THE PREVALENCE AND ASSOCIATED FACTORS OF LUMBOSACRAL SPONDYLOLISTHESIS AMONG PATIENTS WITH LOW BACK PAIN REFERRED TO MNH FOR A LUMBOSACRAL MRI BETWEEN 2021 AND 2023

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By

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A Dissertation Submitted in (Partial) Fulfilment of the Requirement for the Degree of Master of Medicine (Radiology) of The Muhimbili University of Health and Allied Sciences

Ocotober 2024

CERTIFICATION

The undersigned certify that they have read and hereby recommend for examination by the Muhimbili University of Health and Allied Sciences a dissertation entitled ***"The Prevalence And Associated Factors of Lumbosacral Spondylolisthesis Among Patients With Low Back Pain Referred to MNH For A Lumbosacral MRI Between 2021 And 2023",*** in (partial) fulfilment of the requirements for the degree of Master of Medicine (Radiology) of Muhimbili University of Health and Allied Sciences.

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DECLARATION AND COPYRIGHT

I, **Saeed Afshar**, declare that this dissertation is my original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature ……. Date …….

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DEDICATION

To my dearest love, My family

In every step of my academic journey, you have been my steadfast anchor, my guiding light, and my solid foundation through every difficulty. Your love, patience, and constancy have been the pillars upon which I've built my academic endeavours.

As I reflect on your sacrifices and unwavering faith in me, I extend my deepest gratitude to you. I dedicate this dissertation to you, my dearest, as a testament to our love and your tireless support.

Forever devoted to you,

Amor vincit omnia.

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ABBREVIATIONS

BMI	Body Mass Index
CT	Computer Tomography
MIP	Maximum Intensity Projections
MNH	Muhimbili National Hospital
MPR	Multi Planar Reformats
MRI	Magnetic Resonance Imaging
SPL	Spondylolisthesis
MUHAS	Muhimbili University of Health and Allied Sciences
DJD	Degenerative Joint Disease
IRB	Institutional Review Board
RA	Research Assistant
PI	Principal Investigator
AP	Anteroposterior
BMD	Bone Marrow Density
SPSS	Statistical package of social science
DS	Degenerative Spondylolisthesis
LSA	Lumbosacral Angle

DEFINITIONS OF KEYWORDS

Spondylolisthesis:	Spondylolisthesis is the slippage of one vertebral body with respect to the adjacent vertebral body causing mechanical or radicular symptoms or pain (1–3).
Degenerative Joint Disease:	Degenerative joint disease, also known as osteoarthritis (OA), is a common “wear and tear” disease (1–3).
MRI scan:	Magnetic resonance imaging (**MRI**) is a type of **s**can that uses strong magnetic fields and radio waves to produce detailed images of the inside of the body.
Spondylolysis:	It occurs when a crack or stress fracture develops through the pars interarticularis, which is the weakest portion of the vertebra (1-3)

ABSTRACT

Background: A displacement of the vertebral body relative to the surrounding vertebral bodies is referred to as spondylolisthesis. It is estimated that around 25% of individuals with spondylolisthesis experience at least one episode of significant back pain at some point. Even though spondylolisthesis could be frequent in Tanzania, its prevalence and severity are still undetermined.

Main objective: To determine the prevalence and associated factors of incidental lumbosacral spondylolisthesis among patients with lower back pain referred to Muhimbili National Hospital (MNH) for a lumbosacral magnetic resonance imaging (MRI) between 2021 and 2023.

Materials & Methods: Adult patients referred for a lumbar MRI imaging at MNH between 2021 and 2023 were the subjects of **a single-centre retrospective cross-sectional descriptive investigation**. The researchers used a checklist to collect information about the patient's demographics and MRI findings. Information was collected from patient files and electronic records, and the collected data was managed and analyzed using SPSS version 26. Frequencies and percentages summarise categorical data, while means and standard deviation summarise continuous data**. Cross-tabulations and Fisher's exact tests were employed to assess the associations, with a significance threshold of $p < 0.05$.**

Results: A total of 247 participants were analysed; females were 136 (55.1%) and males 111 (44.9%).The mean age for spondylolisthesis patients was 63.12 (±10.95) years, and 2/3 (66%) were over 50. The prevalence of incidental lumbosacral spondylolisthesis was 50 (20.2%). Females had a higher 33 (24.2%) proportion of spondylolisthesis than males 17(15.3%). Grade I spondylolisthesis and L5-S1 level account for 68% and 64% of all lumbosacral spondylolisthesis cases, respectively.

Conclusion: The findings of our study suggest relatively higher prevalence of lumbar spondylolisthesis (20.2%). Spondylolisthesis is more prevalent in patients with lower back pain over 60 years, so it should not be ignored in this age group.

Keywords: Low back pain, MRI, Spondylolisthesis

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

Spondylolisthesis is a vertebral body moving away from or towards its neighbouring vertebra(1,2) The name is derived from the Greek words spondyl and olio-thesis, which respectively indicate vertebrae and dislocation (1). Spondylolisthesis prevalence varies with age and sex. According to reports, the prevalence rises from 5% to 10% among adults; however, based on countries, it was 3%–31% (1). Women are more affected in adulthood than men are, with men being more affected in childhood (1, 2, 4).

Etiological classification of spondylolisthesis

It is estimated that around 25% of the individuals with spondylolisthesis experience at least one episode of significant back pain at some point in their life (5). Spondylolisthesis can be classified as either isthmic or degenerative in terms of its etiology (2). Spondylolysis, a birth abnormality, or a post-traumatic break in the pars interarticularis cause isthmic spondylolisthesis. Children and adolescents are the most common age groups to experience this form of spondylolisthesis. Additionally, spondylolytic spondylolisthesis is frequently seen in athletes whose sports require repeated spine flexion, extension, and truncal rotation (6). The pars interarticularis suffers stress damage as a result of these movements (6**).**The two main causes of spondylolisthesis are "degenerative," which is related to degeneration of which the posterior facet joints and/or intervertebral disc, and "isthmic," is related to spondylolysis (7). Degenerative spondylolisthesis primarily affects the (L4-L5) level, (L5-S1) as opposed to isthmic spondylolisthesis, which most usually affects the lumbosacral level (7).Degenerative conditions like degenerative arthritis or disc space problems are the main causes of degenerative spondylolisthesis. As a result, it is frequently seen in people over 60. Research has also revealed that women are four times more likely than men to get degenerative spondylolisthesis. This can be explained by the fact that women have a lower threshold for back pain and women are more likely to seek pain treatment than men;

moreover,the association between menopause and degenerative spondylolisthesis was proposed with consideration of the higher incidence of degenerative spondylolisthesis in postmenopausal women than in age-matched men (4). Spondylolisthesis is also linked to degeneration of facet joints, decreased stabilizer muscle thickness both at rest and during contraction, and excessive usage of stabilizing muscles in adults and the elderly (8).

Spondylolisthesis grades

Meyerding classification system can be used to grade spondylolisthesis. This approach uses standing, neutral lateral radiographs of the lumbar spine to classify the severity or degree of vertebral body slip into five categories.(1) Slippage in Grade I ranges from 0% to 25%, in Grade II from 26% to 50%, in Grade III from 51% to 75%, in Grade IV from 76% to 100%, and in Grade V from greater than 100%.(1) The grades can also be divided into low and high grades, with grades I and II falling into the low grades group and grades III, IV, and V into the high grades category.(1)This classification was originally developed for anterolisthesis but can be adapted for retrolisthesis, and some publications have used the same .Below is a summary of grades according to the Meyerding's classification system**(Table, Figure 1)** (6).

Table 1: The Meyerding Classification System of Spondylolisthesis

Grade I	0 - 25%	Low Grade
Grade II	26-50%	
Grade III	51-75%	High Grade
Grade IV	76-100%	
Grade V (spondyloptosis)	>100%	

