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RESEARCH ARTICLE

CORRELATION OF ANATOMIC LEVELS AND SITES OF LUMBAR DISC HERNIATION WITH SYMPTOMATOLOGY AND FUNCTIONAL DISABILITY AMONG ADULTS WITH LOW BACK PAIN IN ENUGU, NIGERIA

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ABSTRACT

Background: Lumbar intervertebral disc herniation is a pathological condition in which a tear in the outer fibrous ring (annulus fibrosus) of an intervertebral disc allows the soft central portion (nucleus pulposus) to be extruded to the outside of the disc. It is usually due to the degeneration of the intervertebral disc. It is one of the most common causes of low back pain (LBP) among adults with or without lower extremity symptoms. It has significant economic, social and health impact on affected individuals. **OBJECTIVES:** The study aims to correlate the anatomic levels and sites of occurrence of lumbar disc herniations with the presenting symptoms and functional disability among adults with low back pain in Enugu urban. **Methodology:** The study was a clinically based prospective study at National Orthopedic Hospital Enugu and Annunciation Specialist Hospital, Enugu over a 12-month period. Written informed consent was obtained from all the participants. The inclusion criteria were adults 18 years and above who had low back pain and have done lumbosacral spine MRI scan depicting lumbar disc herniation(s). Those who had traumatic spinal cord injury with paraplegia and those who had previous lumbar spine surgery were excluded. Adults who met the inclusion criteria were consecutively recruited. The patients' MRI scans were viewed using DICOM software on windows® 7 laptop computer and cross checking the findings with the accompanying radiologist report. The data included the patients' demographics, presenting symptoms, functional disability index for back pain, weight, height, anatomical level(s) and site(s) of the herniated disc material, number of affected levels and duration of the low back pain. The data were analyzed with SPSS version 20.0. The results obtained were subjected to statistical tests and p-value < 0.05 was considered significant. **Results:** A total of 81 subjects who met the inclusion criteria were included in the study and analyzed. The mean age of the subjects is 52.99 ± 13.13 years. The most common affected age group is 51-60 years (27.2%). Slightly higher proportions were females 43(53%) with a male to female ratio of 1:1.1. Majority of the subjects (64; 79.0%) were either overweight or obese. Majority of the subjects (68; 84%) had their herniations at more than one lumbar intervertebral disc level which usually includes L4 level (74; 91.4%). Majority of the subjects presented with associated sciatica (78; 96.3%) and tingling sensation in the lower limbs (77; 95.1%). However, few subjects had associated loss of bladder and bowel controls (9; 11.1%). Most of the subjects showed moderate to severe (50; 61.8%) disability index. **Conclusion:** It can be concluded that lumbar disc herniation is usually associated with sciatica and tingling sensation in the lower limbs. Also, that lumbar disc herniation at L4 anatomic level is significantly associated with more functional disability. Again, that central/foraminal sites of disc herniation is significantly associated with herniation at L1 anatomic level.

Key words: Anatomic levels, Anatomic sites, Lumbar disc herniation, Symptoms, Functional disability.

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INTRODUCTION

Lumbar intervertebral disc herniation is anatomical abnormality in which a tear in the outer fibrous ring (annulus fibrosus) of an intervertebral disc allows the soft central portion (nucleus pulposus) to be extruded to the outside of the disc (Fardon and Milette, 2001).

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Disc herniation is used to describe a wide spectrum of abnormalities involving disc extension beyond the interspace, from a bulge to a frank extrusion and sequestration (Jansen et al, 1994). It is due to the degeneration of the intervertebral disc. It is one of the most common causes of low back pain (LBP) among adults (Stephen et al, 2010). The onset of the back pain most often occurs between the ages of 30-50 years (Abdi et al, 2007). Most of the studies based the diagnosis of the problem on patient reported symptom (Deyo et al, 2006). Some of the factors attributable to lumbar disc herniation include obesity, smoking, physical inactivity and trauma

