

Original Research Article

Lumbar disc degenerative disease and lumbar stenosis: a correlation between the MRI findings and disability among low back pain patients using oswestry disability index in hospital Serdang, Malaysia

Faridah Hanim Mohamed¹, Suraini Mohamad Saini^{2*}, Rozi Mahmud, Norafida Bahari²

¹Department of Radiology, Hospital Serdang, Selangor, Malaysia

²Department of Radiology, Faculty of Medicine and Health Sciences, University Putra Malaysia (UPM), Serdang, Selangor, Malaysia

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*Correspondence:

Dr. Suraini Mohamad Saini,
E-mail: surainims@upm.edu.my

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ABSTRACT

Background: Low back pain is a major global disability affecting all ages and nations, costing more than coronary heart disease, diabetes, alzheimer's, and renal illnesses. Research has shown no significant correlation between MRI results and patient symptoms, highlighting the need for further investigation.

Methods: A retrospective descriptive and analytical cross-sectional study was done at Hospital Serdang. From January 2017 to December 2018, data was collected retrospectively. Secondary data came from eHIS, RIS, and PACS. The data collecting forms recorded age, race, gender, oswestry disability index score, disc prolapse, and AP/SCA measures. Pearson Chi-Square and Fisher's exact tests found relationships between independent categorical variables. Pearson and Spearman's correlations determined the link between two numerical variables. We compared numerical variables, one categorical variable, and two groups using an independent T-test and a Mann-Whitney U-test. We defined statistical significance as p-value <0.05.

Results: This research covered 104 patients. Hospital Serdang sees more women than men aged 30-39 with low back pain. According to the Oswestry Disability Index (ODI), patients' pain levels are most concerning and standing is most irritating. It found no correlation between MRI results (disc prolapsed and lumbar stenosis) and patient impairment (ODI score). However, patient age is significantly correlated with disc prolapse. Previous research found similar results.

Conclusions: The study confirms previous MRI findings that disc degeneration and lumbar stenosis do not correlate with patient impairments, but reveal a significant correlation between disc prolapse and patient age, possibly due to structural and anatomical differences.

Keywords: Disc degeneration, Low back pain, Lumbar stenosis, MRI, Oswestry disability index

INTRODUCTION

For many years now, LBP has been recognized as one of the most common causes of work disability and accounts for a large proportion of workers' compensation costs. Despite the efforts and skill, for all our resources, low back disability is getting steadily worsened. LBP is

experienced by all age groups in all countries worldwide and has caused a lot of disabilities that deteriorate the quality of life of patients. In corresponding to the increasing aging population, the incidence of LBP has increased rapidly exceeding 54% between the periods 1990 to 2015. There are many studies conducted to find the root cause of the pain, however, the majority of the

LBP causes become unknown, while the rest of the patients are due to trauma, infection, or carcinoma.¹ Other possible risk factors may contribute to LBP as proven by previous studies which include BMI, aging, smoking, lifestyle, occupation, psychosocial factors, and socioeconomic status.²⁻⁴

LBP can be temporary in most patients, some may experience it only once in a lifetime while others may have recurrence and persistence that eventually result in disabilities, psychological distress, emotional disturbances, and physical activities. This illness has resulted in high health expenditures for the country as much as other diseases such as heart disease, diabetes, hypertension, kidney problems, and so on.⁵

METHODS

Study design

This study is a retrospective descriptive and analytical cross-sectional study.

Study duration

The study duration was three years, from January 2017 until December 2019.

Study population

The study population is all patients with LBP who went for an MRI lumbosacral examination.

Sampling method

The study involved 416 patients at Hospital Serdang who underwent MRI lumbosacral between January 2017 and December 2018. 212 patients were excluded, and 204 were selected using random numbers from a final list.

Sample size estimation

The s resulted in a sample size of 104, with a precision of the previous study, $p^* = 0.173$.⁶

Sampling frame

The lists of patients who are going for an MRI lumbosacral were retrieved from the PACS and Radiology Information System (RIS).

