INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

THE DIAGNOSTIC ROLE OF LUMBOSACRAL SPINE MAGNETIC RESONANCE IMAGING IN PATIENTS PRESENTING WITH LOW BACK PAIN

Original Research

Abdul Salam[1], Abdul Wadood[2], Ayesha Malik[3], Muhammad Khan[4], Malika Uzma[5], Muhammad Tayyeb[6]*, Alia Wazir[1], Satia Gul[1]

[1]Lecturer, Department of Medical Imaging Technology, Faculty of Allied Health Sciences, Wazir Muhammad Institute of Allied Health Sciences, Gandhara University, Peshawar, Pakistan.
[2]Clinical Technologist, Department of Radiology, Hayatabad Medical Complex (HMC), Peshawar; Assistant Professor, Department of Radiology, Faculty of Allied Health Sciences, NCS University System, Peshawar, Pakistan.
[3]Lecturer, Department of Radiology, Faculty of Allied Health Sciences, Iqra National University (INU), Peshawar, Pakistan.
[4]Head of Department, Medical Imaging Technology, Multan University of Science and Technology, Multan, Pakistan.
[5]Assistant Professor, Department of Medical Lab Technology, Faculty of Allied Health Sciences, TIMES Institute, Multan, Pakistan.
[6]Lecturer, Department of Anesthesia, Faculty of Allied Health Sciences, College of Medical Technology, Bacha Khan Medical College, Mardan, Pakistan.
Corresponding Author: Muhammad Tayyeb, Lecturer, Department of Anesthesia, Faculty of Allied Health Sciences, College of Medical Technology Bacha Khan Medical College Mardan, Pakistan. tayyabm851@gmail.com

Acknowledgement: The authors gratefully acknowledge the support of the radiology department staff at Hayatabad Medical Complex, Peshawar, and the guidance provided by the consultant radiologists throughout this study.

Conflict of Interest: None Grant Support & Financial Support: None

ABSTRACT

Background: Low back pain (LBP) is a prevalent musculoskeletal disorder, affecting nearly 20% of the global population and contributing significantly to disability and reduced quality of life. Magnetic resonance imaging (MRI) plays a crucial role in diagnosing lumbar spine pathologies due to its ability to detect soft tissue abnormalities, degenerative changes, and nerve involvement. Early identification through MRI can help in better clinical decision-making and effective management of LBP.

Objective: This study aimed to assess the diagnostic significance of lumbosacral spine MRI in patients presenting with low back pain, focusing on degenerative disc conditions and related structural abnormalities.

Methods: A total of 389 patients with clinically diagnosed LBP underwent lumbar spine MRI. Patients with traumatic back injuries were excluded. Imaging protocols included T1-weighted imaging with contrast and gradient echo (GRE) sequences for suspected neoplastic or inflammatory conditions. MRI images were analyzed using a picture archiving and communication system (PACS). Radiological reports were generated by the principal investigator under the supervision of two experienced neuroradiologists. Statistical analyses included Pearson's chi-square test and multivariate correlation, applied to both adjusted and unadjusted models to determine associations and significance ($p < 0.05$).

Results: Among 389 participants, 215 (55.2%) reported moderate LBP severity, predominantly linked to informal occupations and physical stress activities such as weightlifting. Radiating pain was observed in 292 patients (75.0%), with higher prevalence in individuals aged ≥49 years (42.7%). The most commonly affected spinal segment was L4-L5, identified in 306 cases (78.6%). High-intensity zones (HIZ) and disc desiccation were more prevalent in older adults. Annular tears were found in 184 patients (47.3%), particularly among those with severe pain intensity and burning sensations.

Conclusion: The diagnostic utility of MRI is significant in identifying degenerative changes in patients aged 40 years and above, particularly involving the L4-S1 intervertebral discs. Key pathological findings included disc herniation, annular tears, disc desiccation, and high-intensity zones. A strong association was noted between physical stress, occupational factors, and severity of LBP, with burning sensations often correlating with disc bulges and annular tears.

Keywords: Annular Tear, Diagnostic Imaging, Disc Herniation, High-Intensity Zone, Low Back Pain, Magnetic Resonance Imaging, Spinal Degeneration.

INTRODUCTION

Low Back Pain (LBP) is defined as pain and discomfort below the costal margin and above the superior gluteal line, either in the presence or absence of related pain in the lower extremities. It is among the top 10 causes of consultation, and 05 to 10% of workers are annually absent from their work for more than seven days (1). LBP is a common health issue affecting most of the population, with a prevalence of 20% worldwide. In Africa, the annual prevalence of LBP is 57%, while 20% is in Uganda. The peak age for LBP is between 35 and 55 years (2). The prevalence of LBP is as high as 70- 85% (3). In the United States (US), approximately $50 billion is spent on LBP every year and it is the second-ranked cause of absentees at work (4). In North Carolina, the number of persons who reported chronic low back pain impaired activity more than doubled between 1992 and 2006, from 3.9% to 10.2% (5). In 2003, a survey in Kuwait of 7,670 adults showed that 43% of the Musculoskeletal (MSK) pain was due to LBP (6).