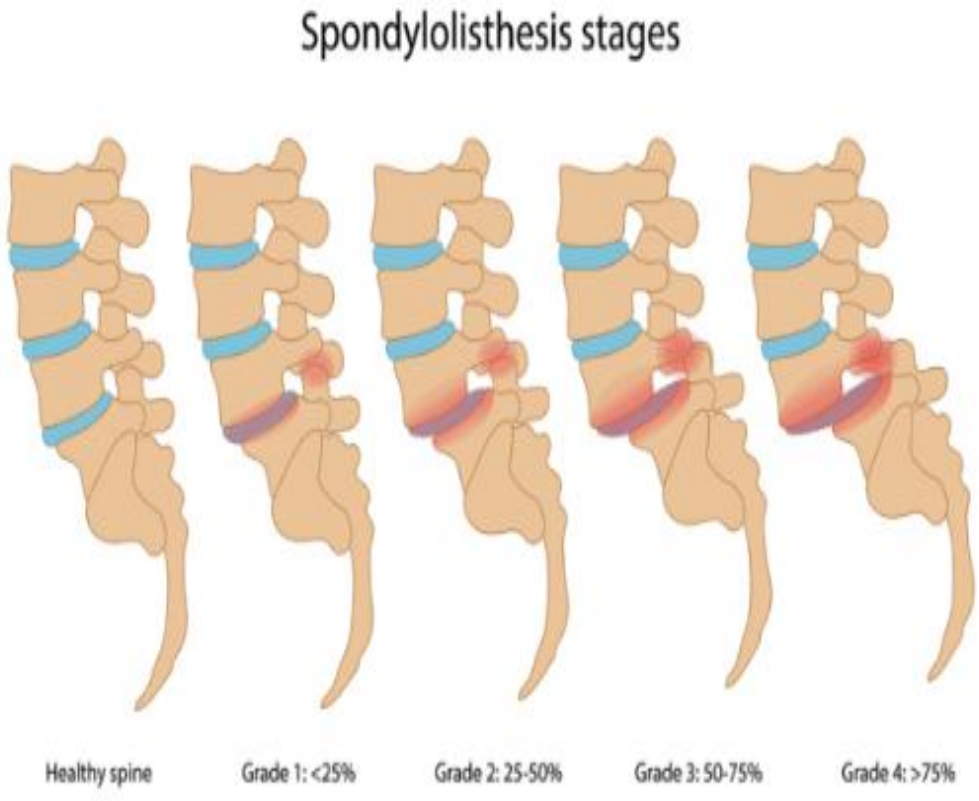


Figure 1: A pictogram representation of the Meyerding classification

Diagnostic investigations of spondylolisthesis

There are a number of imaging modalities that can be used to study spondylolisthesis, including X-ray imaging, CT scans, and MRI tests. (9), but X-ray imaging and MRI (which took the place of CT imaging) are the most often employed modalities (9). Static or dynamic approaches may be used in X-ray imaging. When a translation of more than 3 millimeters in the sagittal plane is noticed, static X-ray imaging is the gold standard for the diagnosis of spondylolisthesis.(10) This score is regarded as the "macro instability" cutoff .flexion/extension that is dynamic When a rotational movement of larger than 10° or a

translation of more than 3mm in the sagittal plane compared to static X-rays is seen. MRI is a popular noninvasive diagnostic method for assessing a variety of lumbar spine illnesses. A bulging disc, thickened ligamentum flavum, and/or narrowed intervertebral foramen are just a few examples of the pathologic features that can be difficult to detect with conventional MRI because it is typically done with patients in the supine position.(13,14) Therefore, there is a chance that traditional MRI was significantly underestimate the severity of pathologic features in the lumbar spine.(13–16)To imitate physiologically appropriate weight-bearing conditions in the supine position, a system for performing axial loading of the lumbar spine with the patient in that position during MRI was designed.(13–16)

Despite these developments, it is still not apparent which diagnostic method is most effective for spondylolisthesis detection. Determining the prevalence of incidental lumbosacral spondylolisthesis among individuals with low back pain who are referred for a lumbar Spinal MRI and associated variables is the aim of this study.

1.2 PROBLEM STATEMENT

Lumbar spondylolisthesis presents a significant challenge in orthopaedics and neurosurgery due to its diverse clinical manifestations and substantial impact on patients'quality of life as one cause of low back pain. The clinical impact of lumbar spondylolisthesis encompasses a spectrum of symptoms ranging from localized lower back pain to severe neurological deficits. Patients commonly present with varying degrees of radiculopathy, neurogenic claudication, diminished lower extremity motor function, or even irreversible neurological sequelae, leading to substantial functional impairment and disability. In addition to the physical ramifications, lumbar spondylolisthesis exerts a considerable emotional and socioeconomic burden on affected individuals and healthcare systems. Chronic pain, limited mobility, and the uncertainty of future prognosis contribute to psychological distress and decreased overall well-being. Moreover, the financial strain associated with prolonged treatment, including surgical interventions and rehabilitative services, underscores the urgent need for effective management strategies that address both clinical symptoms and socioeconomic implications.

Therefore, there is a pressing need for comprehensive research endeavours aimed to elucidate the multifaceted clinical impact of lumbar spondylolisthesis, optimise diagnostic and treatment algorithms, and ultimately enhance the quality of care for affected individuals. By addressing these critical gaps in knowledge and practice, clinicians and radiologists can strive towards improved patient outcomes and a better understanding of this debilitating spinal condition. Despite the evidence of 40% agreement for low back pain and lumbar spondylolisthesis, very few studies on the prevalence of lumbar spondylolisthesis have been done in Tanzania.(3,25) .Therefore, This study aims to determine the prevalence of lumbar spondylolisthesis by MRI at differentiation of levels, grades, age, and sex in patients at Muhimbili National Hospital (MNH).

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1.3 CONCEPTUAL FRAMEWORK

Source: Author 2022

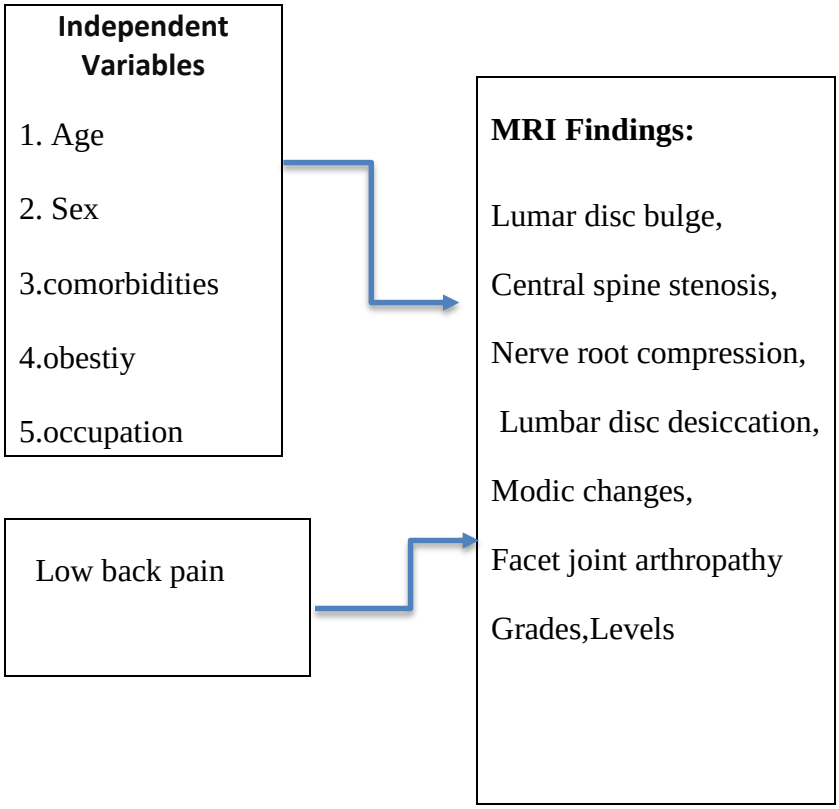


Figure 2: Conceptual framework

CONCEPTUAL FRAMEWORK CLARIFICATIONS

For all patients with back pain, a sociodemographic factor assessment was conducted using a data collection checklist, collecting the following information; age, sex. The prevalence of lumbosacral spondylosis was examined. For each patient's lumbosacral MRI, the cause of the back pain could fall into either spondylolisthesis or non-spondylolisthesis categories. For spondylolisthesis, the grading and levels were assessed. For patients with spondylolisthesis, its association with sociodemographic factors examined including age and sex. For patients with spondylolisthesis, causes of lower back pain such as Modic changes, disc degeneration, disc herniation, spinal canal stenosis, and nerve compression were also assessed.

Independent variables: Sociodemographic: Age, sex.

Dependent variables: Proportion of spondylolisthesis, Grades, levels

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1.4 RATIONALE

Spondylolisthesis is widely used in clinical decision- making in patients with low back pain; however, in Tanzania, there has not been a systematic study of the prevalence of spondylolisthesis among individuals with low back pain in the region yet.

This study addresses a critical gap in the existing literature by focusing on the prevalence of spondylolisthesis specifically within the context of patients presenting with low back pain (LBP) and referred for lumbar MRI at MNH. While studies on the prevalence of low back pain exist, there is a scarcity of data specifically examining the prevalence of spondylolisthesis among this population in Tanzania. Lumbosacral spondylolisthesis as a cause of low back pain could be frequent in Tanzania, but because of the multiplicity of the course and the management of patients, its prevalence and severity are still undetermined in our country. By narrowing the scope to patients undergoing lumbar MRI, this research offers a unique opportunity to explore more the relationship between low back pain and spondylolisthesis, providing valuable insights into the burden of this condition within the Tanzanian healthcare system

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1.5 RESEARCH QUESTION

What is the prevalence and associated factors of lumbosacral spondylolisthesis among patients with lower back pain referred to MNH for lumbosacral MRI?

1.5.1 BROAD OBJECTIVE

To determine prevalence of lumbar spondylolisthesis among patients with lower back pain referred to MNH for lumbosacral MRI between December 2021 and December 2023.

