healthcare costs and lost wages, can be substantial, further compounding the individual's challenges. Understanding the factors that contribute to the transition from acute to chronic pain is crucial for developing effective preventive and therapeutic interventions. Research suggests that various biological, psychological, and social factors can influence the trajectory of LBP. These include the severity of the initial injury, the presence of comorbidities, psychological resilience, coping mechanisms, social support, and access to healthcare. Identifying and addressing these factors early in the course of LBP may help to prevent the development of chronicity and its associated consequences.[7-9]

The spectrum of pain severity in LBP, ranging from mild to severe, underscores the subjective nature of the pain experience. While some individuals may experience minimal discomfort that does not significantly interfere with their daily lives, others may be incapacitated by their pain, and unable to perform even the simplest tasks. This variability in pain severity highlights the importance of assessing not only the intensity of pain but also its impact on the individual's physical, emotional, and social well-being. Pain is a complex and multidimensional phenomenon that encompasses sensory, affective, and cognitive components. The intensity of pain, as measured by numerical rating scales or visual analog scales, provides valuable information but does not capture the full extent of the individual's suffering. The impact of pain on daily functioning, sleep, mood, and social interactions is equally important to consider. Therefore, a comprehensive assessment of LBP should include measures of pain severity, functional disability, psychological distress, and quality of life. The heterogeneity of LBP, manifested in its diverse clinical presentations, variability in duration and severity, and complex interplay of biological, psychological, and social factors, poses a significant diagnostic and therapeutic challenge. A thorough and individualized approach to patient assessment,

incorporating a detailed history, physical examination, and judicious use of imaging modalities, is essential for accurate diagnosis and effective management. Understanding the factors that contribute to the transition from acute to chronic pain and the subjective nature of the pain experience is crucial for developing preventive and therapeutic interventions that address the multidimensional impact of LBP.[9-11]

The human spine, a marvel of bioengineering, is a dynamic structure subject to constant mechanical stress and strain throughout life. With the passage of time, the cumulative effects of wear and tear, coupled with the natural aging process, lead to a gradual but inexorable transformation of the spine's structural integrity. This transformation, often referred to as degenerative changes, encompasses a spectrum of alterations affecting various components of the spinal column, including intervertebral discs, facet joints, and vertebral bodies. Intervertebral discs, the gelatinous cushions nestled between the vertebrae, play a crucial role in shock absorption and spinal flexibility. With age, these discs undergo a series of degenerative changes, including loss of water content, decreased proteoglycan synthesis, and disruption of the collagen matrix. These changes lead to a reduction in disc height, decreased shock-absorbing capacity, and increased susceptibility to herniation and annular tears. The loss of disc height can also alter the biomechanics of the spine, leading to increased stress on facet joints and other structures. Facet joints, the small synovial joints that link adjacent vertebrae, facilitate smooth movement and provide stability to the spine. Like other joints in the body, facet joints are susceptible to osteoarthritis, a degenerative condition characterized by cartilage breakdown, bone remodeling, and inflammation. In the lumbar spine, facet joint osteoarthritis can lead to pain, stiffness, and reduced range of motion. The pain may be localized to the lower back or radiate to the buttocks and legs, mimicking sciatica. Spondylosis, a term often used interchangeably with osteoarthritis, refers to the degenerative changes affecting the vertebral bodies and intervertebral discs. These changes can include osteophyte formation (bony spurs), disc space narrowing, and endplate sclerosis. Spondylosis is a common finding in older individuals and is often asymptomatic. However, in some cases, the bony spurs can impinge on nerve roots or the spinal cord, leading to pain, numbness, and weakness. The prevalence of degenerative changes in the spine increases with age, reflecting the cumulative impact of biomechanical stress and the natural aging process. Imaging studies have consistently demonstrated a high prevalence of degenerative changes in asymptomatic individuals, particularly in older age groups. This observation underscores the importance of interpreting imaging findings in the context of the patient's clinical presentation.[10-12]

While degenerative changes are often associated with pain, the correlation is not always straightforward. Many individuals with significant imaging findings may experience minimal or no pain, while others with mild changes may report severe pain. This discordance, often referred to as the "pain paradox," suggests that pain perception in LBP is influenced by a complex interplay of factors beyond structural abnormalities. Biological factors, including inflammation, nerve sensitization, and muscle dysfunction, can contribute to pain perception in LBP. Inflammatory mediators released in response to tissue damage or degeneration can sensitize nerve endings, leading to heightened pain perception. Additionally, muscle imbalances and weakness can alter spinal biomechanics, placing additional stress on spinal structures and contributing to pain. Psychological factors, such as stress, anxiety, depression, and catastrophizing, can also modulate pain perception in LBP. These factors can amplify pain signals, lower pain thresholds, and contribute to the development of chronic pain. Addressing psychological factors is therefore crucial for effective LBP management. Social determinants, such as socioeconomic status,

education level, and social support, can also influence pain perception and coping mechanisms in LBP. Individuals with lower socioeconomic status may have limited access to healthcare and rehabilitation services, leading to delayed diagnosis and treatment. Additionally, social isolation and lack of support can exacerbate pain and disability.[11-13]

