Epidemiological analysis of lumbar spine degenerative disease diagnosed by MRI: Level-wise and sex-based distribution in the Gandaki province population

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ABSTRACT

Introduction: Degenerative diseases of lumbar spine is a significant global health concern causing low back pain and is leading contributor of disability and economic burden worldwide. Approximately 266 million people living with low back pain are suffering from lumbar degenerative disease globally and affecting 3.6% of population each year. Because of accurate non-invasive assessment of spinal degenerative diseases, Magnetic Resonance Imaging is considered to be the gold standard tool for imaging spine. This study aimed to determine the frequency of degenerative lumbar spine diseases across different spinal levels and to assess the distribution of degenerative diseases according to sex and age. **Methods:** A descriptive cross-sectional quantitative study was conducted with 348 participants of age group 28 to 81 years in the Radiology department of Pokhara Academy of Health Sciences in Gandaki province of Nepal. Magnetic Resonance Imaging of the participants were conducted and T1 weighted, T2 weighted, and STIR sequences were done to get sagittal, axial and coronal images of the lumbar spine. Pattern of Lumbar spine degenerative diseases were assessed. **Results:** The most common site of the diseases was L4/L5 and L5/S1 level. The most common disease diagnosed was disc bulge (91.09%). The degenerative diseases were found in 58.90% of the females compared to 41.1% of the males. The commonest age group to have this disease was 41 to 50 years of age. **Conclusions:** Women are more susceptible to the disc degenerative diseases causing lower back pain at the lower level of lumbar spine.

Keywords: Degenerative disc disease, disc bulge, lumbar spine.

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INTRODUCTION

Degenerative diseases of lumbar spine is a significant global health concern that causes low back pain and is a leading contributor of disability and economic burden worldwide. Approximately 266 million people living with low back pain are suffering from lumbar degenerative disease globally and affecting 3.6% of population each year.[1] According to the Global Burden of Disease Study, low back pain remains the primary cause of years lived with disability across all regions and age groups.[2]

The lumbar spine's susceptibility to degenerative changes is primarily due to its crucial role in weight-bearing, making it prone to intervertebral disc degeneration, spondylolisthesis, spinal stenosis, and facet joint arthropathy.[3] With aging populations and increasing prevalence of sedentary lifestyles, the burden of lumbar degenerative disease is expected to rise, making its epidemiological characterization clinically and socially significant.[4]

Because of its excellent soft tissue contrast and ability of accurate

non-invasive assessment of spinal degenerative diseases, Magnetic Resonance Imaging (MRI) is considered to be a gold standard tool for imaging spine. It can give better visualisation of soft tissue structure, grading of degenerative pathologies such as disc degeneration, herniation, spinal stenosis, facet joint arthropathy and other vertebral changes.[5] Several studies have attempted to describe the prevalence of specific degenerative changes on MRI in general populations,[6,7] but there is variation in reported frequencies across populations and limited data on the distribution of pathology at different lumbar levels and across sexes. For example, rates of diagnosis are highest in European regions (5.7%) and lowest in Africa (2.4%) reflecting variations and disparities in healthcare access.[1]

Despite extensive research, substantial gaps remain in the understanding of how MRI-diagnosed lumbar degenerative diseases are distributed across population subgroups and lumbar spine levels. It has been reported that the pattern and severity of disease can vary between individuals, and sex-based differences. For example, men may show higher prevalence of disc degeneration, while women may be more susceptible to facet joint arthropathy and spondylolisthesis.[8] Understanding these variations is essential for improving diagnostic accuracy, informing clinical decision-making, and guiding targeted interventions.

Therefore, this study was done with two aims. First, to determine the frequency of degenerative lumbar spine diseases across different spinal levels. Second, to assess the distribution of degenerative diseases according to sex and age.

METHODS

This was a descriptive cross-sectional quantitative study. The ethical approval for the research was obtained from institutional review committee (IRC) of Pokhara Academy of Health Sciences (Ref. No. 181/080).

The study population were patients undergoing MRI in the radiology department referred from out-patient department due to low backache. A convenience sampling technique was used to enroll the eligible cases as per the calculated sample size. Sample size was calculated by precision-based formula [$n=z^2 p(1-p) / E^2$] with prevalence value of 71%, margin of error being 5% and assumed confidence interval was 95% with z-value 1.96.[9] The total sample size was 348.

