Journal of Medical and Surgical Practice (JMSP)
Vol. 08, No. 01, January-March, 2022

The Relationship between Clinical Features and Magnetic Resonance Imaging Proven Lumbar Disc Bulging and Herniation

Iba'a Nadhum Ali[1]*, Khalid Jawad Mutlag[2]
Ali Sagid Khudair [3]

1.MBChB, Diploma of Rheumatology and Medical Rehabilitation, Ministry of Health/ Karbala Health Directorate/ Rehabilitation Center and Disabled Limbs Factory

2,3. MBChB, Diploma of Rheumatology and Medical Rehabilitation, Ministry of Health/ Karbala Health Directorate/ Ain al-Tamr Hospital/ Rheumatology Unit

**Corresponding Author , contact email : dr.khalidjawad80@gmail.com*

Original Article

Summary

The Magnetic resonance imaging (MRI) is a gold standard noninvasive investigation for viewing lumbar anatomy and physiology in great details.Obesity is strongly linked to biomechanical changes that damage the spine and contribute to a range of spinal diseases including intervertebral disc herniation. To assess the relationship between clinical features and magnetic resonance imaging proven lumbar disc bulging and herniation. We conducted a cross-sectional study during the period from October 2017 to May 2018 including 100 patients with lumbar disc bulging and herniation proved by MRI. According to MRI findings, (72%) of the studied group had disc bulge, (13%) disc protrusion and (15%) had disc extrusion. Multiple disc involvements reported in (73%) of these patients. The correlation between body mass index and the total disc bulge/extrusion score was statistically significant. A significant association was found between neurological deficit and body mass index also with straight leg raising test, femoral stretch test, neurological deficit and the waist to hip ratio. No other significant association was found between other parameters. The sensitivity of straight leg raising test, femoral stretch test and crossed straight leg raising test were (39.6%), (25.3%) and (6.6%) respectively. In conclusion,overweight and obesity associated with lumbar disc herniation and its global severity. Clinical findings were more severe in overweight and obese patients. Clinical features were not associated with nerve root compression across the BMI. The type of disc displacement was poorly associated with clinical signs and symptoms as well as obesity.

Keywords: *Lumbar Disc,Bulging , Herniation, clinical features, MRI*

***Article information**: Received: November, 2021, Accepted and Published online February, 2022*

***How to cite this article**: Ali I. N, Mutlag K. J, Khudair A S.The Relationship between Clinical Features and Magnetic Resonance Imaging Proven Lumbar Disc Bulging and Herniation. JMSP 2022; 8(1): 191-204*

1. INTRODUCTION

Lumbar disc herniation (LDH) is one of the commonest causes of low back pain, there is higher weight load on the lower lumbar spine and its connection to the sacrum, that results in increased mechanical stress with subsequent herniations of the corresponding discs. Nerve root impingement results in sciatica which has such a high sensitivity (95%) that its absence makes clinically significant lumbar disc herniation less likely (1-3). The prevalence of symptomatic herniated lumbar disc worldwide is about 1–3% with the highest prevalence among people aged 30 to 50 years, with a male to female ratio of 2:1. In people aged 25–55 years, about 95% of herniated discs occur at the lower lumbar spine (L4/5 and L5/S1 level); disc herniation above this level is more common in people aged over 55 years (4-6). There are several risk factors that contribute to the development of LDH; with ageingdiscs gradually dry out, lose their strength and easily induce the occurrence of herniation with aging (7). Men have twice the risk for LDH compared with women (5,6). Other risk factors include physically demanding work, abnormal activities, such as repetitive bending, twisting, and frequent lifting of heavy objects (4,7). Smoking, overweight and obesity and increasing height all proved to be risk factors for LDH (8-10). Obesity is strongly linked to biomechanical changes that damage the spine and contribute to a range of spinal diseases including IVD degeneration, spinal stenosis, reduce disc height, herniation of the disc, hypertrophy of the spinal ligaments, osteoarthritis and increased compression forces on disc surfaces (11-15). Overall, 23.2% and 9.8% of the world's adult population are overweight and obese, respectively (16). Miscellaneous risk factors: including poor posture, sedentary lifestyle, frequent driving, chronic cough and pregnancy (4,8). For diagnostic considerations, the onset may be sudden or gradual. Alternatively, repeated episodes of low back pain may precede sciatica by months or years (17). General symptoms of LDH include typical sciatica symptoms, loss of bladder or bowel control, pain exacerbation with sneezing, coughing or bending at the waist (4, 18,19). However, general physical and neurologic examination, may help to identify patients who have a systemic disease or neurologic involvement. The neurologic examination includes motor testing, knee and ankle deep tendon reflexes, tests for dermatomal sensory loss and muscle atrophy. A straight-leg raising test (SLRT) is positive if radicular pain is produced when the leg is raised less than 60 degrees, while the crossed SLRT is considered positive if sciatica is reproduced when the opposite leg is raised (3). Pain felt in the back or the front of the thigh occurs if the femoral stretch test (FST) is positive when the patient in prone position and the hip is gradually extended (20).Diagnostic tests are not required unless symptoms persist for more than 4 weeks (3).Magnetic resonance imaging (MRI) is gold standard noninvasive investigation for viewing lumbar anatomy and physiology in great details (21,22). Computerized tomography (CT) can provide helpful diagnostic images of the disc protrusion and/or narrowing of the exit foramina, but it gives more bony details (17,19). Plain X-rays of the lumbar spine are of little value in the diagnosis of lumbar disc disease (17). Electrodiagnostic studies can confirm nerve root compression and define the distribution as well as severity of involvement (3).

