"PREVALENCE OF LUMBAR INTERVERTEBRAL DISC HERNIATION IN ASYMPTOMATIC INDIVIDUALS ON MAGNETIC RESONANCE IMAGING: A ONE YEAR HOSPITAL BASED CROSS SECTIONAL STUDY"

BY

REG. NO. BS0122012

Dissertation

Submitted to the

KLE Academy of Higher Education and Research, Belagavi, Karnataka

In partial fulfilment

of the requirements for the degree of

M.D.

IN

RADIO-DIAGNOSIS

DEPARTMENT OF RADIO-DIAGNOSIS, J. N. MEDICAL COLLEGE,

BELAGAVI -590010. KARNATAKA

SEPTEMBER / OCTOBER 2025

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ABSTRACT

BACKGROUND

Lumbar intervertebral disc herniation is a common spinal condition often identified incidentally through Magnetic Resonance Imaging (MRI) in asymptomatic individuals. While symptomatic herniations are linked to pain, numbness, or neurological deficits, many individuals show disc abnormalities without any clinical signs. The increasing use of MRI has led to a higher detection rate of these incidental findings, raising concerns about overdiagnosis and overtreatment. Understanding the prevalence of asymptomatic disc herniation is vital to improve clinical decision-making, refine diagnostic strategies, and identify risk factors for potential progression to symptomatic conditions. Factors such as age, lifestyle, occupation, and genetic predisposition are believed to influence disc health, making comprehensive studies essential for better management strategies.

OBJECTIVE

To evaluate the prevalence of lumbar intervertebral disc herniation in asymptomatic individuals aged 20 to 80 years using MRI at a tertiary care hospital.

MATERIALS & METHODS

This hospital-based cross-sectional study was conducted over one year at KLE'S Prabhakar Kore Hospital and Medical Research Centre. A total of 89 asymptomatic participants undergoing whole spine MRI for unrelated reasons were included. Imaging data were analyzed for the presence of disc bulges, protrusions, extrusions, and sequestrations across lumbar levels (L1-S1). Statistical analysis was performed using R version 4.2.1 and Microsoft Excel to identify prevalence patterns and demographic associations.

RESULTS

Among the 89 participants, total prevalence of herniation is 52.8% and lumbar disc bulges were found in 2.2% at L1-L2, 4.5% at L2-L3, 4.5% at L3-L4, 29.2% at L4-L5, and 18.0% at L5-S1. Protrusions were detected in 1.1% at L3-L4, 9.0% at L4-L5, and 9.0% at L5-S1. No cases of disc extrusion or sequestration were identified. Age-related trends were noted, with disc changes more common in older age groups. No significant differences were found based on sex, dietary habits, or smoking status. Participants with no exercise habits showed a higher prevalence of disc abnormalities.

CONCLUSION

The study highlights that incidental lumbar disc herniations are relatively common in asymptomatic individuals, particularly at the L4-L5 and L5-S1 levels and in older age groups. These findings underscore the importance of correlating imaging results with clinical symptoms to prevent unnecessary interventions. Further research is recommended to explore factors influencing the progression of asymptomatic disc changes.

KEYWORDS: Lumbar disc herniation, Asymptomatic disc herniation, MRI spine, Prevalence of disc herniation, Lifestyle impact on disc herniation

LIST OF ABBREVIATIONS

BMI	Body Mass Index
CT	Computed Tomography
DC	Disc Count
DWI	Diffusion-Weighted Imaging
L1–L2, L2–L3, etc.	Spinal segment levels
MRI	Magnetic Resonance Imaging
PC	Person Count
PELD	Percutaneous Endoscopic Lumbar Discectomy
STIR	Short Tau Inversion Recovery
T1WI	T1-Weighted Imaging
T2WI	T2-Weighted Imaging

TABLE OF CONTENTS

LIST OF IMAGES

LIST OF GRAPHS

LIST OF TABLES

INTRODUCTION

Lumbar disc herniation is a common spinal condition where the nucleus pulposus protrudes through the annulus fibrosus, potentially impinging on neural structures. It is a leading cause of low back pain and radiculopathy, contributing to significant disability and healthcare costs. However, not all disc herniations are symptomatic, and the gap between imaging findings and clinical presentation is an ongoing area of research. [1]

The lumbar intervertebral discs, vital for weight-bearing and movement, consist of a nucleus pulposus and annulus fibrosus, both prone to degeneration. Aging, genetics, stress, and environmental factors contribute to disc degeneration, increasing herniation risk. The lumbar spine's high mechanical load makes it especially susceptible to these changes. [2]

Advances in imaging, especially MRI, allow detailed visualization of the lumbar spine, revealing disc herniation in many asymptomatic individuals. These incidental findings raise questions about the clinical relevance of imaging and its impact on patient management. While MRI's high sensitivity aids in early detection, it also risks overdiagnosis and unnecessary interventions.[3]

The natural course of lumbar disc herniation is often favorable, with many cases resolving spontaneously or improving with conservative treatment. Mechanisms like dehydration, material shrinkage, and macrophage-mediated resorption contribute to regression. However, factors such as herniation size, type, location, and patient-specific variables affect the chances of symptom resolution and need for intervention.[4]

Conservative management, including physical therapy, medications, and lifestyle changes, is the first-line treatment for lumbar disc herniation. Surgery, like discectomy, is considered for persistent symptoms or neurological deficits unresponsive to non-surgical measures. Advances in minimally invasive techniques, such as Percutaneous Endoscopic Lumbar Discectomy (PELD) and epidural steroid injections, have reduced surgical risks and improved recovery times. [5]

Epidemiological studies show that lumbar disc herniation is common in both symptomatic and asymptomatic individuals, highlighting the need to correlate imaging findings with clinical symptoms. Asymptomatic herniations challenge traditional views of spinal pathology, calling for a more nuanced approach to diagnosis and treatment. [6]

Factors like herniation size, direction, neural compression, pain threshold, and individual inflammatory responses contribute to the asymptomatic nature of some lumbar disc herniations. Understanding these factors is key to predicting the clinical course and personalizing management strategies. [7]

Inflammation plays a key role in lumbar disc herniation. Pro-inflammatory cytokines released by herniated disc material can sensitize nerve roots, causing pain even without significant compression. The absence of a strong inflammatory response in asymptomatic cases may explain the lack of symptoms.[8]

Asymptomatic disc herniation challenges clinicians in balancing treatment risks and benefits. Overdiagnosis can lead to unnecessary procedures, while underestimating it may delay intervention. This highlights the need for evidence-based guidelines and a patient-centered approach.[10]

This study aims to evaluate the prevalence of lumbar intervertebral disc herniation in asymptomatic individuals aged 20 to 80 years using MRI. By focusing on a hospital-based cross-sectional sample, the study seeks to provide reliable data on the epidemiology of asymptomatic herniation and its distribution across different age groups.

OBJECTIVE OF THE STUDY

To evaluate the prevalence of herniation of intervertebral disc at lumbar level in asymptomatic individuals of age group between 20-80 years on MRI

REVIEW OF LITERATURE

2.1 Anatomy and Biomechanics of the Lumbar Spine

Overview of Lumbar Spine Anatomy

The lumbar spine is essential for structural support and flexibility while protecting the spinal cord. It consists of five large vertebrae (L1 to L5) arranged in a lordotic curve, which helps distribute mechanical forces and maintain balance during movement and load-bearing activities.[11]

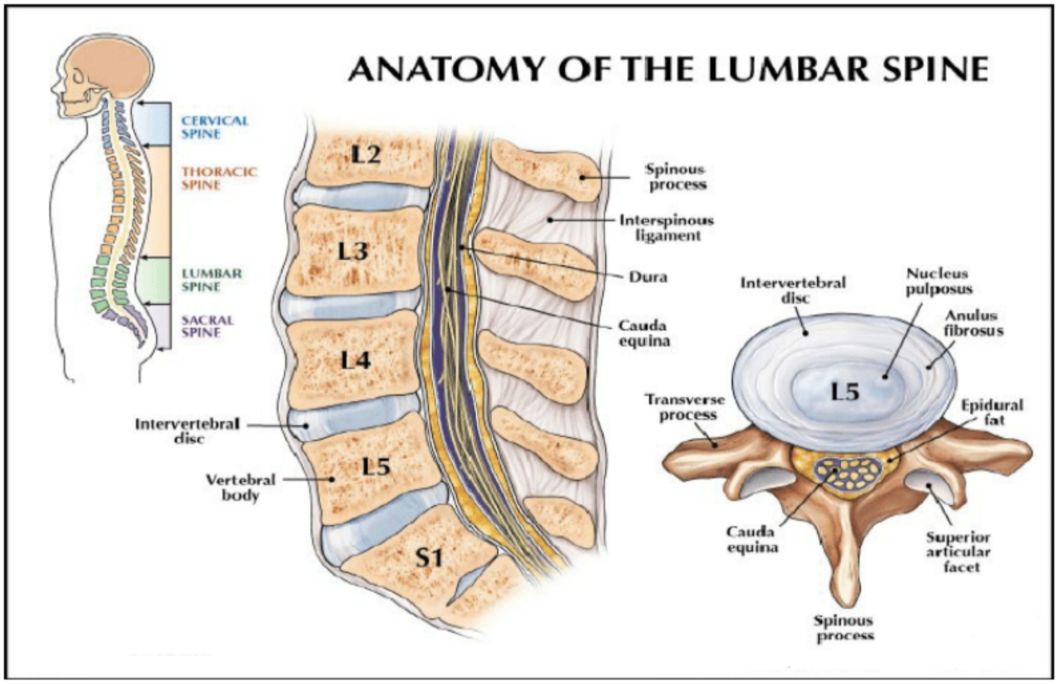


Figure 1: Anatomy of the spine with view of the disk [11]

Structural Components of Lumbar Vertebrae

Each lumbar vertebra consists of a vertebral body, pedicles, laminae, spinous process, transverse processes, and facet joints. The vertebral body bears the primary load, while the posterior elements enable movement and serve as attachment points for ligaments and muscles. Intervertebral discs between adjacent vertebrae act as shock absorbers, reduce friction, and allow motion. These discs have a gelatinous nucleus pulposus surrounded by a fibrous annulus fibrosus.. [12]

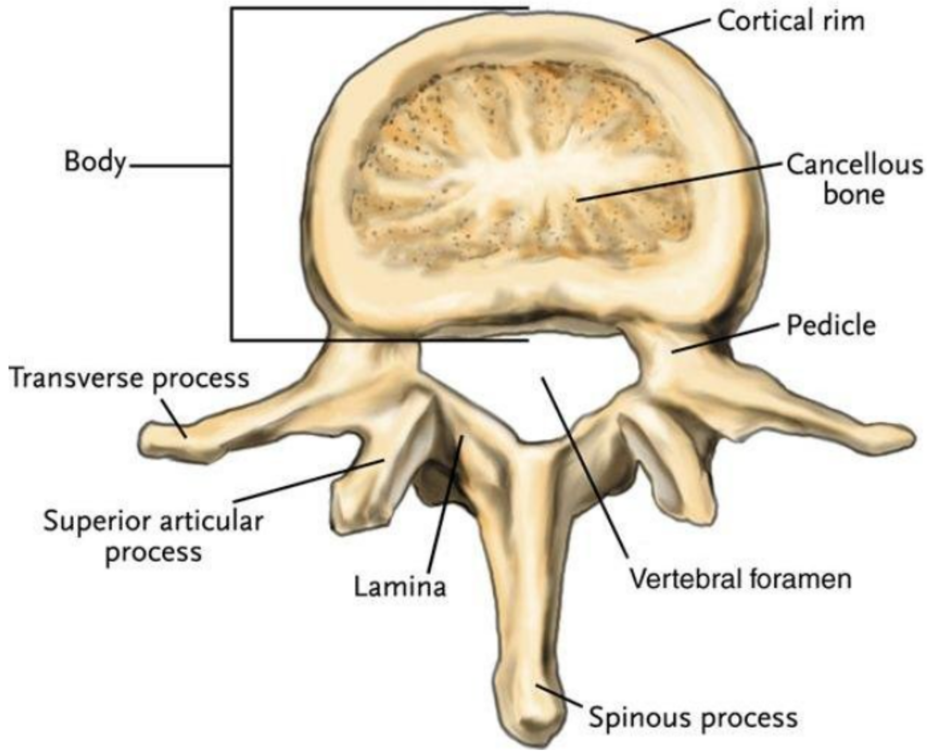


Figure 2: Main components of common vertebrae found in the lumbar spine region [12]

Blood Supply of the Lumbar Spine

The blood supply to the lumbar spine is primarily derived from the segmental arteries, which include the lumbar arteries originating from the abdominal aorta. These arteries provide vascular branches to the vertebral bodies, intervertebral discs, and surrounding soft tissues. Venous drainage is achieved through the internal and external vertebral venous plexuses, which communicate with the systemic venous system. [13]

