

Peer Reviewed **Original Article****MAGNETIC RESONANCE IMAGING FINDINGS AND SOCIO-DEMOGRAPHIC DETAILS OF PATIENTS DIAGNOSED WITH CERVICAL SPINE PATHOLOGIES IN RIVERS STATE****Michael Promise Ogolodom¹ MSc | Anthony Chukwuka Ugwu¹ PhD | Christopher O. Akosile² PhD**¹Department of Radiography and Radiological Sciences, Faculty of Health Sciences and Technology, Nnamdi Azikiwe University, Nnewi Campus, Nigeria.²Department of Medical Rehabilitation, Faculty of Health Sciences and Technology, Nnamdi Azikiwe University, Nnewi Campus, Nigeria.<https://doi.org/10.54450/saradio.2022.60.1.635>**ABSTRACT**

Background. Cervical spine pathology is becoming increasingly prevalent with an aging world population and is associated with significant morbidity, affecting all areas of the world and magnetic resonance imaging (MRI) is the modality of choice for a detailed evaluation of cervical spine pathologies. This study aimed at documenting the MRI findings and socio-demographic details of patients presenting with cervical spine pathologies in Rivers State, Nigeria.

Materials and method. This was a prospective, cross-sectional study involving 91 patients (n=91) diagnosed with cervical spine pathologies on MRI. Data used for this study were analysed using descriptive and inferential statistics.

Results. The majority of patients were male (63.7%) and between the ages of 20-39 years of age (41.8%). The mean age of the sample included in this study was 52.16 ± 13.2 years. The majority (34.1%) had cervical spondylosis. Majority (n=40/43.96%) presented with Nurick grade I. There were no statistically significant relationships between the Nurick grades (0: $\chi^2 = 30.9$, $p = 0.073$; I: $\chi^2 = 26.3$, $p = 0.134$; II: $\chi^2 = 24.5$, $p = 0.962$ and IV: $\chi^2 = 18.6$, $p = 0.086$) and gender.

Conclusion. Cervical spine pathologies are numerous and common among young adult males. The commonest of these pathologies is spondylosis with a predilection for C5 vertebra. Nurick grade I disability is the most common in terms of the Nurick grading scores of disabilities arising from cervical pathologies and is independent of gender.

Keywords: Disability, neck disorder, pathology

LAY ABSTRACT

The researchers investigated common neck pathologies among patients in Nigeria and explored associations between these pathologies and the participants' socio-demographic variables.

INTRODUCTION

Many pathological conditions can affect the structure and function of the cervical spine. These conditions can be aetiologically categorised as degenerative, traumatic, infectious, neoplastic, congenital, inflammatory, auto-immune, and vascular. Cervical spine pathologies may result in a variety of symptoms presenting as pain or motor and/or sensory disturbances in the head, neck, or upper extremities. Cervical spondylosis is the most common pathology. It is a degenerative process of the cervical spine with a gradual onset, which alone, or in combination with other factors, causes spinal cord compression and spinal canal stenosis.^[1-3]

Cervical spine pathology is becoming increasingly prevalent with an aging global population and is associated with significant morbidity.^[4] According to the literature, the prevalence of spinal pathologies would have affected 95% of

individuals by their 7th decade leading to an increased dependence rate with a concomitant decrease in the quality of life (QoL) in older populations.^[3,5-7] This poses a global health risk, particularly in developing countries, as individuals in this age group (60 to 69 years) face high rates of symptomatic cervical pathology.^[8]

The diagnosis of cervical spine pathologies can be made with accurate patient history, complete physical clinical examination, and appropriate imaging studies. Magnetic resonance imaging (MRI) currently is the imaging modality of choice for the demonstration of pathologies of the cervical spine and intervertebral discs when compared with plain radiography and computed tomography, either separately or combined.^[2,3] It gives thorough information about the morphology and integrity of the intervertebral discs, intervertebral foramina, vertebrae, facets, joints, and ligaments on both T1 and T2 weighted images, especially

sagittal plane images with a sensitivity of almost 100%. It is a non-invasive procedure.^[7,9-11] The superior soft-tissue resolution of MRI and its ability to detect lesions within the spinal cord, bone marrow, and intervertebral discs without radiation exposure to the thyroid gland gives it an advantage over other imaging modalities.