The sociodemographic and Oswestry disability index (ODI) scores of the patients were assessed via the Hospital Information System (eHIS) going

Study instruments

This investigation used secondary data from the Hospital Information System (eHIS), Reporting Information

System (RIS), and Picture Archiving and Communication System. It examined disc prolapsed and lumbar stenosis, measured anteroposterior (AP) diameter and spinal canal area (SCA) at each lumbar level, and used measurement methods based on⁶ (Figure 1 and Figure 2).

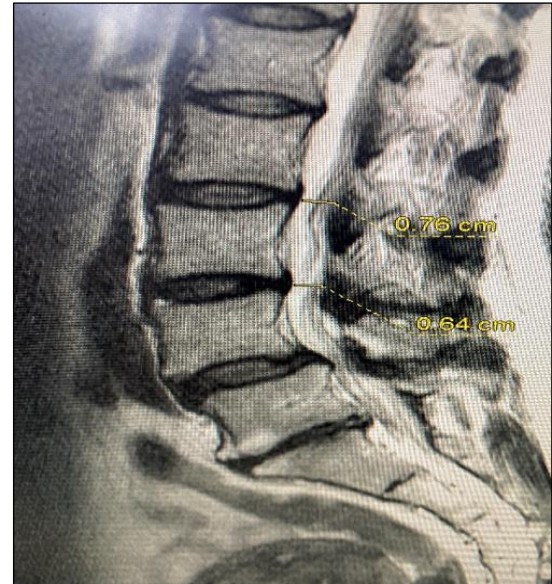


Figure 1: Measurement of AP diameter.

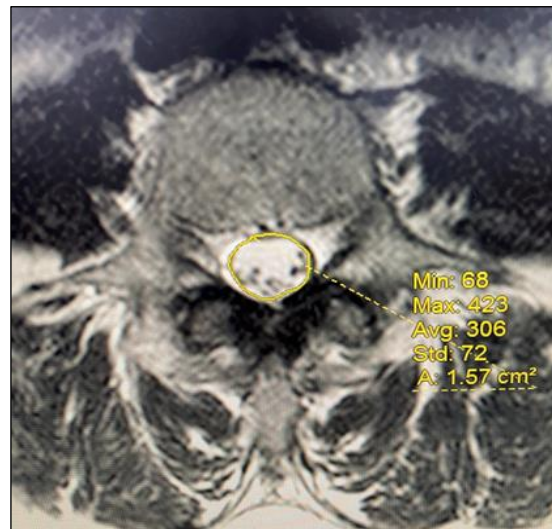


Figure 2: Measurement of SCA.

Data collection process

Data on age, race, gender, ODI score, disc prolapse, and spinal canal measurements were collected and transferred to SPSS.

Risk of bias assessment

The study involved 104 patients' spinal canal size measurements, supervised by two senior radiologists, three times, and average figures to reduce bias.

Data analysis

The study used SPSS Version 22 for data analysis, using descriptive statistics for mean, standard deviation, frequency, and percentage. Tests included Pearson Chi-Square, Fisher's Exact, Pearson correlation, Spearman correlation, Independent T-test, and Mann Whitney U Test, with a p-value of less than 0.05 indicating statistical significance.

Ethical approval

The study received ethical approval from the Ministry of Health's Medical Research and Ethics Committee and the Ethics Committee for Research Involving Human Subjects at Universiti Putra Malaysia. Data was kept confidential for at least three years for analysis before destruction.

RESULTS

Socio-demographic characteristics of the participants

The study involved 104 patients with lumbar puncture (LBP) at Hospital Serdang, with a majority being Malay (79.8%), followed by Indian (13.5%) and Chinese (6.7%) (Table 1).

MRI findings of disc prolapse

The study found that 78.8% of patients experienced disc prolapse at the L4-L5 level, followed by L5-S1 with 78 (75.0%), L3-L4 with 55 (52.9%), L2-L3 with 12 (11.5%), and L1-L2 with 3.8% (Table 2).

