

Original Article

Frequency of Lumbar Disc Herniation in Patients with Lower Back Pain on Magnetic Resonance Imaging at Peshawar Institute of Cardiology

Aisha Mansoor¹, Hassan Khan², Faisal Amin¹, Abdullah Khan¹, Aisha Kalib¹

¹ Pakistan Institute of Medical and Management Sciences (PIMMS), Affiliated with Khyber Medical University, Peshawar, Pakistan

² Lecturer, Sarhad Institute of Allied Health Sciences, Sarhad University Peshawar, Pakistan

Correspondence: ash.mansoor15@gmail.com

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ABSTRACT

Background: Lumbar disc herniation (LDH) represents a common etiology of lower back pain (LBP), contributing significantly to disability and healthcare burden globally. The condition involves displacement of intervertebral disc components, leading to nerve compression and pain, with regional variations in prevalence potentially influenced by demographic and occupational factors (1-4). Despite being a frequent clinical concern, data specific to LDH prevalence in Peshawar, Pakistan, remains limited, necessitating regional studies to inform diagnostic and preventive strategies (5-7). Objective: To determine the frequency of lumbar disc herniation among patients presenting with lower back pain and identify the most commonly affected disc levels on magnetic resonance imaging (MRI). Methods: A retrospective descriptive study was conducted at the Radiology Department of Peshawar Institute of Cardiology between January 2023 and January 2024. MRI reports of 249 patients aged 18 to 75 years with lower back pain were reviewed using a structured questionnaire. Data analysis involved descriptive statistics computed with SPSS version 27. Results: Of 249 patients, 231 (92.8%) exhibited LDH, with a slightly higher frequency in females (47.0%) than males (45.8%). The L4-L5 and L5-S1 levels were most affected (28.8%). Disc bulging was the predominant type (49.8%), and 95.9% reported LBP symptoms. Conclusion: LDH is highly prevalent among LBP patients in Peshawar, with L4-L5 and L5-S1 discs being most involved. Early detection and public awareness may reduce morbidity associated with this condition.

Keywords: Lower Back Pain, Lumbar Disc Herniation, MRI, Peshawar, Disc Bulging, Epidemiology

INTRODUCTION

Lower back pain (LBP), defined as discomfort between the inferior gluteal folds and the twelfth rib, remains a prevalent health concern affecting individuals globally, often manifesting between the ages of 30 and 50 and contributing substantially to disability and economic burden through reduced productivity and quality of life (8,9). LBP can be categorized as acute, lasting up to four weeks, or chronic when persisting beyond three months, with chronic forms frequently accompanied by psychological distress such as anxiety and depression, further exacerbating functional impairment (10-12). Among the diverse causes of LBP, lumbar disc herniation (LDH) is widely recognized as a leading pathology, characterized by displacement of disc material, including the nucleus pulposus and annulus fibrosus, beyond the confines of the intervertebral disc space, potentially compressing adjacent neural structures and provoking symptoms ranging from localized pain to radiculopathy (13-16).

Variations in herniation types, including bulging, protrusion, extrusion, and sequestration, arise largely from degenerative processes where cellular senescence and diminished proteoglycan synthesis weaken the intervertebral disc architecture, predisposing the lumbar spine to mechanical failure (17-19). Anatomically, the lumbar spine consists of five vertebrae that support substantial axial loads and facilitate mobility, with the intervertebral discs composed of a fibrocartilaginous annulus fibrosus encasing a gelatinous nucleus pulposus and bounded by cartilaginous endplates, collectively serving critical roles in load distribution and spinal stability (20-23). Biomechanical stress is particularly pronounced at the L4-L5 and L5-S1 levels, which are subject to repetitive flexion, extension, and rotational forces, rendering these segments vulnerable to herniation (24,25).

