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EVALUATING THE FREQUENCY OF SCIATICA FEATURES ON MRI IN PATIENTS WITH LOWER BACK PAIN

Original Article

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ABSTRACT

Background: Sciatica is a prevalent condition affecting millions globally, often caused by irritation or compression of the sciatic nerve. It manifests through symptoms such as lower back pain, leg discomfort, numbness, tingling sensations, and muscle weakness. Despite its frequency, sciatica remains misdiagnosed or misunderstood, particularly in patients with lower back pain. Given its high prevalence, accurate diagnosis and management are critical for improving patient outcomes and quality of life.

Objective: To evaluate the frequency of sciatica features on magnetic resonance imaging (MRI) in patients presenting with lower back pain.

Methods: An observational descriptive study was conducted at Farooq Hospital, Lahore, over four months from June to September 2023. A non-probability convenience sampling technique was used to enroll 57 patients of both genders presenting with sciatica symptoms, including back pain radiating to one or both legs and numbness. Exclusion criteria included claustrophobia or a history of non-spinal sciatica causes. MRI scans were performed using a Siemens Magnetom C machine with a 0.35 Tesla strength, utilizing T1-weighted, T2-weighted, STIR sequences, and additional planes to detect spinal pathologies.

Results: Among the 57 patients, 32 (56.1%) were male, and 25 (43.9%) were female, with a mean age of 48.58 years (range: 29–70 years). The most common risk factors were physical inactivity (50.8%), overweight status (42.1%), and diabetes mellitus (29.8%). MRI findings revealed disc herniation in 19 patients (33.3%) and osteoarthritis in 14 (24.6%). Cord compression and degenerative changes were present in 14 (24.6%) and 12 (21%) patients, respectively. The most frequently affected spinal level was L5-S1 (19.3%), followed by L4-L5 (14%) and S1-S2 (12.3%).

Conclusion: This study confirms MRI as an effective diagnostic tool for identifying sciatica-related abnormalities, with disc herniation and osteoarthritis as the leading causes. Lifestyle factors such as physical inactivity and overweight status were the most significant risk factors. The L5-S1 spinal level was the most commonly affected segment, highlighting the importance of targeted diagnostic and therapeutic interventions for patients with lower back pain.

Keywords: Back pain, Cord compression, Degenerative changes, Disc herniation, Lumbar spondylosis, Magnetic resonance imaging, Sciatica.

INTRODUCTION

Sciatica, a prevalent condition affecting millions globally, arises primarily from the irritation or compression of the sciatic nerve. This condition manifests through a range of symptoms, including lower back pain, leg discomfort, numbness, tingling sensations, and muscle weakness (1). Despite its frequency, sciatica is often misunderstood, with studies highlighting its complex nature and frequent misdiagnosis. Research from Harvard University suggests that the lifetime risk of experiencing sciatica can be as high as 40%, with its prevalence increasing notably with advancing age (2). In the United Kingdom, the incidence of sciatica linked to a herniated lumbar disc stands at 3.1% among men and 1.3% among women, with the condition most commonly affecting individuals aged 30 to 50 years (3). The underlying pathophysiology of sciatica typically involves compression or irritation of the sciatic nerve, leading to symptoms such as pain, numbness, and weakness radiating from the lower back to the legs (4). A herniated disc is the most frequent cause, where protrusion of the disc material impinges on adjacent nerves. Other notable causes include spinal stenosis, characterized by the narrowing of the spinal canal, and spondylolisthesis, where a vertebra slips over the one below it (5). Chronic sciatica can lead to secondary complications, including muscle weakness and atrophy, which may result in musculoskeletal imbalances and exacerbate overall dysfunction (6). Inflammation and nerve root irritation are central mechanisms contributing to sciatica's clinical presentation (7). The neurological system is the most profoundly affected, although the musculoskeletal system also plays a significant role, with muscle rigidity, spasms, and weakness compounding the symptoms (8). Chronic pain further activates the hypothalamic-pituitary-adrenal (HPA) axis, contributing to systemic stress responses and complicating the clinical picture. Additionally, inflammatory responses, including the release of cytokines and immune molecules, can exacerbate nerve injury, amplifying pain and neurological deficits (9). Accurate evaluation of sciatica typically involves a comprehensive clinical examination and patient history assessment. These evaluations focus on pain levels, range of motion, and tests of reflexes and muscle strength to determine potential causes such as nerve impingements or muscular imbalances (10). Specific clinical tests, including the straight leg raise test and the slump test, are commonly used to assess nerve tension, while additional assessments like the crossed straight leg raise and femoral nerve stretch test help identify the involved nerve roots (11).

