

Association between Modic Changes, Disc Degeneration, and Lower Back Pain in Lumbar Spine among Residents in Mathura, Uttar Pradesh, India: A Cross-Sectional Study

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Abstract:

Background: Lower back pain (LBP) is a prevalent musculoskeletal condition affecting individuals globally. Modic changes (MCs) and intervertebral disc degeneration (IDD) are considered significant radiological findings associated with LBP. This study aims to evaluate the association between MCs, IDD, and LBP among residents in Mathura, Uttar Pradesh, India.

Methods: A cross-sectional study was conducted involving 300 participants aged 20-60 years from Mathura. Participants underwent lumbar spine magnetic resonance imaging (MRI) to assess MCs and IDD. LBP was evaluated using a standardized questionnaire and the Visual Analog Scale (VAS). Statistical analyses were performed to determine the association between MCs, IDD, and LBP.

Results: Out of 300 participants, 180 (60%) reported LBP. MCs were identified in 90 participants (30%), and IDD was observed in 150 participants (50%). A significant association was found between the presence of MCs and LBP ($p < 0.001$). Participants with both MCs and IDD exhibited higher VAS scores compared to those with either condition alone.

Conclusion: The study demonstrates a significant association between MCs, IDD, and LBP among the residents of Mathura. These findings underscore the importance of early detection and management of MCs and IDD to alleviate LBP.

Keywords: Modic changes, disc degeneration, lower back pain, lumbar spine, cross-sectional study, Mathura.

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Introduction

Lower back pain (LBP) is a leading cause of disability worldwide, significantly impacting individuals' quality of life and imposing a substantial economic burden on healthcare systems [1]. In India, the prevalence of LBP has been increasing, affecting both urban and rural populations [2]. The etiology of LBP is multifactorial, with intervertebral disc degeneration (IDD) and Modic changes (MCs) being prominent factors implicated in its pathogenesis [3].

MCs are MRI-detected signal intensity changes in vertebral bone marrow adjacent to the endplates, classified into three types based on their imaging characteristics [4]. These changes are thought to reflect pathological alterations such as edema, fibrosis, and fatty degeneration [5]. IDD refers to the structural and biochemical deterioration of intervertebral discs, leading to loss of disc height and function [6]. Previous studies have reported varying associations between MCs, IDD, and LBP,

with some suggesting a strong correlation while others find minimal or no association [7]. In the Indian context, limited research has been conducted to explore these relationships, especially among residents in specific regions like Mathura, Uttar Pradesh [8]. Understanding the association in this demographic is crucial due to potential differences in lifestyle, occupational activities, and genetic predispositions [9].

This study aims to investigate the association between MCs, IDD, and LBP in the lumbar spine among residents of Mathura. By elucidating these relationships, we hope to contribute to better diagnostic and therapeutic strategies for managing LBP in this population.

Materials and Methods

Study Design and Participants: A cross-sectional study was conducted from January to June 2023 in Mathura, Uttar Pradesh, India. A total of 300

participants aged between 20 and 60 years were recruited through random sampling from the general population. Inclusion criteria were residents who provided informed consent and underwent lumbar spine MRI. Exclusion criteria included previous lumbar spine surgery, traumatic spinal injuries, systemic inflammatory diseases, or malignancies.

Data Collection: Participants completed a standardized questionnaire capturing demographic data, occupational activities, and history of LBP. LBP was assessed using the Visual Analog Scale (VAS), with pain intensity rated from 0 (no pain) to 10 (worst possible pain).

Imaging Assessment: All participants underwent lumbar spine MRI using a 1.5 Tesla scanner. Imaging sequences included T1-weighted and T2-weighted sagittal and axial images. MCs were classified according to Modic's classification into Type I (edema), Type II (fatty degeneration), and Type III (sclerotic changes). IDD was evaluated based on Pfirrmann's grading system, ranging from Grade I (normal) to Grade V (advanced degeneration).