Most studies in the literature focus on neck pain as it relates to degenerative changes.^[3,7] None evaluated the general pathologies of the cervical spine and its correlation with socio-demographic characteristics of patients. Knowledge of imaging appearances and the prevalence of cervical spine pathologies should enlighten radiographers, radiologists, and clinicians for optimal diagnosis. To the best of our knowledge, there is a dearth of documented evidence of MRI findings in a patient presenting with cervical spine pathologies in our setting. This study aimed at documenting the MRI findings and socio-demographic details of patients presenting with cervical spine pathologies in Rivers State, Nigeria.

MATERIALS AND METHODS

This was a prospective, cross-sectional study carried out among all symptomatic and asymptomatic patients (participants) who were referred for cervical spine MRI at two selected diagnostic imaging centres in Rivers State, Nigeria from July 2020 to November 2020. Ethics approval was obtained from the Human Research and Ethics Committee of University of Port Harcourt Teaching Hospital, Rivers State, Nigeria (UPTH/ADM/90/SII/VOL.XL/897). Permission to conduct the study at the selected research sites was obtained before commencement of participant recruitment.

The purpose of the study was explained to potential participants and that informed consent was necessary. They were told that their participation was voluntary. Once the participants provided informed consent, their data were included in the study. Inclusion criteria were those that were diagnosed with cervical spine pathologies. Exclusion criterion was patients with normal cervical spine MRI findings.

A convenience sampling strategy was employed to recruit participants. The desired sample size was calculated using the formula for unknown populations, given below.

$$n = Z\alpha^2 pq / d^2$$

Where

n = Desired sample size

$Z\alpha$ = significant level usually set at 95% confidence level, $Z\alpha$ is 1.96 (two sided)

p = proportion of the population with similar attributes under study = 50% (0.5)

d = Margin of error tolerated or absolute error = 10.3% (0.103)

$$q = 1 - p = 1 - 0.5 = 0.5$$

$$n = (1.96)^2 \times 0.5 (1 - 0.5) / (0.103)^2$$

$$n = 0.9604 / 0.010609$$

$$n = 91$$

The desired sample size was calculated as 91 participants ($n = 91$).

Cervical spine MRI examinations were performed using an open type MRI machine (Brivo MR235, General Electric, and Siemens Magnetom C) of 0.35 tesla strength using both medium and large neck spine array volume coils. Each participant was examined lying supine with their head and neck in a neutral position. Fast spin-echo sequences were used to obtain T1 weighted (T1W) and T2 weighted (T2W) images in axial and sagittal planes. Coronal images for T1W and T2W and short tau inversion recovery (STIR) sequences were also acquired for adequate cervical spine assessment. The acquired images were interpreted by the researchers and two radiologists with more than three years of experience in MRI spine reporting. The imaging findings were categorised into levels of spinal involvement (single, double, and multiple) and types of pathologies that were present. The participants were evaluated for disabilities using the Nurick grading classifications below.

0: Signs or symptoms of root involvement but without evidence of spinal cord disease.

1: Signs or symptoms of spinal cord disease but no difficulty in walking.

2: Slight difficulty in walking but does not prevent full-time employment.

3: Difficulty in walking, which prevented full-time employment or ability to do all household work, but which was not enough to require somebody's help to walk.

4: Able to walk only with someone else's help or with aid of a frame.

5: Chairbound or bedridden.^[12]

The grading information, socio-demographic variables such as gender, age, duration of pathology and occupation (professionals: teachers, lawyers, accountants etc., and non-professionals: masons, mechanics, carpenters, etc.) were obtained verbally from the participants by the researchers. Their data were captured on a proforma survey designed according to the study objectives. All data collected from the imaging and proforma survey were captured on an Excel spreadsheet.

Descriptive (mean, standard deviation, percentages, and distribution frequency tables) and inferential (chi-square test) statistics were done using the Statistical Package for Social Sciences (SPSS) version 21 (IBM Corp, Amornk, NY, 2012). The chi-square test was used to determine whether associations between age, gender, duration of pathology, and the Nurick grading scores existed. It was also used to determine whether associations between the levels of spinal involvement and the categories of patients' occupation existed. The level of statistical significance was set at $p < 0.05$.

