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THE RELATIONSHIP BETWEEN CLINICAL FEATURES AND MAGNETIC RESONANCE IMAGING PROVED LUMBAR DISC BULGING AND HERNIATION

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ABSTRACT: Background: Lumbar disc herniation is one of the commonest causes of low back pain. The magnetic resonance imaging is a gold standard non-invasive investigation for viewing lumbar anatomy in detail. **Aim of the Study:** To evaluate the effects of body mass index on the presence, extent and severity of lumbar disc bulging and herniation as well as to determine the relationship between clinical features and magnetic resonance imaging has proven lumbar disc bulging and herniation. **Patients and Methods:** A cross-sectional study conducted on 100 patients with lumbar disc bulging and herniation proved by MRI were included. **Results:** The correlation between body mass index and the total disc bulge/extrusion score was statistically significant. There was a significant association between neurological deficit and body mass index as well as between straight leg raising test, femoral stretch test, neurological deficit, and the waist to hip ratio. On the other hand, there was no significant association between clinical features and nerve root compression for patients with both normal body mass index as well as overweight and obese ones, although the frequency of patients with positive clinical findings was higher in patients with nerve root compression but the difference did not reach the significant level (P-value >0.05). **Conclusion:** There is an increase in the likelihood of having a lumbar disc herniation and its global severity in overweight and obese patients. The type of disc displacement associated poorly with clinical signs and symptoms as well as with obesity.

INTRODUCTION: Lumbar disc herniation (LDH) affects a large number of patients annually. It has been reported that intervertebral disc disorders represent the largest specific diagnosis among patients with spinal pathologies [1].

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Lumbar Disc Appearance on MRI: For the diagnosis of disc herniation, radiologists use sagittal T1- and T2-weighted as well as axial views, sagittal views of lumbar intervertebral disc (IVD) generally appear elliptical, but the herniated discs may change their shape.

Disc signal intensity in T2-weighted MRI is the most sensitive sign for intervertebral disc degeneration and its related abnormalities, the intensity levels of herniated discs are usually less than the normal discs [2]. The influence of obesity on the LDH: 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 [3, 7].

Indeed, the skeleton critically underpins movement and is highly sensitive, responsive and adaptive to its mechanical environment [8, 9], thus, knowledge of the interactions and interplay between bone material and bone structure to deliver bone strength, in addition to the synergy and neutrality of localized muscle mass to modify the behavioral mechanics of bone is of critical interest to clinicians, researchers and physical therapists.

PATIENTS AND METHODS:

Study Design and Setting: A cross-sectional study was conducted at Baghdad Teaching Hospital, Rheumatology unit during the period from October 2017 to May 2018, after approval of the study protocol by University of Baghdad, College of Medicine, Department of Medicine, Rheumatology and Medical Rehabilitation Unit. One Hundred individuals with lumbar disc bulging and herniation proven by MRI that was already performed, who attended the Rheumatology Unit in Baghdad Teaching Hospital and met the inclusion criteria were recruited and asked to participate in the study after obtaining their consent inclusion criteria.

All patients aged ≥18 years who had a lumbar disc bulge and/or herniation diagnosed by MRI were included in the study. Exclusion criteria: patients with one or more of the following criteria were excluded from the study.

Congenital diseases of the lumbar spine, spondylolisthesis and spinal deformities, previous surgery of the lumbar spine, malignancy and infectious and inflammatory diseases of the spine.

Data Collection: Data were collected using a data collection sheet containing a questionnaire which included the followings: age, gender, occupation, smoking, height, weight, waist circumference, hip circumference (HC), BMI, waist-hip ratio (WHR), dermatomal level of the pain, straight leg raising test (SLRT), Crossed SLRT, femoral stretch test (FST), knee and ankle reflexes, sensory alteration and muscle weakness.

Clinical Methodology: Height was measured in meters (m) using a stadiometer, and weight was measured in kilograms (kg) using a weighing scale. Waist circumference was measured in centimeters (cm) at a point midway between the sub costal margin and the iliac crest, in standing position. Hip circumference was measured in centimeters (cm) over light clothing at the widest diameter of the hip across the greater trochanters [10]. Body mass index was calculated as weight in kilograms divided by height in meters squared and then was classified into five categories: underweight ≤18.5 kg/m^2, normal = 18.5-24.9 kg/m^2, overweight = 25-29.9 kg/m^2, obesity ≥30 kg/m^2, morbid obesity ≥40 kg/m^2, in accordance with the international classification system of the World Health Organization [11].