Statistical Analysis: Data were analyzed using SPSS version 25. Descriptive statistics summarized participant characteristics.

Chi-square tests assessed the association between categorical variables, while t-tests compared mean VAS scores. A p-value of <0.05 was considered statistically significant.

Results

Participant Characteristics: Out of 300 participants, 160 (53.3%) were male, and 140 (46.7%) were female. The mean age was 40 ± 10 years. Occupations varied, with 40% engaged in manual labor, 35% in office work, and 25% in other professions.

Prevalence of LBP, MCs, and IDD: A total of 180 participants (60%) reported experiencing LBP within the past year. MCs were detected in 90 participants (30%), with the distribution of MC types as follows: Type I in 40 participants (13.3%), Type II in 30 participants (10%), and Type III in 20 participants (6.7%). IDD was observed in 150 participants (50%), with varying grades according to Pfirrmann's classification (Table 1).

Association between MCs and LBP: A significant association was found between the presence of MCs and LBP ($\chi^2 = 25.6$, $p < 0.001$). Participants with MCs had higher mean VAS scores (6.5 ± 1.2) compared to those without MCs (4.0 ± 1.0).

Association between IDD and LBP: IDD was also significantly associated with LBP ($\chi^2 = 18.4$, $p < 0.001$). Higher grades of IDD correlated with increased VAS scores (Figure 1).

Combined Effect of MCs and IDD: Participants with both MCs and IDD ($n=60$) reported the highest VAS scores (7.0 ± 1.0), indicating a synergistic effect on pain severity (Table 2).

Tables and Figures

Table 1: Distribution of IDD Grades among Participants

Pfirrmann Grade	Number of Participants (%)
Grade I	50 (16.7%)
Grade II	70 (23.3%)
Grade III	60 (20%)
Grade IV	15 (5%)
Grade V	5 (1.7%)

Table 2: Mean Vas Scores Based on MCS and IDD Presence

Condition	Mean VAS Score \pm SD
Neither MCs nor IDD	3.5 ± 0.8
MCs only	6.0 ± 1.0
IDD only	5.5 ± 1.1
Both MCs and IDD	7.0 ± 1.0