(Schumann *et al*, 2010). Patients with disc herniation most commonly present with low back pain radiating to limbs, which increases with activity and relieved with rest. In some cases, they may present with bladder dysfunction in the form of voiding difficulties or with foot drop. The investigation of choice for suspected lumbar disc herniation is Magnetic Resonance Imaging (MRI) (Asghar *et al*, 2013). Low back pain constitutes a major health problem. According to recent studies, the degenerative disc disease occurs even in asymptomatic patients but for about 10% of the population, it results in permanent chronic pain and disability (Asghar *et al*, 2013). Majority (90-97%) of the disc herniation occurs at L4-L5 and L5-S1 levels and also in males (Veresciagnia *et al*, 2010). Less than 5% of all disc herniation occur at the upper lumbar vertebral segment (Kim *et al*, 2010). The general aim of this study is to correlate the anatomic levels and sites of occurrence of lumbar disc herniations with the presenting symptoms and functional disability among adults with low back pain in Enugu urban. Enugu is the capital city of Enugu state, one of the five South-Eastern States in Nigeria. It has an estimated population of about 722,664 people according to the 2006 Nigerian population census (Federal Republic of Nigeria official Gazette, 2007). The population of Enugu is predominantly Christian. It has a total area of 113 km², located on 6° 30' N and 7° 30' E co-ordinates and about 223m above sea level (Iyi, 2014).

METHODOLOGY

The study was a clinically based prospective cross sectional study conducted at National Orthopedic Hospital Enugu and Annunciation Specialist Hospital Emene Enugu over a 12-month period (January 2017 - December 2017). Written informed consent was obtained from all the participants. The inclusion criteria were Nigerian adults 18 years and above who had low back pain and have done lumbosacral spine MRI scan showing lumbar disc herniation(s). Those who had traumatic spinal cord injury with paraplegia and those who had previous lumbar spine surgery were excluded. Adults who met the inclusion criteria were consecutively recruited. The standardization of the MRI findings was ensured by using only MRI scans performed with at least 0.35 Tesla units MRI machine, viewing the MRI using the Digital Imaging and Communications in Medicine (DICOM) software on windows® 7 laptop computer and finally cross checking the findings with the accompanying radiologist report. The data were collected using well designed and structured proforma and The Revised Oswestry Disability Index questionnaire. The data included the patients' demographics (age, sex, and occupation), the patients' presenting symptoms, the patients' functional disability index for low back pain, the patients' weight and height, the anatomical level(s) and site(s) of the herniated disc material on magnetic resonance images, number of affected levels and duration of the low back pain. The patients' BMI were categorized as follows; underweight < 18.5 kg/m², normal 18.5 – 23.0 kg/m², overweight 23.0 – 27.5 kg/m² and obese > 27.5 kg/m². The data generated were presented in texts, tables, figures and graphs. The data collated were coded, entered and analysed with electronic computer software, Statistical Package for Social Science (SPSS) version 20.0. Descriptive statistics which includes frequency, percent, mean and standard deviation were used to summarize categorical and continuous variables. Associations between categorical variables were analysed using chi-square and Fisher's exact tests of significance. Student's t-test was used to

compare means of continuous variables. All tests were regarded as significant at p-values < 0.05 level of significance.

RESULTS

A total of 81 subjects who met the inclusion criteria were included in the study and analyzed. The age range of the subjects is 23 - 78 years with a mean age of 52.99 ± 13.13 years.

Table 1. Age distribution of the subjects

Age(years)	Frequency	Percent
21-30	5	6.2
31-40	9	11.1
41-50	21	25.9
51-60	22	27.2
61-70	17	21.0
71-80	7	8.6

Table 1 above shows that the most common affected age group is 51-60 years.

