DOI:https://doi.org/10.53350/pjmhs20231710164

ORIGINAL ARTICLE

Evaluation of MRI Findings in Patients with Non-Traumatic Low Back Pain and Their Correlation with Clinical Disability Scores

AZQA ZAFAR[1], SHUMAILA RANA[2], UZMA ZAMAN[3], KALSOOM ANJUM[4], AKHTER JAVED[5], HUSNAIN HASHIM[6]
[1]*Department of Radiology. Al-Aleem Medical College/Gulab Devi Teaching Hospital Lahore, Pakistan*
[2]*Consultant Radiologist, Islamabad Diagnostic Center, Lahore, Pakistan*
[3]*Consultant Radiologist, Mid-City Hospital, Lahore, Pakistan*
[4]*Charge Nurse, Department of Radiology, Children's Hospital Lahore, Pakistan*
[5]*Senior Medical Imaging Technologist, Department of Radiology, Children's Hospital Lahore, Pakistan*
[6]*Consultant Neurologist & Stroke Specialist, Neurology Department, Fauji Foundation Hospital, Rawalpindi, Pakistan*
Correspondence to: Shumaila Rana, Email: Shumailarana443@gmail.com

ABSTRACT

Background: Low back pain (LBP) is one of the major causes of functional disability worldwide and is among the most common musculoskeletal disorders. Magnetic resonance imaging (MRI) is used extensively to detect spinal abnormalities, but many MRI findings have clinical significance that is controversial because degenerative changes are present in virtually all asymptomatic people.

Aims and Objectives: The purpose of this study was to examine MRI findings of patients with non-traumatic LBP and compare them to the clinical disability score measured by the Oswestry Disability Index (ODI). And the study also looked at the relationship of inflammatory biomarkers and demographic factors with disability severity.

Methodology: This was a cross-sectional study conducted at Gulab Devi Teaching Hospital and Children's Hospital, Lahore, Pakistan, between July 2022 and July 2023. There were 80 patients ranging from 20 to 70 years suffering from non-traumatic LBP. The ODI was used for clinical disability assessment. Lumbar spine MRI was performed to measure disc degeneration, bulge, herniation, spinal stenosis, and facet arthropathy. High sensitivity C-reactive protein (hs-CRP), erythrocyte sedimentation rate (ESR), interleukin 6 (IL-6), tumor necrosis factor alpha (TNF-α), and vitamin D levels were analyzed in the blood samples. These statistical correlations were assessed using SPSS v 25.0.

Results: Of all the MRI findings, the most common were disc degeneration (77.5%) and bulge (60%). Significant positive correlation was found with ODI scores for the negative cases between ODI scores and disc herniation ($p < 0.001$) and spinal stenosis ($p = 0.002$). A moderate association with elevated hs-CRP and IL-6 was found with higher disability. Other risk factors included older age, diabetes, smoking, and manual labor occupations.

Conclusion: Key predictors of disability in non-traumatic LBP are disc herniation, spinal stenosis, and elevated inflammatory markers. Clinical, imaging, and laboratory assessments are used to better manage patients.

Keywords: Low back pain, MRI, Oswestry Disability Index, disc herniation, spinal stenosis, biomarkers

INTRODUCTION

LBP is one of the most common musculoskeletal complaints worldwide, and it affects people of all ages and socioeconomic levels. Based on estimates, it is believed that almost 60–80% of the adult population will have at least one episode of LBP at some point in their lifetime. Low back pain is a leading cause of disability, reduced quality of life, work absenteeism, and healthcare expenditure, and therefore is a major public health problem. A large proportion of LBP cases are non-traumatic, which implies that they have not occurred due to an acute injury or trauma. Most of the cases are the result of degeneration of aging, poor posture, mechanical strain, or underlying spinal abnormality [1, 2].