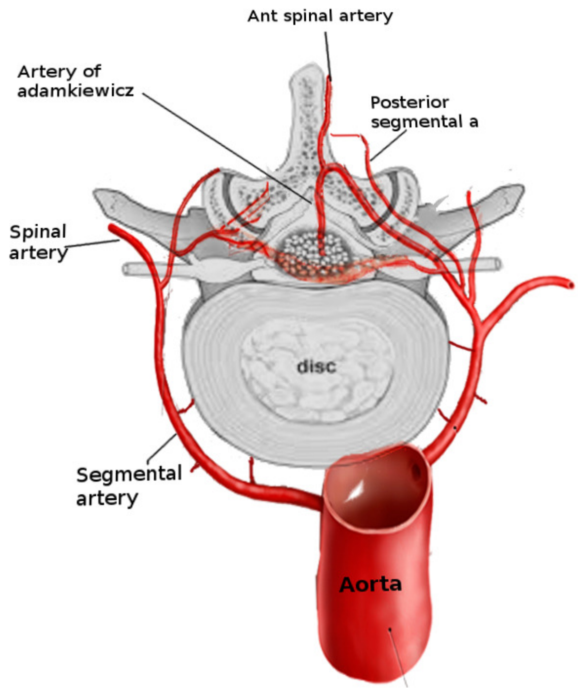


Figure 3: An Overview of Blood Supply To Vertebral Body And Spinal Cord [85]

Nerve Supply of the Lumbar Spine

The lumbar spine's nerve supply comes from the lumbar spinal nerves, part of the lumbosacral plexus. Each nerve exits through the intervertebral foramen, dividing into anterior and posterior rami. The posterior rami innervate the back muscles and skin, while the anterior rami supply the lower limbs and pelvic structures. The close association between lumbar nerves and intervertebral discs explains why disc herniation often causes radicular symptoms. [14]

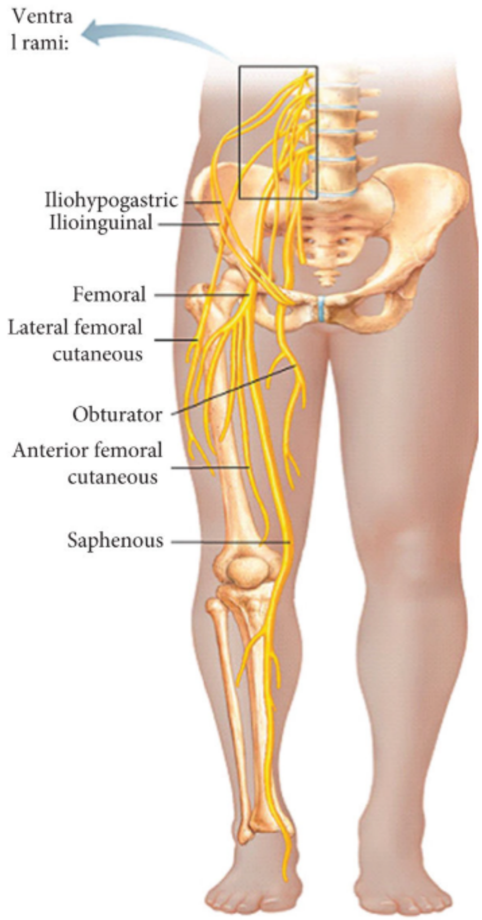


Figure 4: Distribution of the major nerves from the lumbar plexus to the lower limb [14]

Biomechanics of the Lumbar Spine

The biomechanics of the lumbar spine are shaped by its structural components and the forces acting on it. Intervertebral discs distribute compressive loads and provide flexibility, while facet joints guide and limit movement. Ligaments like the longitudinal ligaments, ligamentum flavum, and interspinous ligaments offer stability. Together, these elements enable flexion, extension, lateral bending, and axial rotation.[15]

Forces Acting on the Lumbar Spine

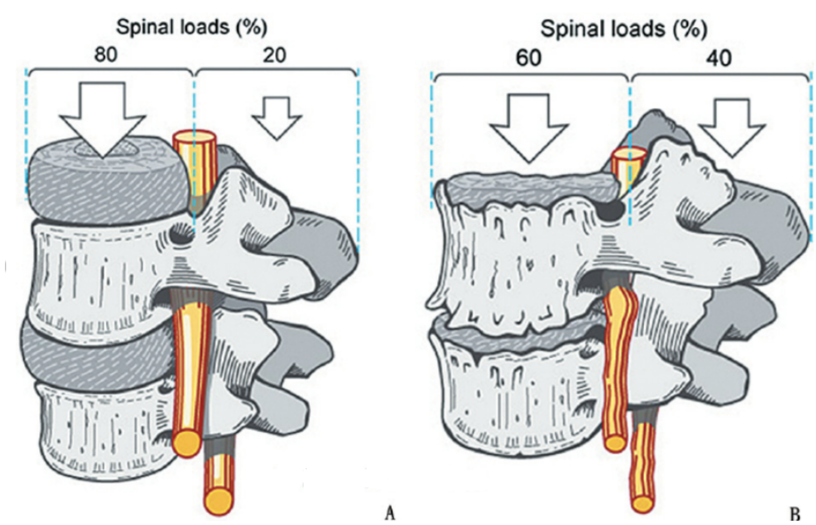
The lumbar spine endures axial loading, bending, and torsion during daily activities. Its structure and component interactions allow it to withstand these forces. However, repeated stress or pathological conditions can lead to disc herniation, potentially compromising its function.[17]

Protective Role of the Lumbar Spine

The lumbar spine also serves a protective role by housing the cauda equina, a bundle of spinal nerves extending beyond the spinal cord at L1-L2. The cauda equina innervates the lower limbs and pelvic organs. Any damage to the lumbar spine's structure can lead to neurological deficits, emphasizing its clinical importance. [18]

Lumbosacral Junction and Load Distribution

The lumbosacral joint, where the lumbar vertebrae meet the sacrum, is a key junction between the axial skeleton and pelvis. This joint bears significant stress, especially during activities like lifting and bending. The alignment of the lumbosacral angle and load distribution are crucial for spinal health and injury prevention. [19]



(A) Distribution of spinal loads on the anterior and posterior weight-bearing columns in a normal lumbar spine.
(B) Shifting of spinal loads to the posterior column after degenerative pathology to the lumbar spine.

Figure 5: Overview of distribution of spinal loads on the anterior and posterior weight-bearing columns in a normal lumbar spine [19]

2.2 Physiology and Degeneration of Intervertebral Discs

Intervertebral discs, located between adjacent vertebrae, function as load distributors and enable flexibility. Each disc consists of the nucleus pulposus, a gelatinous structure primarily made of water, proteoglycans, and collagen and the annulus fibrosus, a layered structure of fibrocartilage and collagen fibers. Cartilaginous endplates between the disc and vertebral bodies facilitate nutrient exchange.

The disc's physiology depends on its biochemical composition and the forces it experiences. The nucleus pulposus, rich in proteoglycans, retains water, crucial for bearing compressive loads. The annulus fibrosus has anisotropic properties, allowing it to withstand complex forces. [22]

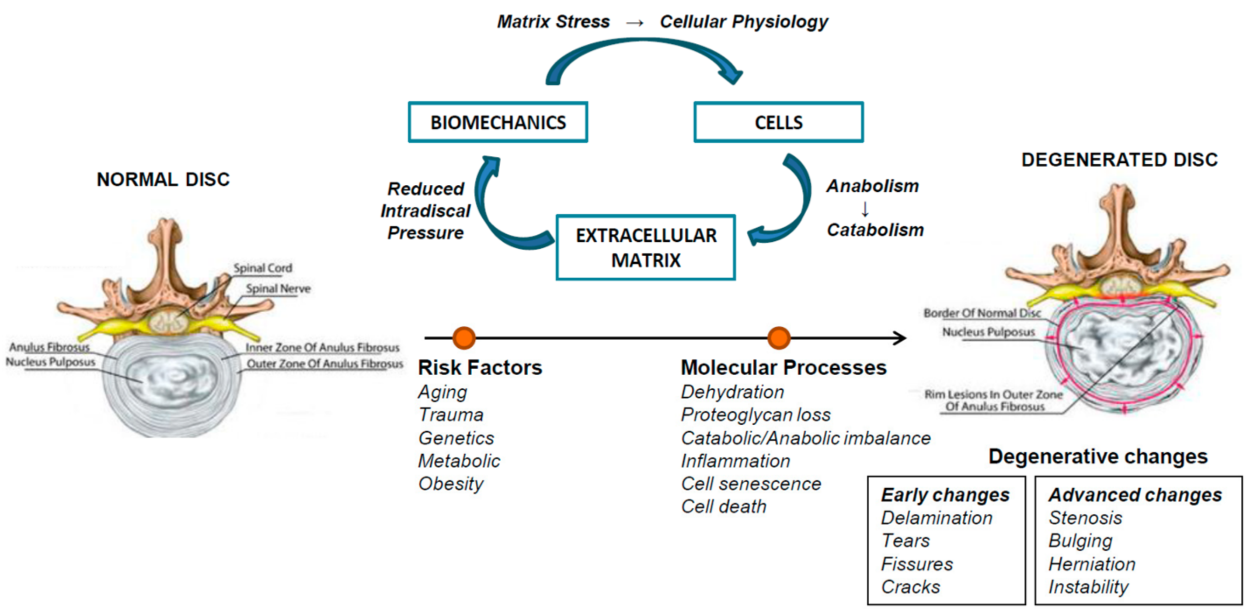


Figure 6: Overview of pathophysiology of intervertebral disk degeneration [21]

Intervertebral disc degeneration is influenced by genetics, aging, mechanical stress, and lifestyle. Early changes include loss of proteoglycans in the nucleus pulposus, leading to dehydration and reduced function. The annulus fibrosus also weakens, forming microtears, making it more prone to bulging or herniation. [23]

Calcification of cartilaginous endplates impairs nutrient diffusion, accelerating disc degeneration. The breakdown of extracellular matrix components triggers inflammation, increasing pro-inflammatory cytokines and matrix metalloproteinases, which worsen degeneration. [24]

Age-related changes significantly contribute to disc degeneration. Decreased water content in the nucleus pulposus leads to reduced disc height and increased stiffness, altering spinal biomechanics and increasing injury risk. Accumulation of advanced glycation end products (AGEs) reduces the disc's viscoelasticity, while the annulus fibrosus becomes less elastic and more prone to tears. These changes are often worsened by genetic factors, with certain polymorphisms increasing the risk of degeneration. [25]

Mechanical stress from repetitive loading, heavy lifting, and spinal flexion causes microtrauma, leading to tears in the annulus fibrosus and extrusion of nucleus pulposus material. This is worsened by factors like poor posture and weak core muscles, highlighting the multifactorial nature of degeneration. [26]

The role of inflammation in disc degeneration has garnered significant attention in recent years. Degenerative discs often exhibit increased levels of pro-inflammatory mediators, such as interleukin-1 beta (IL-1β) and tumor necrosis factor-alpha (TNF-α). Cytokines degrade the matrix and sensitize nerve endings, causing pain. [27]

Lifestyle factors significantly affect intervertebral disc health. Smoking reduces spinal blood supply, promoting degeneration, while obesity increases mechanical stress, accelerating wear. Diet impacts degeneration through inflammation and nutrient availability, and sedentary habits weaken core strength, worsening degeneration. Regular physical activity, especially core-strengthening exercises, can reduce these risks, highlighting the importance of lifestyle changes for spinal health. [28]

2.3 Pathophysiology of Lumbar Disc Herniation

Lumbar disc herniation is a multifactorial condition involving structural, biochemical, and cellular changes within the intervertebral disc. Degenerative changes, influenced by aging, genetic predisposition, mechanical stress, and environmental factors, initiate the process. Mechanical stress weakens the annulus fibrosus, making it susceptible to herniation, especially in the posterior and posterolateral regions. Additionally, the biochemical environment contributes through the release of pro-inflammatory mediators like IL-1β, TNF-α, and MMPs, which degrade the extracellular matrix and amplify inflammation. When the nucleus pulposus breaches the annulus fibrosus, an autoimmune-like response may further inflame and sensitize nerve roots. This localized inflammation in the epidural space can result in edema, fibrosis, and chronic compression, potentially leading to granulation tissue and adhesions that contribute to long-term complications. [31, 33, 34, 36]

While lumbar disc herniation involves degeneration, spontaneous regression may occur depending on the herniation's size, location, and inflammatory response. Some individuals experience symptom relief, whereas others may develop persistent pain or neurological deficits. Advanced imaging techniques, particularly MRI, are instrumental in assessing herniation characteristics, nerve compression, and inflammation. T2-weighted images help evaluate disc hydration and degeneration levels. Understanding the interplay between structural, biochemical, mechanical, and genetic factors is crucial for developing effective treatments and preventive strategies, emphasizing the importance of ergonomic practices and lifestyle modifications. [38, 39, 40]

2.4 Epidemiology of Lumbar Disc Herniation in Asymptomatic Individuals

Lumbar disc herniation is frequently observed in asymptomatic individuals, with MRI studies revealing that herniation does not always correlate with symptoms. Age-related degeneration increases its prevalence, though younger individuals may still experience herniation without symptoms due to the spine's adaptability. Gender differences in prevalence remain debated, with some studies linking higher rates in males to occupational strain, while others suggest hormonal and structural factors may play a role. [41, 42, 43]

Occupational risks such as heavy lifting, prolonged sitting, and poor posture elevate the likelihood of asymptomatic herniation, whereas physical activity, particularly core-strengthening exercises, provides a protective effect. Factors like herniation size, location, and activity levels influence symptom progression, underscoring the importance of identifying individuals who may require monitoring or preventive strategies. [44, 46]

2.5 Advancements in Magnetic Resonance Imaging for Lumbar Spine Assessment

Magnetic resonance imaging (MRI) has revolutionized the evaluation of lumbar spine disorders, including intervertebral disc herniation. MRI has become the gold standard for assessing lumbar spine pathology due to its high-resolution, multiplanar images and lack of ionizing radiation. Its superior soft tissue contrast enables detailed visualization of intervertebral discs, spinal nerves, and ligaments, making it crucial for detecting subtle abnormalities. [48]