Diagnostic imaging modalities including radiography, CT scan, MRI, nuclear medicine, and discography can also evaluate LBP pathologies; however, Magnetic Resonance Imaging (MRI) is the gold standard modality of choice and the best non-invasive approach to detect lumbar spine pathologies and can show a clear three-dimensional visualization of spinal structures. The most common findings are degenerative changes in the lumbar spine, such as disc degeneration, disc herniation, spinal canal stenosis, and facet joint hypertrophy (7). Due to the lack of ionizing radiation, high spatial resolution, and good visualizing abilities, soft tissue MRI is the most useful method for the evaluation of spinal infections, spinal metastases, nerve root disorders, and disc abnormalities (8). MRI has a sensitivity of 96% and specificity of 92% for detecting spinal infections, whereas for spinal stenosis, MRI sensitivity is (87–96%) and moderate specificity is (68–75%) (9). It also increases the likelihood of the disc being the source of low back pain (10). The demand for MRI modalities is increasing by 13% each year (11). Magnetic resonance imaging (MRI) also allows the detection of morphological changes caused by various interventions (12). Diagnostic imaging can be used to determine the affected disc level preoperatively (13).

The 99% of the population studied in Nigeria had some abnormalities on their MRI, whereas in India, 97.5% of the patients had changes on their MRI. Approximately 59% of patients had common pathologies on MRI, including disc desiccation, and disc height reduction, and 56.25% of patients had disc herniations. In Nigeria, 27 of .5% of patients had a common finding of Spinal canal stenosis in patients with low back pain. This is similar to the 24.5% recorded in Iran; most of the patients had multilevel abnormalities, predominantly at L4/L5 and L5/S1 (14). Generally, the lumbar spine is not fully diagnosed and evaluated, which is necessary for the proper management of patients with different pathologies of the spine. Most patients complain of lower back pain due to different abnormalities in the lumbar spine but lack of knowledge and unavailability of diagnostic facilities, and the ratio of affected individuals increases daily and may lead to a serious problem. The purpose of conducting this study in ……. was to determine the variabilities in LBP patients' lower spines, involving lumbosacral joints, aiming to enable patient's improved quality of life. This study also observes and assesses the diagnostic roles of MRI for LBP, specifically the correlation of multilevel spin involvement and where the pathologies lie.

METHODS

This cross-sectional study was conducted at the Hayatabad Medical Complex (HMC), Peshawar, Pakistan, a tertiary care hospital offering both outpatient and inpatient services. The Radiology Department, equipped with a 1.5 Tesla Phillips MRI machine, a 128-slice computed tomography (CT) scanner, eight ultrasound machines, conventional and digital X-ray facilities, mammography, and a DEXA scan machine, served as the primary setting for this investigation. Approximately 90 patients presenting with low back pain (LBP) undergo MRI evaluations each month at this facility.

The study population comprised patients who presented with low back pain and underwent lumbar spine MRI at HMC. All participants were carefully evaluated through detailed history-taking and thorough clinical examinations. Medical records were meticulously reviewed in consultation with the referring radiologists to control for confounding factors and minimize bias. The final sample size consisted of 389 patients, calculated using an 82.2% prevalence rate with a 1% margin of error and a 99% confidence interval, employing the OpenEpi sample size calculator.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Inclusion criteria encompassed patients aged 18 to 55 years who had undergone lumbar spine MRI with a documented history of LBP. Exclusion criteria included patients without a history of low back pain, those with a history of falls involving the lumbar spine, or trauma involving the lumbar spine. Formal ethical approval was obtained from the Hayatabad Medical Complex [HMC-QAD-F-00 Approval No: 1176]. Recruitment was carried out at the MRI room reception station, where participants were informed of the study's purpose and benefits. Written and oral consent was obtained, ensuring participant anonymity and confidentiality. Approval was also secured from the heads of the involved clinical units and the radiology department.

Participation was entirely voluntary, with individuals given the freedom to withdraw at any stage without any consequences. To maintain confidentiality, identifiable information was excluded from data collection forms. Ethical considerations adhered strictly to the principles outlined in the Helsinki Declaration (2013 revision) and the International Ethical Guidelines for Health-related Research Involving Humans (2016).

MRI scans were conducted using a 1.5 Tesla Phillips MRI machine with a dedicated receive-only spine coil, following a standardized lumbar spine imaging protocol. Sagittal T1-weighted (T1W), T2-weighted (T2W), T2W short tau inversion recovery (STIR), and T2W myelographic sequences were performed, along with axial reformats from T12 to S1 levels. For suspected neoplastic or inflammatory conditions, additional imaging with contrast-enhanced T1-weighted imaging and gradient echo (GRE) sequences was acquired. All images were reviewed on Picture Archiving and Communication System (PACS) workstations by the principal investigator and two experienced consultant radiologists. Any discrepancies were resolved through consensus.

Data were recorded using a standardized collection form with unique, anonymized study identifiers. The forms were rigorously checked for accuracy, completeness, and consistency, with immediate correction of any discrepancies. Categorical variables such as age group, gender, occupation, pain onset (gradual or sudden), side affected, quality of pain, pain duration, aggravating and alleviating factors, and site of pain were analyzed.