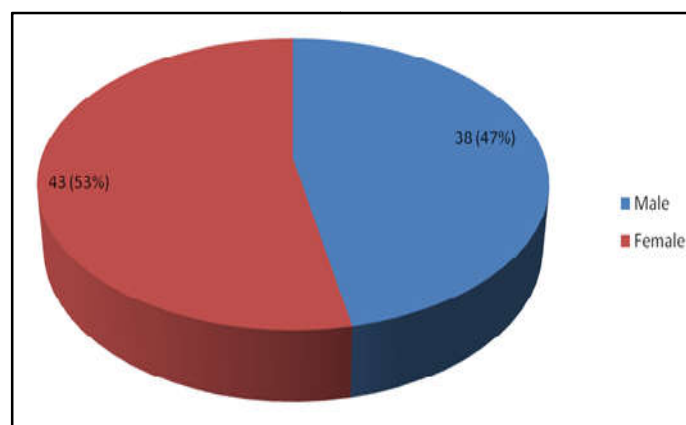


Figure 1. Sex distribution of the subjects

Figure 1 shows that slightly higher proportions were females 43(53%) with a male to female ratio of 1:1.1.

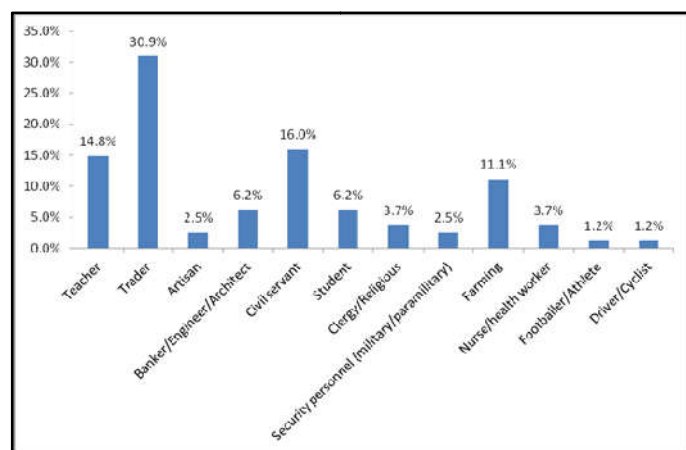


Figure 2. Occupation of the subjects

Figure 2 shows that the most common affected subjects were traders (25; 30.9%) followed by civil servants (13; 16.0%). Table 2 shows that the most common presenting associated symptom among the subjects is sciatica (78; 96.3%) closely followed by tingling sensation (77; 95.1%) in the lower limb(s).

Table 2. Distribution of presenting associated symptoms of the subjects

Symptoms	Frequency	Percent
<i>Sciatica</i>		
Present	78	96.3
Absent	3	3.7
<i>Tingling Sensation</i>		
Present	77	95.1
Absent	4	4.9
<i>Weakness</i>		
Present	30	37.0
Absent	51	63.0
<i>Loss of bladder control</i>		
Present	9	11.1
Absent	72	88.9
<i>Loss of bowel control</i>		
Present	9	11.1
Absent	72	88.9

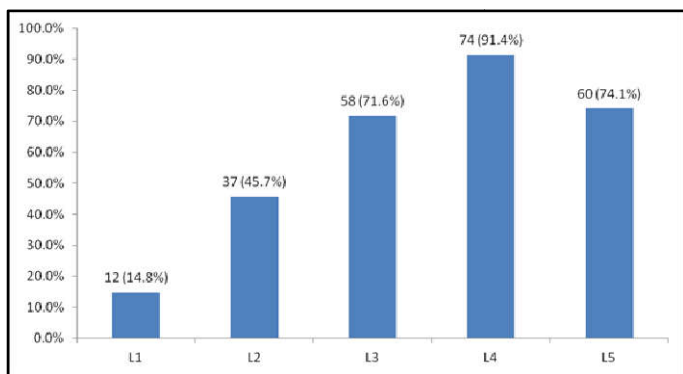
**Figure 3. Distribution of the anatomic levels of lumbar disc herniations in the subjects**

Figure 3 shows that majority of the subjects (74; 91.4%) had disc herniation at the fourth lumbar (L4) anatomic level.