1.5.2 SPECIFIC OBJECTIVES

1. To determine the social demographic characteristics of patients with lower back pain referred to MNH for a lumbosacral MRI between December 2021 and December 2023.
2. To assess the prevalence of lumbosacral spondylolisthesis among patients with low back pain
3. To examine the association between social demographic characteristics and the prevalence of lumbosacral spondylolisthesis among patients with lower back pain
4. To classify the lumbosacral spondylolisthesis grades and levels among spondylolisthesis patients with low back pain.
5. To identify the associated MRI findings among lumbosacral spondylolisthesis patients with low back pain

1.6 LITERATURE REVIEW

1.6.1 The demographic distribution of lumbosacral spondylolisthesis and its association.

Spondylolisthesis has been shown to be higher in men than women with retrolisthesis (backward sliding) being predominant than anterolisthesis (forward sliding) On the other hand, anterolisthesis occurs commonly in women, mostly with increasing number of child birth.(5) Other studies have shown that the prevalence distribution for men and women are such that women are more prevalent than men by 1.3:1(5). Patient data showed that female patients more often received surgical treatment than male and preliminary data showed the ratio of female to male patients receiving surgical treatment, being around 2:1 in the elderly population. This can be explained by the fact that women have a lower threshold for back painand women are more likely to seek pain treatment than men.(4) The existing data also suggest that menopause may be a contributing factor for the accelerated development of degenerative splondylolisthesis in postmenopausal women. The association between menopause and degenerative spondylolisthesis was proposed with the consideration of the higher incidence of degenerative spondylolisthesis in postmenopausal women than in age-match men. Before the age of 50 years, degenerative spondylolisthesis is rare; and the prevalence of congenital spondylolisthesis is actually more common in men as discussed above . Low levels of female sex hormones inpostmenopausal women can be associated with accelerated degeneration of disc degeneration and disc spacenarrowing higher prevalence of osteoarthritis, including that of facet joints and general laxity of the paraspinal ligaments. It has been shown that hormone replacement treatment (HRT) preserves muscle strength in postmenopausal women They found bilateral oophorectomy with no hormonal replacement therapy was a risk factor for degenerative spondylolisthesis with an odds ratio of 7.5 (95% confidence interval) (4).

Age-specific prevalence of spondylolisthesis shows an increase with age in both men and women especially over 60 years(5).No concurrent association factor of smoking or alcoholism have been shown to have an effect with spondylolisthesis.(5)

1.6.2 The prevalence of lumbosacral spondylolithesis

There is much debate about the epidemiology of lumbar spondylolisthesis. In order to better understand the prevalence in the general population, J Wang et al conducted a systematic review. Their findings indicated that the prevalence is very age- and gender-specific(5). Both men and women start to have spondylolisthesis after the age of 50, with women experiencing it more quickly than men. The prevalence of spondylolisthesis varies between 4% and 25%, according to different authors in France, Denmark, Japan, and the USA but it would probably be underestimated in the black population due to anatomical differences, healthcare disparities and cultural and societal factors (7).

1.6.3 Grades and levels of lumbosacral spondylolisthesis

By using the Meyerding spondylolisthesis system, spondylolisthesis can be measured most effectively. Sections of the superior vertebra's anteroposterior (AP) diameter are separated, and slips of one, two, three, or four of these sections are given a grade of I through V, respectively.(6)The spondylolisthesis degree was measured as a percentage of the distance from the posterior border of the caudal vertebra to the posterior border of the rostral vertebra, normalized to the superior end plate diameter of the former(Figure 3). Below is a calculation formula for grades of spondylolisthesis according to the Meyerding's classification system.(6) Majority of the patients with spondylolisthesis had a Grade I slip (84.3%) (8) Spondylolisthesis occurs frequently at L5-S1 level (85-95%) and L4-5level (5-15%) (12).

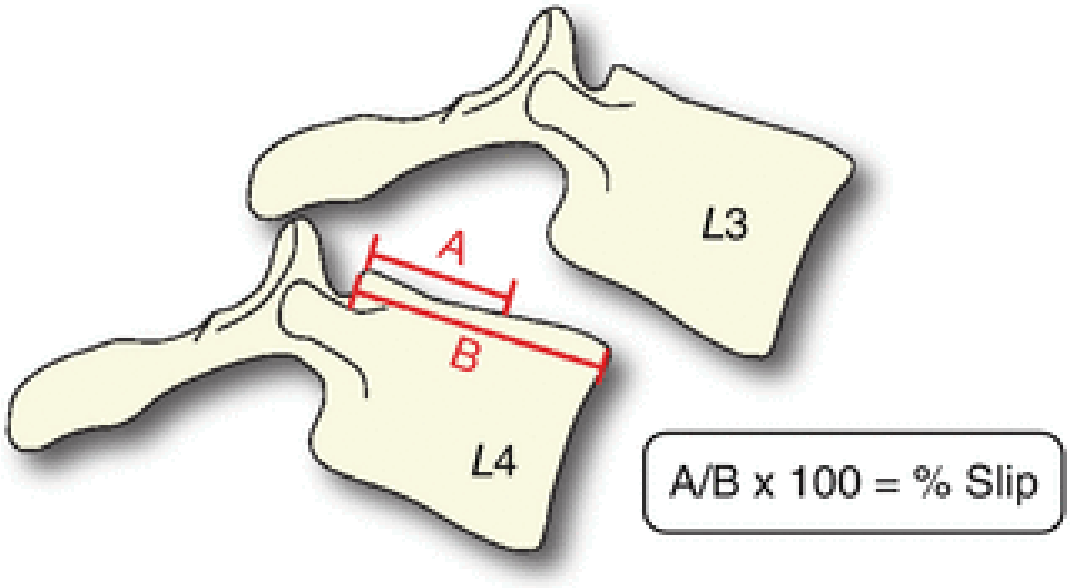


Figure 3: A pictogram representation of the degree of spondylolisthesis formula(12)

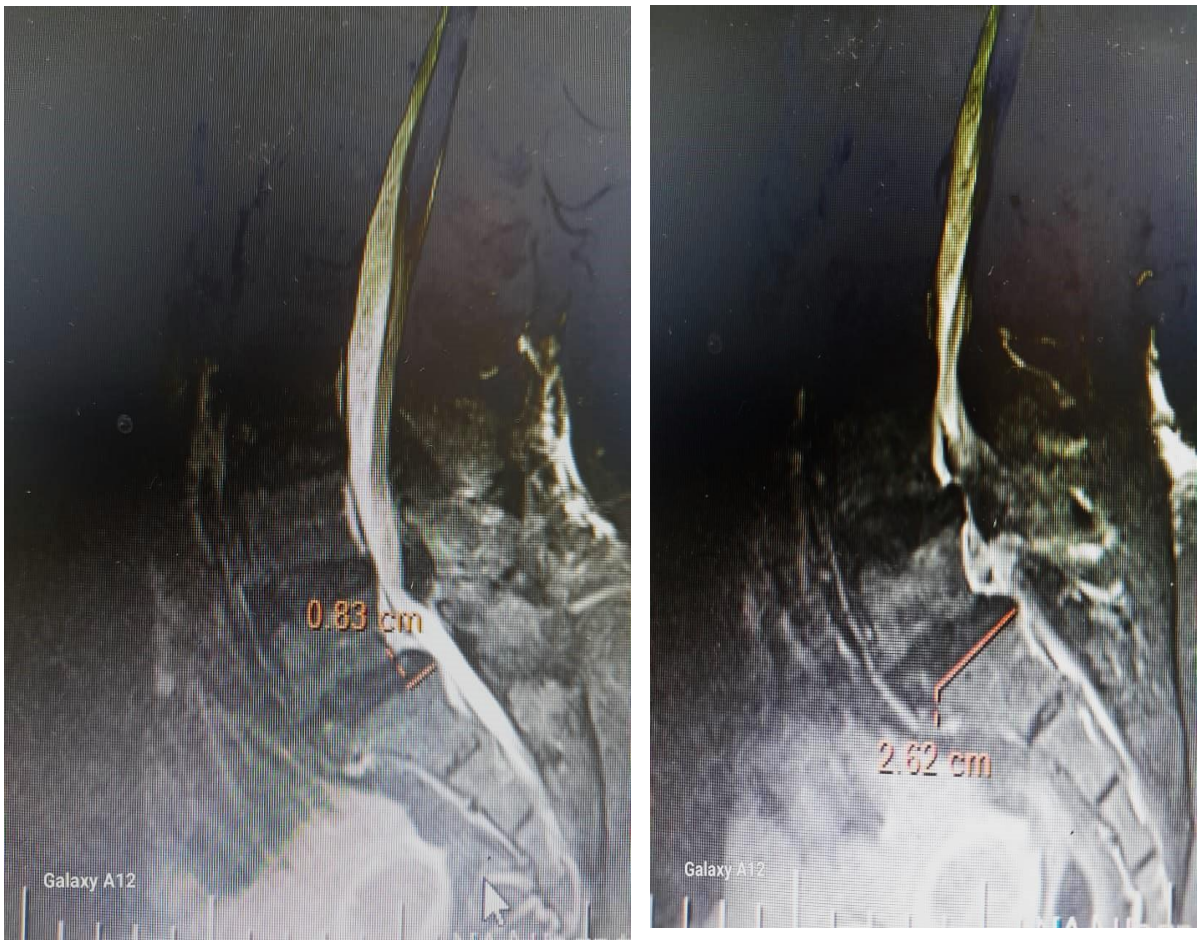


Figure 4: Representative lumbar sagittal T2-weighted magnetic resonance images demonstrating Grade 2, L5-S1 spondylolisthesis in a 68- year-old patient

(A/B × 100%; 0.83/2.62 x100%=31 %=grade II)

