https://doi.org/10.29309/TPMJ/2025.32.12.9891

The Professional Medical Journal
www.theprofesional.com
2025, Volume, 32 Issue, 12

ORIGINAL ARTICLE

Clinico-radiologic patterns and BMI association in degenerative disease of the lumbosacral spine: A retrospective MRI study from a tertiary care hospital in Pakistan.

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Article Citation: Aziz R, Khan MI, Afzal F, Siddique F, Nisar M. Clinico-radiologic patterns and BMI association in degenerative disease of the lumbosacral spine: A retrospective MRI study from a tertiary care hospital in Pakistan. Professional Med J 2025; 32(12):1713-1718. https://doi.org/10.29309/TPMJ/2025.32.12.9891

ABSTRACT… Objective: To assess the clinico-radiologic patterns of lumbar spine degeneration as seen on MRI and to examine their association with different BMI categories among adult patients presenting with backache at a tertiary care hospital in Peshawar, Pakistan. **Study Design:** Retrospective study. **Setting:** LRH, Peshawar. **Period:** September 2022 to September 2024. **Methods:** Included 140 patients who reported lower back pain and underwent lumbosacral spine MRI. MRI findings were assessed at each spinal level and analyzed in relation to patients' BMI, which was classified according to WHO standards. Descriptive statistics, chi-square tests, and BMI-based distribution analyses were carried out. **Results:** The average age of participants was 41.8 years (SD = 13.3), with females making up 51% of the sample. The mean BMI was 28.6 kg/m^2 (SD = 4.98), and 68.5% of patients were either overweight or obese. MRI results showed a progressive increase in degenerative changes from the upper to the lower lumbar spine. The L4–L5 level exhibited the most frequent findings (72.1% diffuse bulge), followed by L5–S1 (28.6% diffuse bulge and 21.4% central herniation). Significant associations were observed between BMI and disc pathology at the upper lumbar levels, specifically at L1–L2 ($p = 0.0207$) and L2–L3 ($p = 0.0048$). No statistically significant correlation was found at the lower lumbar levels. **Conclusion:** Higher BMI appears to be linked with early-stage disc degeneration, particularly in the upper lumbar spine. Encouraging weight control and early lifestyle modifications may help reduce the burden of lumbar disc disease, especially in overweight and obese individuals.

Key words: BMI, Intervertebral Disc Degeneration, MRI, Spine.

INTRODUCTION

Low back pain (LBP) ranks among the most common causes of disability across the globe. It affects people of all ages and often presents as a long-term, recurring condition. According to the Global Burden of Disease (GBD) study, over 500 million people were affected by LBP in 2017, making it one of the top contributors to years lived with disability (YLDs) worldwide.[1,2] The impact of LBP isn't limited to health—it also carries significant economic consequences due to healthcare expenses and lost productivity.[3]

In high-income countries, widespread imaging and large-scale population studies have highlighted degenerative disc disease as a key factor in chronic LBP, especially in middle-aged and older adults. Magnetic Resonance Imaging (MRI) has become the preferred method for identifying degenerative changes in the lumbar spine, such as disc dehydration, bulging, herniation, and narrowing of the spinal canal.[4] However, MRI can sometimes reveal these changes even in people who don't have symptoms, which makes diagnosis more complex. Still, MRI remains essential in linking a patient's symptoms to specific anatomical changes.[5]

An increasing number of studies from developed countries have connected excess body weight with spinal degeneration. Obesity adds pressure to the spine's discs and triggers inflammatory processes that may speed up disc degeneration.[6]

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Article received on: 04/06/2025
Accepted for publication: 20/08/2025

Extensive research, such as United Kingdom Adult Twin Registry, has shown a significant correlation between higher body mass index (BMI) and both the prevalence and severity of lumbar disc degeneration.[7] Senker et al. further suggest that these degenerative changes may begin early in obese individuals and result from both mechanical stress and systemic effects.[8] Overweight individuals are also at greater risk of needing surgery for lumbar disc herniation.[9]

On the other hand, there is a noticeable lack of similar research in developing countries. Even though obesity rates are climbing in many low- and middle-income regions, including South Asia, there are few localized studies that examine how BMI relates to lumbar disc degeneration.