Table 3. Distribution of patterns of anatomic sites of disc herniations within the spinal canal in the subjects

Anatomic site of disc herniation(s)	Frequency	Percent
Central	22	27.2
Paracentral	22	27.2
Subarticular	11	13.6
Paracentral/Subarticular	1	1.2
Central/foraminal	16	19.8
Central/Paracentral	3	3.7
Paracentral/foraminal	6	7.4

Table 3 shows that the most common anatomic sites are central (22; 27.7%) and paracentral (22; 27.2%) sites closely followed by the combinations of central and foraminal sites (16; 19.8%).

Table 4. Association of severity of lumbar disc herniation (RODI score) and anatomical level of the disc herniation

	RODI score Mean \pm SD	t	P value
<i>L1</i>			
Present	54.50 \pm 15.28	0.206	0.838
Absent	55.91 \pm 22.88		
<i>L2</i>			
Present	55.29 \pm 16.51	0.153	0.879
Absent	56.05 \pm 25.69		
<i>L3</i>			
Present	54.03 \pm 19.68	1.093	0.278
Absent	59.91 \pm 26.59		
<i>L4</i>			
Present	54.00 \pm 21.35	2.345	0.022
Absent	73.74 \pm 20.15		
<i>L5</i>			
Present	56.20 \pm 22.29	0.344	0.732
Absent	54.29 \pm 20.99		

Table 4 shows that there is statistically significant difference in the severity of lumbar disc herniation (RODI score) at L4 anatomical level of the disc herniation (p-value = 0.022) compared to other levels. This implies that disc herniation at L4 level is associated with more functional disability when compared to other levels.

Table 5. Mean comparison of severity of low back pain (RODI score) across anatomical sites of lumbar disc herniations

	N	Mean	Std. Deviation	F	P value
Central	22	58.82	22.64		
Paracentral	22	53.73	22.33		
Subarticular	11	48.36	24.33		
Paracentral/Subarticular	1	74.00	-	0.440	0.850
Central/foraminal	16	57.13	21.66		
Central/Paracentral	3	60.00	18.33		
Paracentral/foraminal	6	56.00	20.07		

Table 5 shows that the severity of low back pain (RODI score) is not significantly associated with the anatomical pattern of disc herniation (P = 0.850).

Table 6a. Association of disc herniation at L1 anatomical level and pattern of disc herniation

	L1		χ^2	P value
	Present n (%)	Absent n (%)		
Central	4 (33.3)	18 (26.1)	13.167	0.040
Paracentral	1 (8.3)	21 (30.4)		
Subarticular	0 (0.0)	11 (15.9)		
Paracentral/Subarticular	1 (8.3)	0 (0.0)		
Central/foraminal	4 (33.3)	12 (17.4)		
Central/paracentral	0 (0.0)	3 (4.3)		
Paracentral/foraminal	2 (16.7)	4 (5.8)		

Table 6a shows that the pattern disc herniation is statistically associated with L1 level of disc herniation (P < 0.05) with the central and central/foraminal patterns being the most common patterns.

Table 6b. Association of disc herniation at L2 anatomical level and patterns of disc herniation

	L2		χ^2	P value
	Present n (%)	Absent n (%)		
Central	10 (27.0)	12 (27.3)	3.390	0.759
Paracentral	10 (27.0)	12 (27.3)		
Subarticular	3 (8.1)	8 (18.2)		
Paracentral/Subarticular	1 (2.7)	0 (0.0)		
Central/foraminal	8 (21.6)	8 (18.2)		
Central/paracentral	2 (5.4)	1 (2.3)		
Paracentral/foraminal	3 (8.1)	3 (6.8)		

Table 6b shows that although, the central and the paracentral patterns of disc herniations were the most common patterns at L2 Level, there is no statistically significant association with the pattern of herniation at this level (P > 0.05).