1.6.4 Associated lumbosacral MRI findings

MRI is a popular noninvasive diagnostic method for assessing a variety of lumbar spine illnesses.The MRI accomplishes two tasks. First, in cases of severe low back pain that may necessitate lumbar spinal fusion, an MRI can reveal adjacent segment degenerative disc desiccation. In this situation, preoperative discography might be advised to determine

whether neighboring degenerative discs are the source of the low back pain. Second, in the setting of lumbar radiculopathy, MRI can precisely depict the site and point of nerve root compression (11, 22). The clinical signs of radiculopathy and nerve root impingement have been strongly associated in studies. Because of the foramen's more horizontal orientation and the resulting bulging of the intervertebral disc into it, lytic spondylolisthesis frequently results in nerve root compression, which presses the exiting nerve root against the underside of the pedicle (23, 24). Very rarely, nerve root compression and a prolapsed disc may be to blame. Both radicular symptoms from the compression of the nerve root and neurogenic claudication from lumbar spinal canal stenosis brought on by the slippage, hypertrophy of the ligamentum flavum, and/or marginal bony osteophytes can occur in patients with isthmic and degenerative spondylolisthesis (22). The greater mobility of the slipped vertebra and the antero-inferior pressure on the disc may lead to increased pressure on the spine even if these symptoms are both neurogenic and radicular in origin(22). Large (>1.5 mm) facet joint effusions are highly predictive of degenerative spondylolisthesis at L4-L5, even in the absence of demonstrable anterolisthesis in the supine position. Only this indication may be visible on the supine MRI (9). X-ray imaging is the gold standard for the diagnosis of unstable spondylolisthesis.(11) The term "micro instability" is also used to describe this phenomenon.(11,19) If radiographic series is not diagnostic , limited thin section computed tomography (CT) technique will demonstrate both stress reactions and established defects, though establishing a diagnosis of spondylolysithesis as the cause of the low back pain. Thin-section CT, performed with a reverse gantry angle, is the best modality for defining the bony anatomy of spondylolisthesis.(12)

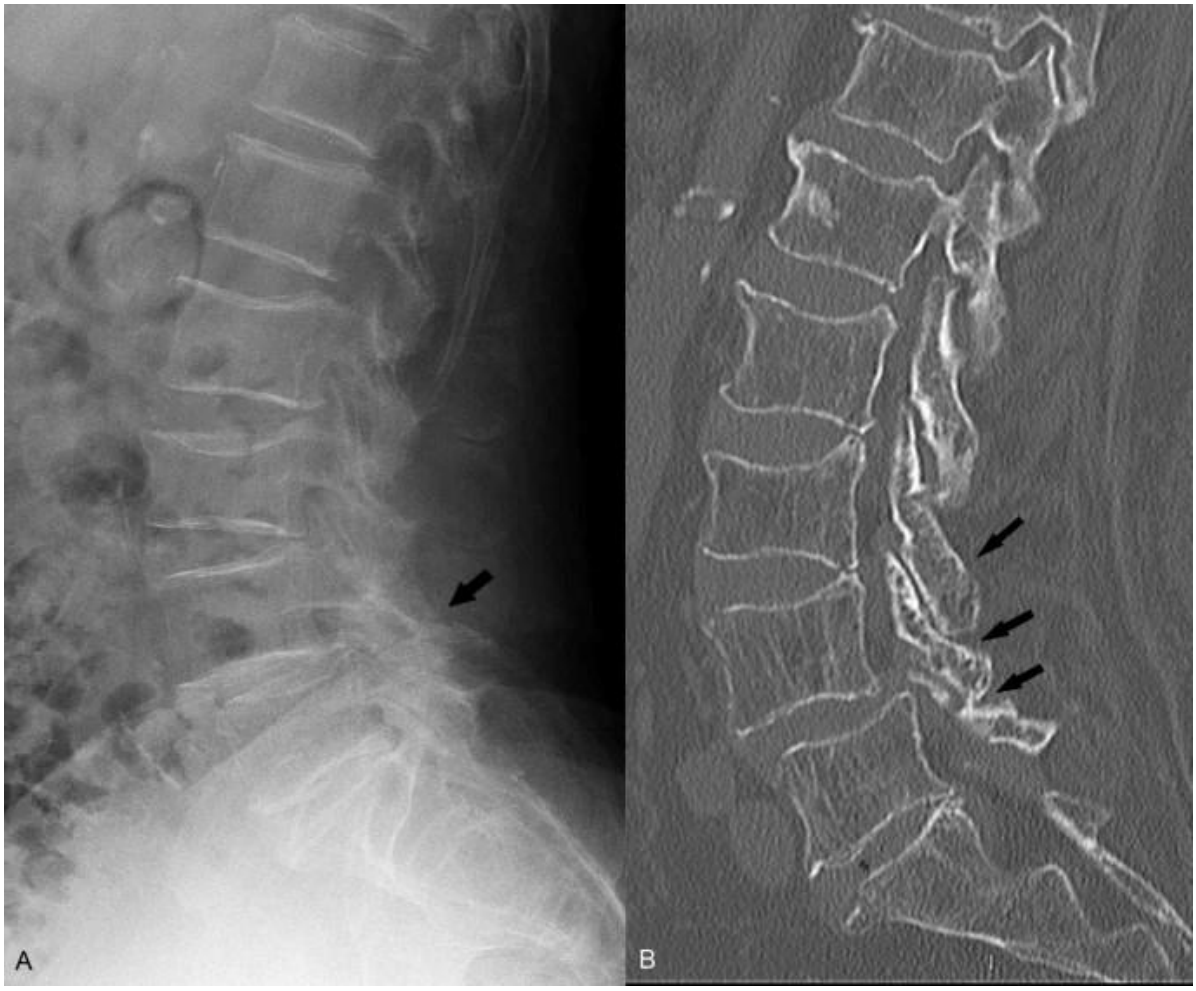


Figure 5 : A representative lateral radiograph (A) and sagittal reconstructed CT image (B) of this 78 year old woman shows a 10 % anterolisthesis of L4 associated with severe facet joint osteoarthrosis (arrows) ; Degenerative Lumbar Spondylolisthesis (DLS). In this patient, severe osteoporosis has led to a fragility fracture of the L3 vertebral body.

CHAPTER TWO

2.0 MATERIALS AND METHODS

2.1 STUDY DESIGN

The cross-sectional retrospective study design used secondary data of all adult patients referred for lumbosacral MRI imaging at MNH from December 11, 2021, to December 11, 2023, and for whom the necessary MRI data was accessible.

2.2 STUDY POPULATION, SAMPLE SIZE, AND SELECTION

2.2.1 Study population and study area.

The study involved documentation of the clinical and imaging findings of lumbosacral spondylolisthesis patients treated at MNH referred for a lumbosacral MRI scan between December 2021 and December 2023. MNH is located in Ilala municipality in Dar es Salaam. The hospital has a state-of-the-art MRI facility for all adult patients with low back pain referred to MNH, and around 154 monthly low back patients are received for a lumbosacral MRI.

2.2.2 Sampling and Sample Size

Sampling strategy

Systematic sampling techniques was employed to select the sample population to be included in the study. On average, 5 patients are referred to MNH for a lumbosacral MRI daily. This sums up to a total of 1825 patients for the whole year. The study collects 2 year-long data (2021 – 2023), the total study population is 3650 patients.

Estimated interval (k) = No. of study population (N)

No. of sample population (n)

$= 3650 / 241$

$k = 15.15 \approx 15$

A list of all patients who underwent lumbar MRI between December 2021 and December 2023 was obtained, arranged by date of procedure, and the first selection was picked at random from the list. Thereafter, we randomly choose a starting point from the list and then select every 15th person from that point onward for the study.

Sample size estimation

Using the sample size estimation formula shown below, the sample size for this study was determined.

$$N = \frac{Z^2 \times P(100-P)}{\varepsilon^2}$$

whereby

N - the predicted sample size

Z=1.96, which is a regular standard Z value related to the degree of significance 5%

In a study of **a Chinese population**, the prevalence of spondylolisthesis was determined to be P=Prevalence **17.26**%.**(13)**

The permitted margin of error is = 5%.

Adding the aforementioned values to the formula

$$N = \frac{1.96^2 \times \mathbf{17.26}\ (100 - \mathbf{17.26})}{5^2}$$

N = **219.45≈219** patients

A 10% contingency is planned to cover patients with data gaps.

= **219** + (10% x **219**)

= **240.9≈241**

N adjusted = **241** patients

The sample size was 241 patients

2.2.3 Inclusion criteria

All adult patients from 18years, diagnosed with low back pain referred to MNH for a lumbosacral MRI between December 2021 and December 2023.

All patients who underwent lumbar MRI with available data at MNH center

2.2.4. Exclusion criteria

Patients diagnosed with spondylolisthesis without available lumbosacral MRI data.

Patients with history of surgery, infectious diseases, major spine trauma, poor-quality imaging, and scoliosis.

2.3 VARIABLES

The following was variables used in the study.

Independent variables: Sociodemographic: Age, sex.

Dependent variables: Proportion of spondylolisthesis, Grades, levels.

