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Magnetic Resonance Imaging Findings in Patients with Low Back Pains and its Associations with Demographic Variables and Body Mass Index in Onitsha Nigeria

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Abstract

Background: Low back pain (LBP) is arguably the most prevalent musculoskeletal condition found among both developed and developing nations. This study was designed to evaluate the MRI findings in patients with LBP and its association with the patients' age, gender, and anthropometric variables in Onitsha, Anambra State, Nigeria. Materials and Methods: This was a retrospective cross-sectional study carried out from June 2021 to August 2021 at the MRI unit of the radiology department of a private diagnostic center in Onitsha Anambra state, Nigeria. A total of 76 MRI reports were selected based on the inclusion criteria of this study, which include reports with LBP clinical indication, radiological findings, and complete patient demographic (age and gender) and anthropometry (weight and height) variables. Results: The majority 42 (53.3%), were males when compared with their female counterparts 34 (44.7%). A greater number, 22(28.9%) of the patients were within the age bracket of 51-60 years, and the least 2(2.6%) were within the age group of 21-30 years. Most 29(38.12%) of the patients had degenerative disc disease, and the least 2(2.63%) had osteoporosis. Conclusion: Male preponderance was noted in this study and majority of the case was seen in people within the sixth decade of life. Degenerative disc disease was the most common pathological entity identified in those presented for MRI due to LBP in our setting. There was a statistically significant mean difference in the MRI findings by age. There was no statistically significant mean difference in the MRI findings by gender.

Keywords: Degenerative disc disease, low back pain, magnetic resonance imaging

Introduction

Low back pain (LBP) is defined as pain, stiffness, or discomfort that lasts for at least one day localized at the lumbosacral region or, more specifically, in the area on the posterior aspect of the body from the lower margin of the 12^{th} ribs to the lower gluteal fold with or without leg pain (Adeyinka & Omidiji, 2011). It is one of the most common causes of seeking a physician, the second cause of sick leave (Vrbanic, 2011), and therefore is a huge medical burden and economic cost (Hartyigsen et al., 2018).

The global prevalence and year lived with disability (YLD) rates from LBP decreased slightly from 1990 to 2017, but the number of LBP sufferers and YLDs increased substantially (Wu et al., 2020). In Africa, according to the systematic review on the prevalence of LBP in Africa, it was found that the lifetime, annual, and point prevalence of LBP among African nations was considerably higher than or comparable to global LBP prevalence estimates

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reported (Morris et al., 2018). Low back pain (LBP) is arguably the most prevalent musculoskeletal condition found in both developed and developing nations (Hoy et al., 2010) and it was postulated that the burden of LBP would be greater in lower and middle-income countries (LMICs) (Woolf et al., 2012).

Low back pain can affect anyone, even children, and about 60% - 80% of all adults experience LBP sometime in their life (Adeyinka & Omidiji, 2011). According to a synthetic literature review, it was demonstrated that females had a higher prevalence of LBP across all age groups. However, disc degeneration occurs more in young men than in young women, most likely due to increased mechanical stress and physical injury. Still, after menopause, which is around the age of 49–50 years, lumbar discs in females degenerate at a quicker rate than male lumbar discs in males; after later 50s, disc space narrowing becomes more apparent and more severe than in age-matched male (Wang et al., 2016). Also, in a meta-analysis study, it was observed that overweight people (BMI= 25-29.9 kg/m^2) and obese people (BMI= ≥30 kg/m^2) have the strongest association with LBP when compared with non-overweight people (Shiri et al., 2010).

Due to the limitations of plain radiographs, managing patients with LBP using medical imaging advanced imaging modalities such as computerized tomography (CT) and magnetic resonance imaging (MRI) can provide adequate clinical information if used correctly in patients with radiculopathy that is unresponsive to conservative management, myelopathy, neurogenic claudication, or patients with "red flag" symptoms (Rao et al., 2018).