Statistical analysis was conducted using SPSS version 26.0. Descriptive statistics, including means and standard deviations, were calculated for quantitative variables, while frequencies and percentages were determined for categorical variables. Pearson's chi-square test and multivariate correlation analysis were applied to assess the association between independent variables (demographic and clinical characteristics) and dependent variables, including disc desiccation, disc bulge, high-intensity zone (HIZ), and annular tear. Both adjusted and unadjusted models were analyzed, with statistical significance set at a p-value of less than 0.05. The relationships were expressed in terms of significance levels and correlation strength across different variables.

RESULTS

The sample size of this study was 389, ranging from ≤ 33, 34-48, and ≥ 49. Table 1 shows that the percentage of each age category was almost similar, about 30%. More than half were female (53.7%), and almost half of them were housewives (47.6%).

Regarding the onset of pain, more than half of respondents experienced sudden pain (50.59%) and felt the side of the back affected in the right. The majority of pain quality was aching (65.7%), and more than half experienced moderate pain in the months (55.2%).

In terms of aggravating factors, the data show that a third of participants said that the Aggravating Factor was bending (30.4%), and only a small proportion of participants said they were sitting and standing (6.7%). On the other hand, a quarter of participants said that the alleviating factor was sitting only (24.5%), and a small proportion of participants stated that the alleviating factors were walking, sitting, and standing (6.2%). Regarding the site of pain, the majority of participants stated that they had radiated pain (75.0%).

Table 1: Socio-demographic characteristics of respondents (n=389)

Variable	Categories	Frequency	Percentage (%)
Age *median (IQR)*		40 (30 – 51)	
Age Group	<= 33	135	34.7%
	34 - 48	128	32.9%

	49+	126	32.4%
Variable	**Categories**	**Frequency**	**Percentage (%)**
Gender	Male	180	46.3%
	Female	209	53.7%
Occupation	Housewife	185	47.6%
	Students	38	9.8%
	Business	72	18.5%
	Other	53	13.6%
	Teacher	22	5.7%
	Laboure	11	2.8%
	Driver	8	2.1%
Onset of Pain	Gradual	192	49.5%
	Sudden	196	50.5%
Side of back Effected	Right	162	41.8%
	Left	107	27.6%
	Both	117	30.2%
	NO	2	0.5%
Quality of Pain	Aching	255	65.7%
	Burning	101	26.0%
	Both	11	2.8%
	NO	21	5.4%
Severity of Pain in Months	Mild	102	26.4%
	Moderate	213	55.2%
	Sever	71	18.4%
Aggravating Factor	Bending	118	30.4%
	Sitting	59	15.2%
	Standing	32	8.2%
	Bending, Sitting	67	17.3%
	Bending, Standing	27	7.0%
	Sitting, Standing	26	6.7%
	Bending, Sitting, Standing	43	11.1%
	NO	16	4.1%
Alleviating Factors	Walking	74	19.1%

	Sitting	95	24.5%
	Laying Down	42	10.8%
	Walking, Sitting	57	14.7%
	Walking, Laying Down	41	10.6%
	Sitting, Laying Down	35	9.0%
	Walking, Sitting, Standing	24	6.2%
	NO	20	5.2%
Site of Pain	Localized	97	25.0%
	Radiated	291	75.0%

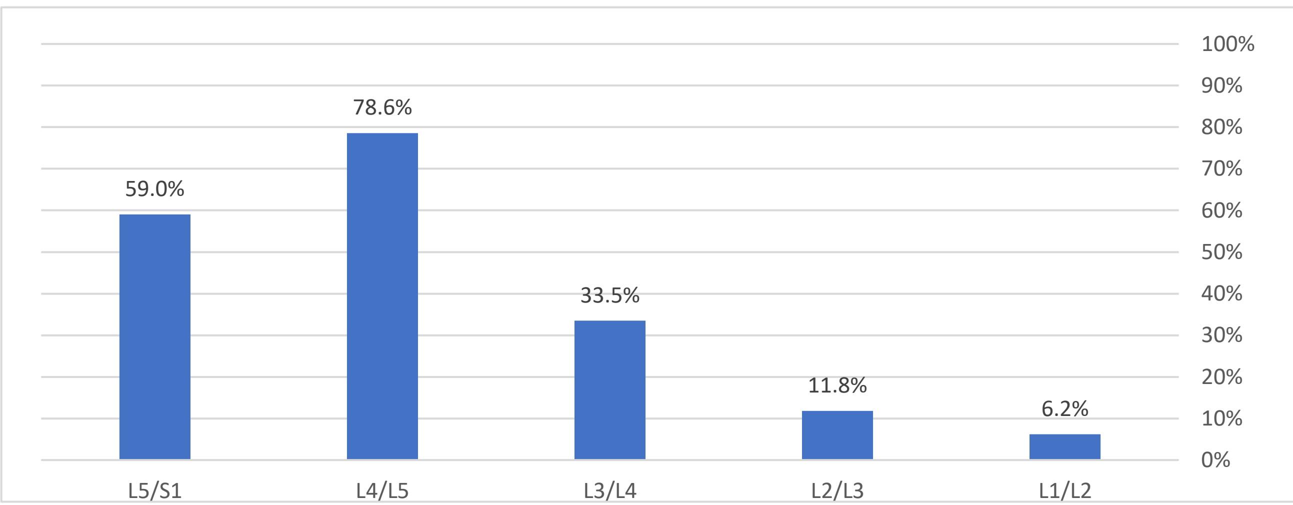

Figure 1 Level of intervertebral disc desiccation

Figure 1 shows that the highest proportion of level l of intervertebral disc desiccation was L4/L5 (78.6%), and the lowest was L1/L2.