2. PATIENTS and METHODS

A cross-sectional study conducted at rheumatology unit during the period 2017 - 2018, included 100 Iraqi patients with lumbar disc bulging and herniation proved by MRI.The study includedIraqi patients aged 18 years or older with lumbar disc bulge and/or herniation proved y MRI were included while patients with congenital diseases of lumbar spine, spondylolisthesis, spinal deformities, previous surgery of lumbar spine, malignancy or infectious and inflammatory diseases of the spine were excluded.

Data were collected using a data collection sheet included demographic and clinical data, dermatomal level of the pain, SLRT, Crossed SLRT, FST, knee and ankle reflexes, sensory alteration and muscle weakness, in addition to a table containing the type and level of the herniated disc. Height, weight waist circumference, hip circumference and BMI were measured aor calculated using standard equations and methods (23). Body mass index categorized in accordance with the international classification system of the World Health Organization (24). Waist to hip ratio (WHR) used to assess central obesity which is defined as WHR above 0.90 for males and above 0.85 for females (23). The neurological examination was performed for all patients. The straight leg raising test, crossed SLRT, the femoral stretch test were all performed.

Magnetic resonance imaging scans were performed using a 1.5Tesla (Siemens Avento) from L1 to S1. Total disc bulge/extrusion score (TDBE) was calculated based on the followings: no disc bulge, protrusion nor extrusion (0 points), disc bulge/protrusion (1 point), and disc extrusion (2 points); thus the potential range for the overall lumbosacral score was 0-10, considering both the type of disc herniation as well as the number of disc levels affected (25). Data were entered and analyzed using the statistical package for social sciences (SPSS) version 23 used for data entry and analysis. Frequency and percentage used to represent the categorical data. Chi-square (fisher exact when not applicable) tests, multivariate analysis and Pearson correlation were used for analysis.P-value < 0.05 considered significant.

3. RESULTS

The descriptive characteristics of studied sample revealed that (55%) of the patients fell in age group of ≥40 years, (50%) were males. House workers, light workers and heavy workers were (48%), (29%) and (23%) respectively, (81%) were nonsmokers, (76%) were either overweight or obese and (80%) had high WHR as represented in (Table 1). According to MRI findings, disc bulge, disc protrusion and disc extrusion reported in 72%, 13% and 15%, respectively, (Figure 1).In overweight and obese patients, bulged disc found in 77.8%, protrusionin 84.6% and extrusion in 80%, (Table 2).

Among the studied group,(76.4%) of patients with bulged disc, (53.8%) of patients with protrusion and (60%) of those with extrusion had high WHR (Table 3).