Table 6c. Association of disc herniation at L3 anatomical level and patterns of disc herniation

	L3		χ^2	P value
	Present n (%)	Absent n (%)		
Central	15 (25.9)	7 (30.4)	1.413	0.965
Paracentral	16 (27.6)	6 (26.1)		
Subarticular	7 (12.1)	4 (17.4)		
Paracentral/Subarticular	1 (1.7)	0 (0.0)		
Central/foraminal	12 (20.7)	4 (17.4)		
Central/paracentral	2 (3.4)	1 (4.3)		
Paracentral/foraminal	5 (8.6)	1 (4.3)		

Table 6c shows that although, the central and the paracentral patterns of disc herniations were the most common patterns at L3 Level, there is no statistically significant association with the pattern of herniation at this level ($P > 0.05$).

Table 6d. Association of disc herniation at L4 anatomical level and patterns of disc herniation

	L4		χ^2	P value
	Present n (%)	Absent n (%)		
Central	19 (25.7)	3 (42.9)	7.691	0.262
Paracentral	21 (28.4)	1 (14.3)		
Subarticular	10 (13.5)	1 (14.3)		
Paracentral/Subarticular	1 (1.4)	0 (0.0)		
Central/foraminal	16 (21.6)	0 (0.0)		
Central/paracentral	3 (4.1)	0 (0.0)		
Paracentral/foraminal	4 (5.4)	2 (28.6)		

Table 6d shows that although, the central and the paracentral patterns of disc herniations were the most common patterns at L4 Level, there is no statistically significant association with the pattern of herniation at this level ($P > 0.05$).

Table 6e: Association of disc herniation at L5 anatomical level and patterns of disc herniation

	L5		χ^2	P value
	Present n (%)	Absent n (%)		
Central	15 (25.0)	7 (33.3)	2.104	0.910
Paracentral	16 (26.7)	6 (28.6)		
Subarticular	8 (13.3)	3 (14.3)		
Paracentral/Subarticular	1 (1.7)	0 (0.0)		
Central/foraminal	12 (20.0)	4 (19.0)		
Central/paracentral	3 (5.0)	0 (0.0)		
Paracentral/foraminal	5 (8.3)	1 (4.8)		

Table 6e shows that although, the central and the paracentral patterns of disc herniations were the most common patterns at L5 Level, there is no statistically significant association with the pattern of herniation at this level ($P > 0.05$).

Table 7. Comparison of mean RODI scores of subjects with single level disc herniation and those with multiple level disc herniations

	Single Mean \pm SD	Multiple Mean \pm SD	T	P value
RODI score	60.62 \pm 25.69	54.76 \pm 21.13	0.883	0.380

Table 7 shows that the functional severity of low back pain (RODI scores) in the subjects is not associated with the number of levels of the lumbar disc herniations ($P = 0.380$).

DISCUSSION

This was a clinically based cross sectional study on lumbar disc herniations among adults presenting with low back pain. It highlights the socio-demographic characteristics of the subjects, the anatomic levels and anatomic sites of lumbar disc herniation(s) within the spinal canal and their correlations with the presenting symptoms and the functional disability suffered by the subjects. Lumbar disc herniations were found to occur most commonly within the age bracket of 41 – 70 years with a peak age of 51 – 60 years. This is similar to the findings by Daoyou *et al*, (2013), Rosecrance *et al*, (2006), Yong *et al*, (2003), Mboka, (2011) and Chaiwanichsiri *et al*, (2007). However, it differed from those by Asghar *et al*, (2013) in

Peshawar and Abidi *et al*, (2007) that both reported peak age range of 31 – 50 years in their respective studies. These differences are probably due to the influence of the population being studied (Schumann *et al*, 2010). Similarly, the mean age of affected subjects of 52.99 ± 13.13 years found in the study agrees with the average age of 65 years reported by Daoyou *et al*, (2013) in their study. The study also found slightly female preponderance with male to female ratio of 1: 1.1 which differed from the male preponderance reported by Mohammad *et al*, (2013) and Uduma *et al*, (2011) in their series. This difference is probably due to the higher body mass index (BMI) values of the female subjects studied compared to those of the males in our locality. The most commonly affected subjects were traders (30.9%) followed by civil servants (16.0%) while the least affected subjects were footballers, athletes, drivers and cyclists (1.2%). This agrees with the findings reported by Orege *et al*, (2013), Frymoyer *et al*, (1983) and N' Gbesso *et al*, (1996) who noted lumbar disc herniations with low back pain more in subjects that live sedentary lifestyle and those whose work required limited physical exercise in the lumbosacral spine. It also agreed with the report by Orthoinfo, (2012) that noted regular exercise to be important in preventing lumbar disc herniation.