RESULTS

One hundred and thirty ($n = 130$) MRI cervical spine examinations were performed from July to November 2020 at the selected study. In terms of the inclusion criteria ($n = 91$) MRI

Table 1. Socio-demographic details of the participants

S/N	SOCIO-DEMO-GRAPHIC DETAILS	FREQUENCY (N)	PERCENTAGE (%)
a)	Gender		
	Male	58	63.7
	Female	33	36.3
	Total	91	100
b)	Age group (Years)		
	< 20years	7	7.7
	20 – 39years	38	41.8
	40 – 59 years	33	36.3
	60 years and above	13	14.3
	Total	91	100
c)	Occupation		
	Professionals	34	37.36
	Non-professionals	57	62.64
	Total	91	100
	Total	91	100

examinations demonstrated cervical spine pathologies. Informed consent was obtained from the 91 participants to use their data in the study.

Table 1 presents the socio-demographic characteristics of the participants. The majority were male (63.7%). Most participants (41.8%) were between 20 to 39 years old. The majority (62.64%) were non-professionals. The mean age was 52.16 years with a standard deviation of 13.2 years.

The cervical spine pathologies of the participants are presented in Table 2. Most (63.8%) had a single pathology. From the single pathology category, cervical spine spondylosis was most common (34.1%) followed by disc herniations (6.6%). Only a few participants (9.9%) presented with multiple cervical spine pathologies.

Table 3 presents data regarding cervical spine level involvement in relation to participants' occupation. Most only had pathology at a single level of the cervical spine (46.17%), with the C5 level commonly affected (15.38%). In the double pathologies category, C4/C5 was most affected (13.15%); and in the multiple category C2/C4/C6 were most often affected (7.70%). There were statistically significant relationships between the participants' occupation and cervical spine level involvement (Table 3). For the professional participants (n = 34) statistically significant relationships were found for sin-

Table 2. Frequency and percentage distribution of cervical spine pathologies

S/N	CERVICAL PATHOLOGIES	FREQUENCY (N)	PERCENTAGE (%)
a)	Single pathology		
	Spondylosis	31	34.1
	Disc herniations	6	6.6
	Exit nerve root compression	3	3.3
	Facetal arthrosis	2	2.2
	Fat marrow changes	1	1.1
	Ligamentum flava hypertrophy	1	1.1
	Narrowing of neural foramina	2	2.2
	Osteoarthrosis	1	1.1
	Osteomyelitis	5	5.5
	Radiculopathy	1	1.1
	Spinal canal stenosis	5	5.5
b)	Double pathology		
	Degenerative disc disease, spinal canal stenosis	2	2.2
	Degenerative disc disease, spinal stenosis	3	3.3
	Exit nerve root compression, spinal canal stenosis	6	6.6
	Osteoarthrosis, spondylosis	2	2.2
	Radiculopathy, spondylosis	6	6.6
	Spinal canal stenosis, exit nerve root compression	3	3.3
	Spondylosis, fat marrow changes	1	1.1
c)	Multiple pathologies		
	Disc herniation, spinal canal stenosis, exit nerve root compression	9	9.9
	Total	91	100

Table 3. The relationship between spinal levels of involvement and the participants' occupation

S/N	SPINAL LEVELS	FREQUENCY N (%)	OCCUPATION			
			PROFESSIONALS		NON-PROFESSIONALS	
			χ^2	p	χ^2	p
a)	Single		4.61	0.024	3.62	0.031
	C1	2(2.20)				
	C2	4(4.40)				
	C3	6(6.60)				
	C4	13(14.29)				
	C5	14(15.38)				
	C6	2(2.20)				
	C7	1(1.10)				
b)	Double		2.34	0.091	4.81	0.001
	C1/C2	6(6.60)				
	C2/C3	10(10.98)				
	C4/C5	12(13.15)				
	C5/C6	5(5.49)				
	C7/T1	1(1.10)				
c)	Multiple		2.02	0.031	3.76	0.021
	C2/C3/C5	5(5.49)				
	C2/C4/C6	7(7.70)				
	C3/C5/C7	3(3.30)				
	Total	91(100%)				

Table 4. Frequency distributions of Nurick grades for gender, age group and durations of pathology