A direct (positive) significant correlation was found between BMI and TDBE (R=0.500, P-value=0.01). The mean value of TDBE also higher in overweight or obese patients compared to those with normal BMI , (P<0.05) (Table 4) and (Figures 2). The results showed that (70%) of patients who had positive SLRT, (76.9%) who had positive femoral stretch test, (50%) who had positive crossed SLRT, (75.4%) who presented with radicular pain and (89.5%) of patients who presented with neurological deficit were overweight or obese. The significant association was reported between neurological deficit and BMI status only, (Table 5).

It had been found that (90%) of positive SLRT patients, (96.2%) of positive FST, (83.3%) positive crossed SLRT patients and (83.1%) who presented with radicular pain and (92.1%) who presented with neurological deficit had high WHR status. The significant association was reported between SLRT, FST, neurological deficit and WHR status, (P<0.05), (Table 6). In overweight or obese patients, (39.3%) with bulged disc, (36.4%) with protrusion and (33.3%) with extrusion had neurological deficit (Table 7).

No significant association had been foundbetween the clinical features and nerve root compression for patients with normal BMI as well as overweight or obese patients, although the frequency of positive clinical findings was higher in patients with nerve root compression but the difference did not reach the significant level as displaced in (Table 8).

Table 1. Descriptive characteristics of studied group

Variable		No.	%
Age category/year	<40	45	45.0
	≥40	55	55.0
Gender	Male	50	50.0
	Female	50	50.0
Occupation	Light work	29	29.0
	House work	48	48.0
	Heavy work	23	23.0
Smoking	Non smoker	81	81.0
	Smoker	19	19.0
BMI	Normal	24	24.0
	Overweight	36	36.0
	Obese	40	40.0
WHR	High	80	80.0
	Normal	20	20.0

BMI: Body mass index, No.: Number, WHR: Waist to hip ratio.

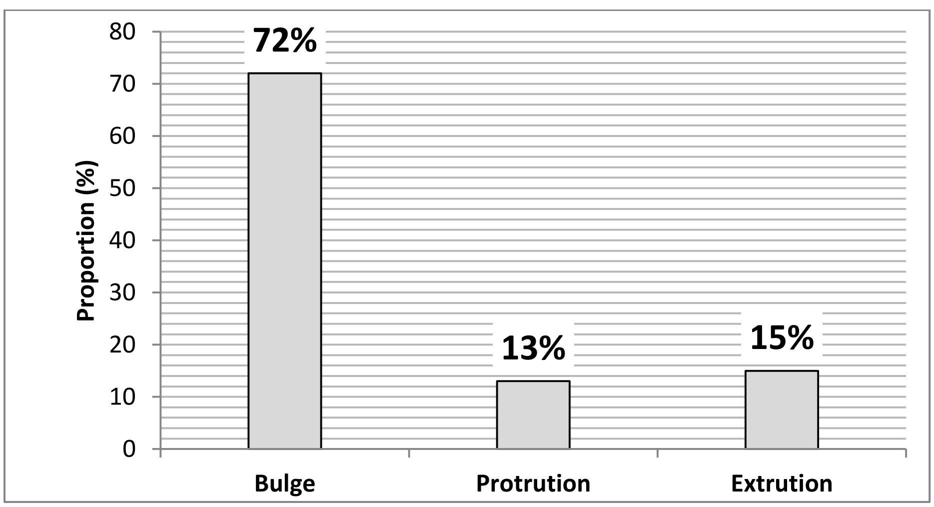

Figure 1. Distribution of herniation status

Table 2. Association between disc displacement type and BMI status

		BMI				**P-value**
		Normal		**Overweight or obese**		
		No.	**%**	**No.**	**%**	
Bulge	Present	16	22.2	56	77.8	0.050
	Absent	8	28.6	20	71.4	
Protrusion	Present	2	15.4	11	84.6	0.400
	Absent	22	25.3	65	74.7	
Extrusion	Present	3	20.0	12	80.0	0.600
	Absent	21	24.7	64	75.3	

Table 3. Association between disc displacement type and WHR status

		WHR				**P-value**
		Normal		High		
		No.	%	No.	%	
Bulge	Present	17	23.6	55	76.4	0.1
	Absent	3	10.7	25	89.3	
Protrusion	Present	6	46.2	7	53.8	0.07
	Absent	14	16.1	73	83.9	
Extrusion	Present	6	40.0	9	60.0	0.06
	Absent	14	16.5	71	83.5	