Furthermore, the study found majority of the subjects studied to have associated symptoms of sciatic (96.3%) or tingling sensation (95.1%) in the leg and/or foot. This agrees with the findings reported by Krismer *et al*, (2007), Mark, (2014), Shamji *et al*, (2008) and Smartzis *et al*, (2014). The prevalence of multiple anatomic levels lumbar disc herniations of 84% on MRI found in the study is similar to that reported by Iruhue *et al*, (2006) in their study. The most common anatomic level of lumbar disc herniation found in the study is at L4/L5 level (74; 91.4%) followed by L5/S1 level (60; 74.1%). This is similar to that reported by Iruhue *et al* in their study in Lagos South West, Nigeria. It also agrees with the rate of 96% at L4/L5 level noted by Rehman *et al*, (2007) and higher rate at L4/L5 followed by L5/S1 reported by Orege *et al*, (2013). Also similar to that reported by Uduma *et al*, (2011) with 2.5% at L4/L5 and L5/S1 anatomic levels each respectively. However, this differed from the findings of most common anatomic level of disc herniation at L5/S1 (52.6%) followed by L4/L5 (39.5%) reported by Asghar *et al*, (2013). The study equally found the most common anatomic site of the disc herniation within the spinal canal to be central (27.2%) and paracentral (27.2%) positions. This is similar to that reported by Daghighi *et al*, (2014). The moderate to severe functional disability index in the majority of the subjects (50; 61.8%) at the time of presentation to the hospitals found in the study is similar to that also reported by Uduma *et al*, (2011). It noted that majority of the subjects with L3 disc herniation were teachers, traders and civil servants with sedentary lifestyle and those whose occupations involve limited physical stress in the lumbosacral spine.

This agrees with the finding by Drammers and Kochler (2002) that reported a strong correlation between the level of lumbar disc herniation and increasing age. They noted that with increasing age, lumbar disc herniation is more cranially localized in the lumbar spine. However, the finding differed from that reported by Daoyou *et al*, (2013) who noted that the most common site is towards the bottom of the spine at L4/L5 and/or L5/S1. This difference is probably due to the influence of the population being studied. The study also found that the Revised Oswestry Disability Index (RODI) score was

significantly associated with lumbar disc herniation at L4 anatomical level when compared to other levels. This implies that subjects with lumbar disc herniation at L4 anatomical level has more functional disability than those with disc herniation(s) at other lumbar anatomical level(s). The study found that lumbar disc herniation at L4 anatomic level is significantly associated with more functional disability when compared to other levels ($P = 0.022$). Similarly, the study also found the severity of low back pain not to be significantly associated with the anatomical pattern of the disc herniation ($P = 0.850$). However, it was found that the central and foraminal sites of lumbar disc herniations were statistically significant at L4 anatomic level ($P = 0.040$) but not at other lumbar anatomic levels ($P=0.05$). The study found that the functional disability of low back pain in the subjects is not significantly associated with the number of levels involved ($P = 0.380$).

Conclusion

From the results of this study, the following conclusions were made;

1. That lumbar disc herniation is usually associated with sciatica and tingling sensation in the lower limbs.
2. That lumbar herniation at L4 anatomic level is associated with more functional disability in affected individuals.
3. That combined central and foraminal sites of herniation is significantly associated with herniation at L1 anatomic level.

Declarations

Funding: None.

Conflict of interest: None declared.

Ethical approval: The study was approved by the ethics committee of the institutions.

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