2.4 DATA COLLECTION METHODS

Data from patients with low back pain were collected using a structured data collection form. The information was retrieved daily from the registries and the Picture Archiving and Communication System (PACS) for all patients admitted with low back pain and then lumbosacral MRI scan for diagnostic accuracy. The lumbosacral MRI findings were evaluated and compared in line with the study's objectives. The principal investigator perused all interpreted images; the images were then reviewed by registered radiologists with a minimum of 2 years of experience in musculoskeletal system imaging. Collected data were also entered into the SPSS software on a daily basis for cleaning and analysis.

2.5 INVESTIGATION TOOLS AND VALIDITY AND RELIABILITY ISSUES

2.5.1 Imaging platform

Lumbosacral MRI imaging at MNH, equipped with a 1.5 Tesla magnet machine made by Siemens in Munich, Germany. Skilled radiographers were responsible for overseeing the operation of the equipment in room number 15 at MNH.

2.5.2 Validity and reliability

To uphold the study's integrity, the data collection instruments underwent meticulous pretesting and necessary modifications, ensuring the adoption of robust data collection techniques. To ensure consistency and dependability, only comprehensive medical records were included in this study. The principal investigator evaluated all documented Lumbosacral MRI images, seeking input from an independent radiologist when uncertainties arose, guaranteeing the recording of the most precise reports.

2.5.3 Pretesting and pilot data tools

The Principal Investigator (PI) created a structured data collection tool and used it to gather data. The tool was divided into two main categories:

Section 1: Characteristics of the population

The information that was gathered is as follows: patient's age, gender.

Section 2: Radiological MRI Findings

In this section, findings from radiological investigations were collected. The type of investigation, the date of investigation, lumbosacral MRI findings, and spondylolisthesis grades and levels.

2.6 DATA ANALYSIS

The statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) version 26. Continuous data were summarised using measures of central tendency with their respective measures of dispersion. Categorical data were summarised using

frequencies and percentages. Fisher's exact tests were deployed to assess the level of association between individual independent categorical variables and the dependent categorical variable, and binary regression analysis was carried out to compute both the unadjusted and adjusted odds ratios for each independent variable. A significance level of less than 0.05 was considered statistically significant.

2.7 ETHICAL ISSUES

The Muhimbili University of Health and Allied Sciences Institutional Research and Publications Committee granted ethical clearance with reference number ' MUHAS- REC-06 -2023-1726 'to conduct the study. After that, approval to gather data for the study was requested and secured from the appropriate MNH authorities. No personally identifiable information, such as patient names, was collected from patients' records to protect confidentiality and privacy. A waiver was obtained from the IRB from obtaining informed consent from participants since the data was collected retrospectively and no patient was interviewed.

2.8 Dissemination plan

The dissertation will be submitted to MUHAS for a Master of Medicine in Radiology. Findings will be shared with key stakeholders, including MNH. Ownership will be jointly held by the university and the principal investigator. Significant discoveries will be published in reputable journals, facilitating broad access and promoting scientific progress

CHAPTER THREE

3.0 RESULTS

3.1 Sociodemographic characteristics of patients with low back pain at MNH.

A sample of 247 patients met the inclusion criteria and was included in the analysis; 136 (55.1%) were female, and 111 (44.9%) were male. (50%) the population was between 51-70 years and less than 10% under 30 years. The mean age for total participants was 55.02 (±15.75) years, whereas for spondylolisthesis patients, it was 63.12(±10.95) years. (Table2, 3)

Table 2: Sociodemographic characteristics of patients with low back pain referred to MNH for a Lumbosacral MRI (N=247)

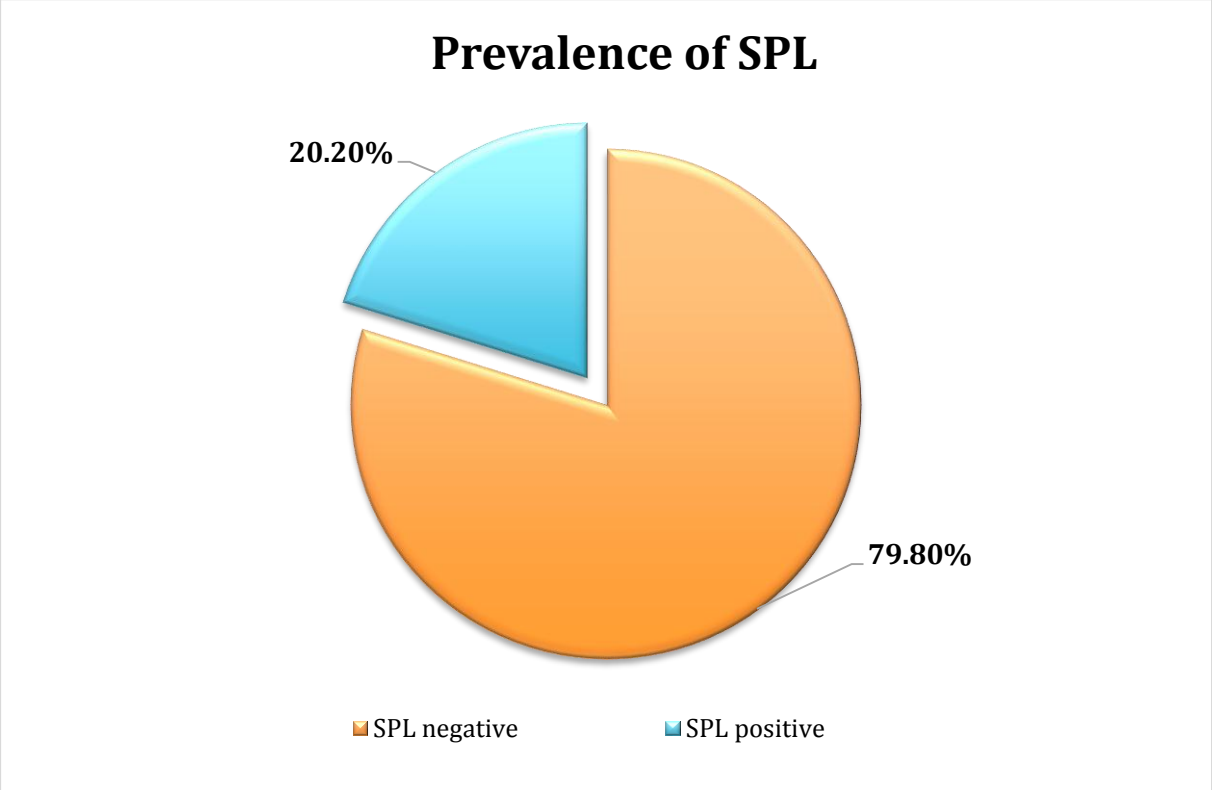
Variable	Frequency (N=247)	%
Patients age(years)		
<30	19	7.7
31-40	31	12.6
41-50	33	13.4
51-60	62	25.1
61-70	58	23.5
>71	44	17.8
Mean(±SD)	55.02(±15.75)	
Sex		
Female	136	55.1
Male	111	44.9
SPL		
SPL (Negative)	197	(79.8%)
SPL (Positive)	50	(20.2%)

(SPL=Spondylolisthesis) ;(Minimum age 18, Maximum age= 90)

3.2 Prevalence of lumbosacral spondylolisthesis.

Our study found that the prevalence of incidental lumbosacral spondylolisthesis was 50 (20.2%), among patients with low back pain referred to MNH for a lumbar MRI. The study participants 197 (79.8%) had no spondylolisthesis (**Figure 6)**

Figure 6: Chart representing the prevalence of lumbosacral SPL at MNH (N=247)



(SPL= Spondylolisthesis)

3.3 Association between the sociodemographic characteristics and the prevalence of Lumbosacral Spondylolisthesis.

Out of 247 participants, most patients with spondylolisthesis were over 60 years old, whereas those aged below 60 years were the minority (32.7% vs.11.6%,p=0.000) respectively. The association between age group variation and the prevalence of