Table 4. Correlation between BMI and TDBE

Correlation parameter	**value**
Correlation coefficient (R)	0.500
P-value	**0.010**

Table 5. Association between clinical findings and BMI status

		Normal BMI		Overweight or obese		P. value
		No.	%	No.	%	
SLRT	Positive	12	30.0	28	70.0	0.200
	Negative	12	20.0	48	80.0	
FST	Positive	6	23.1	20	76.9	0.800
	Negative	18	24.3	56	75.7	
Crossed SLRT	Positive	3	50.0	3	50.0	0.100
	Negative	21	22.3	73	77.7	
Radicular pain	Present	16	24.6	49	75.4	0.800
	Absent	8	22.9	27	77.1	
Neurological deficit	Present	4	10.5	34	89.5	0.010
	Absent	20	32.3	42	67.7	

Table 6. Association between clinical findings and WHR

		Normal WHR		High WHR		P. value
		No.	%	No.	%	
SLRT	Positive	4	36.0	36	90.0	0.040
	Negative	16	44.0	44	73.3	
FST	Positive	1	25.0	25	96.2	0.010
	Negative	19	55.0	55	74.3	
Crossed SLRT	Positive	1	5.0	5	83.3	0.800
	Negative	19	75.0	75	79.8	
Radicular pain	Present	11	54.0	54	83.1	0.200
	Absent	9	26.0	26	74.3	
Neurological deficit	Present	3	35.0	35	92.1	0.010
	Absent	17	45.0	45	72.6	

Table 7. Association of the disc displacement type in MRI and neurological deficit according to BMI status

BMI	MRI finding	Neurological deficit				P-value
		Present		Absent		
		No.	%	No.	%	
Normal	Bulging	4	25.0	12	75.0	0.500
	Protrusion	1	50.0	1	50.0	0.400
	Extrusion	1	33.3	2	66.7	0.800
Overweight/obese	Bulging	22	39.3	34	60.7	0.600
	Protrusion	4	36.4	7	63.6	0.700
	Extrusion	4	33.3	8	66.7	0.500

Table 8. Association of the nerve root compression in MRI and clinical findings according to BMI status

BMI	Clinical finding	Nerve root compression				P. value
		Present		Absent		
		No.	%	No.	%	
Normal	Positive SLRT	11	91.7	1	8.3	0.500
	Positive FST	6	100.0	0	0.0	0.200
	Positive Crossed SLRT	3	100.0	0	0.0	0.400
	Radicular pain Present	15	93.8	1	6.3	0.400
	Neurological deficit Present	4	100.0	0	0.0	0.100
Overweight or obese	Positive SLRT	25	89.3	3	10.7	0.400
	Positive FST	17	85.0	3	15.0	0.400
	Positive Crossed SLRT	3	100.0	0	0.0	0.100
	Radicular pain Present	45	91.8	4	8.2	0.900
	Neurological deficit Present	32	94.1	2	5.9	0.500