Although numerous global studies have documented the prevalence and characteristics of LDH, significant regional variability exists, influenced by demographic, occupational, and lifestyle factors, suggesting the necessity for local epidemiological data to inform clinical practice and preventive strategies (26-28). In Pakistan, especially in Peshawar, comprehensive data delineating the frequency and anatomical patterns of LDH among patients presenting with LBP remain sparse, representing a crucial knowledge gap that impedes the development of targeted interventions and resource allocation (29,30). Consequently, this study seeks to determine the frequency of lumbar disc herniation in patients with lower back pain evaluated by magnetic resonance imaging at the Peshawar Institute of Cardiology and to

identify the most affected disc levels, thereby contributing region-specific evidence to support diagnostic accuracy and early management strategies aimed at mitigating the burden of LBP in this population.

MATERIALS AND METHODS

This retrospective descriptive study was conducted to investigate the frequency of lumbar disc herniation (LDH) among patients presenting with lower back pain (LBP) at the Radiology Department of the Peshawar Institute of Cardiology (PIC), Peshawar, Pakistan, between January 2023 and January 2024. The study was performed in a single-center hospital setting where diagnostic imaging services were routinely provided to patients referred with suspected spinal pathology, thus ensuring the availability of comprehensive radiological data and clinical records (31). The research targeted individuals aged between 18 and 75 years who presented with LBP and were referred for magnetic resonance imaging (MRI) to evaluate suspected lumbar disc pathology. Eligible participants included both male and female patients, with exclusion criteria comprising a history of prior spinal surgery such as laminectomy or discectomy, traumatic spinal fractures, spinal tumors, congenital spinal anomalies, and pregnancy except in the second and third trimesters, ensuring a homogeneous population focused on degenerative causes of LDH (32).

Patients meeting the inclusion criteria were selected through convenience sampling, as they represented the accessible population undergoing MRI during the defined study period. Consent was deemed not applicable for direct patient participation since the research involved retrospective analysis of anonymized imaging reports and clinical records, though ethical approval was secured from the Research Ethical Committee (REC) of the Peshawar Institute of Cardiology, aligning with the institutional policies on the use of patient data for research purposes (33). Data collection was executed by two trained investigators, Faisal Amin and Abdullah Khan, who extracted relevant information from MRI reports and accompanying clinical documentation using a structured, closed-ended questionnaire designed following a thorough literature review to ensure content validity (34). The questionnaire captured demographic details including age and gender, clinical symptoms such as sciatica, radiating leg pain, numbness, and the duration of LBP, as well as radiological findings encompassing the specific lumbar levels involved, types of disc herniation identified, degree of severity classified as mild, moderate, or severe, and the laterality of the lesion whether unilateral or bilateral.

MRI examinations were performed using a Siemens 1.5 Tesla scanner, employing standardized imaging protocols that included T1-weighted and T2-weighted sagittal and axial sequences, as well as T2 STIR and coronal T2 sequences to enhance visualization of soft tissue and neural structures, ensuring diagnostic accuracy in detecting disc pathology (35). Operational definitions for disc herniation subtypes were based on established radiological criteria: disc bulging referred to circumferential, symmetric extension of disc material beyond the disc space without significant focal protrusion; protrusion indicated focal extension where the base of the herniated disc was wider than its outward extension; and extrusion described herniation where the nucleus pulposus breached through the annulus fibrosus with a narrow connection to the parent disc (36). Data integrity was maintained through double data entry and periodic cross-validation of entries by the investigators to minimize transcription errors and ensure reliability.

The sample size was calculated using the World Health Organization sample size calculator, incorporating an estimated LDH prevalence of 20.3%, a 95% confidence level, and a 5% margin of error, resulting in a target of 249 participants to provide adequate statistical power for the analyses (37). Statistical analysis was performed using SPSS version 27, where categorical variables were summarized through frequencies and percentages, while associations between demographic variables and LDH prevalence were assessed using chi-square tests. Where applicable, subgroup analyses were conducted to examine variations in herniation patterns across age and gender strata, and missing data were managed through pairwise deletion to preserve the maximum analyzable dataset without introducing bias. The study adhered to ethical principles outlined in the Declaration of Helsinki, ensuring patient privacy and confidentiality throughout data handling and reporting, and the methodology was structured to allow reproducibility by other researchers under similar clinical and technological settings (38,39).