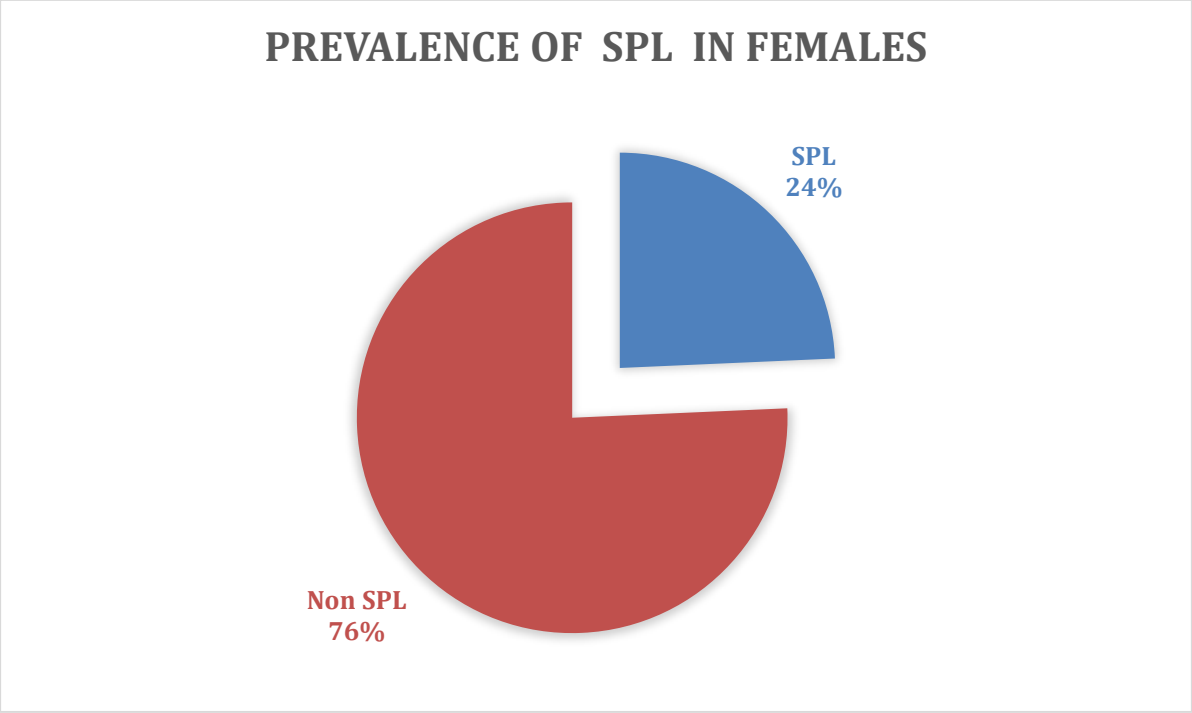
spondylolisthesis is statistically significant (p <0.05). Also, the relationships between patients' mean age and lumbosacral spondylolisthesis prevalence were significantly varied (p <0.05). Meanwhile, in this study, there was no significant association between gender and the prevalence of spondylolisthesis (p > 0.05). However, the study found that females had the highest proportion of SPL compared to males (24.3% vs.15.3%, p= 0.111). **(Figure 7,8).**

Table 3. Relationship between sociodemographic characteristics and the prevalence of lumbosacral SPL by sex and age distribution among patients with low back pain (N=247)

Variable	SPL (+ve) N=50	SPL (-ve) N=197	p-value
Age (years)			
Mean(±SD)	63.12±10.952	52.97±16.145	0.000*
Age >60 years			
Yes	33 (32.7)	68 (67.3)	0.000*
No	17 (11.6)	129 (88.4)	
Sex			
Female	33(24.3)	103(75.7)	0.111
Male	17(15.3)	94(84.7)	

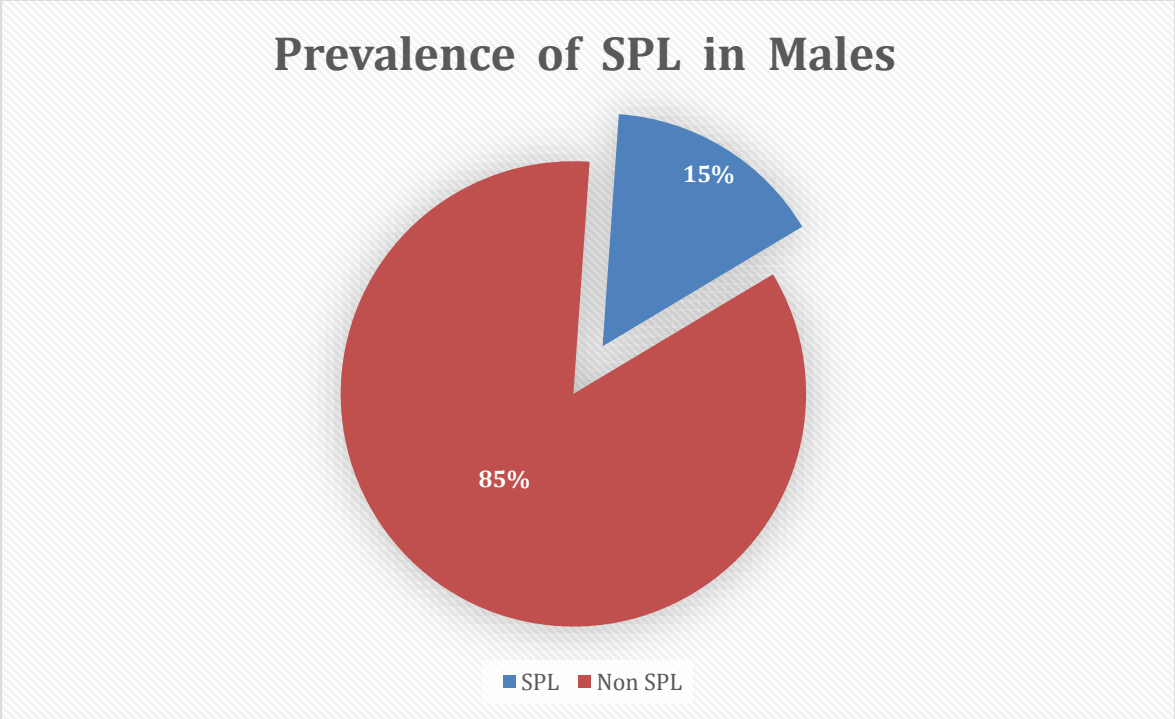
(SPL= Spondylolisthesis), * Statistically significant

Figure 7: Chart representing the prevalence of lumbosacral SPL in females (N=136)



(SPL=Spondylolisthesis)

Figure 8: Chart representing the prevalence of lumbosacral SPL in males (N=111)



(SPL=Spondylolisthesis)

3.4 Lumbosacral spondylolisthesis grades and levels.

According to Meyerding's Spondylolisthesis Classification System, most of the participants with spondylolisthesis in our study had grade I, 34(68%), and 16(32%) had grade II. The majority, 32(64%) had spondylolisthesis at the L5-S1 level, followed by the L4-L5 level in 18 patients (36 %). **(Table 4).**

Table 4: Characteristics of SPL patients based on Grades and Levels of lumbosacral spondylolisthesis at MNH (N=50)

Variable	Frequency (N=50)	%
Grades of spondylolisthesis		
I	34	68
II	16	32
Level of Lumbar spine		
L4-L5	18	36
L5-S1	32	64

(SPL=Spondylolisthesis); No patient was in grade III, IV, or V. No patient was in L1,2or 3 levels.

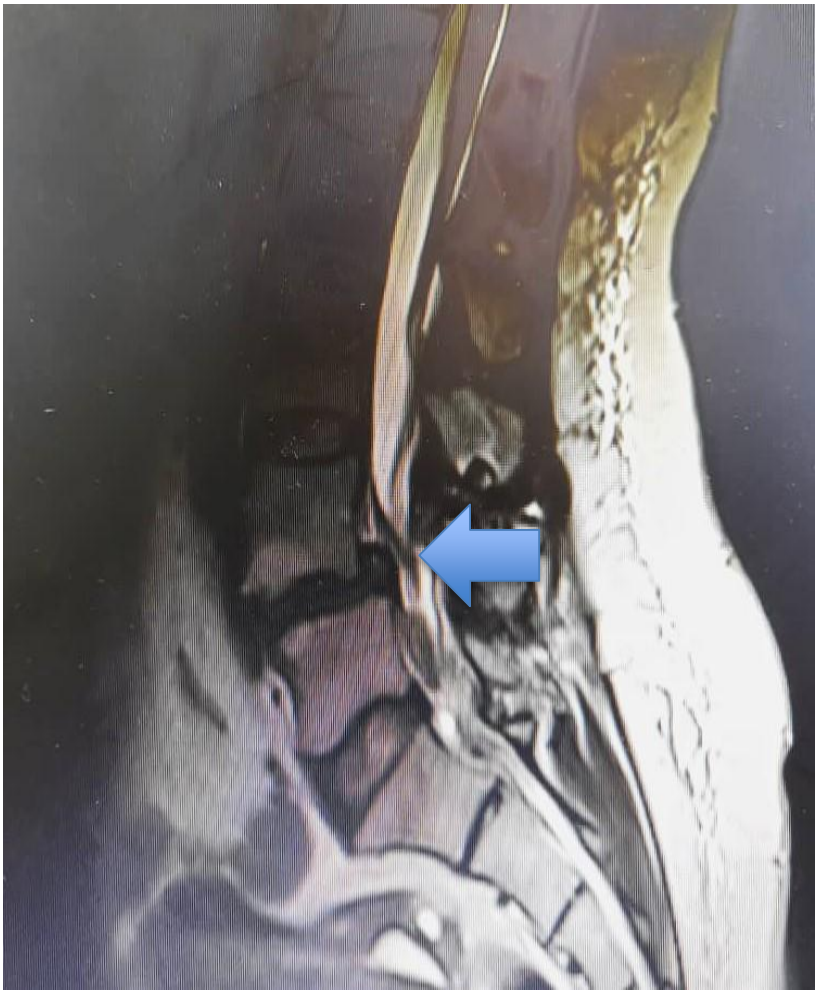


Figure 9: Representative lumbar sagittal T2-weighted magnetic resonance images demonstrating Grade 1, L5-S1 spondylolisthesis in a 60- year-old patient

3.5 Associated MRI findings with Lumbosacral Spondylolisthesis.

Figure 10 shows MRI-associated findings among spondylolisthesis patients, and lumbosacral disc bulge and nerve root compression were experienced by most of the study participants with spondylolisthesis (96% and 92%, respectively). Facet joint arthropathy (36%) and Modic changes (30%) were in the minority. **(Figure 10)**