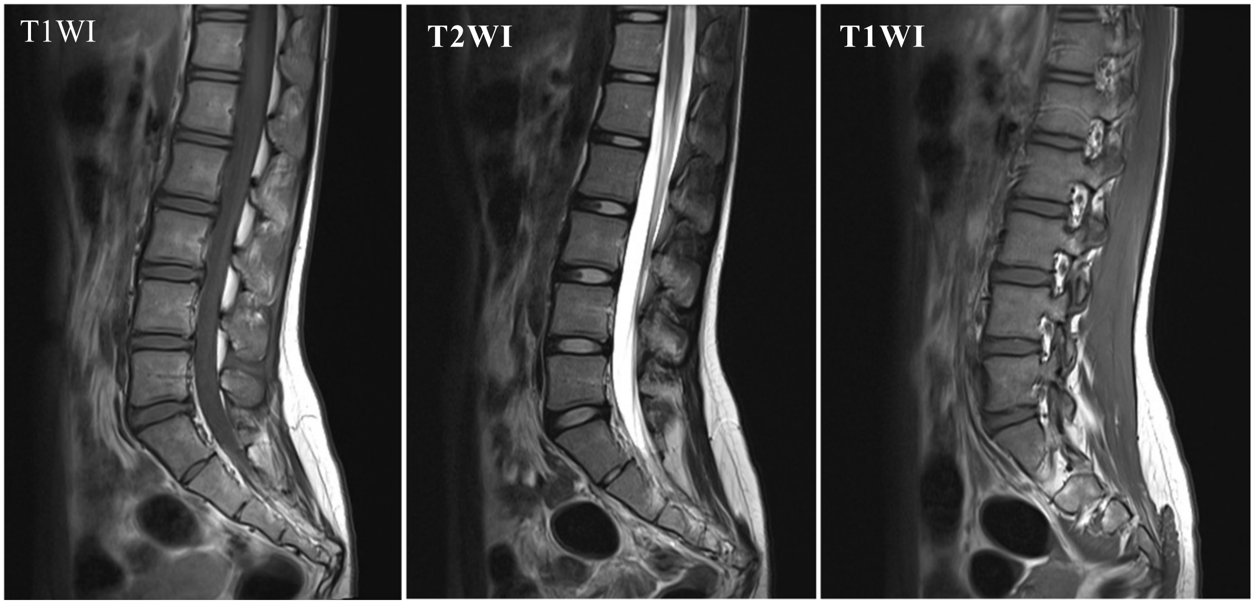


Figure 8: Magnetic resonance imaging examination of the lumbar spine [49]

T2-weighted imaging is key in assessing intervertebral discs, highlighting water content to reveal disc hydration and degeneration. Healthy discs appear hyperintense, while degenerated ones show reduced signal intensity. [50]

In postoperative assessments, contrast MRI distinguishes between recurrent disc herniation and scar tissue, which appear similar on non-contrast images, guiding appropriate management and avoiding unnecessary interventions. [51]

2.6 Interpretation of MRI lumbar spine

MRI is crucial for assessing disc abnormalities like bulge, protrusion, extrusion, and sequestration. A bulge is a circumferential extension of the disc without annulus rupture, often asymptomatic but occasionally causing pain or nerve compression. Protrusion involves localized disc extension, potentially leading to radiculopathy or spinal stenosis. Extrusion occurs when the nucleus pulposus breaches the annulus, often causing significant nerve compression, while sequestration involves detached disc material migrating within the spinal canal, potentially triggering acute neurological symptoms. While bulges and mild protrusions may improve with conservative care, extrusion and sequestration often require surgical intervention. [52, 47, 53]

2.7 Natural History and Prognosis of Lumbar Disc Herniation

Lumbar disc herniation has a variable natural history, with outcomes ranging from spontaneous resolution to chronic pain. Many cases improve within weeks to months without surgery due to the body's natural healing processes. However, some individuals may experience persistent symptoms. The prognosis is influenced by factors such as herniation size, symptom duration, and neurological involvement. [62]

Non-surgical treatments, including physical therapy and NSAIDs, are typically effective in managing symptoms. However, surgery, like discectomy, may be required for patients with progressive symptoms or neurological deficits. [63]

2.8 Implications for Diagnostic and Therapeutic Practices

The diagnosis and management of lumbar disc herniation have evolved significantly due to imaging advancements and recognizing asymptomatic cases. MRI is the gold standard for evaluating lumbar disc pathology, providing detailed visualization of disc morphology and neural structures. [60]

Interpreting imaging findings in lumbar disc herniation requires considering the patient's symptoms, physical examination, and functional status. The presence of a herniated disc on MRI does not automatically necessitate intervention. Treatment decisions should be based on the degree of neural compression, severity of symptoms, and impact on the patient's quality of life. [62]

Given the high success rates of conservative management, lumbar disc herniation therapy emphasizes non-surgical treatments. Physical therapy, NSAIDs, and epidural steroid injections effectively reduce inflammation, relieve pain, and improve mobility in most patients. [63]

2.9 Past Studies

Sasi Kuppuswamy et al. (2017): The study investigated the prevalence of lumbar disc degeneration and herniation in 76 asymptomatic Indian individuals using MRI, analyzing 380 discs. Pathological changes were observed in 28.2% of discs, including bulges (17.8%), protrusions (7.8%), and extrusions (2%), with degeneration increasing with age. The L4-L5 and L5-S1 levels were most affected for herniation and degeneration. The study highlights the mechanical nature of these conditions due to lifestyle factors and emphasizes the need for clinical evaluation to avoid overtreatment based on MRI alone. Findings were consistent with Western studies despite lifestyle differences. [56]

Sharma et al. (2014): In this study, researchers examined the early patterns of degenerative changes in lumbar intervertebral discs subjected to mechanical stress versus those not under stress. Using MRI, they evaluated 93 stressed spinal segments in 87 patients with a mean age of 15.3 years. The study found that stressed discs showed significantly higher burdens of annular tears (0.70 ± 0.34), radial tears (0.48 ± 0.39), herniations (0.07 ± 0.19), and nuclear degeneration (0.17 ± 0.31) compared to control discs, which had much lower values (0.29 ± 0.25, 0.09 ± 0.17, 0.01 ± 0.04, and 0.02 ± 0.08, respectively; $p < 0.01$ for all). The findings highlighted that mechanical stress substantially increased degenerative changes in annulus fibrosus and nucleus pulposus but did not significantly affect the endplates. [55]

Hurinovich and Solovyov (2015): This study explored the use of MRI in diagnosing lumbar intervertebral disc herniations. A sample of 30 cases revealed that lumbar disc herniation was the most common pathology, accounting for 76.67% of cases. Cervical disc herniation was observed in 20%, while thoracic disc herniation was rare, with only 3.3%. Among the patients, 65% had isolated herniations, while 35% had multiple herniations, involving up to four discs. Statistical analysis revealed a negative correlation between age and the number or localization of herniations ($r = -0.15083$). The study underscored lumbar disc herniation as the predominant pathology and highlighted the utility of MRI in objectively assessing disc herniation parameters. [57]

Huang et al. (2016): This case report presented a unique scenario of a herniated intervertebral disc mimicking an intraspinal tumor. A 43-year-old female experienced low back pain and right limb numbness for 60 days. MRI revealed a herniated disc at the L5/S1 level and an unusual strong signal in the spinal canal at L5. The diagnosis of an intraspinal tumor was made initially, but surgery uncovered a lump of nucleus pulposus, confirming the herniation. The report emphasized the diagnostic challenge, particularly with atypical MRI findings, and advocated for the use of gadolinium-enhanced MRI to distinguish between herniated discs and tumors preoperatively. [58]

Zhong et al. (2017): The clinical value of MRI and electrophysiological studies in lumbar disc herniation was evaluated in this study involving 265 patients treated with discectomy. Preoperative assessments showed significant differences between herniated and unaffected discs in terms of the angle between the nerve root canal and disc protrusion (AN value), spinal canal stenotic ratio, and lateral recess width ($p < 0.05$). Postoperative improvements were significant across all indicators, including motor conduction velocity (MCV), sensory conduction velocity (SCV), and nerve action potential (NAP; $p < 0.05$). The study concluded that combining MRI and electrophysiological tests enhanced diagnostic accuracy and provided objective measures for surgical evaluation. [59]

Han and Jang (2018): This study investigated the prevalence of thoracic disc herniation (TDH) and thoracic hypertrophied ligamentum flavum stenosis (HLFS) in 2,212 patients using lumbar MRI with cervicothoracic sagittal images. The prevalence of TDH was 6.5%, and HLFS was 19%. TDH was higher in males (8.0%) and individuals with lumbar surgical lesions (8.2%), while HLFS increased with age and was more common in females (21.6%). The most frequently involved segments were T8/9 for TDH and T10/11 for HLFS. Logistic regression analysis showed significant associations between TDH prevalence and lumbar surgical lesions but no correlation with age. The study highlighted the importance of considering incidental thoracic findings in lumbar MRI assessments. [39]

Pan et al. (2019): This study developed an automatic diagnostic system using deep convolutional neural networks (CNNs) to identify and classify lumbar disc abnormalities on MRI. The system achieved 100% accuracy in locating vertebral bodies (L1-S1) and corresponding intervertebral discs in axial images. It further demonstrated high classification accuracies for normal discs, disc bulge, and herniation across different levels: 92.7% for L1-L2, 84.4% for L2-L3, 92.1% for L3-L4, 90.4% for L4-L5, and 84.2% for L5-S1. By providing automated diagnostic reports, this system significantly improved diagnostic efficiency and reduced the workload of radiologists. The study highlighted CNNs as a transformative tool for interpreting lumbar MR images. [40]

Li et al. (2021): This retrospective analysis examined the diagnostic accuracy of coronal MRI in identifying multi-segment lumbar disc herniation (MSLDH) in 44 patients. The study reported high sensitivity (90.2%) and positive predictive value (94.9%) of coronal MRI in detecting MSLDH. The diagnostic accuracy was 83.4%, while negative predictive value was 80%. Significant reductions in hospital stays ($p = 0.013$) and surgical bleeding ($p = 0.006$) were observed in patients with fewer surgical segments, underscoring the utility of coronal MRI in precise localization. The findings demonstrated that coronal MRI is a reliable method for identifying responsible segments in MSLDH cases. [61]

Banjade (2023): This cross-sectional study analyzed MRI findings in 68 patients with lumbar disc prolapse aged 18 to 55 years (mean age 41 ± 8.79). Disc bulges were observed in 45.28% of cases, protrusions in 43.39%, and extrusions in 11.32%, with the L5-S1 level being the most affected (66.11%). While neurological symptoms were present in 38.23% of patients, the correlation between clinical symptoms and MRI findings was moderate (Kappa = 0.69). The study concluded that although MRI is a gold standard for identifying disc abnormalities, not all findings correlate with clinical symptoms, emphasizing the need for comprehensive assessments. [42]

Afridi (2023): This cross-sectional study of 200 patients over six months investigated abnormalities in intervertebral discs on lumbar MRI. The most commonly affected levels were L4-L5 (30%) and L5-S1 (69.9%). Disc abnormalities included numbness (69.9%), tingling (30%), herniated nucleus pulposus (30%), and disc protrusion (23.5%). Severe canal stenosis was observed in 5.5% of cases. The study also identified diffuse disc bulge as the most prevalent abnormality (96.4%). Middle-aged and older females showed higher rates of disc abnormalities. These findings highlighted the prevalence of L4-S1 involvement and associated clinical symptoms. [43]

Fadoul et al. (2024): This study evaluated the effectiveness of 3D SPACE MRI in distinguishing between sequestered lumbar disc herniation and tumors. Two patients, aged 37 and 42 years, presented with symptoms including lower limb pain and numbness. Standard MRI failed to differentiate between disc fragments and tumor-like structures in the dural sac. However, 3D SPACE MRI provided superior diagnostic clarity by accurately identifying disc fragments. The study emphasized that 3D SPACE MRI can prevent unnecessary surgical interventions by distinguishing between disc-related pathologies and tumors preoperatively. [44]

MATERIALS AND METHODS

1. **Study Design**

   This cross-sectional study evaluated the prevalence of lumbar intervertebral disc herniation in asymptomatic individuals aged 20–80 years. Participants were selected from those referred for whole spine MRI screening at KLE'S Prabhakar Kore Hospital and Medical Research Centre. The study design emphasized systematic data collection and analysis to achieve the research objectives.

2. **Study Setting**

   The study was conducted at the Department of Radio-diagnosis, KLE'S Prabhakar Kore Hospital and Medical Research Centre, Belagavi. The center is equipped with advanced imaging technology, including a 3.0 Tesla Siemens MRI machine (Magnetom Spectra), ensuring high-quality imaging and reliable results under standardized condition

3. **Study Duration**

   The study was carried out over one year, allowing sufficient time for participant recruitment, MRI screenings, and data analysis. This period ensured comprehensive data collection for statistically robust findings.

4. **Participants (Inclusion and Exclusion Criteria)**

   Inclusion Criteria:

   - Healthy volunteers aged 20–80 years.
   - Patients with cervical spine-related symptoms without lower back pain or lower limb paresthesia.
   - Individuals with chronic headaches or cerebral symptoms undergoing whole spine screening.