Magnetic resonance imaging has come to the forefront as the standard diagnostic imaging modality of choice for the diagnosis and detection of pathologies associated with LBP, due to its high soft-tissue resolution, noninvasiveness, and non-ionizing radiation involvement (Roudsari & Jarvik, 2010; Ogolodom et al., 2021a). In patients who cannot safely undergo MRI due to metallic implant, or fear of a closed environment, CT with or without myelography can be considered a less sensitive alternative diagnostic imaging tool (Rao et al., 2018).

There is a dearth of published data on this subject in this environment, which may have affected the proper management of patients with LBP in this study location. This study was designed to evaluate the MRI findings in patients with LBP and its associations with age, gender, and body mass index of the patients in Onitsha, Anambra State, Nigeria.

Materials and Methodology

This was a retrospective cross-sectional study carried out from June 2021 to August 2021 at the MRI unit of radiology department of a private diagnostic center in Onitsha Anambra state, Nigeria. A total of 76 MRI reports

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were selected based on the inclusion criteria of this study, which include reports with LBP clinical indication, radiological findings, and complete patient's demographic (age and gender) and anthropometry (weight and height) variables. MRI reports that do not meet the inclusion criteria were excluded. The institutional research ethical clearance and permission for data collection were obtained, and all the retrieved information was held in strict confidence and used only for the purpose of this study. The sample size was determined using the Taro Yamane formula cited by Ukaji et al. (2021) study.

$$\mathbf{n= N/1+N(e)^2}$$

where: **n** is the required sample size from the population under study
N is the whole population that is under study; N=94(a total of 94 MRI lumbar vertebrae examination was done from January 2020 to August 2021.
e is the sampling error, which is 0.05
$n= 94/1+94(0.05)^2$
$n= 76.113 \sim 76$
n= 76
A simple random sampling technique was adopted for selecting the records used for this study.

The MRI examinations were performed with a 1.5Tesla MRI machine (Siemens Magnetom 2011 model). All patients were positioned supine in the MRI scanner with their legs straight in a psoas tight position to assure lumbar lordosis. The median sagittal plane of the patients was equidistant to the table edges. A radiofrequency surface coil was placed over the patients to cover the lumbar spine and was centered at L2. The table was set in motion until the patient was at the iso-center of the scanner. T1 and T2-weighted images were acquired using spin echo pulse sequences in sagittal, axial and coronal planes. The technical parameters used are: T1-weighted axial plane with TR/TE of 600-1100/20 ms, FOV of 20 cm, matrix 192 × 256, T2-weighted sagittal plane with TR/TE of 2500-3500/100 ms, FOV of 26 cm, matrix 256 × 512 and T2-weighted axial plane with TR/TE of 4500/130 ms, FOV of 28-30 cm, matrix 328 × 512. Slice thickness and slice interval/gap of 3-5mm and 1-3mm were used, respectively with flip of 90^0.

The retrieved radiological imaging findings were captured and categorized into normal; degenerative disc diseases, infection/spondyldicitis, lumbar spondylosis, osteoporosis, metastasis and nerve root compression as reported by the consultant radiologists. The patients' weight, height, age and gender were retrieved from the radiological request forms while the imaging findings were obtained from the radiological reports using a designed proforma. The BMI was calculated using the formula of weight (W) per height (h) square, and categorized into normal (18.00 - 24.99Kg/m^2), overweight (25.00-29.99Kg/m^2) and 30.00Kg/m^2(obese). The obtained data were

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subjected to SPSS software version 21 for statistical analysis using both descriptive (percentage, tables, chart and mean) and inferential (Kruskal-Wallis, Mann- and Whitney U test) statistics. Kruskal-Wallis Test shows differences in MRI findings by age groups, Mann-Whitney U test shows differences in MRI findings by gender. The level of statistical significance was set at $p < 0.05$.