S/N	VARIABLES	NURICK GRADES CLASSIFICATIONS					TOTAL
		0	I	II	III	IV	
a)	Gender						
	Male	8(8.79%)	28(30.77%)	17(19.14%)	4(4.4%)	1(1.1%)	58(63.74%)
	Female	2(2.2%)	12(13.83%)	13(13.83%)	5(5.49%)	1(1.1%)	33(36.26%)
	Total	10(10.99%)	40(43.96%)	30(32.97%)	9(9.89%)	2(2.2%)	91(100%)
b)	Age group (yrs)						
	< 20		4(4.92%)	2(2.2%)	1(1.1%)		7(7.69%)
	20-39	8(8.79%)	20(21.79%)	8(8.79%)	2(2.2%)		38(41.76%)
	40-59	2(2.2%)	8(8.79%)	18(19.78%)	4(4.4%)	1(1.1%)	33(36.26%)
	60 years and above		8(8.79%)	2(2.2%)	2(2.2%)	1(1.1%)	13(14.29%)
	Total	10(10.99%)	40(43.96%)	30(32.97%)	9(9.89%)	2(2.2%)	91(100%)
c)	Duration of pathology						
	< 6months	6(6.5%)	32(35.17%)	14(15.39%)	3(3.3%)		55(60.44%)
	6 months – 1 year		8(8.79%)	13(13.83)	5(5.49%)		26(28.57%)
	1 year – 2 years	3(3.3%)		1(1.1%)		2(2.2%)	7(7.69%)
	2 years – 3 years	1(1.1%)		1(2.2%)			3(3.3%)
	Total	10(10.99%)	40(43.96%)	30(32.97%)	9(9.8%)	2(2.2%)	91(100%)

Table 5. Relationships between Nurick grading scores and gender, age and duration of pathology

NURICK GRADING SCORES	GENDER		AGE GROUP		DURATION OF PATHOLOGY	
	χ^2	p	χ^2	p	χ^2	p
0	30.9	0.073	31.2	0.012	38.4	0.002
I	26.3	0.134	36.4	0.941	33.8	0.001
II	24.5	0.962	56.7	0.651	34.8	0.003
III	36.4	0.001	34.3	0.023	54.6	0.001
IV	18.6	0.086	17.6	0.091	16.7	0.001

gle ($\chi^2 = 4.61$, $p = 0.024$) and multiple ($\chi^2 = 2.02$, $p = 0.031$) levels of spinal involvement. In terms of the non-professional participants ($n = 57$), statistically significant relationships were found for single ($\chi^2 = 3.62$, $p = 0.031$), double ($\chi^2 = 4.81$, $p = 0.001$) and multiple ($\chi^2 = 3.76$, $p = 0.021$).

Table 4 presents the distribution frequencies of the Nurick grading scores in relation to the participants' socio-demographic characteristics. The majority of participants had a Nurick grade I disability (43.96%), were male (63.74%), in the 20-39 years age group (41.76%) and had a pathology duration of less than six months (60.44%). In contrast, the least number of participants had a Nurick grade IV disability (2.2%), were < 20 years of age (7.69%) and had a pathology duration between two and three years (3.3%).

Chi-square test results for the relationship between the Nurick grading scores and the demographic variables are presented in Table 5. Statistically significant relationships were found between Nurick grade 0 scores and age ($p = 0.012$), Nurick grade III scores and gender ($p = 0.001$) and age ($p = 0.023$). Statistically significant relationships between all five Nurick grade scores and duration of pathology were also found (0: $p = 0.002$, I: $p = 0.001$, II: $p = 0.003$, III: $p = 0.001$, IV: $p = 0.001$).

DISCUSSION

In terms of inclusion criteria this study comprised ninety-one ($n=91$) participants. The majority with cervical spine pathologies were males (Table 1). Male preponderance in this study is similar to findings of other studies conducted.^[2,3,7,13-20] A plausible explanation for male preponderance in our study could be that males account for greater numbers of the workforce in our societies and are commonly exposed to spinal pathology predisposing factors such as strenuous jobs. However, other studies^[21-25] found cervical spine pathologies to be more prevalent among females. This difference relative to our study's findings may be ascribed to the cited studies^[21-25] different sample sizes and methods used.

The age group commonly affected with spinal pathologies was evaluated and the results revealed that the majority of the participants with cervical spine pathologies were commonly found within the age group of 20-39 years (Table 1). The mean age of the participants in this study of 52.16 years with a standard deviation of 13.2 years is similar to

the mean ages obtained in previous studies.^[3,13] The preponderance of cervical spine pathologies in the 20 to 39 years age group in our study could be ascribed to the fact that people of these ages are the most active in our context and are usually involved in strenuous jobs and social activities that often predispose them to develop spinal pathologies. The findings of our study concerning the common age group and mean age affected by cervical spine pathologies are inconsistent with the findings of reported studies in the literature.^[2,7,21,26] The discrepancies identified in our findings could be ascribed to the different nature, sample sizes and geographical variations of the cited studies.

