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CAUSES OF CHRONIC LOW BACK ACHE AND ITS MRI FINDINGS IN PATIENTS

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Abstract
Chronic low back ache (CLBA) is the prevalent condition that significantly impacts the quality of life. This study aims to explore the causes of chronic low back ache and its associated MRI findings in the patients. The cross-sectional observational study of 100 patients is conducted, reviewing the MRI scans for structural abnormalities. The most common findings were disc degeneration (15%), spinal stenosis (63%), and facet joint osteoarthritis (6%), Modic changes. A correlation between disc degeneration severity and reported pain intensity was observed. These results underline the importance of MRI in diagnosing CLBA and suggest that MRI-guided treatment strategies may enhance patient care.

INTRODUCTION

Often thought of as a symptom of another disease, low back ache (LBA) is an incredibly common condition which is commonly referred as chronic low back pain (CLBP) that affects nearly all humans, regardless of country and income (1). Though there are many definitions of low back ache, some researchers have proposed using one unified definition to allow for collaboration among researchers (2). This is still not used in all low back pain research, but it is noted as pain in the lumbar region of the spine that starts at the end of the ribcage, also known as the costal margin of the back at the 12th rib, and ends at the top of the buttock at the gluteal folds 2-4. Leg pain also commonly occurs in conjunction with back pain (3).

The anatomical features of this area include muscle, circulatory vessels, lumbar vertebrae, intervertebral discs, the spinal cord, and nerves that stem from the spinal cord. Thus, low back pain can be pain from any of these sources in the lumbar spine (LS). Often it is difficult for physicians to locate the source of pain to any one of these anatomical features (4). If it can be determined, it is often very serious in pathology. The main serious pathologies are cancer/tumor, fractures, neurological deficits, and infection, and can also include inflammatory diseases such as arthritis or ankylosing spondylitis (5,6).

Low back pain has many different classifications based on how long the person has been experiencing pain, and whether the cause of the pain can be diagnosed (7). Back pain can be classified based on the length of time a patient has it, with a pain duration for less than three months being considered acute low back pain (ALBP). The pain that is for the little longest time 4 to 6 month

is called subacute pain. The pain for greater than six months is called chronic low back pain (CLBP). Low back pain can also be classified into one of three categories based on the cause of the pain (8). If no specific pathology caused by the aforementioned causes can be found, the pain is often classified as non-specific low back pain (NSLBP), and if there are neurological symptoms that affect the legs, such as numbness or weakness, a patient is said to have radicular syndrome (9). The third category is called the serious spinal pathology category, including pain that is caused by cauda equina, infection, fracture, or cancer/tumor. Further information is provided in the section on usual care for low back pain.

Chronic low back pain is the complex condition, the causes are occurred due to the various conditions and can be categorized into mechanical causes, degenerative causes, inflammatory, infectious, neoplastic, psychosocial, Modic changes and other causes (10). Low back pain is very rarely caused by a serious condition, though 80% of the population globally will experience it. Prevalence of serious pathologies such as fractures, infection, inflammatory arthritis, and cancer have been estimated to be present in less than 1% of all cases of low back pain (11). Prevalence of Non-Specific (NSLBP) is much more difficult to estimate, but it is thought that the one-year prevalence of any type of low back pain ranges from 0.8% to 82.5%, with a point prevalence ranging from 1% to 58%. It has been shown that 40.65% of the Pakistani population above the age of 50 years suffers from low back pain. It is 2.5 times higher among women who never do moderate physical activity in their routine life (12). Local data also showed that low back pain is more common in the Pakistani population with obesity, prolonged sitting jobs, psychological disorders, lack of exercise, lack of health awareness, and heavy lifting jobs. Its prevalence is higher in urban than in rural areas. The 84% of the total population is suffering from Chronic Low Back Pain, and with the high recurring rates the incidence shows before the age of 45. The more incidence of Chronic Low Back Pain is after the early starting in the third decade and life on (13).

MRI is often used to diagnose the underlying causes of chronic low back pain of degenerative disc diseases (disc dehydration and loss of disc height, disc bulge or herniation), facet joint arthritis (hypertrophy, enlargement of facet joints, synovial cyst, spacing and narrowing), spinal stenosis (hypertrophy of ligamentum, narrowing of spinal canal, compression of spinal cord and nerve roots), spondylolisthesis (Slippage of one vertebrae over the others and can be associated with degenerative changes), sacroiliac joint dysfunctions (inflammation and sacroiliac joints dysfunctions), muscle and ligament abnormalities (atrophy and ligamentous of tears), vertebral compression factors (factors often seen in osteoporotic patients, deformity, and loss of vertebral body), inflammatory conditions (ankylosing spondylitis and inflammatory conditions in vertebral bodies or sacroiliac joints), infections (discitis and osteomyelitis, presence and absence of inflammatory changes), Neoplasms (presence of primary and metastatic changes, vertebral body and soft tissue masses) (14).