Waist to hip ratio is the ratio of WC to HC and is used to assess central obesity which is defined as WHR above 0.90 for males and above 0.85 for females [10]. The straight leg raising test was done with the patient supine by raising the patient's extended leg on the symptomatic side, being careful that the patient was not actively helping in lifting the leg. The test was considered positive if radicular pain was generated between 30 and 60 degrees. The crossed SLRT was considered positive when radicular pain was reproduced in the affected leg while passively raising the opposed leg. The femoral stretch test was accomplished by placing the patient in a prone position and passively extending the hip and leg straight up off the plane of the couch. If the pain was felt in the back or the front of the thigh, the test was considered positive. The value of this test is limited by inadequate information on its sensitivity and specificity [12].

Radiological Methodology: Magnetic resonance imaging scans were performed using a 1.5 tesla (Siemens avento) from L1 to S1. One expert radiologist evaluated the images and their MRI results were recorded as the followings: disc bulge, disc protrusion, disc extrusion, disc sequestration, nerve root compression in addition to the level of herniation. 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 [13].

Statistical Analysis: 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.

RESULTS: The descriptive characteristics of the studied sample are seen in **Table 1.**

TABLE 1: DESCRIPTIVE CHARACTERISTICS OF STUDIED GROUP

		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

Abbreviations: BMI: Body mass index, no. number, WHR: Waist to hip ratio

The findings of the current study for MRI scanning demonstrated that (72%) of the studied group had a disc bulge, (13%) had disc protrusion and (15%) had disc extrusion as shown in **Fig. 1.**

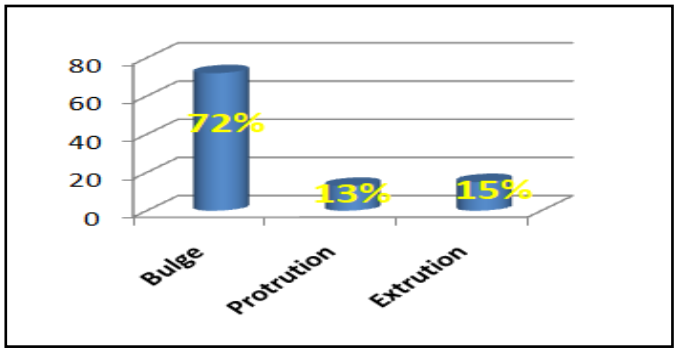

FIG. 1: PREVALENCE OF STATUS OF HERNIATION

The results of our study showed that (77.8%) with a bulged disc, (84.6%) of patients with protrusion and (80%) with extrusion were overweight and obese. On the other hand, this study showed that (76.4%) with a bulged disc, (53.8%) of patients who had a protrusion and (60%) of those with extrusion were of high WHR status as shown in **Table 2.**

There was a significant correlation between BMI and TDBE where the findings revealed there was direct correlation between BMI and TDBE (R=0.5), so the correlation was statistically significant (P-value = 0.01).

TABLE 2: ASSOCIATION BETWEEN DISC DISPLACEMENT TYPE AND BMI STATUS

		BMI				P-value	WHR				P value
		Normal		Overweight or obese			Normal		High		
		No.	%	No.	%		No.	%	No.	%	
Bulge	present	16	22.2	56	77.8	0.05	17	23.6	55	76.4	0.1
	absent	8	28.6	20	71.4		3	10.7	25	89.3	
Protrusion	present	2	15.4	11	84.6	0.4	6	46.2	7	53.8	0.07
	absent	22	25.3	65	74.7		14	16.1	73	83.9	
Extrusion	present	3	20.0	12	80.0	0.6	6	40.0	9	60.0	0.06
	absent	21	24.7	64	75.3		14	16.5	71	83.5	

BMI: Body mass index, No.: Number, P-value: Probability value and it is significant if less than 0.05.WHR: Waist to hip ratio

The mean value of TDBE also higher with overweight or obese patients in comparison to patients who had normal BMI so the difference was statistically significant as seen in **Table 3** and **Fig. 2.**

TABLE 3: CORRELATION BETWEEN BMI AND TDBE

Correlations		
		TDBE
BMI	Pearson correlation	0.5
	P-value	0.01

Body mass index, P-value: Probability value and it is significant if less than 0.05, TDBE: Total disc bulge/extrusion score