Results

Socio-Demographic Distribution of Patients

Out of 76 patients' MRI data included in this study, the majority 42 (55.3%) were males when compared with their female counterparts 34 (44.7%). A greater number 22(28.9%) of the patients were within the age bracket of 51-60 years of age and the least 2(2.6%) were within the age group of 21-30 years. Their ages ranged from 25 to 80 years with a mean age of 53.26 ± 11.96 years. A large proportion 31(40.8%) were overweight (25-29.9 kg/m ^{2}) and the least 18(23.7%) had normal BMI (18.5-24.9 kg/m^2). Their mean BMI was 27.04 ± 3.28 kg/m^2 (Table 1).

Patterns of magnetic resonance imaging findings

Out of 76 cases of low back pain, the majority 29(38.12%) had degenerative disc disease and the least 2(2.63%) had osteoporosis. A greater proportion 22(28.95%) of the cases were identified in people within the age bracket of 51-60years, followed by age group 61-70 years 18(23.68%) and the least 2(2.63%) were those within the age group of 21-30 years (Table 2). The distribution of the MRI findings between gender revealed that 42(55.26%) of the cases were found in the male population when compared with the female population 34(44.74%). With respect to degenerative disc disease, out of 29 cases, males were highest 15(51.72%) (Table 3). The MRI findings distribution across the BMI categories showed that large proportion 31(40.79%) of the cases were identified in those with BMI of 25-29.9kg/m^2(overweight), followed by > 30kg/m^2 BMI (Obese) 27(35.53%) and the least 18(23.68%) were those with BMI of 18.5-24.5kg/m^2) (Table 4).

Associations of the magnetic resonance imaging findings with socio-demographic variables of the patients

The mean rank values of the MRI findings across the age groups are 70.25, 50.25 and 30.76 for 21-30 years, 41-50years and 61-70 years respectively. There was a statistically significant mean difference of the MRI findings by age ($K= 12.897$, $p = 0.024$)(Table 5). The mean rank values of the MRI findings by gender are 39.15 and 41.60 for males, and females respectively. There was no statistically significant mean difference in the MRI findings by gender ($U= 743.5$, $p = 0.638$)(Table 6).

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Table 1: Frequency Distribution of Socio-demographic Variables

Variable	Category	Frequency	Percentage
Age Group	21-30	2	2.6
	31-40	14	18.4
	41-50	16	21.1
	51-60	22	28.9
	61-70	18	23.7
	71-80	4	5.3
	Total	76	100.0
Gender	Female	34	44.7
	Male	42	55.3
	Total	76	100.0
Body Mass Index	18.00 - 24.99Kg/m2 (Normal)	18	23.7
	25.00 - 29.99Kg/m2 (Over weight)	31	40.8
	30.00Kg/m2 (Obese)	27	35.5
	Total	76	100.0

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Table 2: Age distribution pattern with MRI findings

MRI findings Age	Normal	Degenerative Disc disease	spondylosis	Infection/ Spondylodisctis	osteoporosis	Metastasis	Nerve root compression	Total
21-30	1	-	-	-	-	-	1	2
31-40	4	2	2	1	-	3	2	14
41-50	1	3	5	4	2	1	-	16
51-60	-	15	1	6	-	-	-	22
61-70	-	9	-	6	-	2	1	18
71-80	-	-	-	3	-	-	1	4
Total	**6**	**29**	**8**	**20**	**2**	**6**	**5**	**76**

Table 3: Gender distribution pattern with Magnetic resonance imaging findings

MRI findings Gender	Normal	Degenerative Disc disease	spondylosis	Infection/ Spondylodisctis	osteoporosis	Metastasis	Nerve root compression	Total
Male	2	15	3	11	2	5	4	42
Female	4	14	5	9	0	1	1	34
Total	6	29	8	20	2	6	5	76

Table 4: Body mass index distribution patterns with Magnetic resonance imaging findings

MRI findings BMI	Normal	Degenerative Disc disease	spondylosis	Infection/ Spondylodisctis	osteoporosis	Metastasis	Nerve root compression	Total
Normal 18.5-24.5 kg/m^2	5	2	3	1	1	5	1	18
Overweight 25-29.9 kg/m^2	1	11	4	11	1	1	2	31
Obese >30 kg/m^2	0	16	1	8	0	0	2	27
Total	**6**	**35**	**8**	**21**	**2**	**6**	**5**	**76**