Diagnosing the low back pain can be challenging due to the multifactorial nature of the condition. Traditional diagnostic methods, such as physical examination and plain radiography, have limitations in accurately identifying the underlying causes of low back pain. These methods often fail to provide detailed information about soft tissue structures, leading to misdiagnosis or delayed diagnosis (15). Magnetic Resonance Imaging (MRI) has emerged as a vital diagnostic tool for evaluating low back pain. Unlike traditional methods, MRI provides detailed images of soft tissues, including intervertebral discs, muscles, and nerves, enabling accurate identification of underlying pathologies. This non-invasive imaging technique is particularly useful in detecting conditions such as disc herniation, spinal stenosis, and degenerative disc disease, which are common causes of low back pain in young adults (16).

MRI's ability to produce high-resolution images without exposure to ionizing radiation makes it a preferred choice for diagnosing low back pain, especially in young adults. It allows for the comprehensive assessment of spinal anatomy and pathology, facilitating early diagnosis and targeted treatment plans. This is crucial in preventing the

progression of acute low back pain to chronic low back pain, which can lead to long-term disability (17).

The Rationale of this study is MRI findings in CLBP helps in accurate diagnosis, treatment planning, outcome predictions and the monitoring of progress in the patients of chronic low back ache because mostly peoples which ignored the low back ache due to which it converts into chronic low back ache, problem of diagnosing chronic low back ache (18).

The goal of treating the chronic low back ache is often changed with the time, The treatments of chronic low back ache include non-pharmacological treatments, psychological treatment, multidisciplinary rehabilitations, pharmacological treatments, weight loss, oral treatments, topical treatments and spinal and steroidal injections (epidural injections). Non-Pharmacological treatments are **Physiotherapy and Home Exercise therapy;** Although there is insufficient evidence that outcomes from home-based exercises program are different then no care.

Methodology

This cross-sectional observational study was conducted in the Radiology department of Sir Ganga Ram Hospital Lahore for 4 months, The study received approval from the institutional ethical review board. The study includes 100 male and female patients from (age 12-75). Patients with the different causes of chronic low back ache are asked to rate their pain on the pain scale from 0 to 10, with the 0 representing the no pain and 10 representing the worst possible pain, the visual analogue scale can be used where patients mark a line to the point of their pain intensity typically ranging from no pain to worst pain, then the MRI scan is performed in 3 tesla magnetic resonance imaging (MRI) machine. The patient lay in supine (on their back) on the MRI table. Positioning aids such as cushions or pads will be used to ensure the patient remains comfortable and still during the scan, which is crucial for obtaining clear images. The lower back (lumbar spine) will be carefully aligned within the MRI scanner to ensure the targeted area is accurately imaged. A specialized spine coil is placed over the lower back region. This coil acts as an antenna to receive the signals emitted from the body, enhancing image quality and resolution. Images will be taken in Sagittal T1-weighted, Sagittal T2-weighted, Axial T1and T2-weighted Images. The raw data collected during the scan will be processed and reconstructed into high-resolution images. The data were analyzed by using SPSS version 25.0. Sensitivity, specificity and accuracy were calculated by using standard formulas. Chi square test was used to evaluate categorical variables, and p-value <0.05 were considered statistically significant.

Results

Overall, 100 patients with the chronic low back ache with their different causes and their different MRI findings are analysed.