In recent years, magnetic resonance imaging (MRI) has become the method of choice in evaluating LBP because of its high soft tissue resolution and capability to detect early degenerative, inflammatory, infectious, or neoplastic spinal pathologies [3]. As it offers detailed visualization of the intervertebral discs, vertebral bodies, spinal canal, nerve roots, facet joints, ligaments, and paraspinal muscles, an MRI is hugely useful for diagnosing structural causes of LBP. MRI findings in nontraumatic LBP include disc degeneration, disc bulge, disc herniation, Modic endplate changes, spinal canal stenosis, and facet joint arthropathy [4].

Although MRI has become increasingly utilized in clinical practice, several studies have reported poor correlation between structural abnormalities on MRI and reported clinical symptoms by patients. Asymptomatic people often have degenerative changes of disc bulging, disc desiccation, and facet joint hypertrophy. It invites consideration about the clinical relevance of the MRI findings and their propensity to overdiagnosis, unnecessary treatments, and patient anxiety [5].

Clinical disability scoring systems like the Oswestry Disability Index (ODI) have been developed to better assess the impact of LBP on patients' daily lives. The ODI is a widely used validated tool of functional disability to LBP as measured by the pain intensity and its effect on activities of walking, sitting, standing, personal care, lifting, social life, and traveling. This enables clinicians to quantify the severity of disability, monitor therapeutic outcomes, and make treatment decisions [6].

Improvement of the diagnostic approach to non-traumatic LBP requires understanding the relationship between MRI findings and clinical disability scores. Such imaging abnormalities can be identified that are clinically significant to help optimize patient management, avoid unnecessary imaging or surgical intervention, and aid in counseling patients. Although several international studies have examined this relationship, there is little data concerning this population in South Asia, where demographic, occupational, and health care access factors may impact the LBP presentation and management [7, 8].

The current study aimed to evaluate the MRI findings in patients with non-traumatic low back pain and to correlate them with clinical disability, as measured by the ODI. These study's findings are aimed to improve understanding of the clinical value of MRI, providing more accurate diagnosis, and providing evidence-based management strategies for non-traumatic LBP [9].

MATERIALS AND METHODS

The study was performed as a cross-sectional observational study in Gulab Devi Teaching Hospital, Lahore, and Children's Hospital, Lahore, Pakistan, during July 2022 to July 2023. Ethical approval was obtained from the institutional review boards and all participants before enrolment.

Study Population: In all, 80 patients of ages ranging from 20 to 70 years, in whom the LBP was non-traumatic and prolonged for longer than six weeks, were included in the study. Detailed clinical evaluation, MRI scanning, and biomarker assessment were performed on all patients. Consecutive recruitment of patients was

Received on 11-08-2023
Accepted on 20-09-2023

used to avoid selection bias and to representatively sample patients.

Inclusion and Exclusion Criteria: If patients were adults between 20 and 70 years of age, had nontraumatic LBP of at least six weeks' duration, and no history of previous lumbar spine surgery, and they were able to give informed consent, they were included. Also, they had to fill out Oswestry Disability Index (ODI) questionnaires to assess clinical disability. Other exclusion criteria included patients with a history of acute spinal trauma, known spinal tumours or malignancies, spinal infection (e.g. spondylodiscitis, tuberculosis), inflammatory spinal disease (e.g. ankylosing spondylitis), severe neurological deficit necessitating urgent surgery (e.g. cauda equina syndrome) due to disease, pregnancy or systemic inflammatory or infectious diseases which might influence biomarker levels.

Sample Size and Power Analysis: An a priori power analysis was used to calculate sample size. The minimally required sample size was estimated assuming a moderate correlation ($r \approx 0.3$) between the MRI findings, biomarkers, and disability scores, a significance level (α) of 0.05, and a statistical power ($1-\beta$) of 0.80, and was computed to be 67 participants for the same. To allow for possible dropouts or incomplete data, and to have adequate statistical power, the final sample size was augmented to 80 patients.