Some studies from countries like Ethiopia, Saudi Arabia, and Bangladesh do show a high burden of spinal degenerative diseases, but they rarely investigate connections with lifestyle or body measurements.[10-12] This issue is especially relevant in countries like Pakistan, where many people engage in physically demanding work or spend long hours in posture-heavy activities at home.

Given this background, the aim of the study is to describe the clinico-radiological patterns of degenerative disease in the lumbosacral spine and to evaluate its association with body mass index (BMI) among adult patients undergoing MRI at a tertiary care hospital in Peshawar.

METHODS

Study Design and Setting

This was a retrospective study carried out in the Radiology Department of Lady Reading Hospital (LRH), a tertiary care teaching facility located in Peshawar, Pakistan after approval from institutional ethical committee (232/LRH/MTI-03-06-25).

Data was collected from September 2022 to September 2024. A convenient sampling method was used, and a total of 140 adult patients who met the inclusion criteria were enrolled. Patients referred for lumbosacral spine MRI and found to have degenerative changes were included in the study. Exclusion criteria included a history of spinal surgery, sacroiliac arthritis, spinal fractures, spinal infections (such as tuberculosis), active malignancy or metastatic disease, and metabolic bone disorders.

Inclusion Criteria

- Adults ≥18 years
- MRI-confirmed degenerative changes in lumbar spine
- Documented height and weight for BMI calculation

Exclusion Criteria

- History of spine surgery
- Infections, malignancy, or metabolic bone disease
- Incomplete imaging or missing BMI data

Data Collection Procedure

All MRIs were performed using a 1.5 Tesla Toshiba MRI scanner. The imaging protocol included T1-weighted and T2-weighted sequences in both axial and sagittal planes, adhering to a standardized lumbar spine imaging protocol. Images were reviewed using the Picture Archiving and Communication System (PACS) by a consultant radiologist—a Fellow of the College of Physicians and Surgeons Pakistan—with significant experience in musculoskeletal imaging. Written informed consent was obtained from each participant or their legal guardian. As the study did not involve any invasive procedures or radiation exposure, it posed no direct risk to patient safety.

Demographic data, along with each patient's height and weight, were obtained either from clinical records or through direct interviews.
Body Mass Index (BMI) was calculated using the standard formula:
BMI = Weight (kg) / Height (m^2).

Patients were then categorized according to the World Health Organization (WHO) BMI classification[13]:

- Underweight: <18.5 kg/m^2

- Normal weight: 18.5–24.9 kg/m²
- Overweight: 25.0–29.9 kg/m²
- Obese Class I: 30.0–34.9 kg/m²
- Obese Class II: 35.0–39.9 kg/m²
- Obese Class III: ≥40 kg/m²

Clinical indications for MRI were recorded from referral documentation and included symptoms such as low back pain, sciatica, walking difficulty, neurogenic claudication, and a history of trauma.

Occupational data were also collected to assess any potential link between work-related physical demands and the pattern of spinal degeneration.

Each MRI scan was systematically reviewed for lumbar disc degeneration using standardized criteria. Findings such as disc bulges, central and paracentral herniations, and vertebral alignment were assessed based on widely accepted radiologic grading systems by Pfirrmann et al.[14] Degenerative findings were documented for each lumbar level, from L1–L2 through L5–S1.

Statistical Analysis

Data were entered and analyzed using SPSS software, version 24. Descriptive statistics were applied to summarize demographic variables and MRI findings. Frequencies and percentages were calculated for categorical variables, while means and standard deviations were reported for continuous variables.

For inferential statistics, chi-square tests were used to determine associations between BMI categories and disc pathology at individual lumbar levels. A p-value of less than 0.05 was considered statistically significant. An exploratory logistic regression model was also attempted to evaluate the predictive value of BMI for multilevel disc degeneration, although the analysis was limited by data constraints.

RESULTS

A total of 140 patients were included in the study, with a mean age of 41 years (SD = 13.3), ranging 19 – 75 years. The gender distribution was nearly balanced, with females making up 51% of the sample. The average BMI was 28.6 kg/m² (SD = 4.98), indicating that most participants were either overweight or obese. Patient heights ranged from 150 to 193 cm, with a mean of 161.4 cm, and weights ranged from 45 to 117 kg, averaging 74 kg.