Exclusion Criteria:

- Structural deformities such as scoliosis and kyphosis.
- History of spine surgery, trauma, or lumbosacral radiculopathy.
- Known cases of osteoarthritis, rheumatoid arthritis, ankylosing spondylitis, or osteoporosis.
- Systemic diseases like tuberculosis, systemic lupus erythematosus, metastasis, or osteomyelitis.
- Radiotherapy exposure.

5. **Study Sampling**

Purposive sampling was employed, targeting individuals referred for whole spine MRI screening who met the inclusion and exclusion criteria. This approach ensured a representative sample of the target population.

6. **Study Sample Size**

The sample size was calculated using the formula:

$$n = \frac{p\,(100 - p)Z^2}{E^2}$$

Here, p=28.2% Z=1.96 (95% confidence level), and E=10%. The calculation yielded a minimum required sample size of 78 participants, ensuring sufficient statistical power.

$$n = \frac{28.2\text{x}\,(100 - 28.2)\ \text{x}\ 1.96^2}{10^2}$$

$$n = 77.78318 \approx 78$$

7. **Study Groups**

No separate groups were formed as all participants underwent the same MRI screening protocol. However, the analysis considered variations in demographic factors and imaging findings.

8. **Study Parameters**

Key parameters included the presence or absence of lumbar intervertebral disc herniation, demographic details (age, gender), and relevant clinical history. Imaging parameters were assessed using sagittal and axial T1-weighted, T2-weighted, and STIR sequences.

9. **Study Procedure**

Participants were positioned supine in the MRI gantry, and whole spine imaging was performed using a 3.0 Tesla Siemens MRI machine. Standardized protocols were followed for lumbar spine imaging, ensuring consistency in data acquisition. Imaging sequences included sagittal and axial T1-weighted, T2-weighted, and STIR images.

10. **Study Data Collection**

Data were collected from MRI scans and participant records. Demographic and clinical details were recorded systematically. Imaging data were categorized based on the presence or absence of lumbar intervertebral disc herniation.

11. **Data Analysis**

Statistical analysis was conducted using R version 4.2.1 and Microsoft Excel. Categorical variables were summarized as frequencies and percentages, while continuous variables were presented as means ± SD or medians with ranges. The analysis was performed to identify prevalence rates and associations with demographic factors.

12. **Ethical Considerations**

Ethical approval was obtained from the institutional ethics committee. Participants provided informed consent, ensuring they understood the study's purpose and procedures. The study involved no additional cost or intervention for participants, prioritizing their welfare, privacy, and confidentiality.

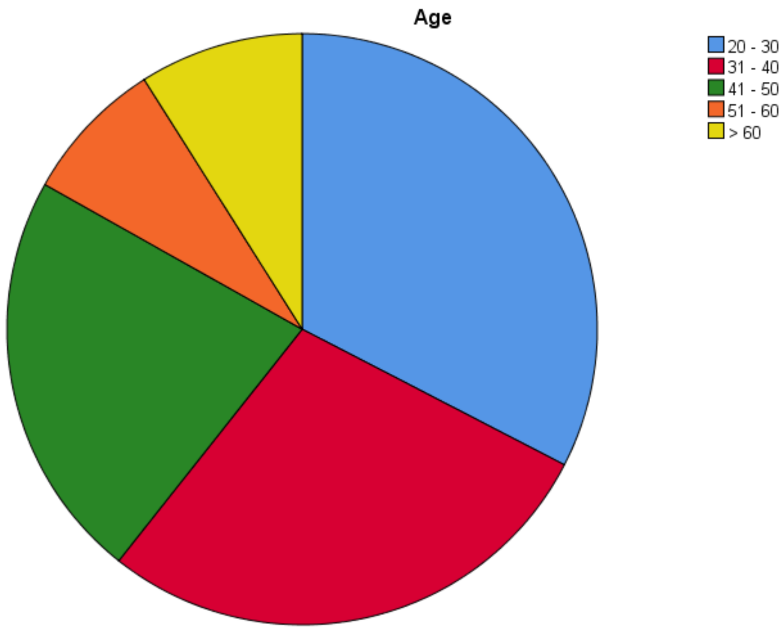
STATISTICAL ANALYSIS AND RESULTS

1. Demographic Profile: Age Distribution

The age distribution of respondents demonstrates a diverse age range among asymptomatic individuals undergoing MRI evaluation. A total of 89 participants were classified into five age groups, with the largest percentage (32.6%) falling between 20 and 30 years, followed by 28.1% between 31 and 40 years, and 22.5% between 41 and 50 years. The older age groups, 51–60 years and over 60 years, represented 7.9% and 9.0% respectively. This stratification suggests that younger individuals predominantly underwent MRI, with a progressive decrease in frequency among older age groups, highlighting potential age-related trends in incidental findings. While disc herniations are typically more prevalent in older age groups, their frequency was lower in this study, likely because symptomatic cases were excluded.

Table 1: Age Distribution of Respondents

Age	Frequency	Percent
20 - 30	29	32.6
31 - 40	25	28.1
41 - 50	20	22.5
51 - 60	7	7.9
> 60	8	9.0
Total	89	100.0

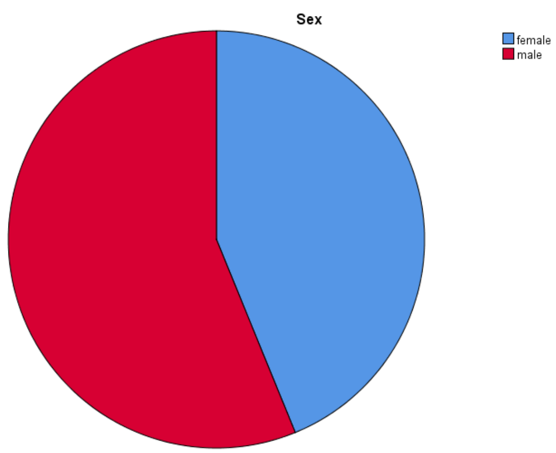


2. Demographic Profile: Sex Distribution

The sex distribution among the 89 respondents indicates a slightly higher proportion of males compared to females. Males accounted for 56.2% of the sample with 50 individuals, while females comprised 43.8% with 39 individuals. This balanced gender representation provides a reliable basis for analyzing potential sex-related differences in MRI findings. Although the study primarily focused on asymptomatic individuals, the distribution suggests that both genders are comparably represented in the investigation of lumbar intervertebral disc changes. The observed ratio allows for meaningful subgroup comparisons and supports the generalizability of the study's conclusions. These observations encourage further gender-specific analyses in future research.

Table 2: Sex Distribution of Respondents

Sex	Frequency	Percent
female	39	43.8
male	50	56.2
Total	89	100.0



3. Descriptive Statistics

Descriptive statistics reveal key physical characteristics of the 89 participants. The mean age was 39.29 years (SD 13.29) with a range of 20 to 76 years, demonstrating broad age variation. Mean height measured 168.53 cm (SD 7.24), and mean weight was 69.52 kg (SD 7.76), indicating average body stature. The average Body Mass Index (BMI) was 24.45 kg/m² (SD 2.23), ranging from 18.9 to 34.5. These figures illustrate a diverse sample with balanced anthropometric profiles, offering a solid framework to explore potential associations between physical parameters and incidental lumbar disc findings on MRI. This variation underpins further subgroup analyses indeed.

Table 3: Descriptive Statistics

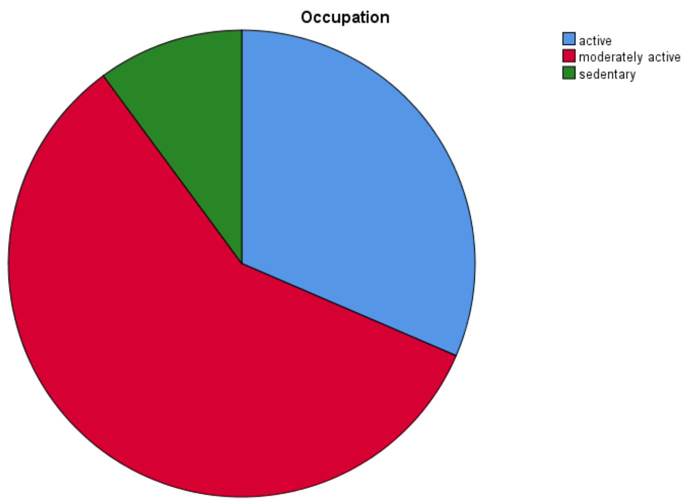
Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	89	20	76	39.29	13.290
Height (cm)	89	152	183	168.53	7.235
Weight (kg)	89	52	86	69.52	7.761
BMI	89	18.9	34.5	24.451	2.2262

4. Occupation

Occupational activity levels among the 89 respondents were categorized into three groups: active, moderately active, and sedentary. Active individuals numbered 28 (31.5%), reflecting high levels of physical engagement, while a majority of 52 (58.4%) were moderately active, indicating moderate daily physical activity. Sedentary individuals constituted 9 (10.1%) of the sample, suggesting limited physical movement. This occupational breakdown provides insights into lifestyle differences that may influence lumbar spine health. The distribution emphasizes that most participants maintain at least moderate activity levels, which could correlate with reduced risk of degenerative changes. Overall, occupational status is a critical variable for understanding study outcomes

Table 4: Occupation Distribution

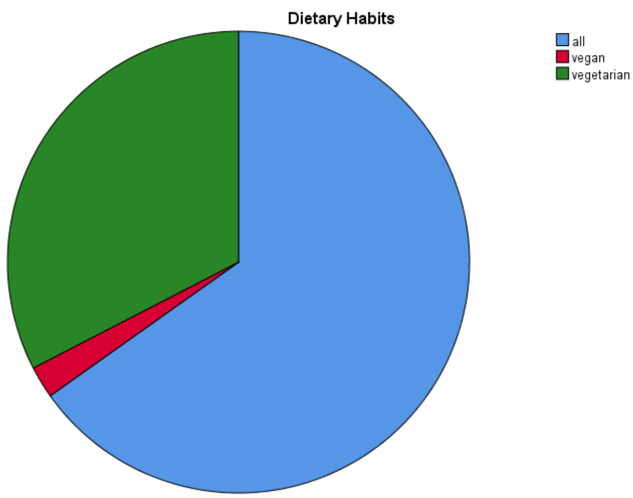
Occupation	Frequency	Percent
active	28	31.5
moderately active	52	58.4
sedentary	9	10.1
Total	89	100.0



5. Dietary Habits

Dietary habits of the study participants were recorded to assess potential influences on lumbar disc health. Among the 89 individuals, the majority (65.2%) reported consuming an "all" diet, while 32.6% adhered to a vegetarian diet and only 2.2% followed a vegan regimen. This distribution indicates a predominant intake of varied foods among respondents, with a substantial portion opting for vegetarian choices. The small number of vegans reflects limited representation of strict plant-based diets in this cohort. Such dietary patterns may have implications for inflammation and overall musculoskeletal health, warranting further investigation into dietary impacts on asymptomatic lumbar disc changes. Notably.

Dietary Habits	Frequency	Percent
all	58	65.2
vegan	2	2.2
vegetarian	29	32.6
Total	89	100.0

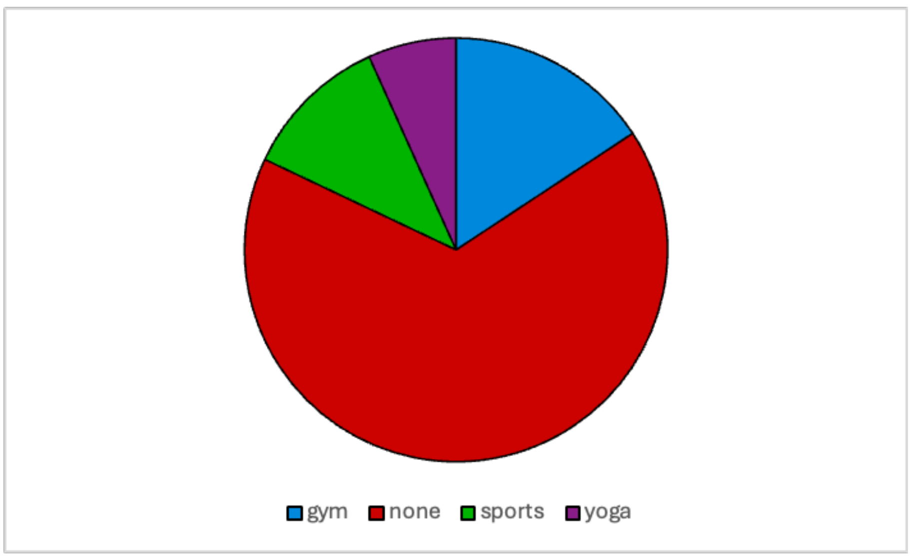


6. Exercise

Exercise habits among the 89 participants were evaluated to determine physical activity patterns that might relate to lumbar spine status. The majority, 66.3%, reported no engagement in exercise, indicating an inactive group. In contrast, 15.7% attended gym sessions, 11.2% participated in sports, and 6.7% practiced yoga. These findings reveal that a significant proportion of individuals lead sedentary lifestyles, while a smaller subset remains physically active. The distribution of exercise types suggests varied levels of activity, which may influence the prevalence of degenerative disc changes observed on MRI. This exercise profile highlights the need to promote physical activity for spine health.