Clinical Evaluation: Detailed history taking and physical examination, as well as documentation of (1) symptom duration, (2) pain intensity, and (3) neurological signs, were performed on all participants. The Oswestry Disability Index (ODI) was used to assess functional disability in the domains of pain intensity, personal care, lifting, walking, sitting, standing, sleeping, social life, travelling, and employment. Minimal, moderate, severe and crippled disability levels were assigned to ODI scores.

MRI Protocol: Thus, MRI of the lumbar spine was done using a 1.5 Tesla MRI scanner first at Children's Hospital and second at Gulab Devi Teaching Hospital. T1 and T2-weighted sagittal and axial images were obtained as standard MRI sequences. Disc degeneration (Pfirrmann grading), disc bulge, disc hernia (protrusion, extrusion, sequestration), spinal canal stenosis, facet arthritis, Modic changes in endplate, and nerve root compression were assessed with MRI. All MRI scans were evaluated by two experienced radiologists, blinded to the clinical and biomarker data.

Biomarker Assessment: All patients were also bled to investigate putative biochemical markers of LBP and spinal degeneration. High sensitivity C-reactive protein (hs CRP) as a systemic inflammatory marker, erythrocyte sedimentation rate (ESR), IL6, TNF α, and serum vitamin D levels were biomarkers assessed. The standard methods and assays were used at the central hospital laboratory for analysis of all blood samples. The biomarker levels were compared to ODI scores and MRI findings to find potential biochemical correlates for pain and disability.

Statistical Analysis: SPSS version 25 was used for data analysis. Mean ± standard deviation were presented for continuous variables, and frequencies and percentages for categorical variables. Pearson's or Spearman's correlation coefficients, by data distribution, were used to assess the correlation between MRI findings, biomarkers, and ODI scores. Independent sample t tests, chi-square tests, or ANOVA were used to analyze comparisons between groups as appropriate. Statistically significant values were considered to have p p-value less than 0.05.

RESULTS

Eighty patients were enrolled in the study with a mean age of 46.8 ± 11.2 years. Thus, the study population consisted of 44 males (55%) and 36 females (45%). Most (72.5%) of the patients were married, and the majority were from an urban background (65%), while the remaining 35% were from rural backgrounds. The mean body mass index was 26.7 ± 3.4 kg/m², and thus, there was a majority of overweight participants. The mean duration of the low back pain symptoms was 14.6 ± 7.3 weeks. As far as occupation was concerned, 40 percent were manual labourers, 35 percent office workers, and 25 percent homemakers or retired. In 30%, smoking, 15%, diabetes, and 10%, hypertension were reported. Overall, the Oswestry Disability Index (ODI) mean score of 38.5 ± 15.7 was moderate disability.

Demographic and Clinical Characteristics: Detailed demographic and clinical features of the study population are summarized in Table 1. Mean age and BMI values were similar in males and females, and a difference in smoking (p = 0.03) was found only in males. For example, ODI scores were similar in the genders (p = 0.28) but were higher in older patients (p = 0.03), smokers (p = 0.003), and in patients with diabetes (p = 0.016 for each).

Table 1: Demographic and Clinical Characteristics of the Study Population

Characteristic	Total (n = 80)	Male (n = 44)	Female (n = 36)	p-value
Age (years)	46.8 ± 11.2	47.5 ± 10.8	46.0 ± 11.7	0.52
BMI (kg/m²)	26.7 ± 3.4	26.9 ± 3.2	26.4 ± 3.6	0.58
Urban residence (%)	52 (65%)	28 (63.6%)	24 (66.7%)	0.78
Married (%)	58 (72.5%)	33 (75.0%)	25 (69.4%)	0.56
Occupation (%)	Manual labor 32 (40%)	Office worker 28 (35%)	Homemaker/retired 20 (25%)	—
Smoking (%)	24 (30%)	19 (43.2%)	5 (13.9%)	0.03*
Diabetes (%)	12 (15%)	7 (15.9%)	5 (13.9%)	0.80
Hypertension (%)	8 (10%)	5 (11.4%)	3 (8.3%)	0.66
ODI score	38.5 ± 15.7	39.6 ± 14.9	37.2 ± 16.6	0.28