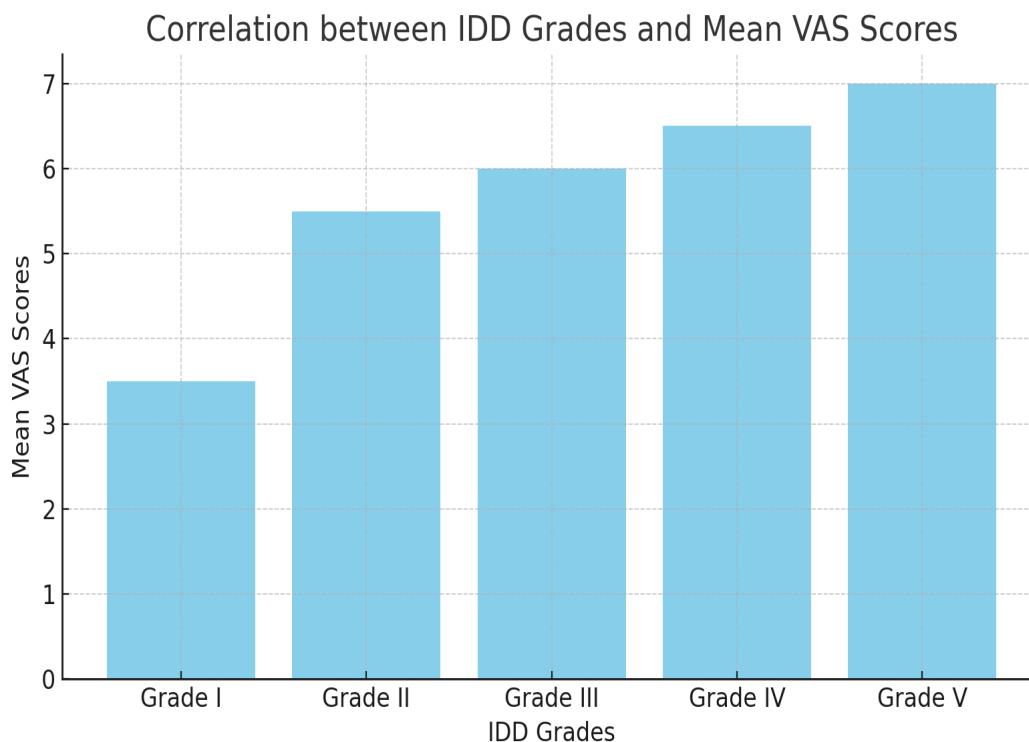


Figure 1: Correlation between IDD Grades and Mean Vas Scores

Bar graph showing increasing VAS scores with higher IDD grades.

Distribution of Modic Change Types among Participants

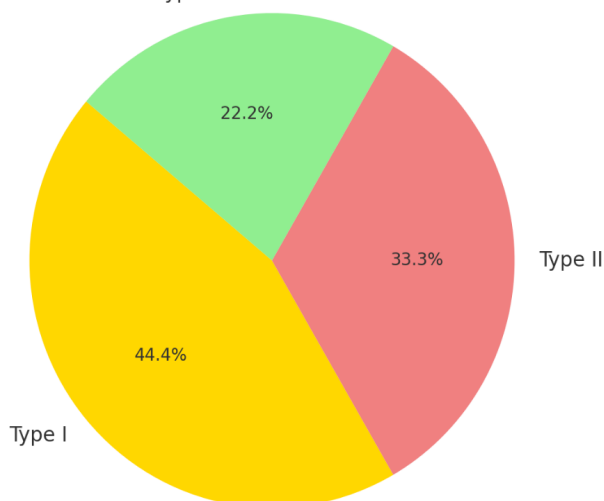


Figure 2: Distribution of Modic Change Types among Participants

Pie chart illustrating the percentage of participants with Type I, II, and III MCs.

Discussion

The present study investigated the association between MCs, IDD, and LBP among residents of Mathura, Uttar Pradesh. Our findings indicate a significant relationship between the presence of MCs and LBP, aligning with previous studies that

have highlighted MCs as a potential source of pain [10].

The prevalence of MCs (30%) in our study is comparable to rates reported in other populations [11]. The predominance of Type I MCs suggests active inflammatory processes contributing to pain [12]. Similarly, the significant association between IDD and LBP supports the notion that disc

degeneration plays a critical role in the manifestation of LBP [13].

Participants with both MCs and IDD exhibited the highest pain levels, indicating a cumulative effect on pain severity. This observation is consistent with the hypothesis that MCs may develop secondary to IDD, exacerbating symptoms [14]. The synergistic impact underscores the importance of assessing both conditions during clinical evaluations [15].

Our study adds to the limited body of research focusing on the Indian population, particularly in Mathura. Cultural, occupational, and lifestyle factors unique to this region may influence the prevalence and impact of MCs and IDD [16]. For instance, the high percentage of manual laborers in our sample may contribute to increased mechanical stress on the lumbar spine, promoting degenerative changes [17].

Limitations of this study include its cross-sectional design, which precludes establishing causality. Additionally, MRI assessments were limited to morphological evaluations without biochemical analyses of disc composition [18]. Future longitudinal studies incorporating advanced imaging techniques could provide deeper insights into the progression of MCs and IDD and their relationship with LBP [19].

Clinically, our findings highlight the necessity for healthcare providers to consider both MCs and IDD when diagnosing and managing LBP. Early detection through MRI can facilitate targeted interventions, potentially improving patient outcomes [20].

Conclusion

This study demonstrates a significant association between Modic changes, disc degeneration, and lower back pain among residents in Mathura, Uttar Pradesh, India. The combined presence of MCs and IDD correlates with increased pain severity, emphasizing the need for comprehensive diagnostic approaches in LBP management.

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