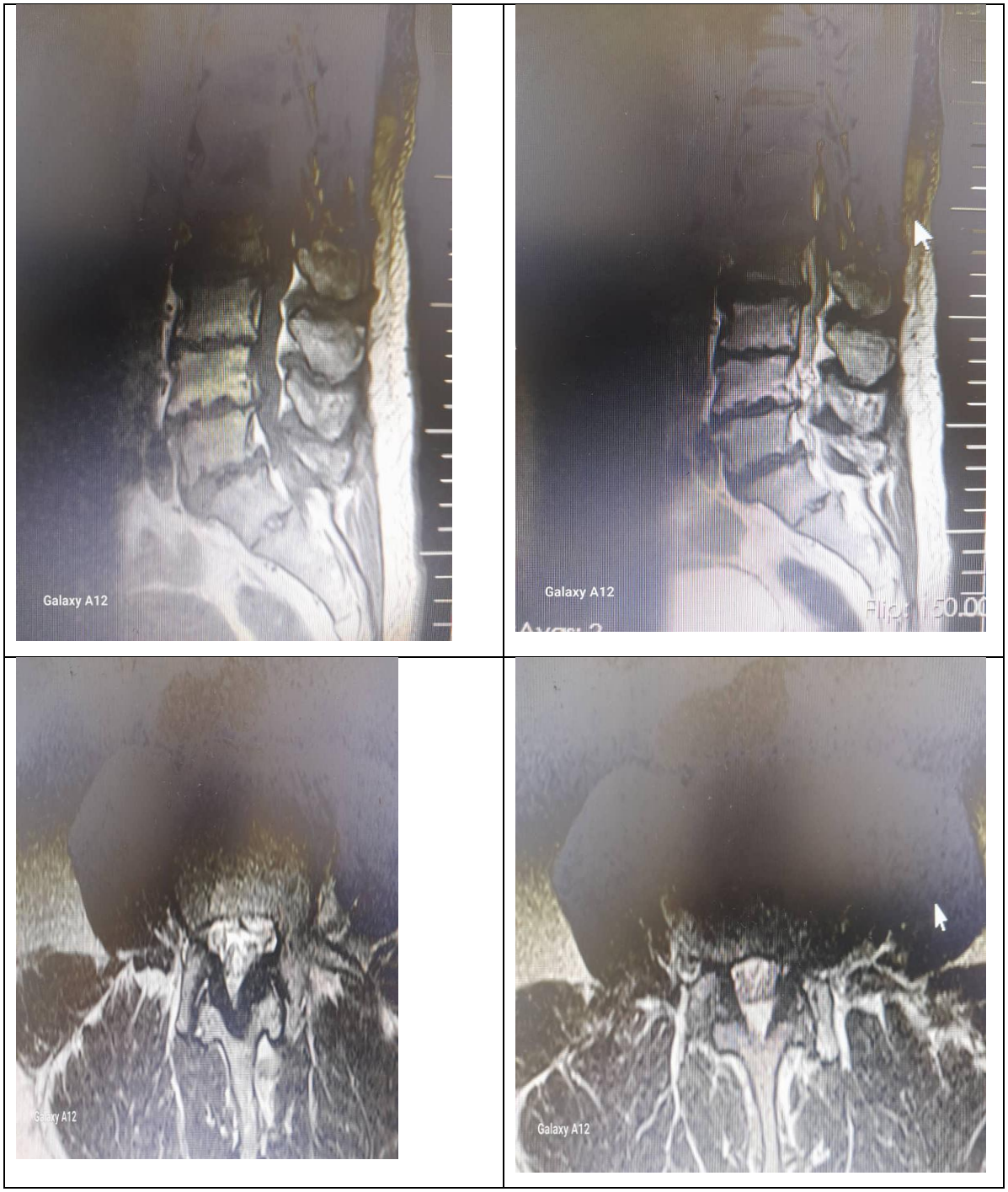
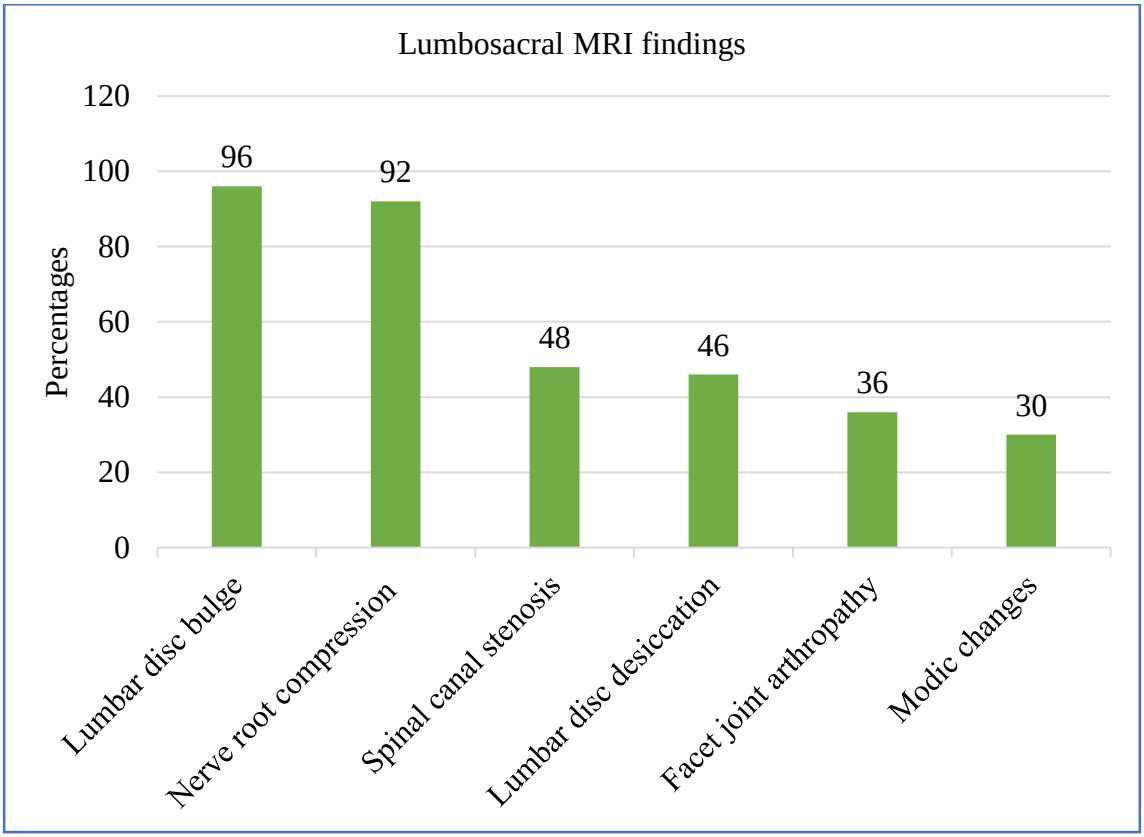


Figure 10: Lumbosacral MRI images in midsagittal and axial views in different sequences (T1WI, T2WI) Grade II at the level of L5-S1 spondylolisthesis in a 75-year-

old patient revealed multi-level disc desiccation, marginal osteophytes, endplate defect and sclerosis, hypertrophied ligamentum flavum, fact joint fluid sign, and multi-level circumferential disc bulge with bilateral neuroforamina stenosis.



(SPL=Spondylolisthesis)

Figure 11: Chart showing lumbosacral MRI findings in SPL patients at MNH (N=50)

CHAPTER FOUR

4.0 DISCUSSION

4.1 Discussion

The sociodemographic characteristics of the study participants revealed that 2/3 of study participants were over 50 years old, with a mean age of 55.02 (±15.75) years, while the mean age among spondylolisthesis patients was 63.12 (±10.95) years.

In the present study, the prevalence of incidental lumbosacral spondylolisthesis was 50 (20.2%) among patients with low back pain referred to MNH for lumbar MRI. There are no significant differences between our study data in comparison to the number of extensive population-based studies on old Chinese people that revealed a spondylolisthesis prevalence of (17.26%) (13), while the prevalence in previous studies based on regions or countries was 3%–31% (13). On the other hand, according to different authors in France, China, and Japan, the prevalence of spondylolisthesis varies between (4%) and (9%) (7). Some African authors found a spondylolisthesis rate of (9.93%) (3). These different results originated from various ethnic groups, study designs or methods of study, sample sizes, diagnostic criteria,genetic factors, and societal factors . Additionally, differences in healthcare access and reporting practices across studies contribute to the variability in the prevalence rates of spondylolisthesis.

Increasing age was significantly associated with the prevalence of incidental lumbosacral spondylolisthesis in our study ($P<0.05$). According to our research, most patients with spondylolisthesis were over 60 years old. In contrast, those aged below 60 years were the minority (32.7% vs. 11.6%), respectively, which shows that participants above 60 are at high risk of developing spondylolisthesis. Similar findings Zu-chang Li et al. were reported by the study done in the Beijing community, where for those aged above 60 years, the prevalence increased significantly to (28.57%) (13). In our research, spondylolisthesis is also age-specific, and patients are more likely to suffer from spondylolisthesis after 60.