We included patients of age 28 years to 81 years, undergoing MRI scan of lumbar spine for complaints of low back pain, radicular pain, neurogenic claudication, or other symptoms that were suggestive of lumbar degenerative diseases. We excluded the patients with spinal infections, recent trauma, tumors, spinal dysraphism, and metabolic conditions. This is because, these may act as confounding factors for low back pain. The patients with implants, and pacemakers were also excluded.

In this study, the MRI examination was done on 1.5T Multiva Philips. After all the MRI safety questionnaire, image acquisition was done in sagittal, axial and coronal planes with T1 weighted, T2 weighted, and STIR sequences.

We followed the previously published paper[10] for the study protocol to get the uniformity and assess the reproducibility which were as:

T1 weighted sagittal: slice thickness – 4 mm; field of view (FOV) – 280 mm; matrix – 307 x 384; Repetition time (TR)-400 ms; echo time (TE) – 8 ms; scan duration- 2.24 min. T2 weighted sagittal: slice thickness – 4 mm; field of view (FOV) – 280 mm; matrix – 280 X 384; Repetition time (TR)-3000 ms; echo time (TE) – 120 ms; scan duration- 1.6 min. T2 weighted Axial: slice thickness – 4 mm; field of view (FOV) – 230 mm; matrix – 256 x 256; Repetition time (TR)-3000 ms; echo time (TE) – 120 ms; scan duration- 3min.

The variables which were assessed as outcome of the study in MRI as degenerative changes were lumbar disc degeneration, disc bulge, disc herniation, nerve root compromise, presence of annular tear, and Modic classification changes.[11] Based on aggregation of the cauda equina nerve roots, we classified lumbar spinal canal stenosis into four gradings: Grade 1(Mild stenosis), meaning mild obliteration of the anterior CSF space, but the cauda equina nerve roots remain clearly separated; Grade 2 (moderate stenosis), meaning aggregation of cauda equina nerve roots; Grade 3 (Severe stenosis), meaning entire cauda equina appears as a bundle.[12]

Data management and statistical analysis was done by Statistical package of social sciences (SPSS) 16.0. Descriptive statistics were calculated and presented as mean and percentages.

RESULTS

A total MRI scans of 348 patients were evaluated for degenerative diseases of lumbar spine. Majority of people 91(26%) underwent MRI and had degenerative diseases belonged to age group 41 to 50 years of age. (Figure 1)

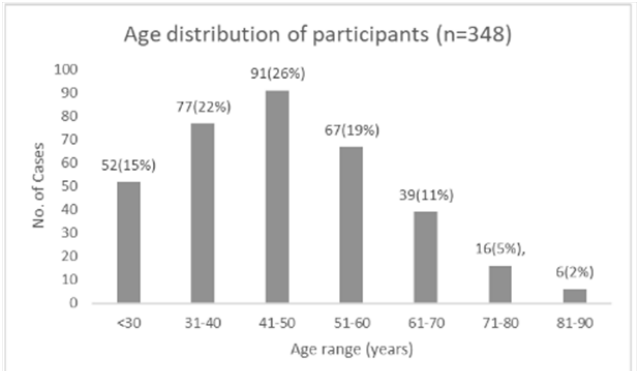

Figure 1: Age distribution of the participants (n=348)

The frequencies of female diagnosed 205(58.90%) with lumbar degenerative diseases outnumbered males 143(41.10%) having those diseases. Degenerative diseases at lumbar spine were more among males at age between 31 to 40 years, while the diseases among females was highest at age group 41 to 50 years. (Table 1)

Table 1: Distribution of age and sex of the patients (n=348)

Age groups (years)	Sex		Total n(%)
	Male	Female	
<30	25	27	52(14.94%)
31-40	37	40	77(22.13%)
41-50	31	60	91(26.15%)
51-60	25	42	67(19.25%)
61-70	14	25	39(11.21%)
71-80	9	7	16(4.60%)
81-90	2	4	6(1.72%)
Total	143(41.10)	205(58.90)	348(100)