Category	Minimum	Maximum	Mean	Std. Deviation
Age	12	70	42.27	13.221
Patient height in Centimetres	146	185	166.30	9.871
Patients weight in Kilograms	51	79	65.21	6.599
Body Mass Index	17.17	30.78	23.76	3.285
Pain scale (Visual Analogue Scale) 1–10	2	10	6.84	1.942

Gender Distribution	
Male	49 (49.0%)
Female	51 (51.0%)
Pain Scale (VAS 1-10)	
Mild Pain (2)	1 (1.0%)
Mild Pain (3)	6 (6.0%)
Moderate Pain (4)	7 (7.0%)
Moderate Pain (5)	8 (8.0%)
Moderate Pain (6)	15 (15.0%)
Severe Pain (7)	29 (29.0%)
Severe Pain (8)	12 (12.0%)
Severe Pain (9)	13 (13.0%)
Worst Pain (10)	9 (9.0%)
Area of Pain	
Lower Back Pain	32 (32.0%)
Back Radiating Pain	18 (18.0%)
Back Pain Radiating to Both Legs	11 (11.0%)
Back Pain Radiating to Left Leg	17 (17.0%)
Back Pain Radiating to Right Leg	22 (22.0%)
Duration of Pain	
Less than a Month	16 (16.0%)
Three Months	26 (26.0%)
Six Months	16 (16.0%)
One Year	12 (12.0%)
Two Years	9 (9.0%)
More than Two Years	21 (21.0%)
Disc Degeneration	
No	85 (85.0%)
Yes	15 (15.0%)
Facet Joints Arthritis	
No	94 (94.0%)
Yes	6 (6.0%)
Modic Changes	
No	37 (37.0%)
Yes	63 (63.0%)

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Lumbar Spondylosis	
No	84 (84.0%)
Yes	16 (16.0%)
Spinal Canal Stenosis	
No	77 (77.0%)
Yes	23 (23.0%)
Radial Angular Tear	
No	43 (43.0%)
Yes	57 (57.0%)
Osteophyte Formation	
No	85 (85.0%)
Yes	15 (15.0%)
Nerve Roots Narrowing	
No	79 (79.0%)
Yes	21 (21.0%)
Disc Protrusion	
No	41 (41.0%)
Yes	59 (59.0%)
Osteoporosis	
No	90 (90.0%)
Yes	10 (10.0%)
Muscle Spasm	
No	48 (48.0%)
Yes	52 (52.0%)

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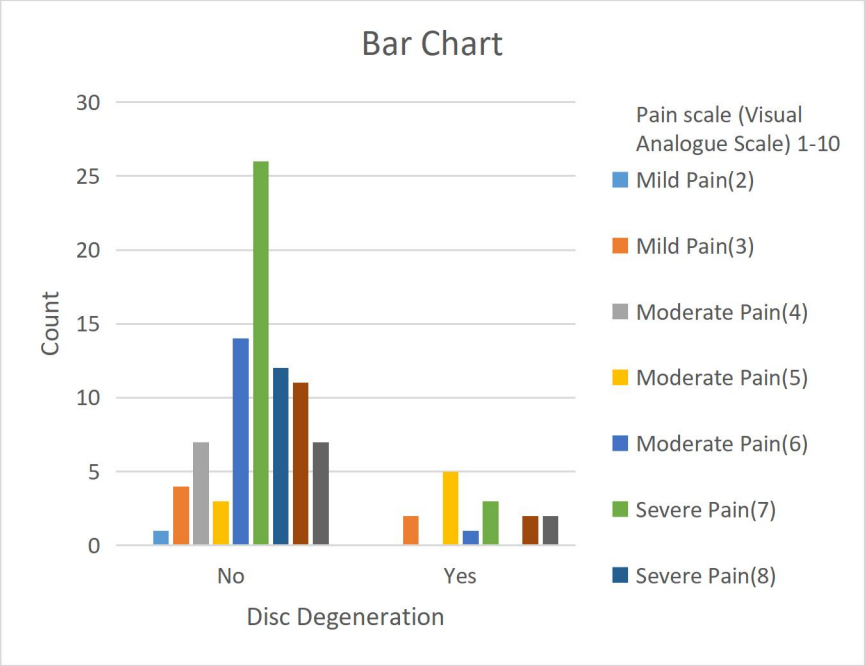
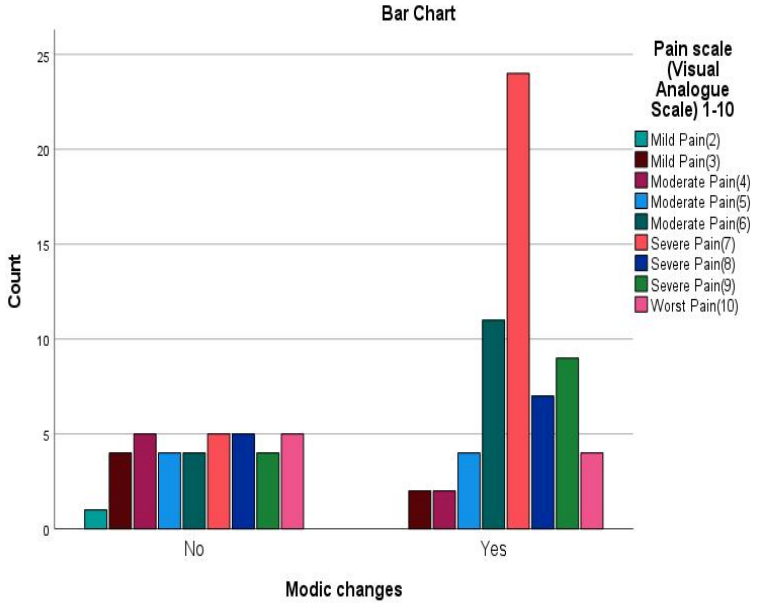
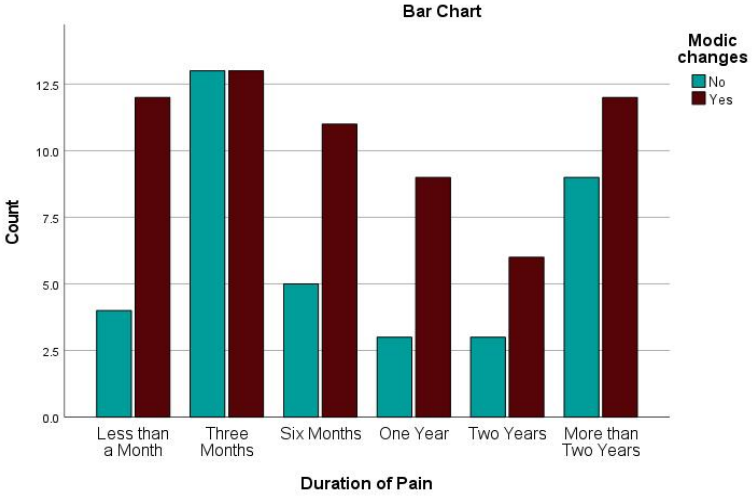