Table 6: Exercise Distribution

Exercise	Frequency	Percent
gym	14	15.7
none	59	66.3
sports	10	11.2
yoga	6	6.7
Total	89	100.0



7. Smoking

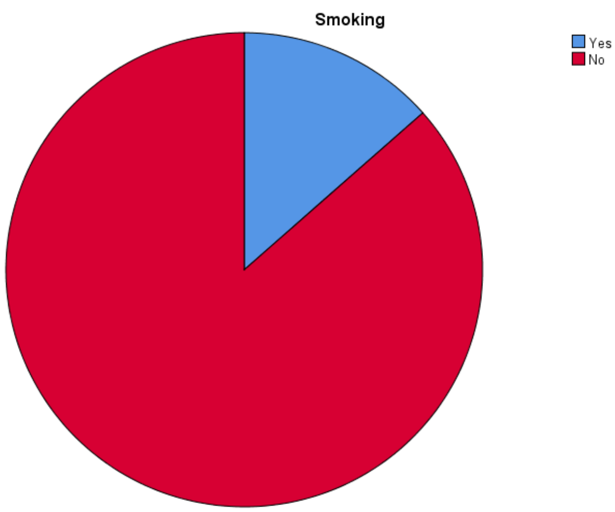
Interpretation

Smoking status among the 89 study participants was recorded to evaluate its potential impact on lumbar disc findings. Only 12 individuals (13.5%) were smokers, while a dominant majority of 77

(86.5%) reported no history of smoking. This low prevalence suggests that most respondents maintained non-smoking lifestyles, potentially reducing additional risk factors for disc degeneration. The distribution emphasizes the minimal contribution of smoking to the overall lifestyle profile. The uneven distribution of smokers and non-smokers in the study has skewed the results, making the findings less applicable for generalization to the public for clinical purposes.

Table 7: Smoking Distribution

Smoking	Frequency	Percent
Yes	12	13.5
No	77	86.5
Total	89	100.0

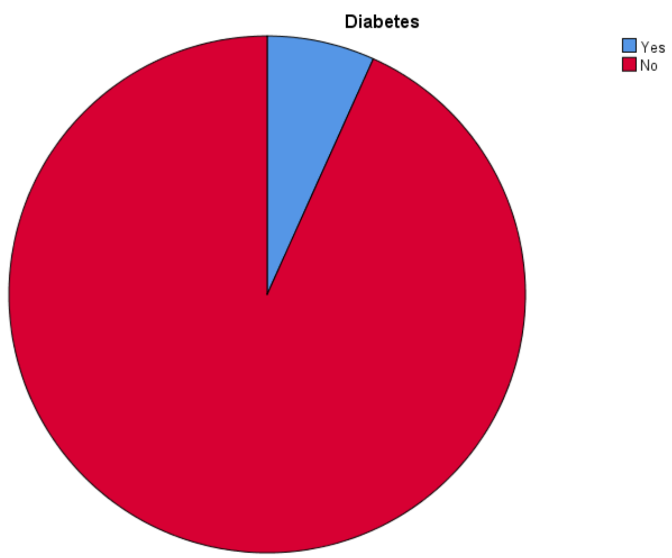


8. Diabetes

Diabetes status among the 89 respondents was assessed to explore its relationship with lumbar disc conditions. Only 6 individuals (6.7%) reported having diabetes, whereas 83 (93.3%) were non-diabetic. This low prevalence suggests that diabetes is not a common comorbidity within the study sample as largest age group of the study is 20- 30 years, reducing its potential confounding effect on disc degeneration. Consequently, the influence of diabetic metabolic factors on lumbar MRI findings appears minimal. This distribution has limited clinical applicability as the association between diabetes and disc herniation could not be studied in detail due to skewed study population.

Table 8: Diabetes Distribution

Diabetes	Frequency	Percent
Yes	6	6.7
No	83	93.3
Total	89	100.0

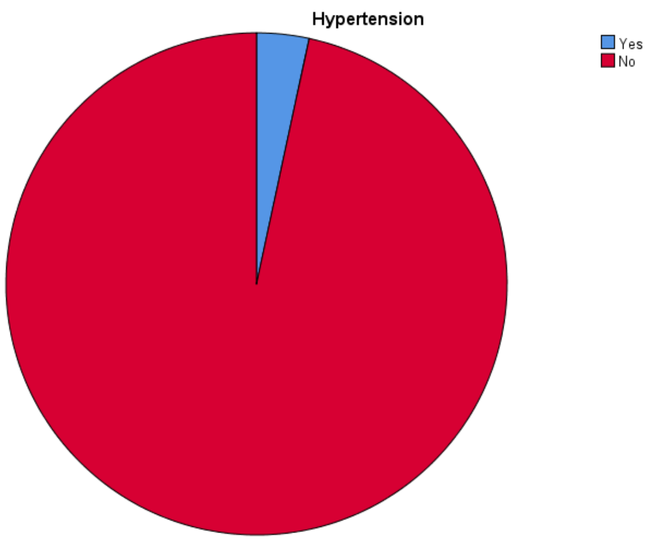


9. Hypertension

Hypertension was evaluated among the 89 participants to determine its prevalence and potential impact on lumbar disc health. Only 3 individuals (3.4%) were hypertensive, while the majority of 86 (96.6%) reported no history of hypertension. This very low prevalence indicates that hypertension is uncommon in this asymptomatic cohort, reducing its confounding impact on disc degeneration. Overall, the hypertension profile establishes a clear baseline for evaluating systemic health effects on spinal integrity.

Table 9: Hypertension Distribution

Hypertension	Frequency	Percent
Yes	3	3.4
No	86	96.6
Total	89	100.0

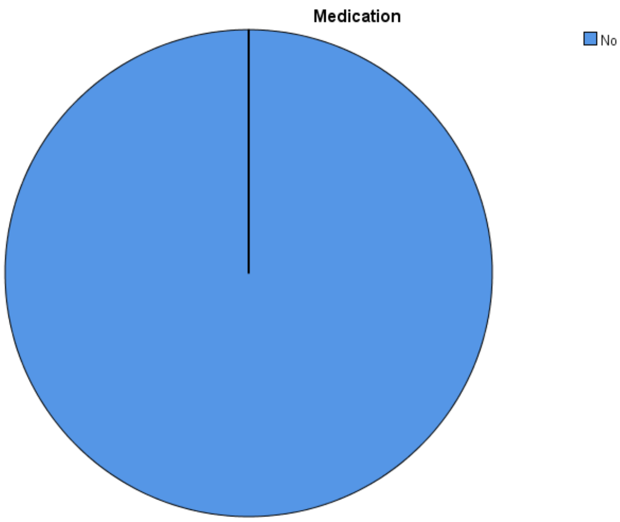


10. Medication

Medication usage among the 89 participants was examined, revealing that none of the respondents were on any medication at the time of the study. This uniform absence of medication intake indicates that the study cohort was free from pharmaceutical interventions that might influence lumbar disc health. The complete lack of medication use simplifies the analysis by eliminating potential confounding effects from drug treatments on MRI findings. Consequently, the results can be attributed to natural variations.

Table 10: Medication Distribution

Medication	Frequency	Percent
No	89	100.0

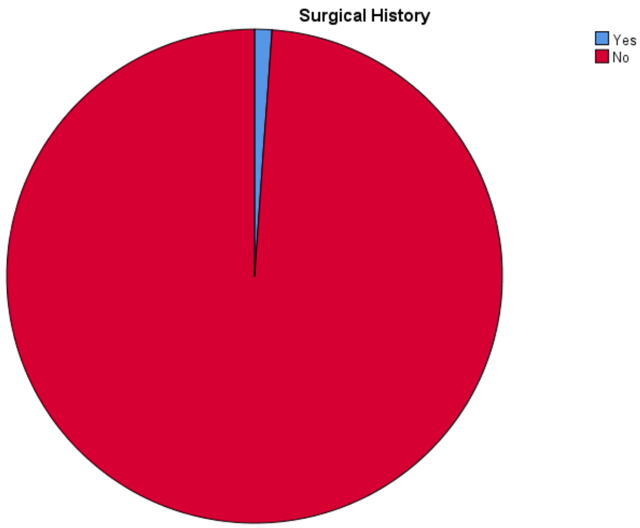


11. Surgical History

Surgical history was assessed among the 89 participants to identify any previous interventions affecting lumbar disc morphology. Only 1 individual (1.1%) reported a history of surgery, while 88 (98.9%) had no surgical history. This overwhelming absence of prior surgical intervention indicates that the study population is largely naive to spine surgeries. The minimal surgical history reduces potential confounding, ensuring that observed MRI findings are not influenced by postoperative changes.

Table 11: Surgical History

Surgical History	Frequency	Percent
Yes	1	1.1
No	88	98.9
Total	89	100.0

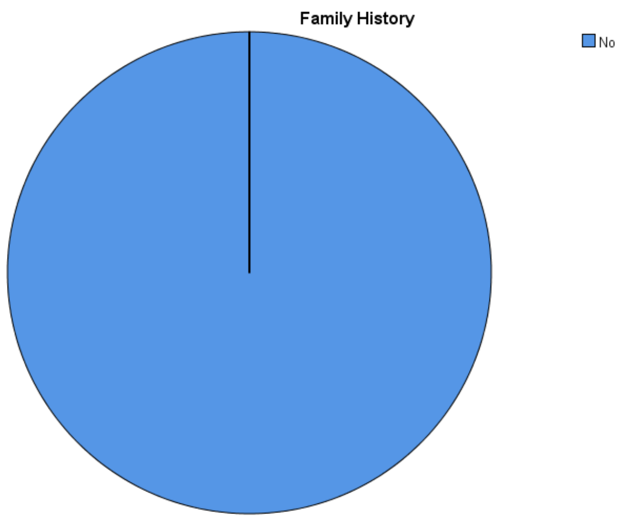


12. Family History

Family history of lumbar disc issues was evaluated among the 89 respondents, and notably, all participants (100%) reported no family history of related conditions. This uniform absence of family history suggests that genetic predisposition or familial patterns did not influence the study population. The complete lack of reported family history reduces the likelihood of inherited risk factors affecting incidental MRI findings. Consequently, the results can be interpreted without the confounding impact of genetic predispositions. This clear family history profile provides a straightforward context for analyzing other lifestyle and demographic variables in relation to lumbar disc changes in asymptomatic individuals, effectively.

Table 12: Family History

Family History	Frequency	Percent
No	89	100.0

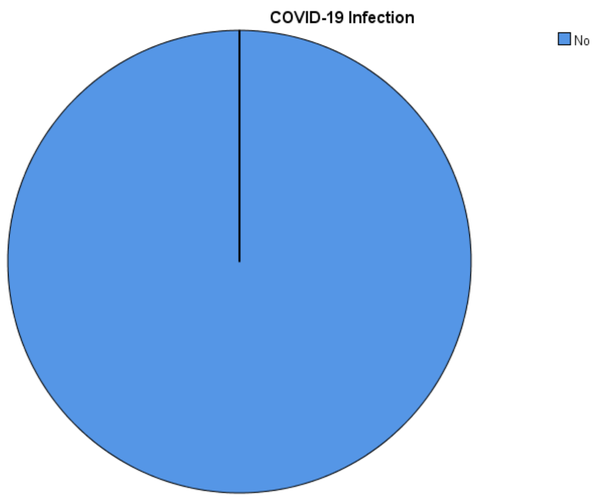


13. COVID-19 Infection

COVID-19 infection status was assessed among the 89 participants, and all individuals (100%) reported no history of COVID-19 infection. This uniform finding indicates that none of the respondents had experienced a COVID-19 infection prior to undergoing MRI evaluation. The absence of COVID-19 in the study population eliminates potential confounding effects related to post-infection inflammatory changes or systemic illness that could impact lumbar disc composition. This infection status provides assurance that the MRI findings are not influenced by viral illness. The homogeneity in COVID-19 status supports the integrity of the data, ensuring that observed disc changes are attributable to other factors.

Table 13: COVID-19 Infection Distribution

COVID-19 Infection	Frequency	Percent
No	89	100.0

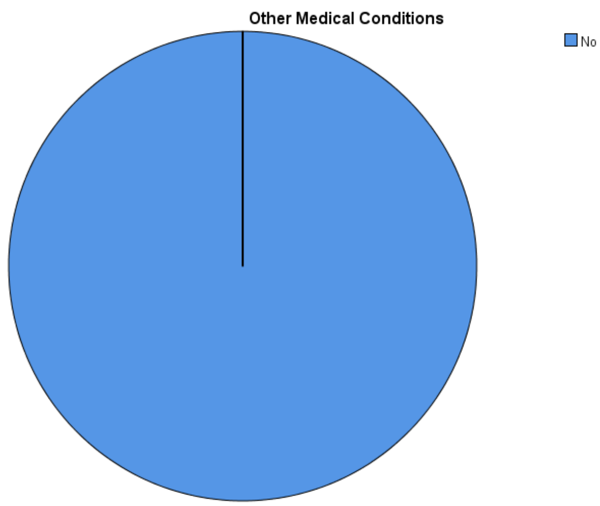


14. Other Medical Conditions

Other medical conditions were evaluated among the 89 respondents, and all individuals (100%) reported no additional medical conditions. This unanimous absence of other health issues indicates that the study cohort was free from co-morbidities that might influence lumbar disc integrity. The lack of other medical conditions simplifies the interpretation of MRI findings by reducing potential confounding factors related to systemic illnesses. With a healthy medical background aside from the primary study focus, the participants provide an ideal baseline for examining incidental disc changes. This homogeneity in health status enhances the reliability of the study's conclusions regarding asymptomatic lumbar disc abnormalities.