Diagnostic imaging techniques, particularly magnetic resonance imaging (MRI), have proven invaluable in identifying the underlying causes of sciatica. MRI offers high-resolution visualization of the spinal cord, discs, and nerve roots, enabling clinicians to detect issues such as herniated discs, spinal stenosis, and even tumors or bone spurs contributing to nerve compression (12). Furthermore, MRI provides critical information on the degree and location of nerve involvement and can reveal inflammation or tissue damage (13). Despite its diagnostic value, MRI should be used judiciously, as unnecessary imaging can lead to unwarranted interventions and increased healthcare costs (14). Certain patient populations, such as those with metallic implants or claustrophobia, may require alternative imaging modalities like X-rays or computed tomography (CT) scans. Sciatica primarily affects the distribution of the lumbosacral nerve roots, with pain often exacerbated by activities such as bending, twisting, or coughing. This study aims to evaluate the frequency and underlying causes of sciatica features on MRI among patients experiencing lower back pain in Pakistan, where limited research has been conducted on this topic. By investigating the specific causes and radiological patterns associated with sciatica, this research seeks to fill a critical knowledge gap. The findings will not only enhance diagnostic accuracy but also guide more effective treatment strategies, ultimately improving patient outcomes in clinical practice.

METHODS

An observational descriptive study was conducted at Farooq Hospital in Lahore over a four-month period from June 2023 to September 2023. The study aimed to assess sciatica features on MRI among patients presenting with lower back pain. A non-probability convenience sampling technique was employed to recruit participants, with a total of 57 patients meeting the inclusion criteria. Eligible participants included both male and female patients experiencing clinical symptoms of sciatica pain, backache, pain radiating to one or both legs, and numbness. Patients were excluded if they were claustrophobic or had a history of sciatica pain caused by non-spinal pathologies, such as tumors or systemic conditions unrelated to spinal abnormalities (15). All participants underwent MRI scanning using a Siemens Magnetom C machine with a magnetic field strength of 0.35 Tesla. The imaging protocol included sequences such as T1-weighted, T2-weighted, Short Tau Inversion Recovery (STIR), and additional planes deemed necessary to visualize spinal pathologies effectively. These sequences were chosen to ensure adequate visualization of soft tissues, nerve roots, and potential disc abnormalities contributing to sciatica symptoms (16). Prior to data collection, the nature and objectives of the study were explained to all participants, and written

informed consent was obtained. Approval from the Institutional Ethics Committee was secured in advance, ensuring adherence to ethical research standards. Patients meeting the inclusion criteria underwent comprehensive assessments, and their clinical histories, including complaints and provisional diagnoses, were recorded using standardized data collection sheets (17). Demographic information such as age, gender, and clinical symptoms was gathered directly from participants. MRI findings were systematically recorded, focusing on spinal abnormalities potentially associated with sciatica, including disc herniation, spinal stenosis, or other degenerative changes. Data were collected by the researcher and recorded in a structured format for further analysis (18).

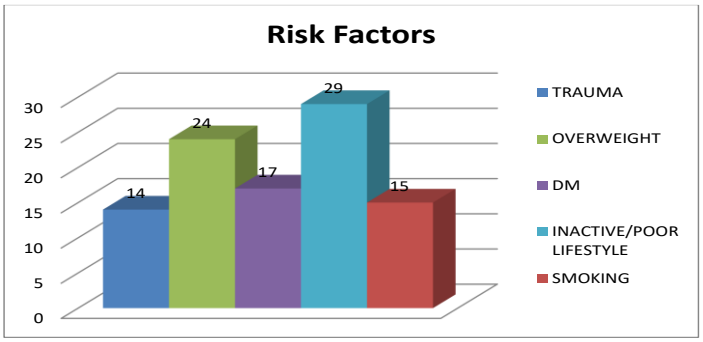
The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS) (version 25). Descriptive statistics, including mean, median, standard deviation, and range, were calculated for continuous variables such as age. The prevalence of specific sciatica-related symptoms—such as lower back pain, radiating leg pain, and numbness—was determined by calculating frequencies and percentages. MRI findings were analyzed to identify the most common underlying spinal pathologies responsible for sciatica in the study population (12). Additionally, associations between demographic variables and the severity or presence of sciatica were explored using appropriate statistical methods. Chi-square tests were applied for categorical variables, while correlation analyses were performed for continuous variables to detect potential relationships between factors such as age or gender and the severity of MRI findings.