The bar chart illustrates the relationship between disc degeneration and pain intensity measured on a visual analogue scale (VAS). Individuals without disc degeneration predominantly reported severe pain (VAS 7), with fewer cases of extreme pain (VAS 8–10). In contrast, those with disc degeneration exhibited a broader range of pain levels, with higher frequencies of extreme pain (VAS 8–10). Mild (VAS 2–3) and moderate pain (VAS 4–6) were observed in both groups but were more frequent in individuals without degeneration. The results indicate that disc degeneration is strongly associated with increased pain severity, particularly at higher VAS levels.



This bar chart illustrates the distribution of pain levels, measured on a 1–10 Visual Analogue Scale (VAS), among individuals with and without Modic changes. The x-axis represents the presence of Modic changes ("Yes" or "No"), while the y-axis indicates the count of individuals.

For individuals without Modic changes, pain levels are distributed relatively evenly, with moderate to severe pain (scores 4–10) being more common. In contrast, individuals with Modic changes exhibit a significant concentration of severe pain (scores 7–10), with the highest count in the "Severe Pain (8)" category. This suggests an association between Modic changes and higher pain intensity.



The bar chart illustrates the correlation between the duration of pain and the presence of Modic changes in patients with chronic low back ache. Patients with a longer pain duration (e.g., "More than Two Years") exhibit a higher frequency of Modic changes ("Yes"), compared to those with shorter durations like "Less than a Month." The highest count of Modic changes is seen in the "Three Months" and "More than Two Years" groups. This pattern highlights a potential link between prolonged pain and degenerative changes observed in MRI findings, emphasizing the chronic nature of Modic changes in back pain pathology. The one-sample t-test showed significant results for the pain scale and disc degeneration. For the pain scale (VAS 1–10), the mean difference was 6.84, with a 95% confidence interval (CI) ranging from 6.45 to 7.23 ($t = 35.218$, $df = 99$, $p < 0.001$). This indicates a significantly high average pain level. Similarly, for disc degeneration, the mean difference was 0.15, with a 95% CI of 0.08 to 0.22 ($t = 4.180$, $df = 99$, $p < 0.001$), demonstrating a statistically significant presence of disc degeneration in the population studied.