MRI findings of lumbar stenosis

The study examined lumbar stenosis MRI results by measuring AP diameter and SCA on axial T2. Normal AP diameter was >1.3 cm, relative stenosis was 1.0 cm-1.3

cm, and absolute stenosis was <1 cm. The cross-sectional area (SCA) was classified as normal if >1 cm, moderate if 0.76-1.0 cm², and severe if less than 0.76 cm². Most patients had normal or no L1-L2 stenosis for AP diameter, with most showing relative stenosis at L1-L2, L2-L3, or L3-L4 (Table 3).

Table 1: Sociodemographic distribution of the participants (n=104).

Variables	Frequency (N)	Percentage (%)	Mean (SD)
Gender			
Male	46	44.2	-
Female	58	55.8	
Race			
Malay	83	79.8	-
Chinese	7	6.7	
Indian	14	13.5	
Age (years)			
20-29	28	26.9	37.99 (11.88)
30-39	36	34.6	
40-49	17	16.3	
50-59	18	17.3	
60-69	5	4.8	

*Descriptive statistics

Table 2: Prevalence of the intervertebral disc prolapsed.

Disc prolapse	N (%)	
	No	Yes
L1-L2	100 (96.2)	4 (3.8)
L2-L3	92 (88.5)	12 (11.5)
L3-L4	49 (47.1)	55 (52.9)
L4-L5	22 (21.2)	82 (78.8)
L5-S1	26 (25.0)	78 (75.0)

*Descriptive statistics; n=frequency; %=percentage

Table 3: Distribution of lumbar stenosis based on classification by AP diameter and SCA.

Variables	N (%)			Mean (SD)
	Normal	Relative stenosis	Absolute stenosis	
AP (cm)				
L1-L2	42 (40.4)	53 (51.0)	9 (8.7)	1.26 (0.18)
L2-L3	21 (20.2)	59 (56.7)	24 (23.1)	1.17 (0.19)
L3-L4	9 (8.7)	52 (50.0)	43 (41.3)	1.04 (0.21)
L4-L5	5 (4.8)	30 (28.8)	69 (66.3)	0.88 (0.29)
L5-S1	6 (5.8)	35 (33.7)	63 (60.6)	0.92 (0.27)
SCA (cm ²)				
L1-L2 (n=10)	10 (100.0)	0 (0.0)	0 (0.0)	1.68 (0.35)
L2-L3 (n=29)	27 (93.1)	1 (3.4)	1 (3.4)	1.52 (0.43)
L3-L4 (n=100)	80 (80.0)	15 (15.0)	5 (4.8)	1.35 (0.41)
L4-L5	62 (59.6)	21 (20.2)	21 (20.2)	1.17 (0.52)
L5-S1 (n=102)	64 (62.7)	16 (15.7)	22 (21.6)	1.29 (0.79)

Summary of ODI category

The Oswestry LBP Questionnaire was used to assess patients' quality of life with low back pain (LBP). The questionnaire, a modified Hospital Serdang ODI, asked questions about pain intensity, personal care, lifting, walking, sitting, standing, sleeping, social life, travel, and pain improvement. The mean score for each question was 2.92 ± 1.29 , with the highest score indicating multiple-choice impairment. The study found that most patients felt extremely severe pain, with most feeling moderate to

severe. Personal hygiene was also a concern, with most patients being cautious about their care. Lifting was a challenge, with most patients experiencing discomfort lifting large weights. Sitting rules were also a concern, with many patients unable to sit for more than one hour. Sleeping patterns were also a concern, with some patients experiencing discomfort. Social life was uncomfortable, with most patients having a normal social life without pain. Travel was also a concern, with most patients experiencing more pain. Pain relief was not a significant concern, with 33.7% of patients not experiencing improvement (Table 4).

Table 4: Summary of ODI data.