The most common type of degenerative disease seen was disc bulge 317(1.09%). Modic changes were the least 108(31%) occurring degenerative changes. (Table 2)

Table 2: Pattern of findings in cases of lumbar degenerative disease on MRI (n=348)

MRI findings	Frequency(n)	Percentage(%)
Disc Desiccation	**289**	**83.05%**
Disc Bulge	**317**	**91.09%**
Disc Herniation	**121**	**34.77%**
Nerve compression	**119**	**34.19%**
Modic Changes	**108**	**31.0%**
Annular Tear	**134**	**38.50%**
Lateral recess narrowing	**236**	**67.81%**
Neural foramina narrowing	**142**	**40.80%**
Canal stenosis	**133**	**38.21%**

We found that L4/L5 and L5/S1 were more susceptible to every type of degenerative diseases compared to other level. The diseases at greatest number at L4/L5 level were disc bulge 265(76.15%), disc desiccation 256(73.56%), annular tear 79(22.71%), lateral recess narrowing 188(54.02%), neural foramina narrowing 85(24.43%), and canal stenosis 82(23.56%). On the other hand, L5/S1 was the most vulnerable level for disc herniation 65(18.67%), nerve compression 68(19.54%), and modic changes 59 (16.95%).(Table 3)

Table 3: Distribution of degenerative imaging findings on MRI at various disc levels (n=348)

MRI Findings	Disc level				
	L1-L2 n(%)	L2-L3 n(%)	L3-L4 n(%)	L4-L5 n(%)	L5-S1 n(%)
Disc Desiccation	83(23.5%)	108 (31.03%)	148 (42.53%)	256(73.56%)	235(67.53%)
Disc Bulge	12(3.45%)	29(8.33%)	96(27.58%)	265(76.15%)	180(51.72%)
Disc Herniation	2(0.57%)	4(1.15%)	15(4.31%)	58(16.67%)	65(18.67%)
Nerve compression	3(0.86%)	3(0.86%)	11(3.16%)	56(16.09%)	68(19.54%)
Modic Changes	9(2.59%)	16(4.59%)	22(6.32%)	52(14.94%)	59(16.95%)
Annular Tear	6(1.72%)	10(2.87%)	30(8.62%)	79(22.71%)	62(17.81%)
Lateral recess narrowing	9(2.59%)	16(4.6%)	58 (16.67%)	188(54.02%)	129(37.07%)
Neural foramina narrowing	1(0.29%)	3(0.86%)	14(4.02%)	85(24.43%)	77(22.13%)
Canal stenosis	0	4(1.15%)	14(4.02%)	82(23.56%)	65(18.68%)

The degenerative findings were more commonly seen in female patients except for nerve compression, which had male preponderance 61(51.26%) in males as opposed to females 58(48.74%). (Table 4)

Table 4: Distribution of degenerative imaging findings on MRI by sex (n=348)

MRI Findings	Sex n(%)		Total
	Male	Female	
Disc Desiccation	116(40.12%)	173(59.86%)	289
Disc Bulge	129(40.69%)	188(59.30%)	317
Disc Herniation	56(46.28%)	65(53.72%)	121
Nerve compression	61(51.26%)	58(48.74%)	119
Modic Changes	48(44.45%)	60(55.56%)	108
Annular Tear	61(45.53%)	73(54.48%)	134
Lateral recess narrowing	95(40.25%)	141(59.74%)	236
Neural foramina narrowing	59(41.55%)	83(58.45%)	142
Canal stenosis	55 (41.35%)	78(58.65%)	133

It revealed that most of the severe (Grade 3) level of complications were noted at the lower vertebral levels for all three complications; lateral recess narrowing, neural foramina narrowing and canal stenosis. (Table 5)