4. DISCUSSION

In the present study, MRI findings demonstrated that (72%) of studied group had disc bulge, (13%) had disc protrusion and (15%) had disc extrusion with no cases of disc sequestration which was similar to the results of a study done by Younis F et al (26). Regarding the association between the type of the displaced disc and obesity, the results of this study shows that (77.8%) of patients with bulged discs, (84.6%) of patients with protrusion and (80%) of those with extrusion were overweight or obese. On the other hand, (76.4%) of patients that had bulged disc, (53.8%) of those with protrusion and (60%) of those with extrusion were of high WHR status. No significant association (P-value >0.05) was reported between the type of the displaced disc and obesity despite the fact that the majority of patients were of high BMI and WHR status. The present study reveals that (73%) of the patients had multiple disc involvement which was consistent with the studies done by Arzpeyma et al (27) and Iftikhar AB et al (28). The correlation between BMI and TDBE in the current study was statistically significant (P-value=0.01), the mean value of TDBE was also higher with overweight and obese patients in comparison to patients who had normal BMI so the difference was statistically significant. These results were compatible with those of Arzpeyma et al (27) and Samartzis et al (29), indicating that there is an increase in the likelihood of having lumbar disc herniation and its global severity in patients with increased BMI. Regarding the association between the clinical features and obesity, there was a significant association between BMI status and the neurological deficit only (P-value=0.01). On the other hand, patients with high WHR status had significant association between SLRT (P-value=0.04), FST (P-value= 0.01) and neurological deficit (P-value=0.01), so the clinical findings were more severe in overweight and obese patients especially in patients with central obesity. Unfortunately, there are no available similar studies to compare with our results. The results of the current study reveals that there was no significant association between the neurological deficit and the types of disc displacement (bulge, protrusion, extrusion) (P-value >0.05). These results were similar to the studies done by Janardhana et al (22) and Thapa SS et al (30) who concluded that the type of disc displacement associated poorly with clinical signs and symptoms. There are several studies that found the relationship between clinical features and MRI findings. These studies also gave contrasting reports and were inconclusive (22,31,32). The data in this study revealed that there was no significant association between clinical features (SLRT, FST, Crossed SLRT, radicular pain and neurological deficit) and nerve root compression for patients with both normal BMI as well as overweight and obese ones, although the frequency of positive clinical findings was higher in patients with nerve root compression but the difference did not reach the statistically significant level (P-value >0.05). The result of the study done by Janardhana et al (22) revealed that there was no significant association between neurological deficit and nerve root compression (p-value= 0.06) which is consistent with the present study. This may be explained by that a single-level nerve root compression may not be sufficient to produce neurological deficits unless it is very severe. Also the site of disc herniation may play a role, with a lateral or centrolateral disc herniation is more likely to cause neurological deficit than central disc herniation. The sensitivity of SLRT in the current study was 39.6% in patients with nerve root compression.The sensitivity of SLRT varied according to different studies, with some studies confirmed that it has a high sensitivity while others showed the opposite. Capra F et al (33) had confirmed that the sensitivity of SLRT was (36%) which was close to our results, while Majlesi et al (34) and Rabin A et al (35) results revealed that the sensitivity of the SLR test was (52%) and (67%) respectively. In other studies, the sensitivity of SLRT was high ranging from (82.8%) in Omar et al study (36) to (91%) in Devillé et al study (37). The lower sensitivity of SLRT found in this study may be related to the strict interpretation of what constituted a positive test result (ie, clear reproduction of the patient's sciatic pain radiating distal to the knee between 30º-60º), while in other studies they performed the test up to 90º or until maximal hip flexion is reached (34,35). Alternatively, prior treatments such as the use of anti-inflammatory drugs may have reduced the acute nerve root irritation and yielded a lower SLRT sensitivity. Other reasons for these wide variabilities between the results could be related to the type and site of the displaced disc. Selvaraj R et al (38) found that the SLRT was positive in (93.3%) in patients with disc bulge and (60%) in disc protrusion. On the other hand, Dutta S et al (39) confirmed that SLRT was positive in (85%), (43%), and (75%) of patients with paracentral, central, and foraminal disc herniation, respectively. The sensitivity of FST in the current study was (25.3%) which was comparable to the results done by Selvaraj R et al (53) in which (10.3%) of patient had positive FST. The sensitivity of crossed SLRT in the present study was (6.6%) which was comparable to the result done by Simons E et al (28%) (40).

5. CONCLUSIONS

There was an increase in the likelihood of having lumbar disc herniation and its global severity in overweight and obese patients. Body mass index was neither associated with clinical features nor nerve root, and the frequency of positive clinical findings was higher in patients with nerve root compression. Clinicians and Rheumatologists must not depend on MRI reports only, but link it with clinical examination . Further studies with larger sample size still needed should for more precise conclusions.

Ethical Clearance: Ethical clearance and approval of the study are ascertained by the authors. All ethical issues and data collection were in accordance with the World Medical Association Declaration of Helsinki 2013 of ethical principles for medical research involving human subjects. Data and privacy of patients were kept confidentially.