Based on BMI classifications, the majority of patients fell into overweight or obese categories. Specifically, 42 patients (30.0%) were overweight, 44 (31.4%) were classified as Obese Class I, and 10 (7.1%) as Obese Class II. Only 1 patient (0.7%) fell into Obese Class III. Meanwhile, 42 patients (30.6%) had a normal BMI, and only one patient (0.7%) was underweight.

Regarding occupational distribution, many patients were involved in physically demanding or posture-intensive roles. The most common occupation was housewife, accounting for 46.4% of participants. Other occupations included laborers (9.3%), shopkeepers (7.1%), students (4.3%), and farmers (3.6%).

Among the 134 patients with documented lumbar spine curvature data, 58.2% had a normal curvature. A straightened lumbar spine—often suggestive of muscle spasm or postural issues—was observed in 36.6% of patients. Reversed curvature, which may indicate significant postural disruption or pathology, was found in 5.2%.

MRI findings revealed a clear pattern of increasing degeneration from the upper to the lower lumbar spine, with the most severe changes seen at L4–L5 and L5–S1 levels (see Table-I).

When disc changes were examined in relation to BMI categories, most cases of disc bulges and herniations were found in overweight and obese patients. The data are shown below.

Statistical analysis using chi-square tests showed significant associations between BMI and disc pathology at the upper lumbar levels:

These results suggest that higher BMI is significantly associated with disc degeneration at the L1–L2 and L2–L3 levels, but not at the lower lumbar levels.

Lumbar Level	Normal	Disc Pathology		
		Disc Bulge	Central Herniation	Paracentral Herniation
L1- L2	131 (93.6%)	7 (5.0%)	2 (1.4%)	-
L2- L3	121 (86.4%)	17 (12.1%)	2 (1.4%)	-
L3- L4	89 (63.6%)	42 (30.0%)	6 (4.3%)	3 (2.1%)
L4- L5	20 (14.3%)	101 (72.1%)	11 (7.9%)	8(5.7%)
L5- S1	44 (31.4%)	50 (35.7%)	35 (25.0%)	11(7.9%)

Table-I. Distribution of degenerative changes by lumbar level

Lumbar Level	BMI Category (kg/m²)					
	Under weight	Normal	Over weight	Obese I	Obese II	Obese III
L1-2		2	3	3	1	1
L2-3		8	4	3	2	2
L3-4		15	20	12	4	
L4-5		34	36	39	9	2
L5-S1	1	27	30	26	8	2

Table-II. Disc Bulge/Herniation by BMI Category

Spinal Level	Chi² Value	P-Value	Significant
L1-2	13.304	0.0207	Yes
L2-3	16.85	0.0048	Yes
L3-4	5.038	0.4113	No
L4-5	7.018	0.2193	No
L5-S1	3.877	0.5672	No

Table-III. Chi-Square Test Results: BMI vs. Disc Pathology

DISCUSSION

This study reveals a high prevalence of degenerative changes in the lumbar spine, particularly among overweight and obese individuals presenting with back pain at a tertiary care facility in Pakistan. As anticipated, the L4–L5 and L5–S1 levels were the most commonly affected. However, a notable and somewhat unexpected finding was the statistically significant association between higher BMI and disc pathology at the upper lumbar levels, specifically L1–L2 and L2–L3.

This supports emerging evidence that overweight individuals may experience early degenerative changes in these upper segments. Interestingly, we did not observe a significant association between BMI and pathology at the L4–L5 or L5–S1 levels, although these levels showed the highest frequency of pathology.

These findings align with Heuch et al.[15], who identified early upper-segment degeneration associated with increased BMI. Our chi-square analysis revealed significant associations at L1–L2 ($\chi^2 = 13.30$, $p = 0.0207$) and L2–L3 ($\chi^2 = 16.85$, $p = 0.0048$), supporting the hypothesis that both axial loading and pro-inflammatory adipokines play a role in early degeneration.

