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A Study on the Association of Modic Changes and Chronic Low Back Pain

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Abstract **Original Research Article**

***Introduction*:** Modic changes refer to specific pathologic changes that occur in the vertebrae adjacent to the endplates of the intervertebral disc. They are observable through Magnetic Resonance Imaging (MRI) and are categorized into three types: Type I, II, and III. These changes are often associated with back pain and are considered a potential diagnostic marker for chronic low back pain. ***Aim of the Study*:** The aim of this study was to assess the association of Modic changes and chronic low back pain. ***Methods*:** This cross-sectional study was conducted in Department of Orthopaedics Surgery, Brahmanbaria Medical College Hospital, Brahmanbaria, Bangladesh, during the period from December 2020 to December 2022. Total 150 patients with chronic low back pain were included in this study. ***Result*:** In our study, all the patients predominantly aged around 52.3 years, with a slight female predominance (52%) and a mean BMI within a healthy range. The average symptom duration was around 4 years. Most subjects showed Modic Type I changes (65.3%). Multivariate analyses demonstrated a stronger association between Type I changes and chronic low back pain, with decreasing associations in Types II and III. Pain variables, including episodes and severity, were associated more with Modic changes for low back pain than sciatic pain, suggesting a moderate link between Modic changes and pain experiences. ***Conclusion*:** In conclusion, this study reinforces the understanding that Modic changes, especially Modic Type I, are significantly associated with chronic low back pain.

Keywords: Association, Modic Changes, and Chronic Low Back Pain.

I. INTRODUCTION

Chronic low back pain (CLBP) is a pervasive condition, impacting a significant portion of the global population. It is associated with substantial disability, decreased quality of life, and significant economic burden [1]. Despite extensive research, the underlying etiology of CLBP remains largely elusive, posing a substantial challenge to the effective diagnosis and management of the disorder. One potential avenue for understanding and managing CLBP is through the exploration of Modic changes (MCs). MCs are pathological alterations in the vertebral bone marrow and endplates observed through Magnetic Resonance Imaging (MRI) [2]. Although the exact etiology of MCs remains unclear, they have been suggested to result from mechanical stress, autoimmune response, or bacterial infection [3]. Some studies have proposed a strong association between MCs and CLBP, suggesting that MCs might serve as a potential imaging biomarker for CLBP. Moreover, several pieces of evidence highlight the potential role of MCs in the prognosis of CLBP, and some therapeutic interventions targeting MCs have shown promising results [4]. Dr. Roos first reported the vertebral endplate changes seen on MRI in 19871 and are often referred to as Modic Changes (MC) after Modic who classified them into three stages according to the T weight intensity [2, 5]. Each type represents histological changes: 1 represents bone marrow oedema and inflammation, 2 is associated with conversion of normal red hemopoietic bone marrow into yellow fatty marrow as a result of marrow ischemia and 3 represents subchondral bony sclerosis [6]. The histological finding of oedema and inflammation led to speculation that MCs identify a process in the etiology of back pain or are even a cause of LBP [7, 8]. However, due to the inconsistent findings across different studies, the relationship between MCs and CLBP remains controversial [9-12]. Some studies report a strong association between MCs and CLBP, whereas others show weak or no correlation [13]. These differences could be brought on by differences in study designs, patient traits, diagnostic standards, or statistical