The one-sample t-test revealed significant findings for Modic changes and BMI categories. Modic changes showed a mean difference of 0.63, with a 95% confidence interval (CI) between 0.53 and 0.73 ($t = 12.983$, $df = 99$, $p < 0.001$), indicating a prevalent occurrence in the sample. BMI categories displayed a mean difference of 2.32, with a 95% CI ranging from 2.20 to 2.43 ($t = 39.729$, $df = 99$, $p < 0.001$), reflecting a significant average BMI level in the study cohort. These results highlight the clinical relevance of Modic changes and BMI in the context of the study population.

Discussion

This study underscores the multifactorial nature of chronic low back ache (CLBA), with significant findings from MRI that correlate structural abnormalities with pain severity. Modic changes, observed in 63% of participants, were the most frequent MRI abnormality. Recent studies confirm the strong association between Modic changes and persistent low back pain, with their prevalence indicating disc degeneration and chronic inflammation as key contributors (1,2). Disc protrusion (59%) and radial angular tears (57%) were also prevalent. Similar findings in contemporary research highlight these abnormalities as primary causes of nerve root compression, radiating pain, and functional impairment. Targhade et al. emphasized the diagnostic significance of such findings in identifying candidates for surgical or conservative interventions (25). Muscle spasms, present in 52% of participants, reflect the interplay between mechanical strain and muscular adaptations in pain

chronicity, consistent with findings from Tagliaferri et al (26). The negative correlation between BMI and pain severity contradicts traditional assumptions, suggesting a complex interaction beyond mechanical stress alone. Studies by Shmagel et al. propose that lower BMI categories may experience heightened pain perception due to metabolic or neurogenic factors (27). Additionally, the association between prolonged pain durations and Modic changes highlights their role in chronicity, necessitating targeted treatment strategies.

Descriptive Statistics

The demographic characteristics of the study population indicate a broad age range of 12 to 70 years, with a mean age of 42.27 years (SD = 13.22), representing a middle-aged population commonly affected by chronic low back ache (CLBA). The average height was 166.30 cm (SD = 9.87), while the mean weight was 65.21 kg (SD = 6.60), resulting in an average BMI of 23.77 (SD = 3.29). These BMI values mostly fall within the normal range, suggesting that body weight may not be the primary mechanical cause of the observed back pain in this population. Pain intensity, as measured on the Visual Analogue Scale (VAS), ranged from 2 to 10, with an average score of 6.84 (SD = 1.94). This indicates that the majority of patients experienced moderate to severe pain. These findings provide a foundational understanding of the sample population's clinical characteristics, which are essential for correlating pain severity with specific MRI findings and other risk factors.

Gender Distribution

The study sample was well-balanced in terms of gender, with 49% males and 51% females. This near-equal distribution minimizes gender bias and enhances the reliability and generalizability of the findings across both groups. Gender-related differences in chronic low back pain have been documented in previous studies, with women more likely to report higher pain severity and chronicity due to hormonal and anatomical factors. The inclusion of both genders in almost equal proportions allows for a nuanced understanding of gender-specific patterns in CLBA and its underlying causes. This balanced representation is critical for identifying potential differences in pain perception, response to treatment, and prevalence of structural abnormalities on MRI.

Pain Scale (VAS 1–10)

The pain scale distribution highlights the predominance of severe pain among participants. Severe pain (VAS 7) was the most frequently reported, affecting 29% of the population, while 15% reported moderate pain (VAS 6). Only 7% experienced mild pain (VAS 2–3), while the worst pain (VAS 10) was noted by 9%. This skew toward higher pain levels underscores the chronic and debilitating nature of CLBA in this population. Pain severity is a crucial parameter for assessing the impact of MRI-detected structural abnormalities. For instance, severe pain is often associated with advanced Modic changes, disc protrusion, and nerve root compression, as observed in this study. The high prevalence of severe pain justifies the need for targeted diagnostic and therapeutic interventions.

Area of Pain

Lower back pain alone was the most common complaint, affecting 32% of participants. Pain radiating to the right leg (22%) and left leg (17%) was also frequently reported, while 11% experienced pain radiating to both legs. These findings highlight the complexity of CLBA, with many patients presenting with radicular symptoms suggestive of nerve root involvement. The distribution pattern of pain provides valuable clues for diagnosing specific structural abnormalities. For instance, unilateral leg pain is often associated with disc protrusion or spinal canal stenosis on the affected side, while bilateral leg pain may indicate more extensive spinal canal narrowing or advanced degenerative changes.