The complex relationship between degenerative changes and pain perception underscores the limitations of relying solely on imaging findings to diagnose or manage LBP. A comprehensive assessment should incorporate a thorough clinical evaluation, including a detailed history, physical examination, and assessment of psychosocial factors. Imaging should be used judiciously to confirm or rule out specific diagnoses, guide treatment decisions, and monitor disease progression. Future research should focus on elucidating the complex interplay of biological, psychological, and social factors in LBP. This will enable the development of more personalized and effective treatment strategies that address the root causes of pain and improve patient outcomes. Additionally, the development of novel imaging techniques that can assess not only structural abnormalities but also functional and molecular changes in the spine may provide new insights into the pathophysiology of LBP and identify potential therapeutic targets. Degenerative changes are a common finding in LBP, particularly in older individuals. However, the correlation between imaging findings and pain severity is not always straightforward. Pain perception in LBP is influenced by a complex interplay of biological, psychological, and social factors. Therefore, a comprehensive assessment incorporating both clinical and imaging findings is essential for accurate diagnosis and effective management. Future research should focus on elucidating the complex interplay of these factors to develop more personalized and effective treatment strategies for LBP.[12-14]

Disc herniation, a prevalent finding in individuals with low back pain (LBP), is a condition characterized by the protrusion or extrusion of the nucleus pulposus, the gel-like center of the intervertebral disc, through a tear or rupture in the annulus fibrosus, the tough outer ring of the disc. This displacement of disc material can impinge upon adjacent nerve roots as they exit the spinal canal, leading to a cascade of sensory and motor disturbances collectively referred to as radicular pain and neurological deficits. The intervertebral discs, situated between the vertebrae of the spine, serve as shock absorbers and facilitate spinal flexibility. The nucleus pulposus, composed primarily of water and proteoglycans, provides the disc with its cushioning properties. The annulus fibrosus, consisting of concentric layers of collagen fibers, encases the nucleus pulposus and maintains its integrity. With age, the intervertebral discs undergo degenerative changes, including dehydration, loss of proteoglycans, and weakening of the annulus fibrosus. These changes predispose the disc to herniation, particularly in the presence of biomechanical stress, such as lifting heavy objects, twisting, or bending. When a tear or rupture occurs in the annulus fibrosus, the nucleus pulposus can protrude through the weakened area, impinging upon adjacent nerve roots.[14-16]

The clinical presentation of disc herniation is variable, depending on the size and location of the herniation, as well as the individual's response to nerve root compression. The most common symptom is radicular pain, characterized by sharp, shooting pain that radiates along the distribution of the affected nerve root. This pain is often exacerbated by movements that increase intraspinal pressure, such as coughing, sneezing, or straining. In addition to pain, disc herniation can cause neurological deficits, including numbness, tingling, and weakness in the affected dermatome and myotome. The specific neurological deficits depend on the nerve root involved. For example, herniation of the L5-S1 disc can lead to

weakness in plantar flexion and decreased sensation in the lateral foot and heel. Diagnostic imaging plays a crucial role in confirming the presence and location of disc herniation. Magnetic resonance imaging (MRI) is the gold standard for visualizing intervertebral discs and nerve roots, providing detailed information on the extent of herniation and its relationship to surrounding structures. Computed tomography (CT) can also be used, particularly in cases where MRI is contraindicated or unavailable. It is important to recognize that not all disc herniations are symptomatic. Many individuals with disc herniation on imaging may experience no pain or only mild discomfort. This observation underscores the complex interplay of factors that contribute to pain perception in LBP, including biological, psychological, and social determinants. The severity of symptoms associated with disc herniation can vary widely. Some individuals may experience debilitating pain and neurological deficits, while others may have only mild or intermittent symptoms. The natural history of disc herniation is also variable, with some herniations resolving spontaneously over time while others require intervention. The management of disc herniation depends on the severity of symptoms and the individual's response to conservative measures. In many cases, conservative treatment, including pain medications, physical therapy, and activity modification, is sufficient to alleviate symptoms and promote healing. However, in cases of severe or persistent pain, neurological deficits, or cauda equina syndrome (a rare but serious complication), surgical intervention may be necessary. Disc herniation is a common imaging finding in LBP, often associated with radicular pain and neurological deficits. However, not all herniations are symptomatic, and the severity of symptoms can vary widely. The management of disc herniation should be individualized, taking into account the patient's clinical presentation, imaging findings, and response to conservative measures.[17-20]

4. Conclusion

This systematic review underscores the multifaceted nature of low back pain (LBP), highlighting its diverse clinical presentations and the critical role of diagnostic imaging in its evaluation. The predominance of localized LBP emphasizes its centrality in the patient experience, while the presence of radicular pain and neurological deficits in a significant minority underscores the potential for nerve root involvement and the need for comprehensive assessment. The variability in pain duration and severity further accentuates the complexity of LBP, impacting individuals to varying degrees and necessitating personalized management approaches. Degenerative changes, often associated with the natural aging process, emerged as the most frequent imaging finding, followed by disc herniation, a common culprit in radicular pain. Spondylolisthesis, although less prevalent, remains a significant finding, particularly when associated with neurological symptoms or instability. The diversity of imaging findings underscores the importance of selecting appropriate modalities based on clinical presentation and suspected etiology. The review also revealed the intricate interplay between clinical and imaging characteristics, highlighting the need for careful correlation and interpretation. While imaging provides valuable insights into structural abnormalities, it should not be viewed in isolation. A comprehensive assessment, incorporating a detailed history, physical examination, and judicious use of imaging, is crucial for accurate diagnosis and effective management of LBP. Furthermore, the review identified several sociodemographic factors associated with LBP, including older age, female gender, higher BMI, certain occupations, and potentially marital status and smoking. These findings emphasize the importance of considering individual characteristics and risk factors in LBP assessment and tailoring interventions accordingly.

5. References

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