Table 5: Level of severity of the complications of degenerative spine disease

Complications of degenerative spine disease	Level of severity	Site				
		L1-L2	L2-L3	L3-L4	L4-L5	L5-S1
Lateral recess narrowing	Mild	9	14	47	116	70
	Moderate	-	1	3	12	2
	Severe	-	1	8	60	57
	Total n (%)	9 (2.59%)	16 (4.6%)	58 (16.67%)	188 (54.02%)	129 (37.07%)
Neural foramina narrowing	Mild	1	3	8	44	37
	Moderate	-	-	4	20	21
	Severe	-	-	2	22	19
	Total n (%)	1 (0.29%)	3 (0.86%)	14 (4.02%)	85 (24.43%)	77 (22.13%)
Canal stenosis	Mild	-	4	9	39	27
	Moderate	-	-	5	34	21
	Severe	-	-	-	9	17
	Total n (%)	0	4 (1.15%)	14 (4.02%)	82 (23.56%)	65 (18.68%)

DISCUSSION

This study was conducted among 348 patients presenting

with low back pain and referred to the radiology department of Pokhara Academy of Health Sciences for MRI.

More than half of the patients in the current study were females with female: male ratio being 1.44:1. This finding is similar to the study conducted by Shrestha et al.[14] which revealed a higher incidence of chronic back pain among females as compared to males. Females experience postmenopausal osteoporotic changes, which can be a greater contributing factor to degenerative changes in the lumbar spine.[15]

The highest number of patients fall within the age group of 41 to 50 years, followed by 31 to 40 years, and this finding is similar to other studies.[16,17] Our findings on the age of patients are similar to the study conducted by Andersons et al.[15] with the mean age of the study group was 47.9 years. Although it is reported that prevalence increases progressively with age, we found it highest among the age group of 41 to 50 years. This might be because they approached for the medical treatment. The reason may be because this age group were in active workforce and could not afford long disability compared to the older people of age more than 60 years who were mostly retired.

The most frequent and severe (Grade 3) changes are persistently observed at L4-L5 level followed by L5-S1 level. In our study, the most common involvement of disc desiccation was observed at the L4-L5 level and the L5-S1 level. This is consistent with abnormal MRI findings at the lowest lumbar levels observed in a study conducted by Thapa et al.[18] who presented the changes at the L4-L5 level were 76.7%, and at L5-S1 level were 55.9%. This observation is most likely because the lower back is especially affected due to the accumulation of high stress in that part of the lumbar spine. Also, the aforementioned finding is supported by the research performed by Rai et al.[19] in which most of the degenerative changes were observed at L4-L5 and L5-S1 levels and the lowest rate of involvement was noted at the L1-L2 level.

The most commonly observed MRI change in our study population was disc bulge. This finding is supported by the study done by Singh et al.[20] in which disc bulge was the most common outcome followed by disc desiccation. Aging is an important risk factor for disc bulge. Increasing age increases the prevalence of the disc bulge.[21] Also, the intervertebral disc becomes more convex in old age.[22] This study is also supported by Gopalakrishnan et al.[23] in which they observed degenerative disease as the most common cause of LBP among which disc bulge was the commonest finding followed by disc degeneration and nerve root compression. Also, a study conducted in Biratnagar, Nepal by Dev et al.[24] disclosed disc bulge in 3.22% of 18-35 years and 38.06% in the 36-55 years age group. In a study executed by Shrinuvasan et al.[25] out of the total involved cases, 35.3% were diagnosed with a disc bulge, the percentage being less than in our study.

CONCLUSIONS

The study concluded that the susceptible area for lumbar spine degenerative diseases were L4/L5 and L5/S1 levels. Females were vulnerable than males towards lumbar spine degenerative diseases. The commonest disease was disc bulge.

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AUTHORS' CONTRIBUTIONS

RP contributed to definition of intellectual content, data acquisition, manuscript editing, manuscript review and is the guarantor of the work. MD contributed to concept, design, literature search, clinical studies, experimental studies, data acquisition, data analysis, statistical analysis and manuscript preparation. MM contributed to definition of intellectual content, literature search, data analysis, statistical analysis, manuscript preparation and manuscript editing. SB contributed to definition of intellectual content, literature search, data analysis, statistical analysis, manuscript editing and manuscript review. SP contributed to definition of intellectual content, literature search, data acquisition, manuscript preparation, manuscript editing and manuscript review. LPL contributed to data analysis, statistical analysis, manuscript editing and manuscript review. AC contributed to literature search, data analysis, statistical analysis, manuscript editing and manuscript review.

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