Duration of Pain

The duration of symptoms varied considerably, with 26% of patients experiencing pain for three months and 21% reporting symptoms for more than two years. Pain duration between six months and one year was less common, reported by 16% and 12%, respectively. These findings illustrate the chronicity

of CLBA, with a substantial proportion of patients suffering from prolonged symptoms. Notably, Modic changes were more frequently observed in patients with longer pain durations, supporting the hypothesis that chronic pain is closely linked to progressive structural degeneration. Understanding pain duration is essential for tailoring treatment strategies, as chronic pain often requires multimodal management approaches that address both structural and psychological components.

Disc Degeneration

Disc degeneration was present in 15% of participants, while 85% showed no signs of degeneration on MRI. Despite the relatively low prevalence in this population, disc degeneration remains a crucial factor in chronic low back ache (CLBA). Degeneration of the intervertebral discs can lead to loss of disc height, altered biomechanics, and increased stress on adjacent vertebrae, contributing to progressive pain and disability. Although the absence of degeneration in 85% of participants may suggest other causes for their pain, it is possible that early degenerative changes, not easily visible on imaging, are still contributing to their symptoms. Degenerative disc disease often coexists with other abnormalities such as Modic changes or disc protrusion, which may explain the significant pain levels reported in this population. Clinically, identifying disc degeneration is important as it influences decisions regarding treatment options, from physical therapy to more advanced interventions like spinal injections or surgery.

Facet Joint Arthritis

Facet joint arthritis was observed in only 6% of participants, indicating that it is relatively uncommon in this cohort compared to other structural abnormalities. The facet joints, which provide stability and limit excessive motion in the spine, are frequently affected by degenerative changes, especially in older adults. While the low prevalence of arthritis in this study may reflect the younger mean age of the population (42.27 years), it is still a notable finding in patients reporting severe pain. Facet joint arthritis can cause localized pain and stiffness, often worsened by extension or rotation movements. In clinical practice, facet joint arthritis should be considered a potential source of pain in patients with non-radicular symptoms. Diagnosis is typically confirmed through imaging and, in some cases, diagnostic facet joint injections.

Modic Changes

Modic changes were the most common MRI abnormality, present in 63% of participants. These changes, classified into three types (I, II, and III), are associated with vertebral endplate degeneration and chronic inflammation. Type I Modic changes, indicative of active inflammation, are strongly correlated with pain, while Type II and III represent fatty and sclerotic changes, respectively. The high prevalence of Modic changes in this population aligns with previous research linking them to chronic discogenic pain and poor treatment outcomes. The association between prolonged pain duration and Modic changes in this study suggests that these changes may not only reflect structural damage but also contribute to the persistence of symptoms. Clinicians should carefully assess for Modic changes when evaluating patients with CLBA, as their presence may warrant specific treatments such as anti-inflammatory medications or spinal stabilization strategies.

Lumbar Spondylosis

Lumbar spondylosis was identified in 16% of participants, indicating a modest prevalence in this cohort. Lumbar spondylosis encompasses a range of degenerative changes, including disc space narrowing, osteophyte formation, and facet joint hypertrophy. These changes can cause significant pain and disability, particularly when they result in spinal instability or nerve compression. Although lumbar spondylosis is often an age-related condition, its presence in younger patients highlights the potential role of genetic predisposition, repetitive stress, or biomechanical factors. Clinically, lumbar spondylosis should be considered in patients presenting with chronic axial back pain and stiffness. Imaging is crucial for confirming the diagnosis and differentiating it from other causes such as disc degeneration or spinal stenosis.

Spinal Canal Stenosis

Spinal canal stenosis was observed in 23% of participants, making it one of the more common structural abnormalities in this study. Spinal stenosis, characterized by the narrowing of the spinal canal, can compress neural structures and cause a range of symptoms, from localized back pain to radicular pain and neurogenic claudication. Patients with spinal stenosis often report worsening symptoms with prolonged standing or walking, relieved by sitting or flexing the spine. The relatively high prevalence of spinal stenosis in this cohort underscores its importance as a cause of CLBA. Clinicians should maintain a high index of suspicion for spinal stenosis in patients with radicular symptoms, particularly those with pain radiating to both legs. Treatment typically includes physical therapy, epidural steroid injections, and, in severe cases, surgical decompression.