Table 14: Other Medical Conditions

Other Medical Conditions	Frequency	Percent
No	89	100.0

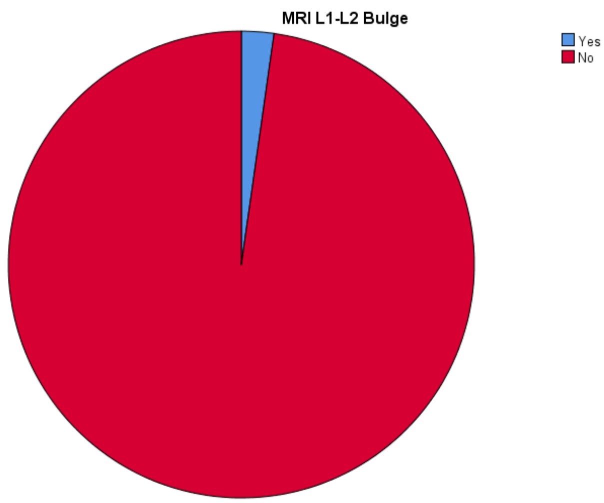


15. MRI Findings at L1–L2

MRI evaluation of the L1–L2 level revealed limited degenerative changes among the 89 asymptomatic participants. A disc bulge was observed in only 2 individuals (2.2%), while 87 (97.8%) showed no bulge. No cases of disc protrusion, extrusion, or sequestration were detected at this level, with all participants (100%) exhibiting normal findings for these categories. These results suggest that the L1–L2 segment is relatively preserved in asymptomatic individuals. The minimal abnormalities may reflect early degenerative processes or incidental findings, emphasizing the importance of correlating MRI findings with clinical presentation. Overall, the L1–L2 data indicate a low prevalence of significant disc pathology.

Table 15: MRI Findings at L1–L2

MRI L1-L2 Bulge	Frequency	Percent
Yes	2	2.2
No	87	97.8
Total	89	100.0

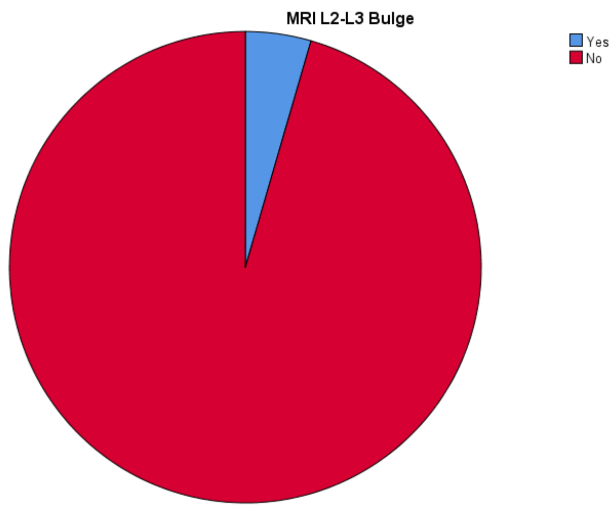


16. MRI Findings at L2–L3

At the L2–L3 level, MRI analysis demonstrated a low prevalence of disc abnormalities among the 89 participants. A disc bulge was identified in 4 individuals (4.5%), with 85 (95.5%) exhibiting no bulge. Similar to the L1–L2 level, there were no instances of disc protrusion, extrusion, or sequestration, as all participants (100%) showed normal findings for these parameters. These findings indicate that the L2–L3 segment is largely preserved in asymptomatic individuals. The occasional presence of a bulge may represent early degenerative changes or contribution of a confounding factor, underlining the need for careful clinical correlation with imaging results to determine clinical relevance in cohort.

Table 16: MRI Findings at L2–L3

MRI L2-L3 Bulge	Frequency	Percent
Yes	4	4.5
No	85	95.5
Total	89	100.0



17. MRI Findings at L3–L4

MRI evaluation at the L3–L4 level demonstrated mild degenerative changes among the 89 participants. A disc bulge was present in 4 individuals (4.5%), while 85 (95.5%) showed no bulge. Additionally, a disc protrusion was observed in 1 participant (1.1%), with 88 (98.9%) exhibiting no protrusion. No instances of disc extrusion or sequestration were identified, as all participants (100%) had normal findings in these categories. These results suggest that while the majority of subjects have normal disc morphology at L3–L4, a small fraction exhibit minor abnormalities. Such incidental findings underscore the need for clinical correlation in asymptomatic individuals, warranting further evaluation.

Table 17a: MRI Bulge Findings at L3–L4

MRI L3-L4 Bulge	Frequency	Percent
Yes	4	4.5
No	85	95.5
Total	89	100.0

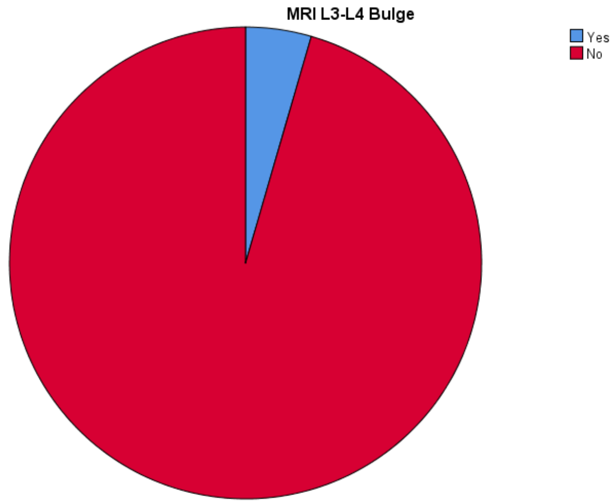
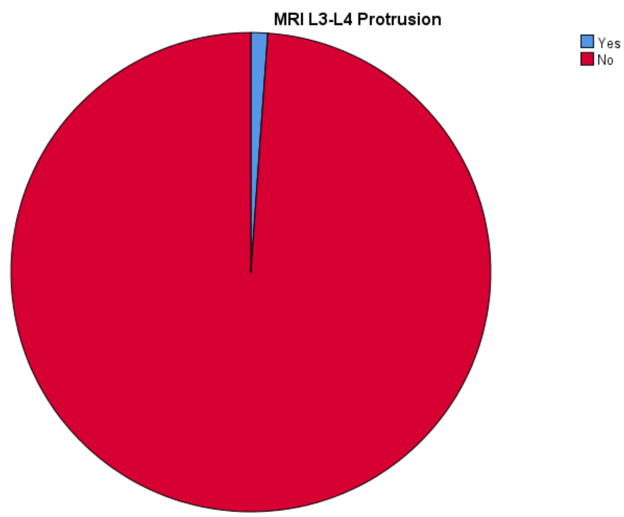


Table 17b: MRI protrusion Findings at L3–L4

MRI L3-L4 Protrusion	Frequency	Percent
Yes	1	1.1
No	88	98.9
Total	89	100.0



18. MRI Findings at L4–L5

At the L4–L5 level, MRI findings indicated more pronounced degenerative changes among the 89 participants. A disc bulge was identified in 26 individuals (29.2%), while 63 (70.8%) showed no bulge. Disc protrusion was observed in 8 participants (9.0%), with 81 (91.0%) having no protrusion. No instances of disc extrusion or sequestration were recorded, as all participants (100%) had normal findings for these categories. These results suggest that the L4–L5 segment is more susceptible to degeneration, even in asymptomatic individuals. The higher prevalence of bulges and protrusions at this level clearly underscores the importance of clinical evaluation while interpreting MRI findings.

Table 18a: MRI Bulge Findings at L4–L5

MRI L4-L5 Bulge	Frequency	Percent
Yes	26	29.2
No	63	70.8
Total	89	100.0

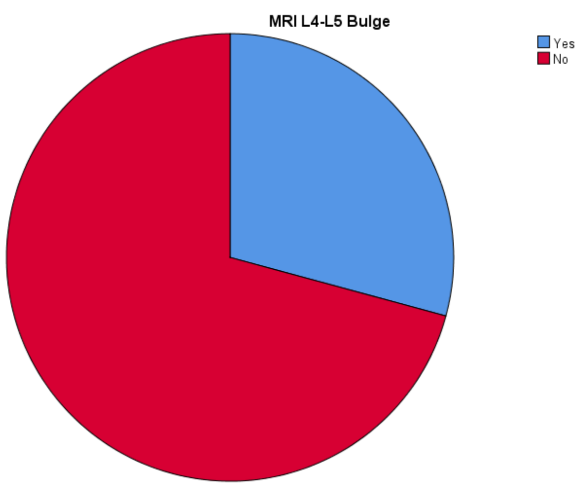
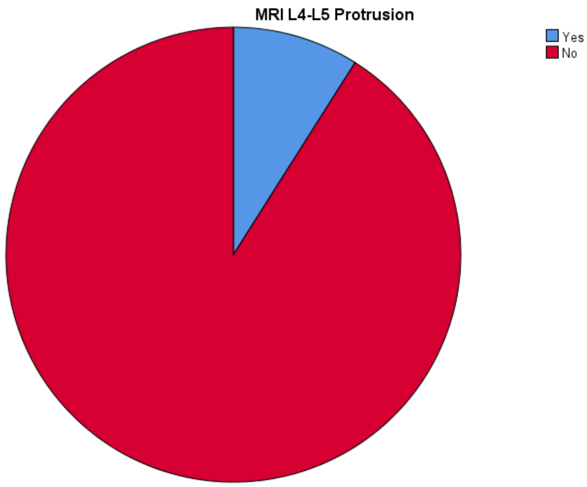


Table 18b: MRI Protrusion Findings at L4–L5

MRI L4-L5 Protrusion	Frequency	Percent
Yes	8	9.0
No	81	91.0
Total	89	100.0



19. MRI Findings at L5–S1

MRI evaluation at the L5–S1 level revealed degenerative changes among the 89 participants. A disc bulge was detected in 16 individuals (18.0%), with 73 (82.0%) showing no bulge. Disc protrusion was observed in 8 participants (9.0%), while 81 (91.0%) exhibited no protrusion. Similar to other lumbar levels, no cases of disc extrusion or sequestration were identified, as all participants (100%) had normal findings in these categories. These observations suggest that the L5–S1 segment demonstrates degenerative alterations in asymptomatic individuals. The findings emphasize the variability of disc pathology across lumbar segments and the importance of correlating imaging with clinical assessments.

Table 19a: MRI Bulge Findings at L5–S1

MRI L5-S1 Bulge	Frequency	Percent
Yes	16	18.0
No	73	82.0
Total	89	100.0

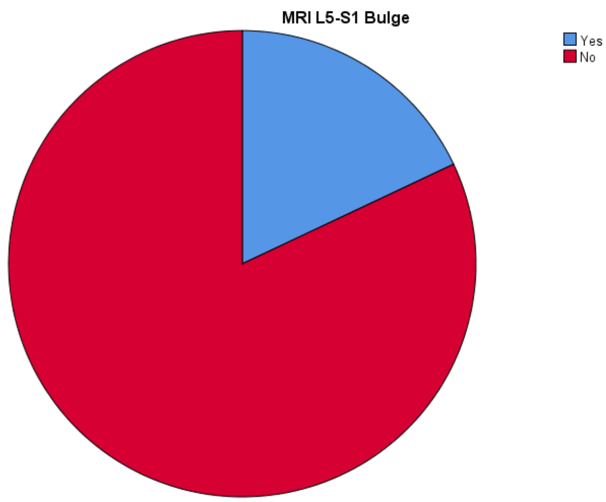
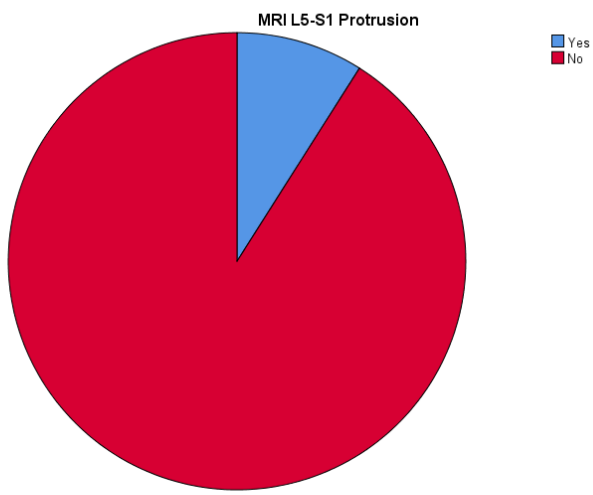


Table 19b: MRI protrusion Findings at L5–S1

MRI L5-S1 Protrusion	Frequency	Percent
Yes	8	9.0
No	81	91.0
Total	89	100.0



MRI Findings and Interpretation

The merged table reveals a comprehensive overview of lumbar disc pathology across multiple segments. In the L2-L3 region, there were no cases of protrusion, extrusion, or sequestration, with 100% of discs appearing normal, indicating minimal degenerative changes in this upper segment. In contrast, the L3-L4 level exhibited early degenerative alterations with 4.5% of discs showing bulges and 1.1% displaying protrusions, while extrusions and sequestrations remained absent. More pronounced changes were observed at the L4-L5 level, where 29.2% of discs had bulges and 9.0% showed protrusions, suggesting that this mid-lumbar segment bears greater mechanical stress. Similarly, the L5-S1 segment showed 18.0% of discs with bulges and 9.0% with protrusions, again with no extrusions or sequestrations. These findings highlight a trend where the lower lumbar segments, which are subject to higher mechanical loads, are more prone to early degenerative changes compared to the upper segments.