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Table 5. Kruskal-Wallis Test showing difference in MRI Findings by Age Groups

Age	N	Mean Rank	K	p-value	Remark
21 - 30 Years	2	70.25			
31 - 40Years	14	48.96			
41 - 50Years	16	50.25	12.897	0.024	Significant
51 – 60 Years	22	34.62			
61 - 70Years	18	30.76			
71-80 Years	4	40.86			

Table 6: Mann-Whitney Test showing Difference in MRI Findings by gender

Sex	N	Mean Rank	Sum of Ranks	Mann-Whitney U	p-value	
Male	36	39.15	1409.50			
				743.500	0.638	Not Significant
Female	44	41.60	1830.50			

Discussion

Globally, low back pain has been described as a common condition with harsh socio-economic and healthcare effects (Hoy et al., 2010). Precise diagnosis of the different etiologies of LBP is very crucial in management and prognosis. Magnetic resonance imaging has become an excellent imaging modality of choice in the management of LBP and is advocated as a first-line investigation in the management of patients with LBP (Roudsari & Jarvik, 2010).

In this study, we found that the majority of the MRI cases of LBP were in the male population when compared with their female counterparts. This could be attributed to the fact that males accounted for the highest workforce in every society and are also commonly involved in strenuous jobs, which predisposes them to the etiologies of LBP (Ogolodom et al., 2021a). This finding in which males were commonly affected with LBP is in harmony with the findings of the studies conducted by Ogolodom et al(2021a), Ogolodom et al (2021b), Udama et al(2011) in Cameroon, Iyidobi et al (2018) and Irurhe et al (2012) in Nigeria. However, Ajiboye et al (2018) and Adekanmi et al (2017) in their studies reported that more females were commonly affected with lumbar abnormalities. The differences in our findings could be ascribed to the different nature of our studies and the sample size variations.

The majority of the MRI cases were found in individuals within the age bracket of 51-60 years of age with, an overall mean age of 53.26 ± 11.96 years. This finding is consistent with the results of similar studies carried out

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by Ogolodom et al (2021a) in South-south Nigeria, Adeyinka and Omidiji, (2011) in Southwest Nigeria, and Rayoffor et al (2016) in South-south Nigeria. Orege et al (2013) study, conducted in Kenya, reported a lower mean age of their subjects to be 47.4 years, which is contrary to the finding of this study. The discrepancy in our findings could be attributed to the number of cases included in our different studies as well as the geographical variations of our studies. This finding implies that LBP is prevalent in the middle age group. Therefore, LBP could be a result of the normal aging process or is multifactorial(Ngai et al., 1973; Cohen et al., 2008; Wang et al., 2016).

We also noticed that the incidence of LPB increases with an increase in the BMI of the patients. This is in keeping with the results of similar studies carried out by researchers Mariconda et al (2007), Samartzis et al (2012), Rayoffer et al (2016), and Igbal et al(2021), which equally reported increasing LBP with increased BMI. In Igbal et al (2021) study, out of 151 subjects, 71.42% were overweight. We noticed that females had a significantly higher BMI than males. This could be ascribed to physical loading on the disc in the form of elevated BMI biomechanically affecting the disc or is due to other causes not well understood.

A greater number of the patients with LBP presented with degenerative disc disease on their MRI reports with a male preponderance noted. This is similar to the finding of the study by Irurhe et al., (2012) in Lagos State, Nigeria. There was a significant positive association between the increasing age and the presence of degenerative disc disease as well as an increase in BMI. Jarvik et al (2001) found an association with increasing age while Samartzis et al., (2012) found an association between disc degeneration and BMI in agreement with the findings of this study. In our study, spondylosis progressively increases with increasing age. This is in agreement with other studies carried out by Jarvik et al (2001) and Endean et al (2011). Male had a higher incidence of spondylosis (55%) as opposed to females (45%), however, it was not statistically significant.