Variables	Frequency (N)	Percentage (%)	Mean (SD)
Pain intensity			
I have no pain at the moment	6	5.8	2.92 (1.29)
The pain is very mild at the moment	8	7.7	
The pain is very moderate at the moment	24	23.1	
The pain is fairly severe at the moment	22	21.2	
The pain is very severe at the moment	38	36.5	
The pain is the worst imaginable at the moment	6	5.8	
Personal care (washing, dressing, etc)			
I can look after myself normally without causing extra pain	29	27.9	1.38 (1.12)
I can look after myself normally but it causes extra pain	25	24.0	
It is painful to look after myself and I am slow and careful	35	33.7	
I need some help but manage most of my personal care	11	10.6	
I need help every day in most aspects of self-care	4	3.8	
I do not get dressed, I wash with difficulty and stay in bed.	0	0.0	
Lifting			
I can lift heavy weights without extra pain	8	7.7	2.04 (1.20)
I can lift heavy weights but it gives extra pain	35	33.7	
Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently placed eg. on a table.	19	18.3	
Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned.	29	27.9	
I can lift very light weights	13	12.5	
I cannot lift or carry anything at all.	0	0.0	
Walking			
Pain does not prevent me from walking any distance	20	19.2	1.64 (1.19)
Pain prevents me from walking more than 1 mile	34	32.7	
Pain prevents me from walking more than ½ mile	17	16.3	
Pain prevents me from walking more than 100 yards	29	27.9	
I can only walk using a stick or crutches	4	3.8	
I am in bed most of the time	0	0.0	
Sitting			
I can sit in any chair as long as I like	17	16.3	1.94 (1.21)
I can only sit in my favourite chair as long as I like	18	17.3	
Pain prevents me sitting more than one hour	32	30.8	
Pain prevents me from sitting more than 30 minutes	29	27.9	
Pain prevents me from sitting more than 10 minutes	7	6.7	
Pain prevents me from sitting at all	1	1.0	
Standing			
I can stand as long as I want without extra pain	11	10.6	2.17 (1.28)
I can stand as long as I want but it gives me extra pain	24	23.1	
Pain prevents me from standing for more than 1 hour	22	21.2	

Continued.

Variables	Frequency (N)	Percentage (%)	Mean (SD)
Pain prevents me from standing for more than 30 minutes	33	31.7	
Pain prevents me from standing for more than 10 minutes	11	10.6	
Pain prevents me from standing at all	3	2.9	
Sleeping			
My sleep is never disturbed by pain	29	27.9	1.37 (1.22)
My sleep is occasionally disturbed by pain	34	32.7	
Because of pain I have less than 6 hours sleep	22	21.2	
Because of pain I have less than 4 hours sleep	14	13.5	
Because of pain I have less than 2 hours sleep	3	2.9	
Pain prevents me from sleeping at all	2	1.9	
Social life			
My social life is normal and gives me no extra pain	21	20.2	1.83 (1.42)
My social life is normal but increases the degree of pain	31	29.8	
Pain has no significant effect on my social life apart from limiting my more energetic interests eg. sport	15	14.4	
Pain has restricted my social life and I do not go out as often	22	21.2	
Pain has restricted my social life to my home	12	11.5	
I have no social life because of the pain	3	2.9	
Traveling			
I can travel anywhere without pain	15	14.4	1.60 (1.19)
I can travel anywhere but it gives me extra pain	44	42.3	
Pain is bad but I manage journeys over two hours	24	23.1	
Pain restricts me to journeys of less than one hour	13	12.5	
Pain restricts me to short necessary journeys under 30 minutes	5	4.8	
Pain prevents me from traveling except to receive treatment	3	2.9	
Improvement of pain			
The pain improved quickly	6	5.8	2.41 (1.22)
Overall, the pain gets better	22	21.2	
Pain improved slowly	21	20.2	
Pain neither gets better nor worse	35	33.7	
Pain becomes worse	18	17.3	
Pain become worse quickly	2	1.9	
Total mean score for disability (%)			38.62 (18.04)

*Descriptive statistics

Table 5: Association between lumbar stenosis (AP diameter and SCA) and ODI score.