*Significant p-value < 0.05

Table 2: MRI Findings in the Study Population

MRI Finding	Total (n = 80)	Male (n = 44)	Female (n = 36)	p-value
Disc degeneration	62 (77.5%)	35 (79.5%)	27 (75.0%)	0.64
Disc bulge	48 (60.0%)	28 (63.6%)	20 (55.6%)	0.44
Disc herniation	26 (32.5%)	17 (38.6%)	9 (25.0%)	0.09
Spinal stenosis	22 (27.5%)	13 (29.5%)	9 (25.0%)	0.66
Facet arthropathy	30 (37.5%)	16 (36.4%)	14 (38.9%)	0.81
Modic changes	14 (17.5%)	8 (18.2%)	6 (16.7%)	0.85

MRI Findings: Table 2 shows the distribution of MRI abnormalities among the patients. The most common finding was disc degeneration (77.5%), followed by disc bulge (60%), disc herniation (32.5%), spinal canal stenosis (27.5%), facet joint arthropathy (37.5%), and Modic changes (17.5%). Older patients and those with a manual labour occupation were slightly more likely to have disc herniation or spinal stenosis, but the differences were not statistically significant (p = 0.07; p = 0.09).

Biomarker Profiles: Table 3 presents the laboratory biomarker findings. Elevated hs-CRP was observed in 35% of patients, elevated ESR in 40%, raised IL-6 in 22.5%, elevated TNF-α in 20%, and vitamin D deficiency in 50%. Patients with diabetes had significantly higher hs-CRP and ESR levels (p < 0.01), and

smokers showed elevated inflammatory markers compared to non-smokers.

Table 3: Biomarker Levels in the Study Population

Biomarker	Abnormal (%)	Mean ± SD
hs-CRP	28 (35.0%)	4.6 ± 2.1 mg/L
ESR	32 (40.0%)	28.4 ± 9.6 mm/hr
IL-6	18 (22.5%)	12.8 ± 5.3 pg/mL
TNF-α	16 (20.0%)	18.7 ± 6.5 pg/mL
Vitamin D deficiency	40 (50.0%)	18.6 ± 7.4 ng/mL

Correlation Between MRI Findings, Biomarkers, and ODI Scores: A good correlation ($r = 0.51$, $p < 0.001$) between ODI scores and disc herniation and a correlation ($r = 0.47$, $p = 0.002$) between ODI scores and spinal canal stenosis were found. Moderate correlation existed between hs-CRP and IL-6 and disability scores ($r = 0.42$, $p < 0.01$ and $r = 0.38$, $p < 0.01$, respectively). Some mild degenerative changes and facet joint arthropathy showed weak correlation with ODI scores ($p > 0.05$). High disability levels were also modestly associated with older age, smoking, and diabetes.

The current study finally shows a strong correlation between functional disability and disc herniation and spinal stenosis on MRI in non-traumatic LBP. Those with elevated hs-CRP and IL-6 levels had worse clinical disability. In addition to demographic factors of older age, smoking, manual labor occupation, diabetes, and higher disability scores were associated with. Common degenerative MRI findings (facet joint changes and mild degenerative changes) were not predictive of clinical severity.

DISCUSSION

The purpose of the present study was to evaluate MRI findings in LBP patients without a history of trauma and to correlate them with ODI clinical disability scores. In addition, it examined how demographic factors or biochemical markers correlate with clinical outcomes. This study also generated several important observations related to the clinical relevance of MRI findings and inflammatory biomarkers in LBP. [10].

As expected, the most common MRI finding in this study was disc degeneration in 77.89%, followed by disc bulge in 60.02% and disc herniation in 32.5%. Although moderate disc degeneration and disc bulging were routinely seen on MRI, there was no association between these findings and the ODI result, implying that moderate disc degeneration and/or disc bulging tend to be age-related characteristics and not necessarily indicators of clinical disability. This matches previous studies that have demonstrated that such degenerative MRI findings are not uncommon in asymptomatic people and do not necessarily correlate with pathological pain generators [11].