The majority of participants had a single pathology affecting the cervical spine with spondylosis as the most common pathological finding (Table 2). This is a similar findings compared with other studies.^[7,13] Spondylosis, as the most common pathology in this study, is contrary to the findings of the studies conducted by Maaji et al.^[2] and Karki et al.^[27] Such differences in the cited findings versus our findings may be because of different sample sizes and sample characteristics, as well as the contexts in which the cited studies were conducted.

The majority of participants in our study had a single level of spinal involvement with C5 commonly affected (Table 3). This is in keeping with the findings of Karki et al.^[27] Olorinoye-Akorede^[3] found C3/C4 to be more commonly affected. Other authors^[28] also reported lower cervical spine levels of involvement (C5-C7). They attributed it to the fact that the spinal cord accommodates three-quarters of the spinal canal at these levels and the vulnerable blood supply to this segment of the cord.^[28] The relationship between the participants' occupations and the levels of spinal involvement was determined using the chi-square test (Table 3). There were statistically significant relationships between the professional participants with a single ($p = 0.024$) and multiple ($p = 0.031$) levels of spinal involvement. This could be ascribed to the nature of professionals' occupations (e.g., teachers, lawyers, accountants, medical doctors) involved in strenuous activities could be ascribed to the nature of their duties (e.g., writing often with their necks in a flexed position). The nature of the professionals' duties is a predisposing factor to the levels of cervical spine pathologies involvement based on the outcome of this study. There were also statistically significant relationships between levels of cervical spine involvement, single ($p = 0.031$), double ($p =$

0.001), and multiple ($p = 0.021$) and the non-professional category of participants. Non-professionals (e.g., masons, mechanics and carpenters) are usually involved in work activities of lifting and carrying of heavy objects and having their necks in flexed positions for long periods of time during their work, which predisposes them to multiple levels of spinal involvement.

The degree of disabilities of the participants was determined using the Nurick grading system (Table 4). Most had a Nurick grade I score (43.96%), which means that they had signs or symptoms of spinal cord disease but no difficulty in walking. In contrast, two of the participants ($n = 2$) presented with Nurick grade IV, which means they were able to walk with the aid of someone or using a walking frame. This finding is dissimilar to other studies.^[3,20] The cited authors found Nurick grades III and IV and Nurick grades II, respectively, to be more common. This could be ascribed to the different scope and sample characteristics of their studies compared to our study.

The majority of the Nurick grade scores showed no statistically significant relationships with patients' age and gender. A statistically significant relationship was found for Nurick grade 0 scores relative to age ($\chi^2 = 31.2$, $p = 0.012$) (Table 5). Statistically significant relationships were also found for Nurick grade III scores relative to gender ($\chi^2 = 36.4$, $p = 0.001$) and age ($\chi^2 = 34.3$, $p = 0.023$) (Table 5). This means participants with signs or symptoms of root involvement, but without evidence of spinal cord disease were associated with their age and gender. There were statistically significant relationships between all the Nurick grade scores and the duration of the pathology (Table 5). This implies that the nature of disabilities exhibited by the participants with cervical spine pathologies was greatly affected by the length of time of their cervical pathologies.

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LIMITATIONS

The small sample size may limit the generalisability of the findings. This study focuses more on degenerative spinal changes and may not be a true representation of all the cervical spine pathologies present in the study population.

CONCLUSIONS

Cervical spine pathologies are numerous and are common among 20- to 39-year-old males. Cervical spondylosis, with a predilection for C5 vertebra, was the most common finding. Nurick grade I disability was the most common in terms of the Nurick grading scores of disabilities. Statistically significant relationships exist between Nurick grade 0 scores and age, Nurick grade III scores and age and gender, and Nurick grade 0 to IV and duration of the pathology. The findings of this study could be considered for optimisation of patients' preparation and care by radiographers and radiologists during spinal MRI investigations. Further studies are recommended with larger sample sizes for generalisability of the findings of this study.

CONFLICT OF INTEREST

None.

AUTHORS' CONTRIBUTIONS

MPO was the main researcher, drafted the manuscript and captured the data. MPO, ACU and COA analysed the results. ACU and COA gave recommendations on the review of the literature and were critical readers of the work. All authors read and approved the final manuscript.

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