RESULTS

The study included a total of 57 participants, with ages ranging from 29 to 70 years, and a mean age of 48.58 years (SD = 12.81). Among the participants, 32 individuals (56.1%) were male, while 25 individuals (43.9%) were female. Various risk factors were evaluated for their association with sciatica pain, including trauma, overweight status, diabetes mellitus, an inactive lifestyle, and smoking habits. An inactive or lethargic lifestyle emerged as the most common risk factor, affecting 29 patients. Overweight individuals comprised 24 participants, while 17 patients were identified as having diabetes mellitus. Both trauma and smoking were recorded in 15 patients each, making them less frequent risk factors compared to physical inactivity and obesity. The MRI findings highlighted several underlying causes of sciatica. Disc herniation was the most frequent cause, observed in 19 patients, followed by osteoarthritis, which affected 14 individuals. Cord compression was also noted in 14 patients, while degenerative changes were present in 12 cases. Lumbar spondylosis was identified in 10 patients, and spinal stenosis was the least frequent pathology, observed in 8 patients. In terms of spinal levels affected, almost all 57 patients exhibited involvement of the L2-S2 spinal segments. Specifically, 3 patients had L2-L3 involvement, while 5 patients exhibited L3-L4 pathology. A total of 8 patients presented with L4-L5 involvement, and L5-S1 pathology was observed in 11 patients. The S1-S2 spinal segment was affected in 7 individuals, whereas the L1 segment remained unaffected across all patients, suggesting its relative preservation in those experiencing sciatica-related pain. Cross-tabulation analyses revealed associations between spinal levels. The involvement of L2 and L3 showed that 4 patients had both levels affected simultaneously. Similarly, the L3-L4 association involved 8 patients with combined pathology. The L4-L5 segment showed higher co-occurrence, with 20 patients experiencing involvement of both levels. The L5-S1 cross-tabulation revealed 22 patients with overlapping pathology at these segments. Lastly, the S1-S2 involvement was identified in 11 cases, indicating its contribution to sciatic symptoms in the study population. Independent sample t-tests were conducted to assess the relationship between specific risk factors and sciatica pain. No statistically significant associations were found between trauma, overweight status, diabetes mellitus, inactive lifestyle, or smoking and the presence of sciatica pain, as all p-values exceeded the threshold for statistical significance ($p > 0.05$).

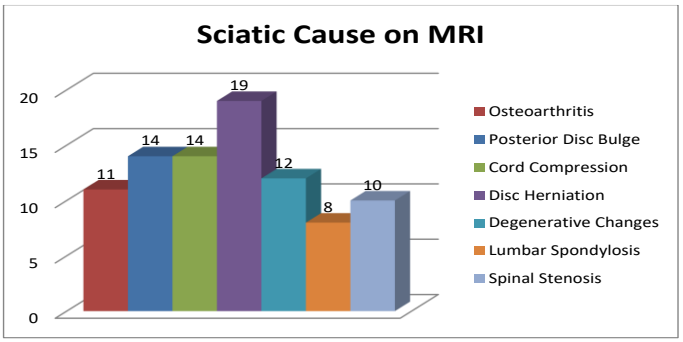
Table 1: Demographic Characteristics of Study Participants

Variable	N	Minimum	Maximum	Mean	Standard Deviation	Frequency	Percentage (%)
Age (years)	57	29	70	48.58	12.81	-	-
Gender: Female	57	-	-	-	-	25	43.9
Gender: Male	57	-	-	-	-	32	56.1



Graph: Risk Factors

Figure 1 Risk Factor



Graph: Sciatic cause on MRI

Figure 2 Sciatic Cause on MRI

Table 2: Cross-Tabulation of Affected Spinal Levels in Patients with Sciatica Pain

Spinal Levels	Affected Level 1: No	Affected Level 1: Yes	Total (Level 1)	Affected Level 2: No	Affected Level 2: Yes	Total (Level 2)
L2 & L3	50	3	53	1	3	4
L3 & L4	48	3	51	1	5	6
L4 & L5	37	12	49	0	8	8
L5 & S1	28	9	37	7	13	20
S1 & S2	35	4	39	11	7	18

Table 3: Independent Samples Test

		t-test for Equality of Means						
		t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Trauma	Equal variances assumed	-.567	55	.573	-.250	.441	-1.133	.633
	Equal variances not assumed				-.250			
Overweight	Equal variances assumed	-.851	55	.399	-.429	.504	-1.438	.581
	Equal variances not assumed				-.429			
DM	Equal variances assumed	-.649	55	.519	-.304	.468	-1.242	.634
	Equal variances not assumed				-.304			
Inactive.Life.style	Equal variances assumed	-1.018	55	.313	-.518	.509	-1.537	.502
	Equal variances not assumed				-.518			
Smoking	Equal variances assumed	-.594	55	.555	-.268	.451	-1.171	.636
	Equal variances not assumed				-.268			