analysis. The review by Zhang *et al.,* [9] included an insufficient reporting of included papers, a limited search, and no quality assessment. Jensen *et al.,* [12] examined two outcomes: reported pain that occurs in daily life, or "usual pain," and pain that appears on discography. Their quality evaluation tool wasn't mentioned. Given that LBP increases with age, Brinjikji *et al.,* [10] study was limited to those under 50, perhaps leaving out many studies that would have been relevant. Their reporting was deficient since it lacked the outcomes of their quality assessment and the findings of specific investigations. After reviewing 31 papers, Herlin *et al.,* [11] were unable to come to any conclusions. It's possible that a number of factors in their review themselves produced conflicting findings. In the beginning, they provided two definitions of pain: common pain and pain from discography. The quality of evidence supporting discography's accuracy is weak, and the false positive rate ranges from 10% to 90% [14]. Secondly, they misapplied the quality assessment method QUADAS to their research [15]. There are quality assessment tools available for etiology research, including cohort, cross-sectional, and case-control studies [16]. There is still controversy over any relationship between MC and LBP in spite of several studies and four systematic reviews. We came to the conclusion that the shortcomings of earlier evaluations warranted a new, systematic study that adhered to the standards set by the Cochrane Collaboration [17, 18]. This current study was conducted to assess the association of modic changes and chronic low back pain.

II. OBJECTIVES

To assess the association of Modic changes and chronic low back pain.

III. METHODOLOGY & MATERIALS

This cross-sectional study was conducted in Department of Orthopaedics Surgery, Brahmanbaria Medical College Hospital, Brahmanbaria, Bangladesh, during the period from December 2020 to December 2022. Total 150 patients with chronic low back pain were included in this study. Consent of the patients and guardians were taken before collecting data. All patients underwent MRI of the lumbar spine. Further, the intensity of the current LBP was evaluated using the Visual Analogue Scale (VAS) score, with 0 representing no pain and 100 the worst pain ever experienced. After collection of data, all data were checked and cleaned. After cleaning, the data were entered into computer and statistical analysis of the results being obtained by using windows-based computer software devised with Statistical Packages for Social Sciences version 22. Multivariate logistic regression analysis was conducted to determine the association between the types of Modic changes and LBP with adjustment for age, sex, body mass index, disc degeneration score, and disc displacement score. To assess the association between variable, odd ratios was calculated. The corresponding 95% CIs were also assessed.

IV. RESULT

Table I describes the demographic characteristics of the study subjects. The mean age of the study subjects is 52.3 years, with a standard deviation of 9.8 years, implying a distribution of ages around the mean. The age range of the participants is quite wide, from as young as 28 years old to as old as 65 years old. The table also presents the gender distribution of the participants. Of the total subjects, 52.0% are female (78 individuals), while 48.0% are male (72 individuals), indicating a near-even split between the two sexes. The participants' BMI is also recorded, with a mean value of 24.6 kg/m2 and a standard deviation of 3.7 kg/m2. This suggests a relatively normal weight range among the study participants, as a BMI between 18.5 and 24.9 is generally considered healthy. The table further indicates the duration of symptoms experienced by the study participants, measured in months. The average duration is 48.3 months, with a standard deviation of 2.5 months. This implies that the subjects have been experiencing symptoms for an average of approximately 4 years. Figure 1 demonstrates that the majority of the subjects in the study, 65.3% (98 individuals), show Modic Type I changes. Around 30.7% of the study subjects (46 individuals) display Modic Type II changes. Finally, a small percentage of the study population, 4.0% (6 individuals), present Modic Type III changes. These changes are less common and are associated with subchondral bone sclerosis. Table II presents the results of multivariate analyses exploring the association of Modic types with chronic low back pain in the lumbar region for a population of 150 study subjects. This association is presented in terms of odds ratios (ORs) with 95% confidence intervals (CIs) for three separate models. In Model 1, Modic Type I changes are associated with an OR of 2.89 (95% CI 1.87-4.37), suggesting that individuals with Type I changes are approximately 2.89 times as likely to have chronic low back pain compared to those without these changes. For Modic Type II, the OR is 1.37 (95% CI 0.97-1.96), while for Type III, the OR is 1.39 (95% CI 0.57-3.35). Model 2 presents slightly lower ORs for each Modic type. For Modic Type I, the OR is 2.65 (95% CI 1.69-4.10). The ORs for Modic Type II and III are 1.19 (95% CI 0.82-1.73) and 1.24 (95% CI 0.51-3.18), respectively. In Model 3, the association between each Modic type and low back pain is further reduced. The OR for Modic Type I is 1.87 (95% CI 1.18-2.95), whereas the ORs for Modic Type II and III are 1.08 (95% CI 0.50-2.68) and 1.09 (95% CI 0.49-2.65), respectively. Table III displays the association of pain variables with Modic changes at all levels combined for a sample size of 150 subjects. The pain variables are categorized under low back pain and sciatic pain, and further broken down into pain episodes and Visual