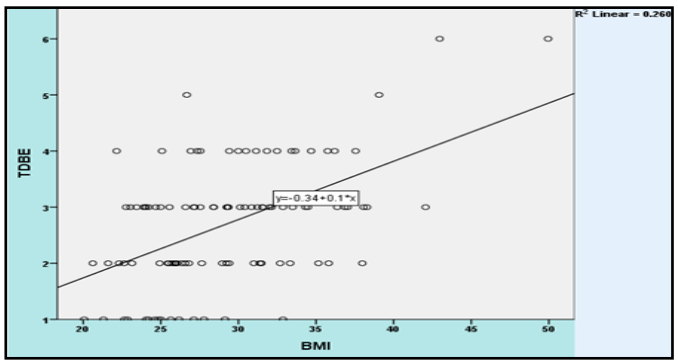

FIG. 2: CORRELATION BETWEEN BMI AND TDBE r^2: coefficient of determination, y: an estimate of the regression line

The associations of clinical findings with BMI status and WHR are represented in **Table 4**.

TABLE 4: ASSOCIATION OF CLINICAL FINDINGS WITH BMI STATUS AND WHR

		BMI				P-value	WHR				P value
		Normal		Overweight or obese			Normal		High		
		No.	%	No.	%		No.	%	No.	%	
SLRT	Positive	12	30.0	28	70.0	0.2	4	10	36	90.0	0.04
	Negative	12	20.0	48	80.0		16	26.7	44	73.3	
FST	Positive	6	23.1	20	76.9	0.8	1	3.8	25	96.2	0.01
	Negative	18	24.3	56	75.7		19	25.7	55	74.3	
Crossed SLRT	Positive	3	50.0	3	50.0	0.1	1	16.7	5	83.3	0.8
	Negative	21	22.3	73	77.7		19	20.2	75	79.8	
Radicular pain	Present	16	24.6	49	75.4	0.8	11	16.9	54	83.1	0.2
	Absent	8	22.9	27	77.1		9	25.7	26	74.3	
Neurological deficit	Present	4	10.5	34	89.5	0.01	3	7.9	35	92.1	0.01
	Absent	20	32.3	42	67.7		17	27.4	45	72.6	

BMI: Body mass index, FST: Femoral stretch test., No.: Number, P-value: Probability value and it is significant if less than 0.05, SLRT: Straight leg raising test. WHR: waist hip ratio

Regarding the BMI, the significant association was reported only with a neurological deficit (p-value 0.01). On the other hand, there were significant associations between SLRT, FST, neurological deficit, and WHR status. The results demonstrated that, for overweight or obese patients, (39.3%) with the bulged disc, (36.4%) with protrusion and (33.3%) with extrusion had neurological deficit as seen in **Table 5**.

TABLE 5: ASSOCIATION OF THE DISC DISPLACEMENT TYPE IN MRI AND NEUROLOGICAL DEFICIT ACCORDING TO BMI STATUS

				Neurological deficit				P-value
				Present		Absent		
				No.	%	No.	%	
BMI	Normal	bulge	present	4	25.0	12	75.0	0.5
			absent	3	37.5	5	62.5	
		protrusion	present	1	50.0	1	50.0	0.4
			absent	6	27.3	16	72.7	
		extrusion	present	1	33.3	2	66.7	0.8
			absent	6	28.6	15	71.4	
	Overweight or obese	bulge	present	22	39.3	34	60.7	0.6
			absent	9	45.0	11	55.0	
		protrusion	present	4	36.4	7	63.6	0.7
			absent	27	41.5	38	58.5	
		extrusion	present	4	33.3	8	66.7	0.5
			absent	27	42.2	37	57.8	

BMI: Body mass index, No.: Number, P-value: Probability value and it is significant if less than 0.05

There was no significant association between 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 were higher in patients with nerve root compression but the difference did not reach a significant level as displaced in **Table 6.**

TABLE 6: ASSOCIATION OF THE NERVE ROOT COMPRESSION IN MRI AND CLINICAL FINDINGS ACCORDING TOBMI STATUS

			Nerve root compression				P-value
			Present		Absent		
			No.	%	No.	%	
Normal	SLRT	Positive	11	91.7	1	8.3	0.5
		Negative	10	83.3	2	16.7	
	FST	Positive	6	100.0	0	0.0	0.2
		Negative	15	83.3	3	16.7	