The presence of disc desiccation was associated with age 49 years. It was discovered that the risk of patients developing disc desiccation increases with age. The difference between the two age groups was statistically significant (p = 0.021); Patients aged 49 years were 11.552 times more likely to develop disc desiccation than those aged ≤33 years. Those between the ages of 34 and 48 years were 9.008 times more likely than those in other age groups to develop disc desiccation, and the difference was statistically significant (p = 0.04).

The occupation distribution additionally predicted the occurrence of disc desiccation. As shown in Table 2, informal workers were 4.62 times more likely to have disc desiccation than formal workers (242 cases versus 126 cases), and the difference was statistically significant (p = 0.043).

Table 2: Association between Independent variable and Disc Generation

Variables	**Disc Generation**		**Unadjusted**			**Adjusted**		
	Yes	**No**	**95% CI**	**COR**	***p***	**95% CI**	**AOR**	***p***
Age								
≤ 33	131 (35.6%)	4 (20.0%)	Ref					

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

34 - 48	119 (32.3%)	8 (40.0%)	1.092-72.239	9.008	.04	1.092-72.239	8.883	0.041
Variables	**Disc Generation**	**Unadjusted**	**Adjusted**		**Variables**	**Disc Generation**	**Unadjusted**	**Adjusted**
≥ 49	118 (32.1%)	8 (40.0%)	1.672-108.440	11.552	.021	1.672-108.440	13.466	0.16
Gender								
Male	167 (45.4%)	12 (60.0%)	Ref					
Female	201 (54.6%)	8 (40.0%)	.377-2.390	.949	.912			
Occupation								
Formal	126 (34.2%)	6 (30.0%)	Ref					
Informal	242 (65.8%)	14 (70.0%)	1.052-20.324	4.623	.043			
Onset of pain								
Gradual	182 (49.5%)	10 (50.0%)	Ref					
Suden	186 (50.5%	10 (50.0%)	.162-1.169	.435	.099			
Site of pain								
Unilateral	256 (69.9%)	13 (65%)	Ref					
Bilateral	110 (30.1%)	7 (35%)	.394-2.872	1.064	.902			
Quality of pain								
No	21 (5.7%)	0 (0%)	Ref					
Aching	240 (65.2%)	15 (75%)	.045-3.591	.400	.413			
Burning	97 (26.4%)	4 (20%)	.331-21.952	2.697	.354			
Both	10 (2.7%)	1 (5%)	.113-35.411	2.000	.636			
Severity of pain in months								
Mild	98 (26.8%)	4 (20.0%)	Ref					
Moderate	197 (53.8%)	16 (80.0%)	.490-6.588	1.797	.377			
Sever	71 (19.4%)	0 (0%)	.427-9.087	1.97	.385			
Walking								
No	61 (16.6%)	3 (15%)	Ref					
Yes	306 (83.4%)	17 (85%)	.216-2.136	.680	.509			
Numbness								
No	176 (47.8%)	8 (40.0%)	Ref					
Yes	192 (52.2%)	12 (60.0%)	.931-7.473	2.638	.068			
Pain Distribution								
Localized	93 (25.3%)	4 (20.0%)	Ref			Ref		

Radiated	275 (74.7%)	16 (80.0%)	.211-1.447	.553	.227	.162-1.219	.444	.115

Table 2 presents the association between various independent variables and disc degeneration. Age showed a significant association, with individuals aged 34–48 and ≥49 years having higher odds of disc degeneration compared to those ≤33 years ($p=0.041$ and $p=0.016$, respectively). Gender, occupation, and pain onset also showed notable trends, with informal workers having higher odds ($p=0.043$). Other variables, including site, quality, and severity of pain, as well as walking ability and numbness, did not demonstrate statistically significant associations. Pain distribution showed a non-significant trend toward higher degeneration odds in patients with radiating pain.

Table 3: Association Between Independent Variable and Disc Bulge

Variables	Disc Bulge	Unadjusted				Adjusted		
	Yes	**No**	**95% CI**	**COR**	***p***	**95% CI**	**AOR**	***p***
Age								
≤ 33	131 (35.6%)	4 (20.0%)	Ref					
34 - 48	119 (32.3%)	8 (40.0%)	.133-1.547	.454	.207			
≥ 49	118 (32.1%)	8 (40.0%)	.132-1.534	.450	.202			
Gender								
Male	167 (45.4%)	12 (60.0%)	Ref					
Female	201 (54.6%)	8 (40.0%)	.721-4.520	1.805	.207			
Occupation								
Formal	126 (34.2%)	6 (30.0%)	Ref					
Informal	242 (65.8%)	14 (70.0%)	.309-2.194	.823	.697			
Onset of pain								
Gradual	182 (49.5%)	10 (50.0%)	Ref					
Suden	186 (50.5%	10 (50.0%)	.415-2.514	1.022	.962			
Site of pain								
Unilateral	256 (69.9%)	13 (65%)	Ref					
Bilateral	110 (30.1%)	7 (35%)	.310-2.054	.798	.640			
Quality of pain								
Aching	240 (71.2%)	15 (78.9%)	Ref			Ref		
Burning	97 (28.8%)	4 (21.1%)	.491-4.682	1.516	.470	.481-4.750	1.512	.479
Severity of pain in months								
Mild	98 (26.8%)	4 (20.0%)	Ref			Ref		
Moderate	197 (53.8%)	16 (80.0%)	.164-1.544	.503	.229	.101-1.265	'.357	.111