Analog Scale (VAS) scores at the 1st week and 4 months. For low back pain, the table shows that the OR for pain episodes is 2.51 (95% CI 1.36-3.87), suggesting that individuals with Modic changes are approximately 2.51 times as likely to experience pain episodes. The VAS scores at the 1st week and 4 months show ORs of 1.43 (95% CI 1.12-2.02) and 1.36 (95% CI 1.09-1.98) respectively, implying a moderate association between the severity of pain (as assessed by the VAS) and the presence of Modic changes. For sciatic pain, the association appears to be less pronounced. The OR for pain episodes is 1.39 (95% CI 0.92-1.85), and the ORs for VAS at the 1st week and at 4 months are 1.21 (95% CI 0.97-1.79) and 1.29 (95% CI 1.02-1.81), respectively. The confidence intervals for these ORs include 1, indicating that the associations are not statistically significant.

Table I: Demographic characteristics of the study subjects

Characteristics		**n**	**%**
Age	Mean ± SD	52.3 ±9.8	
	Range	28-65	
Sex	Male	72	48.0
	Female	78	52.0
BMI, kg/m^2	Mean ± SD	24.6 ±3.7	
Duration of symptoms (months)	Mean ± SD	48.3±2.5	

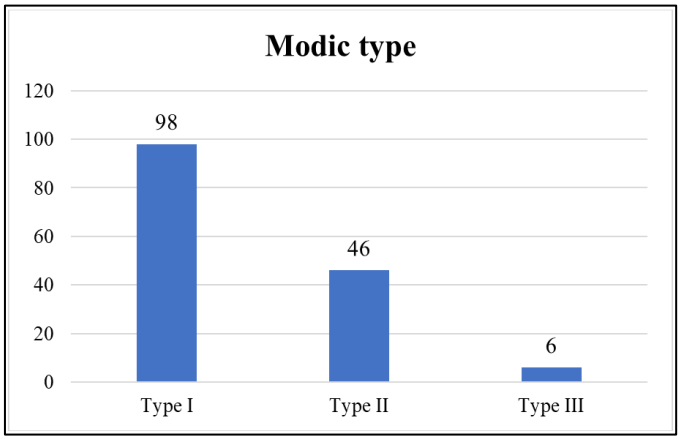

Figure 1: Prevalence of Modic types (N=150)

Table II: Multivariate analyses of association of Modic types with low back pain in the lumbar region (N=150)

Parameter	**Model 1**	**Model 2**	**Model 3**
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Type I	2.89 (1.87-4.37)	2.65 (1.69-4.10)	1.87 (1.18-2.95)
Type II	1.37 (0.97-1.96)	1.19 (0.82-1.73)	1.08 (0.50-2.68)
Type III	1.39 (0.57-3.35)	1.24 (0.51-3.18)	1.09 (0.49-2.65)

Model 1; Unadjusted
Model 2; Age, sex, and BMI
Model 3; Age, sex, BMI, disc degeneration score, and disc displacement score
OR- Odds ratio
95% CI- 95% confidence interval

Table III: Association of pain variables with Modic change at all levels combined (N=150)

Parameter		**OR**	**95% CI**
Low back pain	Pain episodes	2.51	1.36-3.87
	VAS at 1st week	1.43	1.12-2.02
	VAS at 4 months	1.36	1.09-1.98
Sciatic pain	Pain episodes	1.39	0.92-1.85
	VAS at 1st week	1.21	0.97-1.79
	VAS at 4 months	1.29	1.02-1.81