Conflict of interest: Authors declared none

Funding: None, self-funded by the authors

References

1. *Schroeder GD, Guyre CA, Vaccaro AR. The epidemiology and pathophysiology of lumbar disc herniations. InSeminars in Spine Surgery 2016 Mar 1 (Vol. 28, No. 1, pp. 2-7). WB Saunders.*
2. *Rehman L, Khaleeq S, Hussain A, et al. Correlation between clinical features and magnetic resonance imaging findings in patients with lumbar disc herniation. JPMI. 2011; 21(1): 65-70.*
3. *Dixit RK. Approach to the Patient with Low Back Pain. In: Imboden JB, Hellmann DB, Stone JH. Current Diagnosis & Treatment: Rheumatology. 3rd edition, McGraw-Hill Education, United State, 2013; 10: 86-99.*
4. *Ma D, Liang Y, Wang D, et al. Trend of the incidence of lumbar disc herniation: decreasing with aging in the elderly. Clin interv aging. 2013; 8:1047-50.*
5. *Jordon J, Konstantinou K, O'Dowd J. Clinical evidence: herniated lumbar disc. BMJ. 2009;*

3:1118.

6. *Manchikanti L, Abdi S, Atluri S, et al. An update of comprehensive evidence-based guidelines for interventional techniques in chronic spinal pain. Part II: guidance and recommendations. Pain Physician. 2013; 16: S49-S283.*
7. *Abuelnour M. Prevalence and distribution of the intervertebral disc herniation in Sudanese. WJPMR. 2017; 3(1).*
8. *Huang W, Qian Y, Zheng K, et al. Is smoking a risk factor for lumbar disc herniation?. Eur Spine J. 2016; 25(1):168-76.*
9. *Alsudany IA. Y risk factors of recurrent lumbar disk herniation. Medical journal of Babylon. 2015;12(4): 1168–72.*
10. *Alashaw J. The impact of height, weight and body mass Index on the occurrence of herniated intervertebral lumbar disc. Tikrit Medical Journal. 2011;17(1): 133-7.*
11. *Sheng B, Feng C, Zhang D, et al. Associations between Obesity and Spinal Diseases: A Medical Expenditure Panel Study Analysis. Int J Environ Res Public Health. 2017 Feb 13;14(2):183.*
12. *Knutsson B, Sandén B, Sjödén G, et al. Body mass index and risk for clinical lumbar spinal stenosis: a cohort study. Spine. 2015; 40(18):1451-6.*
13. *Urquhart DM, Kurniadi I, Triangto K, et al. Obesity is associated with reduced disc height in the lumbar spine but not at the lumbosacral junction. Spine. 2014 Jul 15;39(16):E962-6.*
14. *Onyemaechi NO, Anyanwu GE, Obikili EN, et al. Impact of overweight and obesity on the musculoskeletal system using lumbosacral angles. Patient Prefer Adherence. 2016;10:291.*
15. *Rihn JA, Kurd M, Hilibrand AS, et al. The influence of obesity on the outcome of treatment of lumbar disc herniation: analysis of the Spine Patient Outcomes Research Trial (SPORT). J Bone Joint Surg Am. 2013 Jan 2;95(1):1.*
16. *Samartzis D, Karppinen J, Chan D, et al. The association of lumbar intervertebral disc degeneration on magnetic resonance imaging with body mass index in overweight and obese adults: A population-based study. Arthritis Rheumatol. 2012 May 1;64(5):1488-96.*
17. *Leach JP, Davenport RJ. Neurology. In: Ralston SH, Penman ID, Strachan M, Hobson RP. Davidson's Principles and Practice of Medicine. 23rd edition, Elsevier, China. 2018; 25: 1061-1146.*
18. *Hao DJ, Duan K, Liu TJ, et al. Development and clinical application of grading and classification criteria of lumbar disc herniation. Medicine. 2017; 96(47): e8676.*
19. *Abdulqader WF. Comparative study between clinical features and MRI findings in lumbo-sacral disc prolapsed. International Journal of Development Research. 2018; 8(1): 18326-18330.*

20. Gibson J, Huntley J. The musculoskeletal system. In: Douglas G, Nicol F, Robertson C. Macleod's Clinical Examination. 13th edition, Elsevier Ltd, China. 2013; 14: 315-54.

21. Albeer MR, Abd alrazaq FK, Alosami MH. Relationship between lumbar disc herniation and benign joint hypermobility syndrome. Ann Rheum Dis. 2017; 76:1000.

22. Janardhana AP, Rao S, Kamath A. Correlation between clinical features and magnetic resonance imaging findings in lumbar disc prolapse. Indian J Orthop. 2010; 44(3):263.