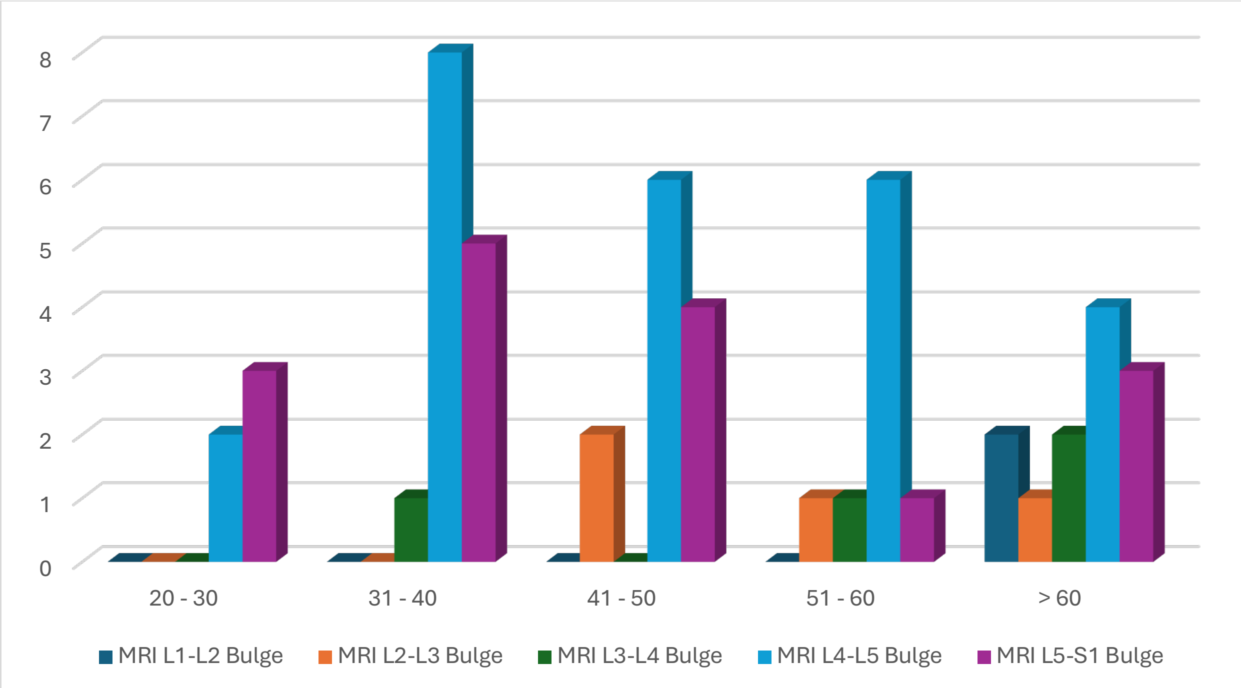
MRI Level	**Finding**	**Yes Frequency**	**Yes Percent**	**No Frequency**	**No Percent**	**Total Frequency**	**Total Percent**
L2-L3	Bulge	4	4.5	85	95.5	89	100.0
L2-L3	Protrusion	0	0.0	89	100.0	89	100.0
L3-L4	Bulge	4	4.5	85	95.5	89	100.0
L3-L4	Protrusion	1	1.1	88	98.9	89	100.0
L4-L5	Bulge	26	29.2	63	70.8	89	100.0
L4-L5	Protrusion	8	9.0	81	91.0	89	100.0
L5-S1	Bulge	16	18.0	73	82.0	89	100.0
L5-S1	Protrusion	8	9.0	81	91.0	89	100.0

20a. Age vs. MRI Bulge Findings

The analysis of age groups in relation to disc bulge findings across lumbar levels reveals age-related trends. At L1–L2, no bulges were observed in younger groups, with bulges appearing only in individuals over 60 years (2 cases, p=0.000). Similarly, for L2–L3 and L3–L4 levels, bulge occurrence increased with age, with p-values of 0.025 and 0.020 respectively. The L4–L5 level showed bulges across all age groups, peaking in the 31–40 years group (8 cases, p=0.001). L5–S1 bulges exhibited no significant age trend (p=0.152). These findings indicate that age is an important factor in disc bulge development. As age increases, there is a noticeable rise in the occurrence of bulges, particularly in the upper lumbar segments in our study. This supports further age analysis.

Table 20a: Age vs. MRI Bulge Finding

MRI Findings	20 - 30	31 - 40	41 - 50	51 - 60	> 60	P value
MRI L1-L2 Bulge	0	0	0	0	2	0.000
MRI L2-L3 Bulge	0	0	2	1	1	0.025
MRI L3-L4 Bulge	0	1	0	1	2	0.020
MRI L4-L5 Bulge	2	8	6	6	4	0.001
MRI L5-S1 Bulge	3	5	4	1	3	0.152

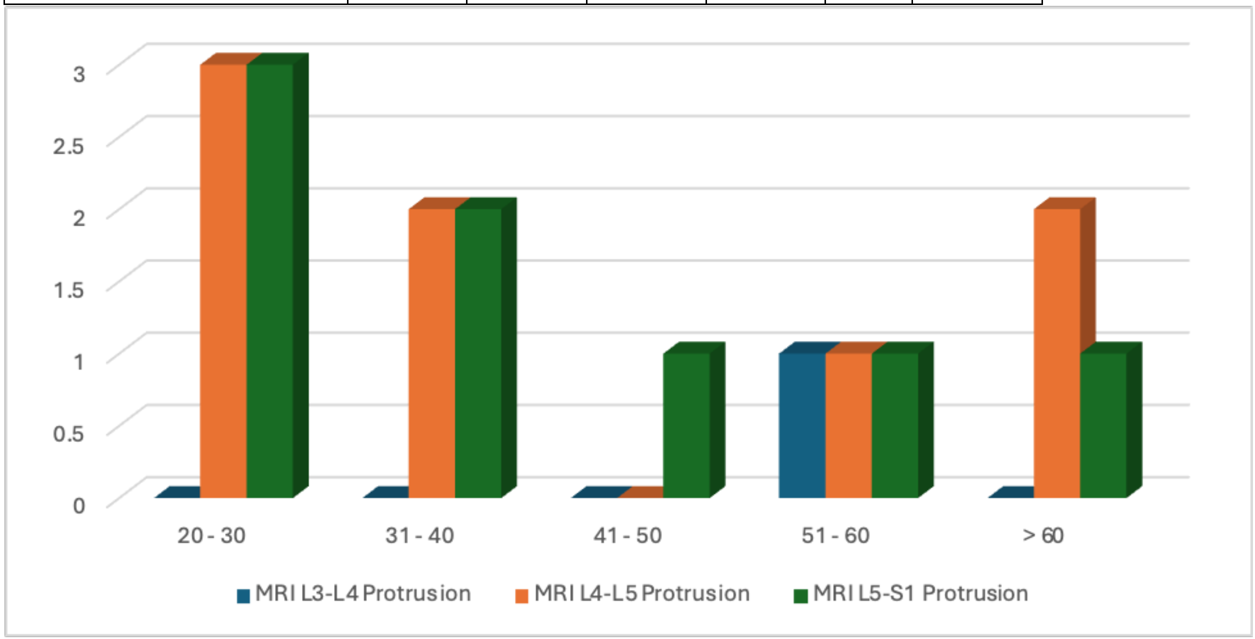


20b. Age vs. MRI Protrusion Findings

Age group analysis of disc protrusion findings across lumbar levels reveals distribution patterns among the 89 participants. At the L3–L4 level, a protrusion was observed only in the 51–60 years group (1 case, p=0.019). For the L4–L5 level, protrusions occurred with 3 cases in the 20–30 years group, 2 in the 31–40 years group, none in the 41–50 years group, 1 in the 51–60 years group, and 2 in the >60 years group (p=0.307). At the L5–S1 level, protrusions were distributed with 3, 2, 1, 1, and 1 cases across age groups (p=0.493). Age shows little influence on protrusion frequency.

Table 20b: Age vs. MRI Protrusion Findings

MRI Findings	20 - 30	31 - 40	41 - 50	51 - 60	> 60	P value
MRI L3-L4 Protrusion	0	0	0	1	0	0.019
MRI L4-L5 Protrusion	3	2	0	1	2	0.307
MRI L5-S1 Protrusion	3	2	1	1	1	0.493

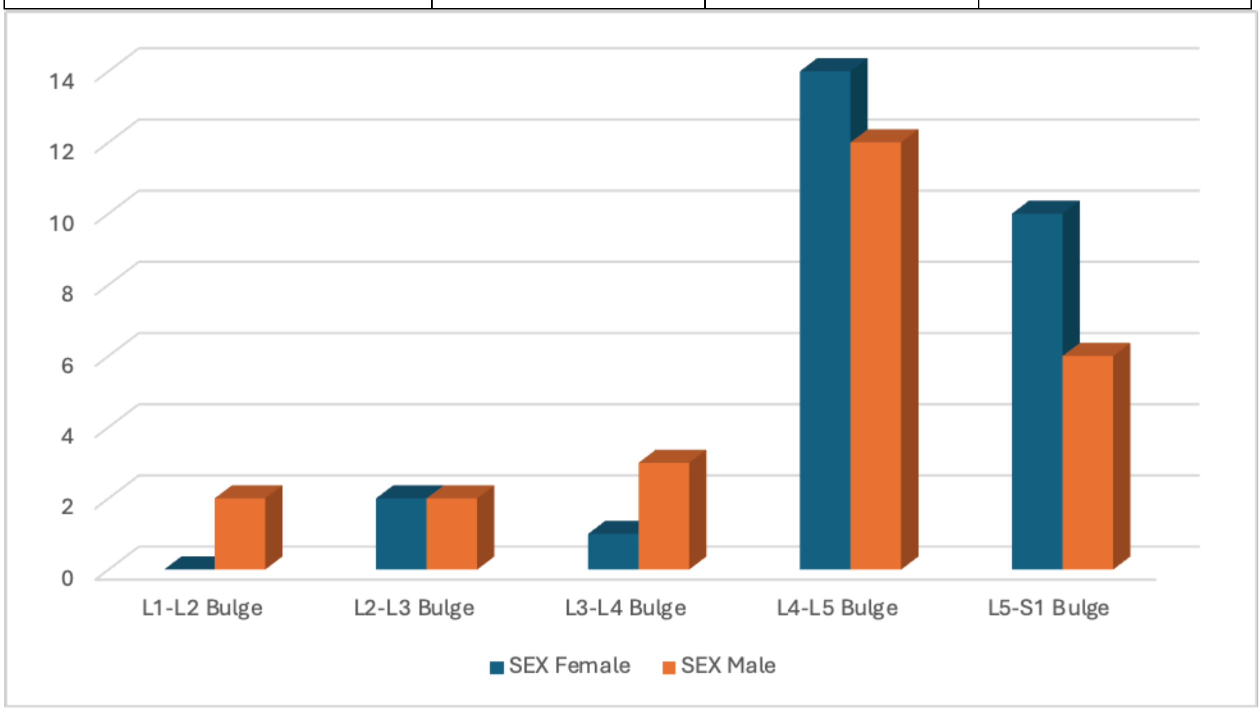


21a. Sex vs. MRI Bulge Findings

Analysis of MRI disc bulge findings by sex reveals no significant differences between female and male participants across most lumbar levels. At L1–L2, bulges were absent in females and present in 2 males (p=0.206). For L2–L3, both genders exhibited an equal distribution of bulges (2 cases each, p=0.799). At L3–L4, females had 1 bulge while males had 3 (p=0.438). The L4–L5 level showed 14 bulges in females and 12 in males (p=0.221), and at L5–S1, 10 females and 6 males had bulges (p=0.48). These results suggest that sex is not a major determinant of disc bulge occurrence.