Ajiboye et al[16] conducted a population-based MRI study in Nigeria, showing obesity's strong independent link with multi-level lumbar disc degeneration. In our cohort, L4–L5 exhibited the highest frequency of disc bulges (72.1%), and L5–S1 presented a mix of bulges and herniations. However, these lower levels did not show significant associations with BMI, likely due to the nearly universal presence of pathology among symptomatic individuals, which limits meaningful comparison across BMI groups.

According to a meta-analysis by Samartzis et al.[17] overweight and obese individuals have a 1.6–2.4 times greater risk of lumbar disc degeneration. This is consistent with our data, where disc pathology—particularly at L4–S1—was nearly universal among patients in Obese Class II and III. All Obese Class II and III patients in our study had L4–L5 abnormalities. However, we could not perform a meaningful logistic regression to assess BMI as a predictor due to "complete separation": only one patient in the entire cohort had a fully normal lumbar spine.

Deguchi T et al.[18] proposed that genetic factors may play a larger role than BMI, especially in younger individuals. Although we did not evaluate genetic predisposition, our study population had a mean age of 41.7 years—an age where cumulative biomechanical stress from elevated BMI may become more apparent.

Lastly, Ding Y et al.[19] noted that radiological findings often do not correlate perfectly with symptom severity. This is an important consideration, since all 140 of our patients were symptomatic. While our study focused on structural imaging findings, pain perception may also be influenced by muscle spasms, psychosocial stressors, or other non-discogenic sources.

CONCLUSION

This study reinforces the association between higher BMI and early-stage lumbar disc degeneration, especially in the upper spinal segments.

Overweight and obese individuals were more likely to show disc pathology at L1–L3 than those with normal or underweight BMI.

Preventive strategies aimed at weight control may play a critical role in reducing the risk and progression of lumbar spine degeneration.

LIMITATIONS

This study has several limitations. First, its cross-sectional design does not allow for conclusions about causality. Second, we did not include grading of disc degeneration severity on MRI, which could have enriched the analysis. Finally, as the study was conducted at a single tertiary care center, with limited representation of patients in extreme BMI categories, the generalizability of the findings is restricted.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

SOURCE OF FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

1. Hartvigsen J, Hancock MJ, Kongsted A, Louw Q, Ferreira ML, Genevay S, et al. **What low back pain is and why we need to pay attention.** Lancet. 2018; 391(10137):2356-67. https://doi.org/10.1016/S0140-6736(18)30480-X
2. Wu D, Hoy D, March L, Smith E, Cross M, Fransen M, et al. **FRI0552 Global, regional, and national burden of low back pain, 1990–2019: A systematic analysis for the Global Burden of Disease Study 2019.** Ann Rheum Dis. 2020; 79(Suppl 1):877-8. doi:10.1136/annrheumdis-2020-eular.2602.
3. Hoy D, March L, Brooks P, Blyth F, Woolf A, Bain C, et al. **The global burden of low back pain: Estimates from the Global Burden of Disease 2010 study.** Ann Rheum Dis. 2014; 73(6):968-74. doi:10.1136/annrheumdis-2013-204428
4. Brinjikji W, Luetmer PH, Comstock B, Bresnahan BW, Chen LE, Deyo RA, et al. **Systematic literature review of imaging features of spinal degeneration in asymptomatic populations.** Am J Neuroradiol. 2015; 36(4):811-6. doi:10.3174/ajnr.A4173
5. Takatalo J, Karppinen J, Niinimäki J, Taimela S, Näyhä S, Mutanen P, et al. **Does lumbar disc degeneration on magnetic resonance imaging associate with low back symptom severity in Young Finnish adults?,** Spine. 2011; 36(25):2180-9. doi:10.1097/brs.0b013e3182077122.
6. He Y, Liu L, Wang T, Chen Y, Yang Y, Li S, et al. **Deep learning for lumbar disc herniation diagnosis and treatment decision-making using magnetic resonance imagings: A retrospective study.** World Neurosurg. 2025; 195:123728. doi:10.1016/j.wneu.2025.123728
7. Gualdi F, Williams FMK, Battié MC, Sambrook PN, Junno JA, Livshits G, et al. **Modic change is associated with increased BMI but not autoimmune diseases in TwinsUK.** Eur Spine J. 2023 Oct; 32(10):3379-86. doi:10.1007/s00586-023-07870-7
8. Senker W, Hartwig CH, Grundner M, Gmeiner M, Fischmeister M, Berghold A. **Perioperative morbidity and complications in minimal access surgery techniques in obese patients with degenerative lumbar disease.** Eur Spine J. 2011 Jul; 20(7):1182-7. doi:10.1007/s00586-011-1689-6
9. Hareni N, Karlsson MK, Hasserius R, Obrant KJ, Gerdhem P. **A study comparing outcomes between obese and nonobese patients with lumbar disc herniation undergoing surgery: A study of the Swedish National Quality Registry of 9979 patients.** BMC Musculoskelet Disord. 2022; 23(1):931. doi:10.1186/s12891-022-05884-8.