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Sever	71 (19.4%)	0 (0%)	-			-		
Walking								
No	61 (16.6%)	3 (15%)	Ref					
Variables	**Disc Bulge**	**Unadjusted**	**Adjusted**					
	Yes	**No**	**95% CI**	**COR**	***p***	**95% CI**	**AOR**	***p***
Yes	306 (83.4%)	17 (85%)	.252-3.114	.885	.849			
Numbness								
No	176 (47.8%)	8 (40.0%)	Ref					
Yes	192 (52.2%)	12 (60.0%)	.291-1.821	.727	.496			
Pain Distribution								
Localized	93 (25.3%)	4 (20.0%)	Ref					
Radiated	275 (74.7%)	16 (80.0%)	.241-2.267	.739	.597			

Association Between Independent Variable and Disc Bulge

As shown in Table 3, in both bivariate and multivariate analyses, none of the independent variables related to disc bulging in patients reached statistical significance.

Table 4: Association Between Independent Variable and High Intensity Zone

Variables	High Intensity Zone		Unadjusted	Adjusted				
	Yes	**No**	**95% CI**	**COR**	***p***	**95% CI**	**AOR**	***p***
Age								
≤ 33	30 (26.1%)	104 (38.2%)	Ref		Ref			
34 - 48	35 (30.4%)	92 (33.8%)	.751-2.315	1.319	.335	.480-1.721	.909	.769
≥ 49	50 (43.5%)	76 (27.9%)	1.328-3.916	2.281	.003	1.120-3.751	2.05	.020
Gender								
Male	48 (41.7%)	130 (47.8%)	Ref		Ref			
Female	67 (58.3%)	142 (53.5%)	.823-1.985	1.278	.275	.391-1.295	.711	.265
Occupation								
Formal	23 (20,05)	109 (40.1%)	Ref		Ref			
Informal	92 (80.0%)	163 (59.9%)	1.595-4.487	2.675	<.001	1.378-5.543	2.764	.004
Onset of pain								
Gradual	64 (55. %)	128 (47.1%)	Ref		Ref			
Suden	51 (44.3%)	144 (52.9%)	.457-1.098	.708	.123	.685-1.950	1.155	.588
Site of pain								

Unilateral	76 (66.7%)	192 (70.8%)	Ref		Ref			
Bilateral	38 (33.3%)	79 (29.2%)	.760-1.943	1.215	.416	.379-1.155	.661	.146
Quality of pain								
Variables	**High Intensity Zone**		**Unadjusted**		**Adjusted**			
	Yes	**No**	**95% CI**	**COR**	***p***	**95% CI**	**AOR**	***p***
Aching	67 (63.8%)	188 (75.2%)	Ref		Ref			
Burning	38 (36.2%)	62 (24.8%)	1.053-2.809	1.72	.030	.816-2.485	1.424	.214
Severity of pain in months								
Mild	13 (11.3%)	89 (33.0)	Ref		Ref			
Moderate	75 (65.2)	137 (50.7%)	1.963-7.154	3.748	<.001	1.632-7.055	3.393	.001
Sever	27 (23.5%)	44 (16.3%)	1.977-8.928	4.201	<.001	1.616-10.061	4.032	.003
Walking								
No	21 (18.3%)	43 (15.9%)	Ref		Ref			
Yes	94 (81.7%)	228 (84.1%)	.475-1.499	.844	.563	.529-2.099	1.053	.883
Numbness								
No	41 (35.7%)	142 (52.2%)	Ref		Ref			
Yes	74 (64.3%)	130 (47.8%)	1.257-3.091	1.971	.003	.783-2.368	1.362	.274
Pain Distribution								
Localized	25 (21.7%)	71 (26.1%)	Ref		Ref			
Radiated	90 (78.3%)	201 (73.9%)	.757-2.137	1.272	.364	.317-1.179	.611	.142

Association Between Independent Variable High-Intensity Zone

Age ≥49 years was linked to the existence of high-intensity zones. Elderly adults were found to have a higher probability of developing high intensity. In the unadjusted model, there was a statistically significant difference between the two age groups (p =.003); patients over the age of 49 had a 2.281-fold increased likelihood of having a high-intensity zone compared to patients under the age of 33. The adjusted model p-value (AOR 2. was 020).

The occupation distribution additionally predicted the occurrence of a high-intensity zone. Table 4 shows that, based on the unadjusted model, informal workers were 2.675 times more likely to have a high-intensity zone than formal workers (92 cases versus 23 cases), and the difference was statistically significant (p < .001). After adjusting the model, it seems that informal occupation was 2.764 more likely to have a high-intensity zone than formal occupation (p = .004).