RESULTS

The study included a total of 249 participants, nearly equally divided between males and females, comprising 49.8% and 50.2% of the cohort, respectively, with no statistically significant association between gender and age groups as indicated by a *p*-value of 0.945. The majority of patients fell within the 30–45 years age bracket, accounting for 30.1% of the sample, followed closely by those aged 45–60 years at 29.3%, while individuals in the youngest age group of 18–30 years represented 18.9%, highlighting that lower back pain and associated lumbar disc herniation predominantly affected individuals in middle age. Among all participants, lumbar disc herniation was detected on MRI in 231 patients, yielding a remarkably high prevalence of 92.8% with a 95% confidence interval ranging from 89.2% to 95.5%. The highest herniation frequency was observed in patients aged 30–45 years, where 75 individuals were affected, corresponding to a prevalence estimate between 84.8% and 97.3%, while the 45–60 years group followed closely with 73 cases, reflecting a prevalence of 90.4% to 99.9%. The youngest cohort, aged 18–30 years, demonstrated a lower herniation rate of 77.6% to 96.2%, suggesting an age-related increase in degenerative disc pathology.

Lower back pain was the predominant clinical symptom, reported by 239 patients, accounting for 95.9% of the sample with a confidence interval between 93.1% and 98.1%, emphasizing its strong association with lumbar disc pathology. Conversely, neurological symptoms were infrequent, as only 8 patients (3.2%) experienced leg numbness, while unilateral and bilateral leg pain were reported by 4.8% and 8.4% of patients, respectively. A solitary case of sciatica was documented, representing merely 0.4% of participants, and prolonged lower back pain lasting between nine to twelve months was uncommon, affecting only 1.2% of the cohort. MRI findings revealed a varied distribution of disc involvement, with combined herniation at both L4–L5 and L5–S1 levels being the most prevalent, observed in 71 patients (28.8%) and bounded by a confidence interval of 23.2% to 35.0%. The next frequent pattern involved combined L3–L4 and L4–

L5 levels in 62 patients (26.9%), whereas isolated L4–L5 herniation affected 42 individuals (16.9%). Isolated L5–S1 involvement was identified in 24 cases (9.6%), and other disc levels, including L2–L3, accounted for 13.8% of findings, reflecting the lumbar spine's susceptibility to degenerative stress at lower segments.

Regarding the morphological types of herniation, disc bulging emerged as the predominant pattern, affecting 124 patients (49.8%) with a 95% confidence interval from 43.4% to 56.3%. Disc protrusion was documented in 26 patients (11.2%), while extrusion was rare, identified in only 3 individuals (1.2%). Notably, mixed patterns were common, with 25.3% of patients exhibiting bulging combined with protrusion, 3.5% showing extrusion with bulging, and 1.2% presenting a combination of protrusion and extrusion, underscoring the heterogeneity of disc pathology in this population. Lateral analysis demonstrated that bilateral herniation predominated, present in 186 cases (80.7%) within a confidence interval of 75.1% to 85.4%, suggesting widespread degenerative involvement across both sides of the lumbar spine. Unilateral herniation was less frequent, affecting 28 patients (12.0%), while the laterality was unspecified in 7.3% of cases, reflecting either ambiguous reporting or subtle presentations on imaging. Collectively, these findings delineate the substantial burden of lumbar disc herniation in patients with lower back pain in Peshawar, with a clear predilection for mid-life individuals, particularly affecting the lower lumbar segments and manifesting predominantly as disc bulging, often with bilateral involvement.