On the one hand, both disc herniation and spinal canal stenosis were strongly and statistically significantly correlated with clinical disability, indicating their role as structural contributors to pain and functional impairment. These findings are consistent with several other international studies, which have demonstrated that degenerative changes alone on MRI are less predictive of severe pain, neurological symptoms, and disablement than these disorders of nerve root compression and thecal sac impingement [12].

The biochemical markers added additional value to the study. High levels of hs-CRP and IL-6 were found to be significantly correlated with higher ODI scores, irrespective of gender and BMI, and thus may represent a role of systemic inflammation in the severity of LBP. Research has shown that inflammatory cytokines may be involved in the pain from discogenic pain, radiculopathy, and the sensitization of nociceptive pathways. It is noteworthy that in this cohort, there is a high prevalence of vitamin D deficiency (50%), which is known to be linked to musculoskeletal health despite an equivocal relationship with LBP severity [13, 14].

There was a modest association between disability scores and older age, smoking, and diabetes. More severe MRI findings and higher ODI scores were associated with occupations that place more mechanical stress on the spine, these occupations were termed as manual labor occupations. These observations underscore the multiple factors involved in the pathogenesis of LBP, which include mechanical, structural, inflammatory, and lifestyle-related factors, all affect clinical outcome [15].

In general, Modic changes and facet joint arthropathy did not correlate with disability levels, and their clinical impact was relatively low. This underscores the need for careful interpretation of MRI reports, especially in highlighting incidental degenerative findings that could result in unnecessary interventions and cause patient anxiety [16].

The study's strengths include the use of imaging and biochemical assessment, and blinded assessment of MRI scans and clinical disability scores. For example, the study is limited by its cross-sectional design, which prevents causal inference, and the relatively small sample size that might limit the generalizability of the findings. Therefore, we aim for future research with larger multicenter cohorts and longitudinal follow-up to extend these insights on the prognostic value of MRI and biomarkers in LBP [17].

CONCLUSION

The purpose of this study was to demonstrate that in patients with non-traumatic low back pain, MRI findings of disc herniation and spinal canal stenosis are strongly correlated with clinical disability (Oswestry disability index). Contrary to this, mild degenerative changes, such as disc bulge and facet joint arthropathy, are common incidental findings that do not predict the severity of disability. Moderate associations between the inflammatory biomarkers hs-CRP and IL-6, and worse clinical outcomes, suggest a potential association of systemic inflammation with LBP. Demographic factors like older age, smoking, diabetes, and manual labor are associated with increased disability. These findings emphasise the need to comprehensively assess (including clinical, imaging, and laboratory) LBP patients. MRI judiciously applied and interpretations thereof in the context of the findings can better inform more patient-centered care and help prevent overdiagnosis and unnecessary intervention.

Funding: No funding was received.

Conflict of interest: The Authors declared no conflict of interest.

Authors contribution: All authors contributed equally to the current study.

Acknowledgment: We acknowledge our colleagues and paramedical staff for supporting us and making the study possible.