Variables	ODI score	
	Correlation coefficient (r)	P value
AP (cm²)		
L1-L2 [€]	0.037	0.711
L2-L3 [€]	0.074	0.456
L3-L4 [€]	-0.206	0.036*
L4-L5 [€]	0.017	0.862
L5-S1 [€]	0.122	0.218
SCA (cm²)		
L1-L2 [¥]	0.588	0.074
L2-L3 [¥]	0.146	0.451
L3-L4 [€]	0.019	0.853
L4-L5 [€]	-0.036	0.719
L5-S1 [€]	0.065	0.519

[€]Pearson's correlation; [¥]Spearman correlation; *p value<0.05

Association between lumbar stenosis with ODI score

Table 5 presents data on the association between AP diameter and SCA with ODI score. No significant association was found between AP diameters of L1-L2, L2-L3, L4-L5, and L5-S1, but a negative association was found between L3-L4 and ODI score.

Association between AP diameter and SCA with socio-demographic data

The study found that male patients had a higher chance of stenosis at L2-L3 of AP due to lower mean diameter, while no significant association was observed between L1-L2, L3-L4, L4-L5, and L5-S1 of AP between male and female patients (Table 6).

Table 6: Association between lumbar stenosis (AP diameter and SCA) with gender.

Variables	Mean (SD)		t statistic (df)	P value
	Male	Female		
AP (cm ²)				
L1-L2	1.25 (0.16)	1.27 (0.19)	-0.543 (102)	0.589
L2-L3	1.13 (0.17)	1.21 (0.20)	-2.024 (102)	0.046*
L3-L4	1.02 (0.18)	1.06 (0.23)	-0.952 (102)	0.343
L4-L5	0.85 (0.29)	0.89 (0.29)	-0.719 (102)	0.474
L5-S1	0.96 (0.25)	0.90 (0.28)	1.218 (102)	0.226
SCA (cm ²)				
L3-L4	1.30 (0.39)	1.39 (0.42)	-1.171 (98)	0.244
L4-L5	1.09 (0.49)	1.23 (0.54)	-1.307 (102)	0.194
L5-S1	1.37 (0.98)	1.22 (0.59)	0.959 (100)	0.340

Independent T-test; t-stats= t-statistics; df= degree of freedom; *p-value<0.05

Table 7: Association between lumbar stenosis (AP diameter and SCA) and age.

Variables	Age (years)	
	Correlation coefficient (r)	P value
AP (cm²)		
L1-L2 [€]	-0.192	0.051
L2-L3 [€]	-0.161	0.102
L3-L4 [€]	-0.238	0.015*
L4-L5 [€]	-0.113	0.252
L5-S1 [€]	0.025	0.805
SCA (cm²)		
L1-L2 [¥]	-0.006	0.987
L2-L3 [¥]	-0.242	0.207
L3-L4 [€]	-0.229	0.022*
L4-L5 [€]	-0.190	0.054
L5-S1 [€]	-0.006	0.955

[€]Pearson's correlation; [¥]Spearman correlation; *p-value<0.05

Table 7 reveals a negative association between AP diameter and SCA diameter with patient age. L3-L4 of AP decreased with increasing patient age, while L1-L2, L2-L3, L4-L5, and L5-S1 of AP and SCA did not. SCA diameter also decreased with increasing patient age.