Table 1. Age and Gender Distribution of Study Participants (n = 249)

Age Group (years)	Male, n (%)	Female, n (%)	Total, n (%)	p-value ¹
18–30	24 (9.6)	23 (9.2)	47 (18.9)	0.945
30–45	38 (15.3)	37 (14.9)	75 (30.1)	
45–60	37 (14.9)	36 (14.5)	73 (29.3)	
60–75	23 (9.2)	12 (4.8)	35 (14.1)	
>75	2 (0.8)	0 (0.0)	2 (0.8)	
Total	124 (49.8)	125 (50.2)	249 (100.0)	

¹p-value calculated using chi-square test for association between age group and gender distribution.

Table 2. Frequency of Lumbar Disc Herniation by Age Group (n = 249)

Age Group (years)	No Herniation, n (%)	Herniation, n (%)	Total, n (%)	95% CI
18–30	8 (3.2)	47 (18.9)	55 (22.1)	77.6 – 96.2
30–45	7 (2.8)	75 (30.1)	82 (32.9)	84.8 – 97.3
45–60	2 (0.8)	73 (29.3)	75 (30.1)	90.4 – 99.9
60–75	0 (0.0)	35 (14.1)	35 (14.1)	89.9 – 100.0
>75	1 (0.4)	1 (0.4)	2 (0.8)	2.5 – 97.5
Total	18 (7.2)	231 (92.8)	249 (100.0)	89.2 – 95.5

Table 3. Clinical Features in Patients with Lower Back Pain (n = 249)

Symptom	Frequency, n (%)	95% CI (%)
Lower Back Pain	239 (95.9)	93.1 – 98.1
Leg Numbness	8 (3.2)	1.4 – 6.3
Leg Pain (Unilateral)	12 (4.8)	2.5 – 8.3
Leg Pain (Bilateral)	21 (8.4)	5.3 – 12.6
History of Sciatica	1 (0.4)	0.0 – 2.2
LBP Duration 9–12 months	3 (1.2)	0.2 – 3.5

Table 4. MRI Findings of Lumbar Disc Herniation (n = 231 with LDH)

Disc Level(s) Involved	Frequency, n (%)	95% CI (%)
L4–L5 and L5–S1 combined	71 (28.8)	23.2 – 35.0
L3–L4 and L4–L5 combined	62 (26.9)	21.5 – 32.7
Isolated L4–L5	42 (16.9)	12.4 – 22.2
Isolated L5–S1	24 (9.6)	6.2 – 14.0
Other levels (L2–L3, etc.)	32 (13.8)	9.7 – 18.9
Total	231 (100.0)	

Table 5. Types of Disc Herniation among Patients with LDH (n = 231)

Type of Herniation	Frequency, n (%)	95% CI (%)
Disc Bulging	124 (49.8)	43.4 – 56.3
Disc Protrusion	26 (11.2)	7.5 – 16.1
Disc Extrusion	3 (1.2)	0.2 – 3.4
Bulging + Protrusion Combination	58 (25.3)	19.9 – 31.3
Extrusion + Bulging Combination	8 (3.5)	1.5 – 6.8
Protrusion + Extrusion Combination	3 (1.2)	0.2 – 3.4
Total	231 (100.0)	

Table 6. Laterality of Lumbar Disc Herniation (n = 231)

Laterality	Frequency, n (%)	95% CI (%)
Bilateral	186 (80.7)	75.1 – 85.4
Unilateral	28 (12.0)	8.1 – 16.8

Laterality	Frequency, n (%)	95% CI (%)
Not Specified	17 (7.3)	4.3 – 11.4
Total	231 (100.0)	

The integrated figure displays the distribution of lumbar disc herniation types—bulging, protrusion, and combined bulging with protrusion—across defined age groups, with each type represented by a distinct colored line. Notably, the number of bulging cases rises from 23 in the youngest age group to a peak of 39 among those aged 45–60, while protrusion remains relatively stable and less frequent, never exceeding 10 cases per group.