REFERENCES

1. Singh N, Singh DK. MRI spectrum and prevalence of lumbar spinal degenerative disease in patients with non-traumatic low back pain. Romanian Neurosurgery. 2020:427-33.
2. Nigam A, Sahu P. Radio-pathologic Evaluation of Non-Traumatic Low Backache in Young Adults (20-40 years). Journal of Medical Science and Clinical Research. 2017;5(1):14-48.
3. De Pauw R, Coppieters I, Meeus M, Caeyenberghs K, Danneels L, Cagnie B. Is traumatic and non-traumatic neck pain associated with brain alterations?–A systematic review. 2017.
4. He B, Sheldrick K, Das A, Diwan A. Clinical and research MRI techniques for assessing spinal cord integrity in degenerative cervical myelopathy—a scoping review. Biomedicines. 2022;10(10):2621.
5. de Rezende Pinto WBV, de Souza PVS, de Albuquerque MVC, Dutra LA, Pedroso JL, Barsottini OGP. Clinical and epidemiological profiles of non-traumatic myelopathies. Arquivos de Neuro-Psiquiatria. 2016;74(02):161-5.
6. Ris I, Juul-Kristensen B, Boyle E, Kongsted A, Manniche C, Søgaard K. Chronic neck pain patients with traumatic or non-traumatic onset: Differences in characteristics. A cross-sectional study. Scandinavian journal of pain. 2017;14(1):1-8.
7. Zhu GC, Böttger K, Slater H, Cook C, Farrell SF, Hailey L, et al. Concurrent validity of a low-cost and time-efficient clinical sensory test battery to evaluate somatosensory dysfunction. European Journal of Pain. 2019;23(10):1826-38.

8. Lee Y-H, Lee KM, Auh Q-S. MRI-based assessment of masticatory muscle changes in TMD patients after whiplash injury. Journal of Clinical Medicine. 2021;10(7):1404.
9. Telles S, Bhardwaj AK, Gupta RK, Sharma SK, Monro R, Balkrishna A. A randomized controlled trial to assess pain and magnetic resonance imaging-based (MRI-based) structural spine changes in low back pain patients after yoga practice. Medical Science Monitor: International Medical Journal of Experimental and Clinical Research. 2016;22:3238.
10. Narvani A, Imam M, Godenèche A, Calvo E, Corbett S, Wallace A, et al. Degenerative rotator cuff tear, repair or not repair? A review of current evidence. The Annals of The Royal College of Surgeons of England. 2020;102(4):248-55.
11. de Vries J, Ischebeck B, Voogt L, Van Der Geest J, Janssen M, Frens M, et al. Joint position sense error in people with neck pain: a systematic review. Manual therapy. 2015;20(6):736-44.
12. Pinto WBVdR, Souza PVSd, Albuquerque MVCd, Dutra LA, Pedroso JL, Barsottini OGP. Clinical and epidemiological profiles of non-traumatic myelopathies. Arquivos de Neuro-Psiquiatria. 2016;74:161-5.
13. Gedde MH, Lilleberg HS, Aßmus J, Gilhus NE, Rekand T. Traumatic vs non-traumatic spinal cord injury: A comparison of primary rehabilitation outcomes and complications during hospitalization. The journal of spinal cord medicine. 2019;42(6):695-701.
14. Castro-Sánchez AM, Lara-Palomo IC, Matarán-Peñarrocha GA, Fernández-De-Las-Peñas C, Saavedra-Hernández M, Cleland J, et al. Short-term effectiveness of spinal manipulative therapy versus functional technique in patients with chronic nonspecific low back pain: a pragmatic randomized controlled trial. The Spine Journal. 2016;16(3):302-12.
15. Fortin M, Wilk N, Dobrescu O, Martel P, Santaguida C, Weber MH. Relationship between cervical muscle morphology evaluated by MRI, cervical muscle strength, and functional outcomes in patients with degenerative cervical myelopathy. Musculoskeletal Science and Practice. 2018;38:1-7.
16. Cloney M, Smith AC, Coffey T, Paliwal M, Dhaher Y, Parrish T, et al. Fatty infiltration of the cervical multifidus musculature and its clinical correlates in spondylotic myelopathy. Journal of Clinical Neuroscience. 2018;57:208-13.
17. Kakadiya G, Gohil K, Soni Y, Shakya A. Clinical, radiological and functional results of transforaminal lumbar interbody fusion in degenerative spondylolisthesis. North American Spine Society Journal (NASSJ). 2020;2:100011.

This article may be cited as: Zafar A, Rana S, Zaman U, Anjum K, Javed A, Hashim H: Evaluation of MRI Findings in Patients with Non-Traumatic Low Back Pain and Their Correlation with Clinical Disability Scores. Pak J Med Health Sci, 2023; 17(10): 164-167.