Gender was not found to be associated with SPL in our study; however, the prevalence of spondylolisthesis differs depending on sex. The findings of our study show that fewer men (15.3%) experience spondylolisthesis than women (24.2%). The prevalence ratio of females to men (F:M) among spondylolisthesis patients was 1.9:1. In our research, women are more likely to suffer from spondylolisthesis than men; however, this association could not be proven with a statistical test ($P > 0.05$). One study of middle-aged people in the Beijing community (2021) showed that the prevalence of spondylolisthesis in males and females was 15.98% and 18.80%, respectively (13).Another study reported for elderly Chinese ($\geq$ 65 years, mean age: 72.5 years), extensive population-based studies Ms (Hong Kong, females: n = 2000) and Mr. (Hong Kong, males: n = 2000) showed degenerative spondylolisthesis prevalence was 25.0% in women and 19.1% in men, and the prevalence ratio of females to men (F: M) was 1.3:1 (1,5). Unlike shown in our study, others reported that the prevalence of spondylolisthesis in the Japanese was higher in males (7.9%) than females (3.9%) (15) or in the Copenhagen Osteoarthritis Study (1533 males, mean age of 62 years; 2618 females, mean age: 65 years), Jacobsen in 2008 reported the prevalence of spondylolisthesis was 2.7% for males and 8.4% for females, with an F: M ratio of 6.4:1(4). These different results could be the consequences of varying sample sizes, heterogeneous study populations, study methods, and different biological factors such as menopause, pain thresholds, and cultural influences.

In our study, spondylolisthesis most commonly occurred at the highest L5-S1 level (64%), followed by L4-5 (36%). Similar findings in one Chinese study reported that the number of the L_5-S_1 was highest among males and females, followed by L4-L5 (6). A systematic review also showed that spondylolisthesis occurs frequently at the L5-S1 level (85-95%), and the L4-5 level (5-15%) is the second most common location for spondylolisthesis (7). We did not come across other levels of spondylolisthesis, but L4/L5 and L5/S1 and retrolisthesis were in our study. Grade I lumbar spondylolisthesis accounts for (68%) of all lumbar spondylolisthesis cases in our study, followed by Grade II at (32%). We did not come across high grades of spondylolisthesis in our research. Similar findings were reported

by the North American Spine Society, where the prevalence of Grade I lumbar spondylolisthesis accounts for (75%) of all cases (21).

We found a high prevalence of abnormalities in the lumbosacral MRI of patients with spondylolisthesis with low back pain. The most common MRI findings among spondylolisthesis patients were lumbosacral disc bulge (96%), nerve root compression (92%), and central spinal canal stenosis (48%). Jasper W. van der Graaf et al. in 2022 also showed that lumbar spondylolisthesis has a 40% estimated agreement (EA) with low back pain, whereas other different studies showed no association with low back pain, specifically (26). Like in our study, they also found approximated similar findings in lumbosacral MRI in the patients with low back pain, such as Modic changes, disc degeneration, endplate defects, disc herniation, spinal canal stenosis, nerve compression, and muscle fat infiltration which all have the highest probability of being related to low back pain. These can be used to improve clinical decision-making for patients with low back pain based on an MRI. An evidence agreement of 67% or higher was considered sufficient evidence for a positive association between low back pain and an image feature; however, the clinical picture should be correlated with the MRI results and vice versa (25, 26).

4.2 Study limitation(s)

Missing information: A potential limitation of this study would be missing information in few patient records as it is a retrospective cross-sectional study. This was mitigated through data triangulation from different sources, including patient files and the hospital’s electronic database.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study included 50 patients diagnosed with lumbosacral spondylolisthesis, with a mean age of 63.12 years (± standard deviations of 10.95 years), The findings of this study suggest a prevalence of lumbosacral spondylolisthesis (20.2%). Notably, the majority affected were female (24.2%). However, no significant association was found between gender and the prevalence of lumbosacral spondylolisthesis. Our results suggest that many spondylolisthesis patients are over 60 years old both males and females.MRI imaging should not be ignored for patients over 60 years of age presenting with low back pain.

5.2 Recommendations

One population-based cohort study in the future may find associations between lumbosacral spondylolisthesis and other related risk factors in patients with low back pain.

5.3 Conflicts of interest

There are no conflicts of interest

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APPENDIXES

APPENDIX I: INVESTIGATION TOOLS

ENGLISH QUESTIONNAIRE

1.File number of participant ……

2. Age of Participant (in years)

Date of birth (in year) …… years

3. Gender a) Male

b) Female

2.MRI Findings:

a) Nerve root compression

b) disc degeneration

c) Modic changes

d) Spinal canal stenosis

e) Disc herniation

f) facet joint arthropathy

3. SPONDYLOLISTHESIS

1.Spondylolisthesis diagnosis

a) Yes

b) No

2.Spondylolisthesis Grades (%)

I (<25%)

II (26%-50%)

III (51%-75%)

IV (>76%)

V Complete listhesis

- 3. *Spondylolisthesis levels*
    - *L1-L2*
    - *L2-L3*
    - *L3-L4*
    - *L4-L5*
    - *L5-S1*

SPSS DATA ANALYSIS

APPENDIX II : ETHICAL CLEARANCE LETTERS

UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

OFFICE OF THE DIRECTOR – RESEARCH, PUBLICATIONS AND INNOVATION

Ref. No.DA.282/298/01.C/1726 Date: 12/06/2023

MUHAS-REC-06-2023-1726

Saeed Afshar

School of Medicine

MUHAS

RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED: PREVALENCE AND ASSOCIATED FACTORS OF LUMBAR SPONDYLOLISTHESIS AMONG PATIENTS WITH LOW BACK PAIN REFERRED TO MNH FOR LUMBAR SPINAL MRI BETWEEN 2019 – 2021

Reference is made to the above heading.

I am pleased to inform you that the Chairman has on behalf of the University Senate, approved ethical clearance of the above-mentioned study, on recommendations of the Senate Research and Publications Committee meeting accordance with MUHAS research policy and Tanzania regulations governing human and animal subjects research.

APPROVAL DATE: 12/06/2023
EXPIRATION DATE OF APPROVAL: 12/06/2024

STUDY DESCRIPTION:

Purpose:

The purpose of this cross sectional study is to determine the prevalence and associated factors of lumbar spondylolisthesis among patients with lower back pain already referred to Muhimbili National Hospital (MNH) for lumbar MRI for a duration of two years from 2019- 2021.

The approved protocol and procedures for this study is attached and stamped with this letter, and can be found in the link provided:

https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%2014781.pdf and in the MUHAS archives.

The PI is required to:

1. Submit bi-annual progress reports and final report upon completion of the study.
2. Report to the IRB any unanticipated problem involving risks to subjects or others including adverse events where applicable.
3. Apply for renewal of approval of ethical clearance one (1) month prior its expiration if the study is not completed at the end of this ethical approval. You may not continue with any research activity beyond the expiration date without the approval of the IRB. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.
4. Obtain IRB amendment (s) approval for any changes to any aspect of this study before they can be implemented.
5. Data security is ultimately the responsibility of the investigator.
6. Apply for and obtain data transfer agreement (DTA) from NIMR if data will be transferred to a foreign country.
7. Apply for and obtain material transfer agreement (MTA) from NIMR, if research materials (samples) will be shipped to a foreign country.
8. Any researcher, who contravenes or fail to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine as per NIMR Act No. 23 of 1979, PART III section 10 (2).
9. The PI is required to ensure that the findings of the study are disseminated to relevant stake holders.
10. PI is required to be versed with necessary laws and regulatory policies that govern research in Tanzania. Some guidance is available on our website https://drp.muhas.ac.tz/.

Dr. Kasusu Nyamuryekung'e
Chairman, MUHAS Research and Ethics Committee

Muhimbili University of Health and Allied Sciences
DIRECTOR
Research & Publications
Box 65001

APPENDIX III : PERMISSION LETTER

THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF HEALTH

MUHIMBILI NATIONAL HOSPITAL

In reply please quote;

Ref. No.: MNH/CRTCU/Perm/2023/421 **Date: 26th June 2023**

Head of Department,
Imaging Diagnostic Section,
Muhimbili National Hospital

RE: PERMISSION TO COLLECT DATA AT MNH.

Name of Student	**Saeeda Afshar**
Title	**"Prevalence and Associated Factors of Lumber Spondylosthesis Among Patients with Low Back Pain Referred to MNH for Lumber Spinal MRI Between 219-2021".**
Institution	Muhimbili University of Health and Allied Sciences
Supervisors	Dr. Christina V. Malichewe (MUHAS)
Co - Supervisor	Dr. Flora Rwakatare (MNH)
Period	26th June, 2023 to 30th August, 2023

Approval has been granted to the above mentioned student to collect data at MNH. **A final study report should be lodged with Clinical Research, Training and Consultancy Unit.** Dissemination of study findings to MNH stakeholders shall be overseen by **Dr. Flora Rwakatare** (MNH) Co – supervisor.

Kindly ensure that the student abide to the ethical principles and other conditions of the research approval.

Sincerely,

HEAD, TEACHING, RESEARCH & CONSULTANCY UNIT P.O. Box 65000 DAR-ES-SALAAM MUHIMBILI NATIONAL HOSPITAL

Dr. Jessie Mbwambo
Head of Clinical Research, Training and Consultancy Unit

c.c DCSS
c.c **Dr. Flora Rwakatare**
c.c **Saeed Afshar**

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