Regarding the quality of pain, in the unadjusted model, it seemed to have a significant association with the high-intensity zone. Patients with burning pain were 1.72 times more likely to have a high-intensity zone than those with aching pain (p = .030). The severity of pain in months also had a significant correlation with the high-intensity zone for both moderate and severe pain. Before adjustment, moderate pain was 3.748 times more likely to have a high-intensity zone than mild (p=<.001), and severe pain was 4.201 times more likely to have a high-intensity zone than mild (p=<.001). After adjustment, moderate pain was 3.393 times more likely to have a high-intensity zone than mild (p=.001) and severe pain was 4.032 times more likely to have a high-intensity zone than mild (p=<.003).

In terms of numbness, it was only strongly associated with the high-intensity zone in the unadjusted model with COR 1.971 and p=.003.

Table 5: Association Between Independent Variable and Annular Tear

Variables	Annular Tear		Unadjusted			Adjusted		
	Yes	**No**	**95% CI**	**COR**	***p***	**95% CI**	**AOR**	***p***
Age								
≤ 33	30 (26.3%)	105 (38.3%)	Ref			Ref		
34 - 48	35 (30.7%)	92 (33.6%)	.759-2.233	1.332	.318	.505-1.801	.954	.884
≥ 49	49 (43.0%)	77 (28.1%)	1.296-3.82	2.227	.004	1.109-3.718	2.031	.022
Gender								
Male	48 (42.0%)	131 (47.8%)	Ref			Ref		
Female	66 (57.9%)	143 (52.2%)	.810-1.958	1.26	.305	.403-1.325	.731	.301
Occupation								
Formal	23 (20.2%)	109 (39.8%)	Ref			Ref		
Informal	91 (79.2%)	165 (60.2%)	1.558-4.385	2.614	<.001	1.319-5.238	2.629	.006
Onset of pain								
Gradual	63 (55.3%)	129 (47.1%)	Ref			Ref		
Suden	51 (44.7%)	145 (52.9%)	.464-1.117	.720	.143	.687-1.949	1.157	.582
Site of pain								
Unilateral	76 (67.3%)	193 (70.7%)	Ref			Ref		
Bilateral	37 (32.7%)	80 (29.3%)	.733-1.882	1.175	.504	.367-1.123	.642	.120
Quality of pain								
Aching	67 (64.4%)	188 (74.6%)	Ref			Ref		
Burning	37 (35.6%)	64 (25.4%)	.992-2.652	1.1622	.054	.754-2.274	1.309	.339
Severity of pain in months								
Mild	13 (11.4%)	89 (32.7%)	Ref			Ref		
Moderate	74 (64.9%)	139 (51.1%)	1.909-6.959	3.645	<.001	1.592-6.848	3.302	.001
Sever	27 (23.7%)	44 (16.2%)	1.977-8.928	4.201	<.001	1.631-10.096	4.058	.003
Walking								
No	21 (18.4%)	43 (15.8%)	Ref			Ref		
Yes	93 (81.6%)	230 (84.2%)	.466-1.471	.828	.520	.513-2.027	1.02	.956
Numbness								
No	143 (52.2%)	142 (52.2%)	Ref			Ref		
Yes	131 (47.8%)	130 (47.8%)	1.239-3.048	1.944	.004	.792-2.394	1.377	.257
Pain Distribution								
Localized	72 (26.3%)	71 (26.1%)	Ref			Ref		
Radiated	202 (73.7%)	201 (73.9%)	.755-2.132	1.269	.368	.335-1.230	.641	.181

Association Between Independent Variable and Annual Tear

An annular tear was associated with age ≥ 49 years. Those older than 49 years had a 2.227-fold higher risk of having an annular tear compared to those under the age of 33 years, which was statistically significant (p =.004) in the unadjusted model. The P-value for the modified model (AOR 2.031) was 022.

The distribution of occupations also indicated the likelihood of annular tears. According to Table 5, informal occupations had annular tears 2.614 times more frequently than formal occupations (91 cases versus 23 cases), which was statistically significant (p.001). After model adjustment, annular tears were 2.629 more likely to occur in informal occupations than in formal occupations (p =.006).

For moderate to severe pain, there was a significant association between the severity of pain in months and annular tears. Before the adjustment, severe pain was 4.201 times more likely to have an annular tear than mild pain, and moderate pain was 3.645 times more likely to have an annular tear than mild (both p.001). After adjustment, severe pain was 4.058 times more likely to have an annular tear than mild pain, and moderate pain was 3.302 times more likely to have an annular tear (p=.001) and p=.003, respectively).

Numbness was significantly correlated with annular tears only in the unadjusted model (COR 1.944, p=.004).

DISCUSSION

The present study emphasized the pivotal role of magnetic resonance imaging (MRI) as a non-invasive diagnostic tool for assessing lower back pain (LBP) and lumbosacral discomfort. As a gold-standard imaging modality, MRI significantly reduces diagnostic discomfort while providing high-resolution images critical for evaluating structural abnormalities. The study, conducted on a cohort of 389 patients with a median age of 40 years, revealed a higher prevalence of LBP among females (53.7%) compared to males (47.6%). Aggravating factors included physical activities such as bending, standing, or prolonged sitting, often associated with disc herniation. These findings align with prior research indicating degenerative disc disease as the most frequent cause of LBP (16). MRI findings confirmed common degenerative changes, particularly intervertebral disc desiccation at the L1/L2 level, consistent with the findings of Muhammad Yousof et al., who reported similar patterns of lumbar degeneration in patients with chronic back pain (17).