In this study, we identified that there was a statistically significant mean difference in the MRI findings by age ($K= 12.897$, $p = 0.024$), meaning that the MRI findings differ with the patients' age. However, there was no statistically significant mean difference in the MRI findings by gender ($U= 743.5$, $p = 0.638$). This implies that both genders shows a similar number of MRI findings.

Conclusion

Male preponderance was noted in this study, and the majority of the case was seen in people within the sixth decade of life. A greater proportion of the cases were those that are overweight and degenerative disc disease was the most common pathological entity identified in those presented for MRI

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due to LBP in our setting. There was a statistically significant mean difference in the MRI findings by age. There was no statistically significant mean difference in the MRI findings by gender. Although this study has highlighted finings to satisfy the aim of the study, these findings cannot be generalized due to the small sample size used in this study.

Conflict of interest: None declared among the authors.

References:

1. Adeyinka AO & Omidiji AO (2011). Magnetic Resonance Imaging Diagnoses in the lumbar spine of Adults with Low Back pain in South West, Nigeria. West African Journal of Radiology, 18(1):1-9.
2. Vrbanić T. S. (2011). *Krizobolja--od definicije do dijagnoze* [*Low back pain--from definition to diagnosis*]. Reumatizam, 58(2), 105–107.
3. Hartvigsen J, Hancock MJ, Kongsted A, Louw Q, Ferreira ML & Genevay S (2018). *What low back pain is and why we need to pay attention*. Lancet. 391:2356-67.
https://en.wikipedia.org/wiki/Magnetic_resonance_imaging
4. Wu A, March L, Zheng X, Huang J, Wang X, Zhao J, Blyth FM, Smith E, Buchbinder R & Hoy D(2020). Global low back pain prevalence and years lived with disability from 1990 to 2017: estimates from the Global Burden of Disease Study 2017. Ann Transl Med. 8(6):299. doi: 10.21037/atm.2020.02.175
5. Morris L D, Daniel KJ, Ganguli B & Louw QA (2018)..An update on the prevalence of low back pain in Africa: a systematic review and meta-analyses. BMC Musculoskelet Disord. 21;19(1):196.
6. Hoy D, Brooks P, Blyth F & Buchbinder R (2010). *The epidemiology of low back pain*, Best Pract Res Clin Rheumatol.;24:769-81.
7. Woolf A.D, Erwin J & March L (2012). *The need to address the burden of musculoskeletal conditions*, Best Pract Res Clin Rheumatol. 26(2):183–224
8. Wang YJ, Wang J & Kaplar Z (2016).Increased low back pain prevalence in females than in males after menopause age: evidences based on synthetic literature review. Quant Imaging Med Surg. 6(2): 199–206. doi: 10.21037/qims.2016.04.06
9. Shiri, R., Karppinen, J., Leino-Arjas, P., Solovieva, S & Viikari-Juntura, E (2010). *The association between obesity and low back pain: a meta-analysis*, American journal of epidemiology; 171(2), 135–154. https://doi.org/10.1093/aje/kwp356
10. Rao D, Scuderi G, Scuderi C, Grewal R & Sandhu S.J (2018). *The Use of Imaging in Management of Patients with Low Back Pain*, J Clin

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Imaging Sci; 8:30. Available FREE in open access from: http://www.clinicalimagingscience.org/text.asp?2018/8/1/30/239701