10. Gebrewold Y, Tesfaye B. **Does lumbar MRI predict degree of disability in patients with degenerative disc disease? A prospective cross-sectional study at University of Gondar Comprehensive Specialized Hospital, North West Ethiopia, 2020.** BMC Med Imaging. 2022; 22(1):138. doi:10.1186/s12880-022-00866-7

11. Singh NN, Rohit K, Padhiyar MA. **To validate and correlate radiologic grading of central and foraminal stenosis post-surgical decompression on degenerative lumbar canal stenosis.** Asian J Med Sci. 2024; 15(2):118-23. Available from: https://nepjol.info/index.php/AJMS/article/download/67624/53261

12. Hassan K, Sultana N, Islam MR, Ahmed S, Haque HF. **The pattern of lumbar spine MRI findings in chronic low back pain in a tertiary hospital in Bangladesh.** J Bangladesh Coll Phys Surg. 2020; 38(2):85-91. https://doi.org/10.3329/jbcps.v38i2.45755

13. World Health Organization. **Obesity: preventing and managing the global epidemic. Report of a WHO consultation. Geneva: World Health Organization; 2000.** (WHO Technical Report Series, No. 894). Available from: https://apps.who.int/iris/handle/10665/42330

14. Pfirrmann CW, Metzdorf A, Zanetti M, Hodler J, Boos N. **Magnetic resonance classification of lumbar intervertebral disc degeneration.** Spine (Phila Pa 1976). 2001; 26(17):1873-8. doi:10.1097/00007632-200109010-00011

15. Heuch I, Heuch I, Hagen K, Zwart J. **Overweight and obesity as risk factors for chronic low back pain: A new follow-up in the HUNT Study.** BMC Public Health. 2024; 24(1):2618. https://doi.org/10.1186/s12889-024-20011-z

16. Ajiboye LO, Gbadegesin SA, Oboirien M, Alimi M, Oyeniyi EO, Sadiq NA. **Body mass index and severity of lumbar degenerative disc disease in adult patients using Oswestry Disability Index: any correlation?** East Afr Orthop J. 2019; 13(1):34-41. Available from: https://www.ajol.info/index.php/eaoj/article/view/191064.

17. Samartzis D, Karppinen J, Mok F, Fong DY, Luk KD, Cheung KM. **A population-based study of juvenile disc degeneration and its association with overweight and obesity, low back pain, and diminished functional status.** J Bone Joint Surg Am. 2011; 93(7):662-70. doi:10.2106/JBJS.I.01568.

18. Deguchi T, Hashizume H, Terao C, Yamada H, Nakamura M, Matsumoto M, et al. **A longitudinal population-based study identifies THBS2 as a susceptibility gene for intervertebral disc degeneration.** Eur Spine J. 2024; 33(9):3334-42. doi:10.1007/s00586-024-08152-6

19. Ding Y, Ruan S, Liu L, Xu S, Zhang Y, Sun Y, et al. **A new four-area method for evaluating biochemical changes in lumbar facet joint degeneration on T2* mapping.** BMC Musculoskelet Disord. 2025; 26:480. doi:10.1186/s12891-025-08737-2

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1	**Rukhsana Aziz:** Study design, data collection, manuscript writing.
2	**Muhammad Imran Khan:** Analysis.
3	**Fariha Afzal:** Study design.
4	**Faridoon Siddique:** Data collection.
5	**Maria Nisar:** Data collection.