OR- Odds ratio
95% CI- 95% confidence interval
VAS- Visual Analogue Scale

V. DISCUSSION

The present study was conducted to assess the association of Modic changes and chronic low back pain. The mean age of the study participants, as presented in Table I, was 52.3 years with a standard deviation of 9.8 years, ranging from 28 to 65 years. This age distribution aligns with previous research which shows that Modic changes, as well as chronic low back pain, tend to increase with age [12]. Furthermore, the gender distribution in this study is nearly balanced, which is reflective of the general consensus that both males and females can be equally affected by Modic changes and chronic low back pain [18]. The presence and types of Modic changes among participants are critical to understanding the pathology of chronic low back pain. In our study, the majority of the subjects in the study, 65.3% (98 individuals), show Modic Type I changes. These changes are characterized by edema and inflammation in the vertebral body and are generally associated with an active degenerative process. Around 30.7% of the study subjects (46 individuals) display Modic Type II changes. This type of change involves conversion of the normal red bone marrow into yellow fatty marrow, indicating a more stable, long-standing degenerative process. Finally, a small percentage of the study population, 4.0% (6 individuals), present Modic Type III changes. These changes are less common and are associated with subchondral bone sclerosis. This distribution parallels other findings that Modic Type I and II changes are more common than Type III [4]. Modic Type I changes represent an active degenerative process and are believed to be more associated with pain than the other types [10]. For the association of Modic types with chronic low back pain, we found that Modic Type I changes were more strongly associated with chronic low back pain than Types II and III across all models, although the strength of this association decreases from Model 1 through Model 3. The ORs for Types II and III are not statistically significant in any of the models (since their 95% CIs cross 1), implying that there's no significant association of these types with chronic low back pain. This is consistent with a study by Määttä *et al.*, [19] which also reported a more significant association of Modic Type I changes with low back pain than the other Modic types. The associations of pain variables with Modic changes, further fortify the link between Modic changes and the intensity and frequency of low back pain episodes. The results also indicate that the severity of pain, as measured by the Visual Analog Scale (VAS), is moderately correlated with the presence of Modic changes. For low back pain, the table shows that the OR for pain episodes is 2.51 (95% CI 1.36-3.87), suggesting that individuals with Modic changes are approximately 2.51 times as likely to experience pain episodes. The VAS scores at the 1st week and 4 months show ORs of 1.43 (95% CI 1.12-2.02) and 1.36 (95% CI 1.09-1.98) respectively, implying a moderate association between the severity of pain (as assessed by the VAS) and the presence of Modic changes. For sciatic pain, the association appears to be less pronounced. The OR for pain episodes is 1.39 (95% CI 0.92-1.85), and the ORs for VAS at the 1st week and at 4 months are 1.21 (95% CI 0.97-1.79) and 1.29 (95% CI 1.02-1.81), respectively. The confidence intervals for these ORs include 1, indicating that the associations are not statistically significant. These findings support the hypothesis that Modic changes, particularly Modic Type I, may be an important factor in the pain experience of people with chronic low back pain [11]. Interestingly, the association between Modic changes and sciatic pain appeared less pronounced. This may be because sciatic pain is often due to specific pathologies, such as disc herniation, which are not necessarily associated with Modic changes [20].

Limitations of the Study

In our study, there was small sample size and absence of control for comparison. Study population was selected from one center in Brahmanbaria city, so may not represent wider population. The study was conducted at a short period of time.

VI. CONCLUSION AND RECOMMENDATIONS

In conclusion, this study reinforces the understanding that Modic changes, especially Modic Type I, are significantly associated with chronic low back pain. These findings highlight the need for medical practitioners to consider the presence of Modic changes when treating patients with chronic low back pain. Furthermore, these results underscore the importance of further research into understanding the precise biological mechanisms linking Modic changes to chronic pain, which could ultimately lead to the development of more effective treatments.

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