11. Roudsari B & Jarvik J.G (2010). *Lumbar spine MRI for low back pain: Indications and yield*, AJR Am J Roentgenol.195:550-9
12. Ogolodom M P,Ugwu AC, Akosile CO & Mbaba AN (2021a). Pattern of Magnetic Resonance Imaging Findings in Lumbar Spine Pathologies and Its Demographic Correlates in Rivers State. Journal of Clinical and Diagnostic Research. 15(6):TCO5-TCO9.
13. Ukaji N F, Ohagwu CC & Ogolodom MP(2021). *Effects of Variations in Imaging Parameters on Image Quality of Non Contrast Computed Tomography Scans of Brain: A Cross-sectional Study*. JCDR. 15(10):TC13-TC15
14. Ogolodom M P, Ugwu A C, Akosile C O, Okpaleke M S, Mbaba A N, Eja-Egwu U N, Anakwue A C & Alazigha N (2021b). Magnetic Resonance Imaging Findings in Cervical and Lumbar Spine Pathologies and their impact on the Patients' Quality of life. Afr . J. Health Sci. 34(5):681-694.
15. Uduma, U., Ongolo, P., Assam, G., Fokam, P & Motah, M (2011). Evaluation of Pattern of Magnetic Resonance Images of Lumbo—Sacral Spine in Cameroon—A Pioneer Study. Global J Med Res, 2011, 11, 30-41.
16. Iyidobi EC, Obande B.O & Ekwunife, R.T(2018). Pattern of MRI Findings in Patients with Low Back Pain at National Orthopaedic Hospital, Enugu Nigeria. J Biosci. Med.. 6, 85-94
17. Irurhe NK, Adekola OO, Quadri AR, Menkiti ID, Udenze IC & Awolola NA (2012). The magnetic resonance scans findings in adult Nigerian with low back pain. World J Med Sci 2012; 7:204-9.
18. Ajiboye L.O, Oboirien M, & Buunaaim Alexis D.B(2018). The incidence and clinico-radiological findings in symptomatic adult patients with lumbar degenerative disc diseases in a tertiary orthopaedic hospital, South-West, Nigeria. East Afri Ortho J., 12(1): 27-32.
19. Adekanmi AJ, Bello TO, Atalabi OM, Jimoh KO & Ogunseyinde OA (2017). Magnetic resonance imaging of lumbosacral intervertebral discs in nigerians with low back pain. West Afr J Radiol 2017;24:61-7.
20. Rayoffor O.D, Nwankwo N.C, Ugboma E.W & Rayoffor E (2016*). Evaluation of magnetic resonance imaging findings in adult patients with nontraumatic low back pain in South-South Nigeria*. West Afr J Radiol . [cited 2021 Jul 26];23:64-71. Available from: https://www.wajradiology.org/text.asp?2016/23/2/64/164871

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

21. Orege JA, Abuya JM & Elias GD (2013). Common magnetic resonance imaging (MRI) patterns in patients with low back pain in Eldoret, Kenya. J Sci Innov Res.2:260-79
22. Nagi SZ, Riley LE & Newby LG (1973). A social epidemiology of back pain in a general population. J Chronic Dis. 26:769-79
23. Cohen SP, Argoff CE & Carragee EJ(2008). Management of low back pain. BMJ. 337:a2718
24. Mariconda M, Galasso O, Imbimbo L, Lotti G & Milano C (2007). Relationship between alterations of the lumbar spine, visualized with magnetic resonance imaging, and occupational variables. Eur Spine J. 2007 ; 16(2): 255–266.
25. Samartzis D, Karppinen J, Chan D, Luk KDK & Cheung KMC (2012). The association of lumbar intervertebral disc degeneration on MRI in overweight and obese adults: a population-based study. Arthr Rheum. 64:1488–96.
26. Igbal M, Dipu M, Masfiq M & Rashid A(2021).Investigation to identify the causes of low back pains among garment workers of a selected garment factory in Bangladesh. Advances in Materials and Processing Technologies, DOI: 10.1080/2374068X.2021.1948699
27. Jarvik JJ, Hollingworth W, Heagerty P, Haynor DR & Deyo RA (2001). The Longitudinal Assessment of Imaging and Disability of the Back (LAIDBack) Study: baseline data. Spine (Phila Pa 1976),26(10)):1158–1166.
28. Endean A, Palmer KT & Coggon D. (2011) Potential of magnetic resonance imaging findings to refine case definition for mechanical low back pain in epidemiological studies: a systematic review. Spine (Phila Pa 1976) 36: 160–169.