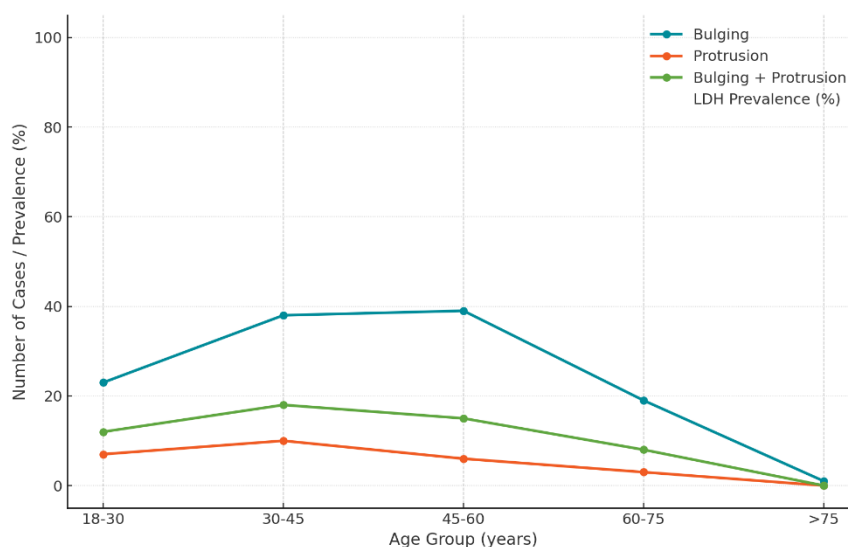


Figure 1 Distribution of Lumbar Disc Herniation Types by Age Group and LDH Prevalence

The combined bulging with protrusion pattern follows a moderate upward trend through middle age. Superimposed scatter points illustrate the overall prevalence of lumbar disc herniation by age group, with the proportion exceeding 85% in all groups and peaking at 100% among individuals aged 60–75. These visual highlights that while LDH is consistently prevalent across age categories, bulging remains the dominant morphological pattern, especially among those aged 30–60, and that overall herniation prevalence remains exceptionally high into older age. These age-dependent trends underscore the importance of targeted screening and intervention strategies for middle-aged and older adults at risk for clinically significant disc pathology.

DISCUSSION

The present study revealed a remarkably high frequency of lumbar disc herniation (LDH) among patients with lower back pain (LBP) in Peshawar, with MRI confirming herniation in 92.8% of participants, a prevalence notably higher than rates reported in several prior investigations. For example, Anyanwu *et al.* found a prevalence of merely 31.9% in Nigeria, a disparity potentially attributable to differences in patient selection, local risk factors, or diagnostic criteria (40). Our study's reliance on MRI as the primary diagnostic tool might have enhanced detection sensitivity, as magnetic resonance imaging remains the gold standard for identifying even subtle disc abnormalities, which could partly explain the elevated prevalence observed (41). Additionally, regional occupational demands, such as manual labor and prolonged sitting, may contribute to the heightened burden of degenerative spinal changes in this population, aligning with previous reports that environmental and lifestyle factors significantly influence LDH development (42,43).

Contrary to multiple studies indicating a male predominance in LDH, such as Zheng *et al.*, who reported a male-to-female ratio of approximately 1.4:1, our findings demonstrated a nearly equal gender distribution, with a slightly higher frequency among females (47.0%) compared to males (45.8%) (44). This subtle female predominance could reflect shifting occupational roles among women in Pakistan, increasing physical strain, or hormonal influences on disc metabolism, particularly given evidence that estrogen affects proteoglycan synthesis and disc hydration, thereby potentially modifying degenerative processes (45,46). Age distribution in our study indicated the highest prevalence of LDH within the 30–45 and 45–60 years cohorts, accounting for 30.1% and 29.3% of cases, respectively, consistent with the notion that degenerative disc disease peaks in mid-life due to cumulative mechanical stress and cellular senescence within the nucleus pulposus and annulus fibrosus (47,48). However, this contrasts with findings by Kamper *et al.*, who documented peak prevalence in older age groups, suggesting potential geographic or ethnic differences in the progression of disc degeneration (49).