Radial Annular Tear

Radial annular tears were present in 57% of participants, indicating a significant prevalence. These tears occur within the annulus fibrosus of the intervertebral disc and are commonly associated with discogenic pain. Radial tears can compromise the structural integrity of the disc, leading to disc herniation or degeneration over time. Clinically, patients with radial tears often present with localized axial pain exacerbated by flexion and loading activities. MRI is the gold standard for detecting these tears, and their high prevalence in this cohort highlights the importance of detailed imaging in diagnosing underlying causes of CLBA. While conservative management is usually the first line of treatment, persistent pain may require more advanced interventions such as intradiscal therapy or minimally invasive surgery.

Osteophyte Formation

Osteophyte formation was found in 15% of participants. These bony outgrowths develop along the edges of vertebrae in response to chronic stress and degeneration. Although osteophytes are often asymptomatic, they can cause significant pain when they impinge on surrounding soft tissues or nerves. The relatively low prevalence of osteophytes in this study may be due to the younger age range of participants, as these changes are typically more common in older populations. However, in patients with symptoms of spinal stiffness or nerve irritation, osteophytes should be considered as a potential contributing factor. Imaging plays a crucial role in identifying their location and impact on adjacent structures.

Nerve Root Narrowing

Nerve root narrowing was observed in 21% of participants. This condition, often caused by disc herniation, spinal stenosis, or osteophyte formation, can lead to radicular pain, weakness, and sensory disturbances. The relatively high prevalence of nerve root narrowing in this study highlights its role as a significant contributor to CLBA. Patients with nerve root compression typically present with radiating pain following a dermatomal pattern, and MRI is essential for confirming the diagnosis and guiding treatment. Management options include physical therapy, nerve root blocks, and surgical decompression for refractory cases.

Disc Protrusion

Disc protrusion was present in 59% of participants, making it one of the most common findings in this study. Disc protrusion occurs when the nucleus pulposus extends beyond its normal boundary, causing localized or radicular pain depending on its size and location. This high prevalence underscores the importance of detailed imaging in identifying disc pathology in patients with CLBA. Clinically, disc protrusion can range from asymptomatic to severely disabling. Treatment should be tailored to the severity of symptoms, with conservative management often effective in milder cases, while more advanced cases may require surgical intervention.

Osteoporosis

Osteoporosis was present in only 10% of participants, indicating that it is relatively rare in this population. As a condition characterized by reduced bone mass and microarchitectural deterioration, osteoporosis increases the risk of vertebral fractures, which can cause acute or chronic back pain. Although the prevalence is low in this study, osteoporosis should still be considered,

particularly in patients with persistent pain and no obvious structural abnormalities on MRI. Clinicians should be vigilant in screening for osteoporosis in high-risk populations, such as postmenopausal women and individuals with a history of steroid use or low body weight. Diagnosis is typically confirmed through dual-energy X-ray absorptiometry (DEXA), and treatment includes calcium and vitamin D supplementation, bisphosphonates, and lifestyle modifications.

Muscle Spasm

Muscle spasms were reported by 52% of participants, highlighting the significant role of soft tissue involvement in chronic low back ache (CLBA). Muscle spasms can result from underlying structural abnormalities such as disc protrusion or spinal stenosis, or they can be a primary cause of pain due to prolonged tension and fatigue in the paraspinal muscles. Clinically, patients often present with localized muscle tenderness and restricted range of motion. While muscle spasms may not show up on MRI, their contribution to pain and disability should not be underestimated. Treatment typically involves a combination of physical therapy, muscle relaxants, and exercises to strengthen the core and improve flexibility. Given the high prevalence of muscle spasms in this study, addressing these factors is crucial for a comprehensive approach to CLBA management.

Correlation Between Pain Severity and BMI

A significant negative correlation ($r = -0.222$, $p = 0.027$) was found between pain severity and BMI, suggesting that individuals with lower BMI reported higher pain intensity. This finding challenges the traditional view that higher BMI correlates with greater mechanical stress and increased back pain. Instead, it aligns with recent studies suggesting that individuals with lower BMI may have heightened pain sensitivity or underlying metabolic or neurogenic factors contributing to pain perception. This finding emphasizes the need for a more nuanced approach when assessing the role of BMI in CLBA, taking into consideration not only mechanical but also metabolic and neurological influences.

Correlation Between Pain Duration and Modic Changes

The crosstabulation analysis revealed a strong association between prolonged pain duration and the presence of Modic changes. Among patients with Modic changes, the highest prevalence was observed in those reporting pain durations of more than two years and less than one month (each group accounting for 12 cases). This bimodal distribution suggests that Modic changes may either develop early in the course of chronic low back pain or persist and worsen over time in untreated cases. Modic changes, particularly Type I, are known to be associated with ongoing inflammation and discogenic pain, which may explain their link to prolonged pain duration in this study. Clinicians should be aware of this relationship, as the presence of Modic changes could indicate a more refractory form of CLBA that requires aggressive management.