The results highlighted a higher prevalence of disc desiccation among individuals aged 49 years and above, with informal occupational settings further increasing the risk. This demographic showed more pronounced aching pain compared to burning or radiating sensations, corroborating the findings of earlier studies (17). Occupational strain, especially involving manual labor and physical exertion, was also identified as a significant factor contributing to lumbar degeneration. Although coughing and sneezing were not observed to aggravate symptoms, tasks involving repetitive lifting or prolonged standing appeared to intensify the discomfort (1). Despite the evident relationship between age, occupation, and lumbar disc changes, the study did not find a statistically significant association between disc bulge or herniation and variables such as sex, occupation type, or physical activity levels.

High-intensity zones (HIZ), markers of internal disc disruption (IDD), were predominantly found in individuals over 49 years of age and those in informal occupations, with a twofold increase compared to younger or formally employed counterparts. This finding aligns with previous research demonstrating the relevance of HIZ in diagnosing internal disc injuries based on T2-weighted MRI scans (16,17). Pain characteristics were also linked to HIZ prevalence, with burning sensations more frequently associated with HIZ than aching or combined pain presentations. Duration and persistence of pain were significantly associated with HIZ, as sustained pain episodes of at least one month correlated with higher incidences of these disruptions, supporting the existing literature on the association between prolonged LBP severity and lumbar degeneration (16).

Annular tears were predominantly observed in patients aged 49 years or older and those engaged in physically demanding informal occupations. These tears, often symptomatic, were closely linked to severe pain, with a three to fourfold increase in risk compared to those with mild or asymptomatic conditions. Such findings are consistent with prior research suggesting that annular tears can progress to disc herniation, particularly in patients with weakened annular fibrosis (20). Contrary to the findings of Wang et al., who reported higher incidences of lumbar degeneration in males due to mechanical stress and physical exertion (21), the current study observed a slightly higher prevalence in females, possibly influenced by occupational and lifestyle factors unique to the study population. The observed consistency with global and regional studies strengthens the validity of these findings, particularly regarding the prevalence of LBP, disc herniation, and annular tears among older individuals (17,22).

The study's strengths include its large sample size, comprehensive evaluation through high-resolution MRI, and analysis of both structural abnormalities and clinical correlations. However, limitations were also present. While MRI remains the gold standard for assessing structural causes of LBP, this study did not explore soft tissue injuries, ligamentous strains, or non-specific factors contributing to LBP, which often have no discernible radiological findings. Additionally, current international guidelines recommend restricting MRI use to cases with severe, persistent symptoms or neurological deficits to prevent unnecessary imaging (23). Despite these recommendations, there has been a significant increase in unnecessary MRI utilization between 1995 and 2015, with studies reporting that up to 35% of scans for LBP lacked clinical justification (24,25). This highlights the need for more targeted imaging practices to avoid unnecessary healthcare costs and patient exposure to irrelevant diagnostics (26).

The findings of this study underscore the importance of MRI in diagnosing structural causes of LBP, particularly in older adults and individuals engaged in physically demanding occupations. However, the increasing trend of unnecessary MRI scans suggests a need for stricter adherence to clinical guidelines. Future research should focus on evaluating the cost-effectiveness of MRI usage in LBP diagnosis, adherence to established imaging protocols, and the potential benefits of integrating clinical decision-making tools. These measures could optimize diagnostic accuracy while minimizing unnecessary healthcare expenditures, ultimately improving patient outcomes and ensuring appropriate utilization of imaging resources.

CONCLUSION

Magnetic Imaging has shown that the ages of the last one or two decades of individual life expectancy of 60 to 65 years are more prone to LBP associated with Annular Tears, Disk Desiccation, Disk Herniation, and prevailing high-intensity Zones at Lower levels of the lumbar spine, sometimes involving S1. Patients complained more of aching pain than burning, but the burning sensation with severe pain index was shown by patients with disk bulges and annular tears.

AUTHOR CONTRIBUTIONS

Author	Contribution
Abdul Salam	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Abdul Wadood	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Ayesha Malik	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Muhammad Khan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Malika Uzma	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Tayyeb*	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Alia Wazir	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Satia Gul	Writing - Review & Editing, Assistance with Data Curation

REFERENCES

1. Teraguchi M, Cheung JP, Samartzis D. High-intensity zones and annular tears. Spine Phenotypes. 2022 Jan 1:187-201.

2. Lukecha KR, Geoffrey E, Gonzaga MA, Sam B. Magnetic resonance imaging findings among young adults with low back pain at Nsambya hospital. BMC Med Imaging. 2022;22(1):1–13.

3. Sathish Babu S, Vinod S, Anu Priya JT. Application of MRI in the Evaluation of Low Backache. 2017;6(2):37–40.

4. Yousof M, Din RU, Ahmad M, Khattak S, Ali S. The Prevalence of Pathologies Causing Low Back Pain Using Magnetic Resonance Imaging for Categorization. 2021;10(4).

5. Nikitha M. *Role of Magnetic Resonance Imaging in the Evaluation of Degenerative Changes of Lumbar Spine* (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)).