DISCUSSION

The findings of this descriptive study, which included 57 patients with sciatica, highlight the significant role of lifestyle factors in the development and progression of sciatic pain. The most common risk factor identified was physical inactivity, affecting 50.8% of the participants. This finding aligns with prior research that established a connection between sedentary behavior and an increased likelihood of sciatica, particularly among individuals engaged in non-occupational activities. The association between a lack of physical activity and sciatica risk has been reinforced in other studies, where factors such as bending, heavy lifting, and prolonged periods of inactivity were significantly associated with sciatica among both working and non-working populations (15). The observed gender distribution, with males being more frequently affected, further supports previously reported trends indicating a higher prevalence of sciatica in men compared to women (19). In the present study, overweight status and diabetes mellitus were also identified as relevant risk factors, affecting 42.1% and 29.8% of patients, respectively. Trauma and smoking were found to be comparatively less frequent but remained notable contributors. These findings are consistent with earlier research, where similar associations were observed between metabolic factors and the onset of sciatic pain (16). The present study also revealed that patients often exhibited multiple risk factors simultaneously, which could contribute to the complexity and severity of their symptoms (20).

MRI evaluations revealed disc herniation as the most prevalent underlying cause of sciatica, present in 33.3% of the patients. Posterior disc bulge and cord compression were observed in 25.5% of the participants, while osteoarthritis and spinal stenosis were identified in 19.2% and 17.5% of cases, respectively. These results are consistent with prior research where disc herniation was reported as the leading cause of sciatic symptoms (17). Additionally, degenerative changes such as lumbar spondylosis and spinal stenosis have been commonly associated with sciatica in previous investigations, reinforcing the importance of age-related spinal degeneration as a contributing factor to nerve compression (18,21). The distribution of spinal involvement predominantly affected the L2-S2 segments, with the L5-S1 level being the most frequently involved. This finding aligns with earlier studies that documented a higher prevalence of sciatic pain originating from the L4-L5 and L5-S1 levels, which are anatomically predisposed to degenerative changes due to their location and biomechanical stress (19). The preservation of the L1 segment in all patients suggests a lower susceptibility of this level to degenerative changes associated with sciatica (22).

The strength of this study lies in its comprehensive evaluation of both clinical and radiological findings, providing a multifaceted understanding of sciatica's underlying causes. The use of MRI allowed for the detailed visualization of structural abnormalities, enhancing diagnostic accuracy. However, the use of non-probability sampling may have introduced selection bias, potentially skewing the findings toward specific patient characteristics (23). Another limitation is the lack of data regarding the duration and severity of symptoms, which could have provided a clearer correlation between clinical presentation and MRI findings. Additionally, the study did not explore the effectiveness of treatment interventions, which would have added value to understanding the impact of radiological findings on patient outcomes (24). Future research should focus on larger, multicenter studies to validate these findings across diverse populations. Longitudinal designs would offer greater insight into the progression of sciatica and the long-term effects of various interventions. Investigations exploring the relationship between lifestyle modifications, rehabilitation programs, and improvements in sciatica symptoms would also contribute valuable evidence for clinical practice. The study highlights that physical inactivity, overweight status, and degenerative spinal changes are the primary contributors to sciatica. MRI remains a valuable diagnostic tool for identifying the underlying causes of sciatic pain. Addressing modifiable risk factors through lifestyle interventions could play a crucial role in managing and preventing the progression of sciatica, ultimately improving patient outcomes.

CONCLUSION

This study concludes that magnetic resonance imaging (MRI) is an essential diagnostic tool for identifying the underlying causes of sciatica, with disc herniation and osteoarthritis emerging as the most common contributors. Other notable factors include disc bulge, posterior disc bulge, cord compression, degenerative changes, lumbar spondylosis, and spinal stenosis. The findings also highlight the significant role of lifestyle-related risk factors, particularly physical inactivity, overweight status, and diabetes, in the development of sciatic pain. Among the affected spinal segments, the L5-S1 level was most frequently implicated in sciatic symptoms. These insights underscore the importance of early diagnosis and the management of modifiable risk factors to improve outcomes for individuals suffering from sciatica.

AUTHOR CONTRIBUTIONS

Author	Contribution
Amna Javed	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Shahzaib Riaz	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
Pakeeza Shafaqat Ali	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Muhammad Nauman Saleem*	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Sara Sajjad	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Saba Ajmal	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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