DISCUSSION

A study involving 104 patients aged 20-69 with lower back pain found that it is more common in younger individuals seeking therapy than in the elderly.⁷ Youthful low back pain is often caused by job or sports injuries, which can worsen disc degenerative illnesses and damage lumbar spine tissues due to poor body posture, ergonomics, and excessive lifting.⁸ MRI abnormalities

are not typically associated with significant lower back pain, and young individuals with no symptoms may misdiagnose lumbar stenosis, leading to a vague diagnosis. LBP is common in young and middle-aged individuals and can be treated with rest, massage, or physiotherapy.⁹

Women are more likely to develop low back pain due to various factors, including employment, family, pregnancy, and nursing. Disc degeneration between the L4 and S1 vertebrae is common, with younger patients experiencing it at L4-S1 and older patients at L1-L3.¹⁰ The degeneration of proteoglycan, metalloproteinase, and collagen matrix leads to increased intervertebral disc mobility, with higher compressive stresses providing the

most mobility for L5/S1, a condition common in the elderly with a higher lordotic angle.¹¹

Summary of the ODI score

The research shows that most patients with lower back pain (LBP) experience moderate impairment, with a mean ODI score of 38.62±18.04. Pain significantly impacts personal care, lifting, walking, sitting, standing, sleeping, socializing, and traveling. Standing, lifting, sitting, and walking can cause discomfort, with most LBP sufferers experiencing worsening pain after 30 minutes of standing. Sleeping is the least disturbed, and standing and sitting worsen LBP while laying supine relieves it.¹²

Standing and walking can increase lower back discomfort due to diminished spinal nerve blood flow, and the ligamentum flavum may expand into the spinal canal, worsening disc protrusions and spinal compression.¹³⁻¹⁴

Clinical correlation of MRI findings and ODI score

Previous research has shown no correlation between MRI findings of disc degenerative degeneration and lumbar stenosis and patient ODI score. Factors such as obesity, smoking, socioeconomic level, psychosocial variables, physical exertion, lifestyles, and age affect LBP and patients' quality of life.⁶ Asymptomatic individuals may also have abnormal MRIs, contradicting previous findings.¹⁵

Clinical correlation MRI findings and sociodemographic (gender and age)

The study found that MRI disc degeneration results do not predict lumbar stenosis by gender, suggesting that lower back pain and lumbar degenerative disease.⁹ there are equally likely in both men and women at Hospital Serdang.

Weakened paravertebral and abdominal muscle support increases lumbar lordosis and intervertebral disc pressure, especially at the lumbosacral junction.¹⁷ AP diameter and SCA do not correlate with patient age or lumbar stenosis due to spinal canal size variations and no narrowing grading system. MRI is often used for lumbar spine diseases in patients with lower back discomfort, sciatica, and neurogenic claudication. Standing imaging is ideal but impractical due to patient rest requirements.

Axial loading MRI is linked to symptoms, prolapsed intervertebral disc, and lumbar stenosis, according to a study by Danielsson et al. The study suggests that cautious patient management has led to surgery.¹⁶

The lack of a correlation between MRI results and patient symptoms could be due to dynamic stenosis, where spinal canal size changes with position, implying that static canal dimension pictures may not accurately predict symptoms.¹⁸

The research has several limitations, including the need for MRI and ODI scores for data collection, not being performed on Hospital Serdang LBP patients, not analyzing data from multiple observers due to time constraints, and the absence of association due to symptoms changing over time and broad lumbar dimensions in non-clinical spinal stenosis patients. Despite these limitations, the research aims to help doctors and patients understand the clinical importance of degenerative results on advanced imaging.

CONCLUSION

The research at Hospital Serdang revealed that most patients with LBP have serious impairments, and MRI results do not correlate with their disabilities or symptoms. The study also noted that Malaysians have smaller spinal canals than Westerners, and no baseline research exists for comparison. Additionally, the MRI sequence T1 does not diagnose disc bulging or lumbar stenosis, and may not be scanned if the patient has acute discomfort.

Recommendations

The ideal MRI posture is axial loading, which can worsen LBP symptoms. Malaysia does not follow this; studies show differences between supine and axial loading positions. Future studies should focus on spine referral centers like TAGS Specialist Centre and Hospital Putrajaya, as elderly participants were not recruited due to time constraints.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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