6. Sima S, Chen X, Sheldrick K, Kuan J, Diwan AD. Reconsidering high intensity zones: its role in intervertebral disk degeneration and low back pain. European Spine Journal. 2024 Apr;33(4):1474-83.

7. Yang L, He L, Hu H, Li W, Yang Y, Zhao H, Wang J, Yu X. Does the high-intensity zone of lumbar intervertebral disc at magnetic resonance imaging have diagnostic value for discogenic low back pain? A meta-analysis. BMC Musculoskeletal Disorders. 2024 Oct 30;25(1):869.

8. Wang ZX, Hou ZT, Hu YG. Anterior high-intensity zone in lumbar discs: Prevalence and association with low back pain. Pain Medicine. 2020 Oct;21(10):2111-6.

9. Khan MF, Sylonia SC, Bahuguna R. Role of MRI in Evaluation of Chronic Low Back Pain in Young Adults. Int J Contemp Surg. 2018;6(2):42.

10. Bartynski WS, Agarwal V, Trang H, Bandos AI, Rothfus WE, Tsay J, Delfyett WT, Nastasi B. Enhancing annular fissures and high-intensity zones: pain, internal derangement, and anesthetic response at provocation lumbar discography. American Journal of Neuroradiology. 2023 Jan 1;44(1):95-104.

11. Hudson D, Knapp K, Benwell M. An evaluation of MRI lumbar spine scans within a community-based diagnostic setting. Musculoskeletal Care. 2021;19(3):384–95.

12. Raudner M, Schreiner MM, Hilbert T, Kober T, Weber M, Szelényi A, Windhager R, Juras V, Trattnig S. Clinical implementation of accelerated T 2 mapping: Quantitative magnetic resonance imaging as a biomarker for annular tear and lumbar disc herniation. European radiology. 2021 Jun;31:3590-9.

13. Kim JH, van Rijn RM, van Tulder MW, Koes BW, de Boer MR, Ginai AZ, et al. Diagnostic accuracy of diagnostic imaging for lumbar disc herniation in adults with low back pain or sciatica is unknown: A systematic review. Chiropr Man Therap. 2018;26(1):1–14.

14. Iyidobi EC, Obande BO, Ekwunife RT. Pattern of MRI Findings in Patients with Low Back Pain at National Orthopaedic Hospital, Enugu Nigeria. J Biosci Med. 2018;6(4):85–94.

15. Nguyen AQ, Harada GK, Leverich KL, Khanna K, Louie PK, Basques BA, Tao Y, Galbusera F, Niemeyer F, Wilke HJ, An HS. High-intensity zones on mri of the cervical spine in patients: epidemiology and association with pain and disability. Global Spine Journal. 2022 Jun;12(5):829-39.

16. Ellis DL, Ehsanian R, Shin PC, Rivers WE, Shin P, Rivers WE. Lumbar annular high-intensity zone as a precursor to disc extrusion. Cureus. 2021 Dec 2;13(12).

17. Soydan Z, Bayramoğlu E. Prevalence and association of high-intensity lesions with degenerative processes in lumbar intervertebral discs. Cukurova Medical Journal. 2024 Mar 3;49(1):113-20.

18. Davoudi M, Zabibah RS, Ramírez-Coronel AA, Al-Khafaji AH, Iswanto AH, Ataei G, Yousefi E, Nosrati FZ, Fazilat-Panah D. Analysis of the Prevalence of Lumbar Annular Tears in Adult Patients Using Magnetic Resonance Imaging Data. Frontiers in Biomedical Technologies. 2024 Mar 31;11(2):177-83.

19. Singh N, Singh DK. MRI spectrum and prevalence of lumbar spinal degenerative disease in patients with non-traumatic low back pain. Romanian Neurosurgery. 2020 Sep 15:427-33.

20. Wan S, Zhang J, Wu C, Lin X, Li J, Wu F, Zhang Z, He L. Nucleus high intensity in the T2-weighted MRI is a potential predictor of annulus tear in cervical injured patients: a case comparative study. BMC musculoskeletal disorders. 2023 Jul 24;24(1):602.

21. Butcher L. The Problem with MRIs for Low Back Pain. 2019. p. 14.

22. van der Graaf JW, Kroeze RJ, Buckens CF, Lessmann N, van Hooff ML. MRI image features with an evident relation to low back pain: a narrative review. European Spine Journal. 2023 May;32(5):1830-41.

23. Sharma S, Traeger AC, Reed B, Hamilton M, O'Connor DA, Hoffmann TC, et al. Clinician and patient beliefs about diagnostic imaging for low back pain: A systematic qualitative evidence synthesis. BMJ Open. 2020;10(8):e037820.

24. Butcher L. The Problem with MRIs for Low Back Pain. 2019. p. 14.

25. Jha SC, Raut S, Gupta PK, Parajuli S. Prevalence of high intensity zone in lumbar spine and its correlation with lumbar disc degeneration in patients attending tertiary hospital of eastern Nepal. Journal of College of Medical Sciences-Nepal. 2021 Mar 31;17(1):81-7.

26. Sharma S, Traeger AC, Reed B, Hamilton M, O'Connor DA, Hoffmann TC, et al. Clinician and patient beliefs about diagnostic imaging for low back pain: a systematic qualitative evidence synthesis. BMJ Open. 2020 Aug 1;10(8):e037820.