23. World Health Organization. Waist circumference and waist-hip ratio: report of a WHO expert consultation. 2011 Dec: 8-11.

24. World Health Organization. Obesity and overweight: fact sheet. http://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight. Accessed at 12/7/2018, 10:00 pm.

25.Cheung K, Samartzis D, Karppinen J, et al. Intervertebral disc degeneration: new insights based on "skipped" level disc pathology. Arthritis Rheumatol. 2010 Aug 1;62(8):2392-400.

26.Younis F, Shahzad R, Rasool F. Correlation of magnetic resonance patterns of lumbar disc disease with clinical symptomatology of patients. ANNALS. 2011; 17(1):41-47.

27. Arzpeyma SF, Mahfoozi G, Moghadam Pour PS. Concomitance of Obesity and Overweight with Disc Height and Disc Herniation in Lumbar Spine. Iranian J Neurosurg. 2016 Dec15;2(3):11-4.

28. 43. Iftikhar AB, Noman M, Javed M, et al. Magnetic Resonance patterns of lumbar disc disease. J Rawal Med Coll. 2004; 8: 53-6.

29. Samartzis D, Karppinen J, Luk KD, Cheung KM. Body Mass Index and its Association with Lumbar Disc Herniation and Sciatica: A Large-Scale, Population-Based Study. Global Spine Journal. 2017 April 20;4(1_suppl):s-0034.

30. Thapa SS, Lakhey RB, Sharma P, Pokhrel RK. Correlation between clinical features and magnetic resonance imaging findings in lumbar disc prolapse. J Nepal Health Res Counc. 2016 May;14(33):85-8.

31. Beattie PF, Meyers SP, Stratford P, et al. Associations between patient report of symptoms and anatomic impairment visible on lumbar magnetic resonance imaging. Spine. 2000 Apr 1;25(7):819-28.

32. Rahman MH, Islam KT, Islam MR, et al. Association between clinically diagnosed lumbar intervertebral disc prolapse and magnetic resonance image findings. Bangabandhu Sheikh Mujib Medical University Journal. 2016 Sep 6;9(3):146-50.

33. Capra F, Vanti C, Donati R, et al. Validity of the straight-leg raise test for patients with sciatic pain with or without lumbar pain using magnetic resonance imaging results as a reference standard. J Manipulative Physiol Ther. 2011 May 1;34(4):231-8.

34. Majlesi J, Togay H, Ünalan H, Toprak S. The sensitivity and specificity of the Slump and the

Straight Leg Raising tests in patients with lumbar disc herniation. J Clin Rheumatol. 2008 Apr 1;14(2):87-91.

35. *Rabin A, Gerszten PC, Karausky P, et al. The sensitivity of the seated straight-leg raise test compared with the supine straight-leg raise test in patients presenting with magnetic resonance imaging evidence of lumbar nerve root compression. Arch Phys Med Rehabil. 2007 Jul 1;88(7):840-43.*
36. *Omar S, Azmat S, Mirza TM, et al. Accuracy of straight leg raise test in patients with lumbar disc herniation keeping magnetic resonance imaging as a reference standard. Pakistan Armed Forces Medical Journal. 2016 Feb 1;66(1):53-6.*
37. *Devillé WL, Dzaferagic A, Bezemer PD, et al. The test of Lasegue: systematic review of the accuracy in diagnosing herniated discs. Spine. 2000 May 1;25(9):1140-47.*
38. *Selvaraj R, Narayana GJ, Ranganathan J, Anandan H. Clinical correlation of magnetic resonance imaging with symptom complex in prolapsed intervertebral disc disease: A cross-sectional study. Int J Sci Study. 2017 Aug 1;5(5):261-65.*
39. *Dutta S, Bhave A, Patil S. Correlation of 1.5 Tesla Magnetic Resonance Imaging with Clinical and Intraoperative Findings for Lumbar Disc Herniation. Asian spine journal. 2016 Dec 1;10(6):1115-21.*
40. *Simons E, Riphagen II, Ammendolia C, et al. Physical examination for lumbar radiculopathy due to disc herniation in patients with low-back pain. Cochrane Database Syst Rev. 2010, 17(2): CD007431*