		Crossed SLRT	Positive	3	100.0	0	0.0	0.4
			Negative	18	85.7	3	14.3	
		Radicular pain	Present	15	93.8	1	6.3	0.4
			Absent	6	75.0	2	25.0	
		Neurological deficit	Present	4	100.0	0	0.0	0.1
BMI			Absent	17	85.0	3	15.0	
	Overweight or obese	SLRT	Positive	25	89.3	3	10.7	0.4
			Negative	45	93.8	3	6.3	
		FST	Positive	17	85.0	3	15.0	0.4
			Negative	53	94.6	3	5.4	
		Crossed SLRT	Positive	3	100.0	0	0.0	0.1
			Negative	67	91.8	6	8.2	
		Radicular pain	Present	45	91.8	4	8.2	0.9
			Absent	25	92.6	2	7.4	
		Neurological deficit	Present	32	94.1	2	5.9	0.5
			Absent	38	90.5	4	9.5	

BMI: Body mass index, FST: Femoral stretch test, No.: Number, P-value: Probability value and it is significant if less than 0.05, SLRT: Straight leg raising test

DISCUSSION: our study shows that (50%) of the patients were males. Previous studies have revealed varying male: female ratio. In Iraq, there was a recent study done by Abdulqader WF that showed male was the predominant gender (56.6%) [14], while in other studies female gender was the predominant (84%) and (57%) [15, 16] respectively. These variations may be the result of genetic, social and environmental factors, such that females engage in heavy duties in some areas of our society, especially in rural areas. The present study reveals (55%) of the patients fell in the age group of ≥40 years, which is near to the study result conducted by Omran *et al.,* [16].

However, another study done by Ma D *et al.,* reported that the incidence of LDH decreases with aging in the elderly population, especially after 80 years old, which was attributed to the fact that the volume and inflammation of the nucleus gets lesser due to degeneration and atrophy with less pressure from the nucleus and lower incidence of annulus injury [17].

Most of the patients in the current study had sedentary occupations with (29%) of them were light workers (officers and constant posture), (48%) were house workers (standard work), (23%) were heavy workers (lifting or carrying heavy objects), which is similar to the result of Omran *et al.,* [16], where all of the patients were either light workers or housewives. It appears that lack of physical loading and sedentary life style which lead to muscle weakness on one hand and the high activity in sports, on the other hand, could both be harmful on the spine [16, 18]. The current study reveals that (76%) of the patients were either overweight or obese with (80%) had high WHR, which was similar to the results of Al-Saeed O *et al.,* [18], Arzpeyma *et al.,* [19] and Perera RS *et al* [20]. Most of the patients in this study (81%) were nonsmokers in contrast to studies done by Huang W *et al.,* [21] and Shiri R *et al.,* [22] that approved smoking is a risk factor and promotes the development of LDH.

This result could be attributed to the fact that half of the patients participated in the current study were females that usually do not smoke in our society. The MRI findings demonstrated that (72%) of the studied group had a 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.,* [23].

Regarding the association between the type of the displaced disc and obesity, the results of this study show 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 discs involvement which was consistent with the studies done by Arzpeyma *et al.,* [19] and Iftikhar AB *et al.,* [24]. 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.,* [19] and Samartzis *et al.,* [25], indicating that there is an increase in the likelihood of having a 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 a 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 reveal 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.,* [26] and Thapa SS *et al.,* [27] who concluded that the type of disc displacement associated poorly with clinical signs and symptoms. Several studies found the relationship between clinical features and MRI findings. These studies also gave contrasting reports and were inconclusive [26, 28, 29].

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.,* [26] 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. In addition, the site of a 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 high sensitivity while others showed the opposite. Capra F *et al.,* [30] had confirmed that the sensitivity of SLRT was (36%) which was close to our results, while Majlesi *et al.,* [31] and Rabin A *et al.,* [32] 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 [33] to (91%) in Deville et al study [34].

The lower sensitivity of SLRT found in this study may be related to the strict interpretation of what constituted a positive test result (*i.e.,* clear reproduction of the patient's sciatic pain radiating distally to the knee between 30º-60º), while in other studies they performed the test up to 90º or until maximal hip flexion is reached [31, 32]. 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.,* [35] 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.,* [36] confirmed that SLRT was positive in (85%), (43%), and (75%) of patients with par central, 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.,* [35] in which, (10.3%) of the 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%) [37].

CONCLUSION: In conclusion the correlation between body mass index and the total disc bulge/extrusion score in this study was statistically significant indicating that there is an increase in the likelihood of having a lumbar disc herniation and its global severity in overweight and obese patients.

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CONFLICTS OF INTEREST: The Authors declare that there are no conflicts of interest.

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