Duration of Pain and Clinical Implications

Pain duration data offers valuable insights into the chronicity of CLBA. While 26% of participants reported symptoms lasting three months, 21% had been suffering for over two years, indicating a substantial proportion of patients with chronic, long-standing symptoms. These findings reflect the natural progression of CLBA, where acute pain episodes may develop into chronic conditions without proper intervention. Prolonged pain duration often leads to structural changes such as Modic changes and disc degeneration, further complicating treatment. Clinicians should prioritize early identification and intervention in patients with acute pain to prevent chronicity and associated complications. For those with long-standing pain, a multidisciplinary approach that includes physical therapy, pharmacologic management, and psychological support is often necessary.

T-Test Results for Pain Scale and Disc Degeneration

The one-sample t-test revealed significant findings for both pain severity and disc degeneration. The mean pain scale score was 6.84, with a 95% confidence interval (CI) ranging from 6.45 to 7.23 ($t = 35.218$, $p < 0.001$), indicating a high average pain level among participants. Disc degeneration

showed a mean difference of 0.15 (95% CI: 0.08 to 0.22, $t = 4.180$, $p < 0.001$), confirming its statistical significance in the population. These results suggest that disc degeneration is a key contributor to the high pain levels observed, reinforcing its clinical relevance in the assessment and management of CLBA.

T-Test Results for Modic Changes and BMI

The t-test for Modic changes revealed a mean difference of 0.63 (95% CI: 0.53 to 0.73, $t = 12.983$, $p < 0.001$), confirming the high prevalence of Modic changes in the study population. This finding is consistent with the known association between Modic changes and chronic pain. Additionally, the mean BMI category difference of 2.32 (95% CI: 2.20 to 2.43, $t = 39.729$, $p < 0.001$) reflects the overall healthy BMI range in the cohort. These results underscore the clinical significance of Modic changes and suggest that BMI may play a complex role in pain perception and progression, beyond simple mechanical factors.

Clinical Relevance and Future Directions

This comprehensive evaluation of MRI findings and clinical characteristics in patients with chronic low back ache highlights the multifactorial nature of the condition. Structural abnormalities such as Modic changes, disc protrusion, and spinal canal stenosis are key contributors to pain and disability, while muscle spasms and metabolic factors like BMI also play significant roles. These findings emphasize the importance of a multidisciplinary approach that integrates advanced imaging, physical therapy, and tailored pharmacologic interventions. Future research should focus on longitudinal studies to better understand the progression of these abnormalities and their response to various treatments.

These findings emphasize the importance of personalized diagnostic and therapeutic approaches. While MRI remains pivotal in identifying structural causes of CLBA, further longitudinal studies are essential to evaluate outcomes and refine management guidelines, particularly in relation to Modic changes, disc pathologies, and associated muscular factors.

Conclusion

This study highlights the intricate interplay of structural abnormalities, patient demographics, and pain characteristics in chronic low back ache (CLBA). Among the 100 participants, MRI findings revealed Modic changes (63%), disc protrusion (59%), and radial angular tears (57%) as the most prevalent structural abnormalities, underscoring their role in the pathophysiology of CLBA. Muscle spasms (52%) and pain radiating to the lower extremities further emphasize the involvement of soft tissues and neural components in the clinical presentation.

Pain intensity, predominantly severe (VAS 7–10), and its duration were closely linked to MRI findings. Modic changes were more prevalent in patients with prolonged pain, particularly those exceeding two years, highlighting the degenerative and chronic nature of this condition. While BMI exhibited an inverse relationship with pain severity, the findings challenge conventional theories of mechanical stress as the sole contributor, pointing to a multifaceted interaction of metabolic and neurogenic factors.

These findings underscore the importance of individualized diagnostic and therapeutic strategies. MRI serves as a critical tool in identifying specific structural causes, enabling targeted interventions. The study also highlights the need for multidisciplinary approaches that address not only anatomical changes but also muscular, neural, and metabolic contributors to CLBA.

Future longitudinal studies are essential to explore the causative relationships between structural abnormalities and pain progression. Evaluating the impact of tailored interventions based on MRI findings will further refine management strategies, ultimately improving quality of life for individuals suffering from chronic low back ache.

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