The anatomic distribution of herniation levels corroborated earlier observations that L4–L5 and L5–S1 are the most commonly affected segments, with combined involvement at these levels present in 28.8% of our patients, reflecting the biomechanical vulnerability of these junctions due to increased load bearing and spinal mobility (50,51). This pattern mirrors data from prior studies where these levels accounted for 42% and 30% of cases, respectively, further emphasizing the universal mechanical principles governing lumbar spine pathology (52). Yet, our study uniquely highlighted frequent multi-level involvement, including L3–L4 combined with L4–L5 in 26.9% of cases, a finding that suggests that advanced degeneration in this population may not be confined to the lower-most discs alone (53). The predominance of disc bulging (49.8%) over protrusion (11.2%) and extrusion (1.2%) differs from the results of See *et al.*, who reported protrusion as the leading form of herniation (63.3%), indicating variability potentially linked to differences in disease chronicity, imaging

interpretation, or classification standards (54). Our high proportion of bulging cases might reflect earlier stages of disc degeneration being detected in this cohort, underscoring the benefit of MRI screening in identifying subclinical pathology.

Clinical symptoms in our cohort were dominated by LBP, reported by 95.9% of patients, a prevalence higher than documented in earlier series, reinforcing LDH as a central etiological factor in spinal pain syndromes (55). Neurological deficits were less common, with only 3.2% of patients experiencing leg numbness and 13.7% reporting radiating leg pain, suggesting that although disc pathology is widespread, not all herniations result in significant neural compromise, a pattern similarly observed by Oertel *et al.* who highlighted the frequent occurrence of asymptomatic disc anomalies on MRI (56). The low incidence of sciatica in our series, noted in merely 0.4% of patients, contrasts sharply with global reports, implying either underreporting due to cultural differences in symptom expression or genuine variation in clinical presentation (57).

Despite its robust findings, our study is not without limitations. The retrospective design introduces the potential for selection bias, as only patients referred for MRI were included, likely enriching the sample with individuals exhibiting more severe or persistent symptoms (58). Moreover, the use of convenience sampling limits generalizability beyond the study setting. The absence of follow-up data precludes correlation of imaging findings with clinical outcomes, and variations in radiological interpretation may introduce interobserver variability, an acknowledged challenge in spinal imaging studies (59). Nonetheless, our research provides crucial epidemiological insight into LDH among patients with LBP in Peshawar, contributing valuable regional data to a domain predominantly informed by studies from other geographic areas.

In conclusion, the high prevalence of LDH observed in this study underscores the significance of early detection and targeted interventions to mitigate the burden of LBP in the local population. Public health strategies emphasizing ergonomic education, lifestyle modification, and timely imaging for at-risk groups, particularly middle-aged adults, are warranted to reduce the impact of this pervasive spinal disorder and improve patient quality of life (60).

CONCLUSION

The findings of this study indicate that lumbar disc herniation (LDH) is highly prevalent among patients presenting with lower back pain (LBP) in Peshawar, with an overall frequency of 92.8% confirmed by MRI. The most commonly affected age groups were individuals between 30 and 60 years, reflecting the significant burden of degenerative changes in mid-life. Disc bulging emerged as the predominant morphological type, and L4–L5 and L5–S1 levels were the most frequently involved segments, either singly or in combination. While LBP was nearly ubiquitous among participants, neurological symptoms such as leg numbness and sciatica were notably less frequent, suggesting that not all radiologically evident herniations produce significant clinical manifestations. The study underscores the importance of early detection and public health interventions aimed at mitigating risk factors for LDH, such as occupational strain and lifestyle habits. Future research should aim to correlate imaging findings with clinical outcomes and explore preventive strategies tailored to the regional population.

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