Table 21a: Sex vs. MRI Bulge Findings

	SEX		
MRI Level	Female	Male	P value
L1-L2 Bulge	0	2	0.206
L2-L3 Bulge	2	2	0.799
L3-L4 Bulge	1	3	0.438
L4-L5 Bulge	14	12	0.221
L5-S1 Bulge	10	6	0.48

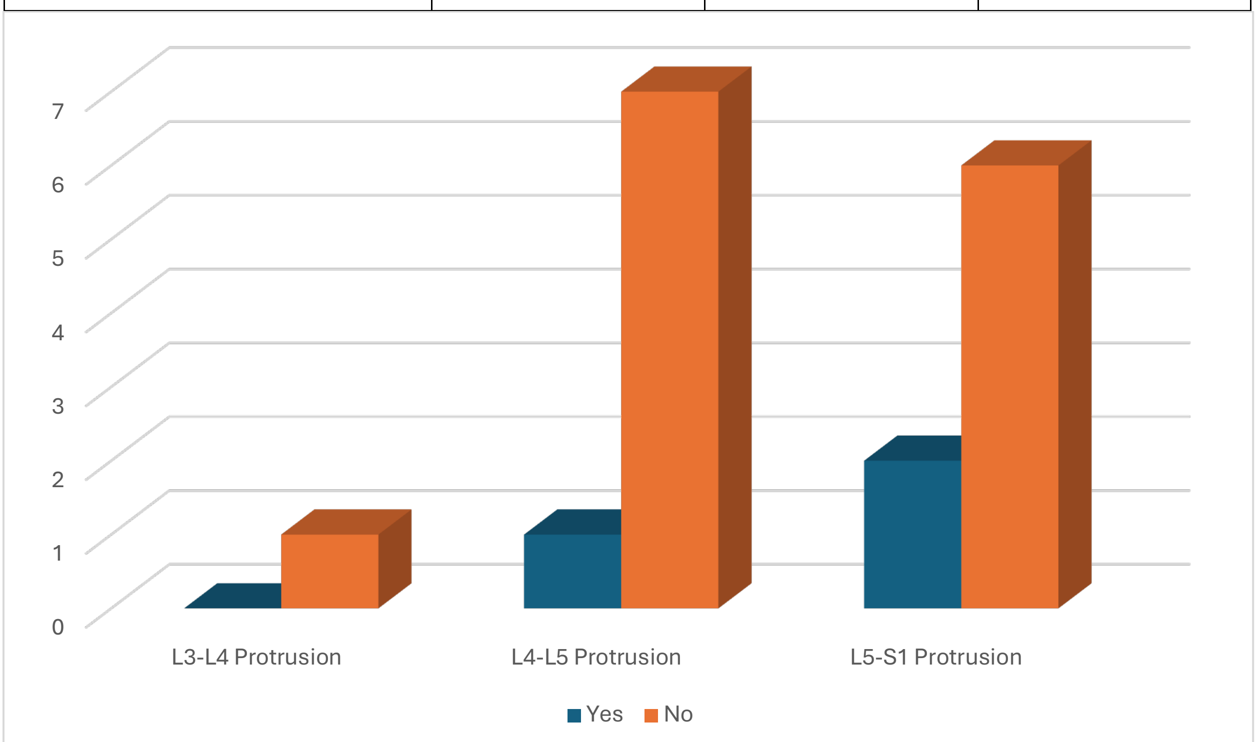


21b. Sex vs. MRI Protrusion Findings

Sex-based analysis of disc protrusion findings shows minimal differences between female and male groups. At the L3–L4 level, a protrusion was noted in 1 female and none in males, achieving statistical significance (p=0.024). At the L4–L5 level, both females and males exhibited equal occurrences of protrusion, with 4 cases each (p=0.712). Similarly, at the L5–S1 level, 3 protrusions in females and 5 in males were observed (p=0.706). These results indicate that while a slight difference was observed at L3–L4, overall, sex does not appear to be a strong predictor of disc protrusion, warranting further research.

Table 21b: Sex vs. MRI Protrusion Findings

	SEX		
MRI Level	Female	Male	P value
L3-L4 Protrusion	1	0	0.024
L4-L5 Protrusion	4	4	0.712
L5-S1 Protrusion	3	5	0.706

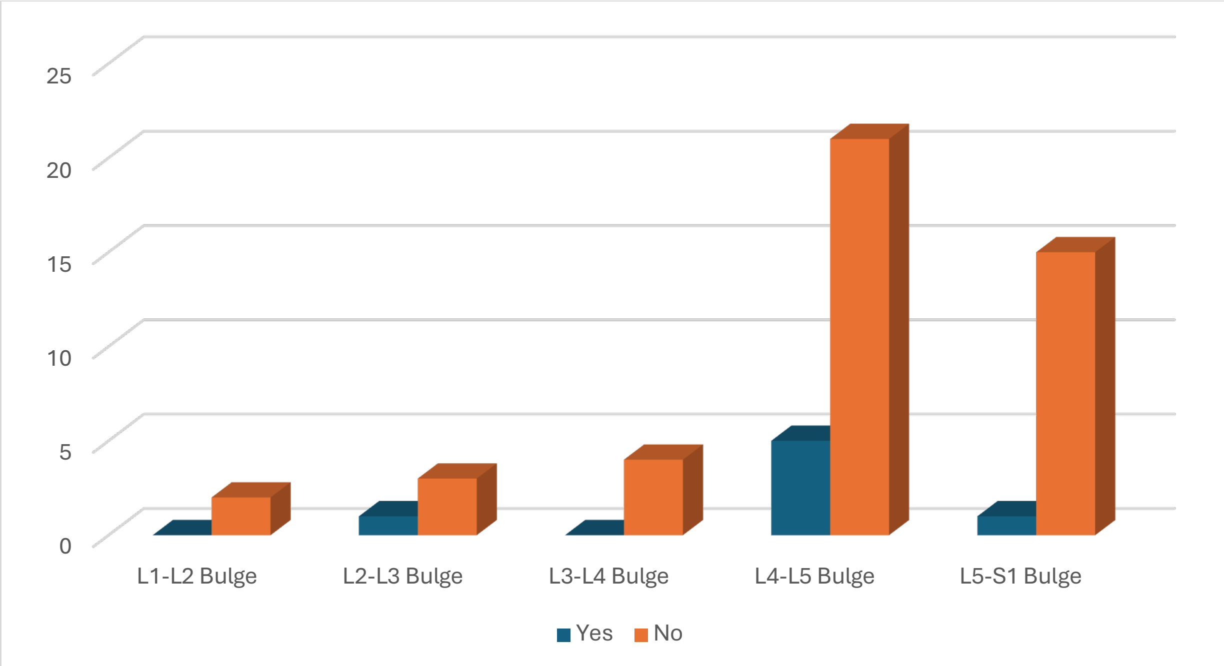


22a. Dietary vs. MRI Bulge Findings

Analysis of disc bulge findings by dietary habits reveals significant variations among the 89 participants. At the L1–L2 level, bulges were observed in 2 individuals following an “all” diet, with none in vegan or vegetarian groups (p=0.02). For the L2–L3 level, 3 cases were noted in the “all” group, none in vegans, and 1 in vegetarians (p=0.017). Similarly, at L3–L4, 3 cases were observed overall, with 1 case in vegetarians (p=0.001). At L4–L5 and L5–S1 levels, bulge frequencies varied significantly across dietary groups (p=0.015 and 0.025 respectively). These results suggest diet may influence disc bulge occurrence.

Table 22a: Dietary vs. MRI Bulge Findings

	Dietary			
MRI Level	All	Vegan	Vegetarian	P value
L1-L2 Bulge	2	0	0	0.02
L2-L3 Bulge	3	0	1	0.017
L3-L4 Bulge	3	0	1	0.001
L4-L5 Bulge	13	1	12	0.015
L5-S1 Bulge	10	1	5	0.025

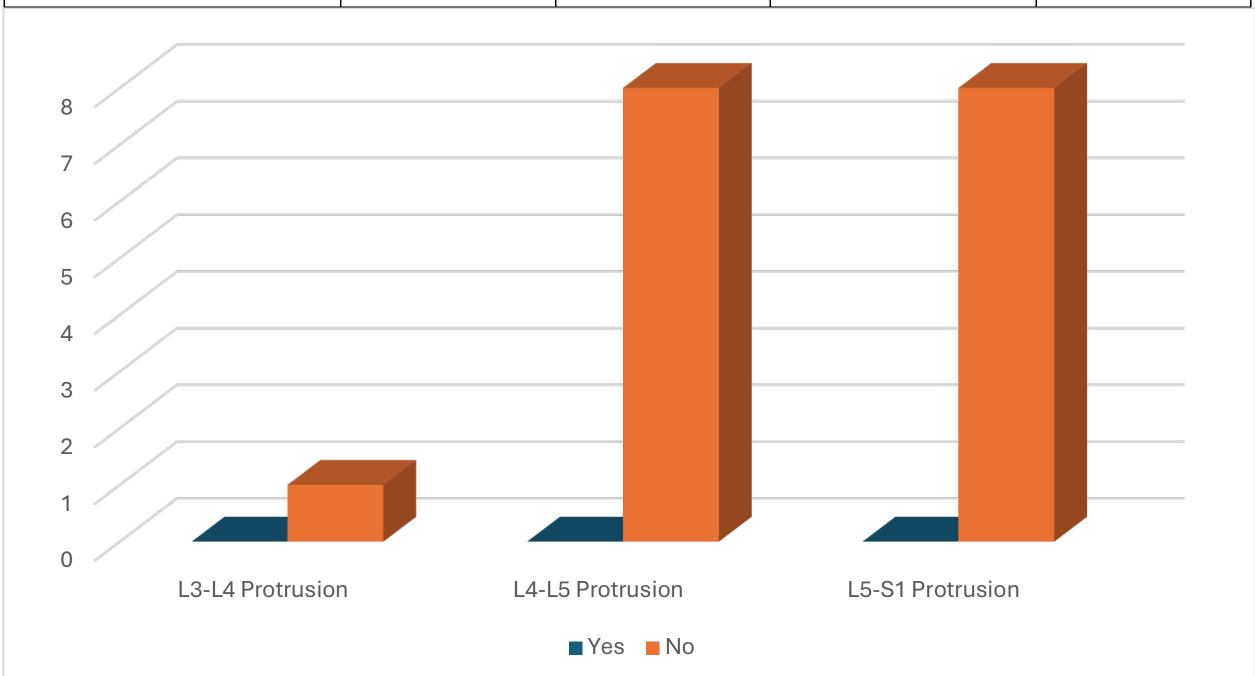


22b. Dietary vs. MRI Protrusion Findings

Dietary habits also appear to influence disc protrusion findings in this study. At the L3–L4 level, no protrusions were observed in the "all" or vegan groups, whereas 1 case was noted in the vegetarian group (p=0.049). For the L4–L5 level, protrusion was present in 5 individuals from the "all" group, none from vegans, and 3 from vegetarians, though the difference was not statistically significant (p=0.873). At the L5–S1 level, protrusions were found in 8 cases overall, with a significant difference observed across dietary groups (p=0.045). These results indicate that vegetarian diets may be associated with differences in disc protrusion occurrence. Since protrusion occurrences are relatively low in our study, the applicability of influence of dietary habits on the prevalence of protrusion is limited.

Table 22b: Dietary vs. MRI Protrusion Findings

	Dietary			
MRI Level	All	Vegan	Vegetarian	P value
L3-L4 Protrusion	0	0	1	0.049
L4-L5 Protrusion	5	0	3	0.873
L5-S1 Protrusion	8	0	3	0.045

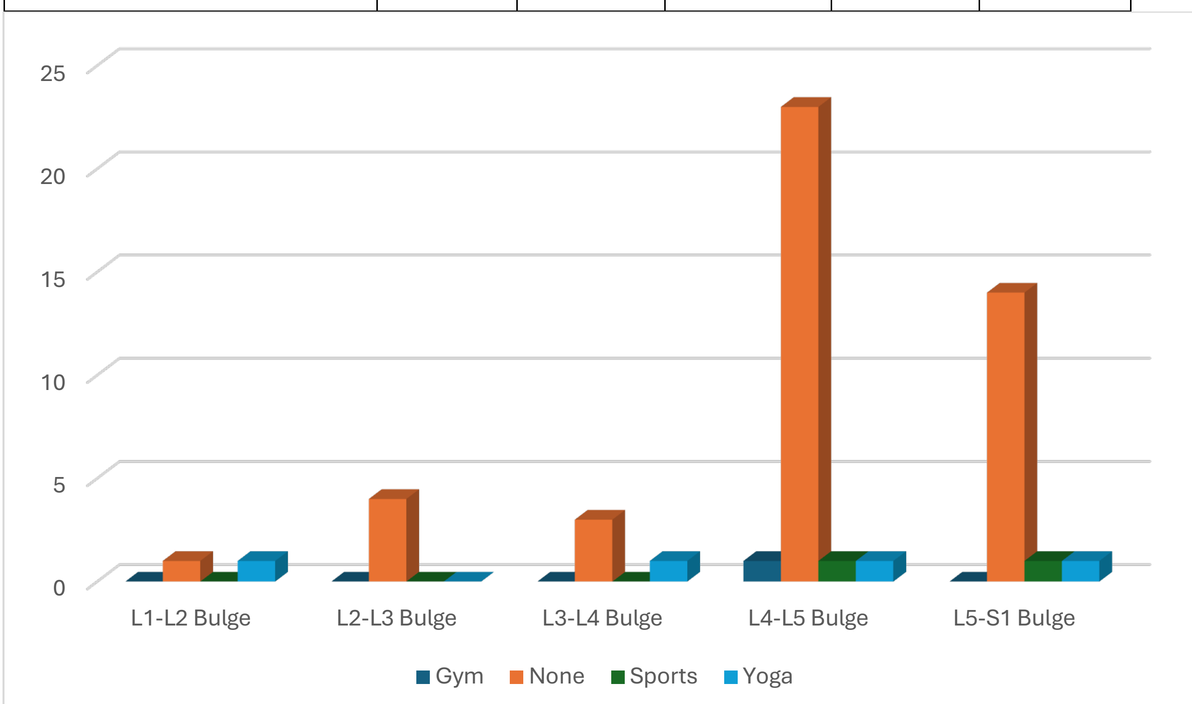


23a. Exercise vs. MRI Bulge Findings

Exercise habits were analyzed in relation to disc bulge findings, revealing significant associations at various lumbar levels. At L1–L2, minimal bulge occurrence was observed across exercise types, with no clear pattern (p=0.325). At L2–L3, bulges were significantly more frequent among non-exercisers (4 cases) compared to gym, sports, or yoga participants (p=0.024). Similarly, at the L3–L4 level, non-exercisers accounted for 3 cases (p=0.470). At L4–L5, the majority of bulges were found in non-exercisers (23 cases, p=0.036), and at L5–S1, non-exercisers again showed the highest frequency (14 cases, p=0.001). These findings suggest that prevalence of bulges is significantly less at all lumbar levels in exercise groups as compared to non-exercise group.

Table 23a: Exercise vs. MRI Bulge Findings

	Exercise				
MRI Level	Gym	None	Sports	Yoga	P value
L1-L2 Bulge	0	1	0	1	0.325
L2-L3 Bulge	0	4	0	0	0.024
L3-L4 Bulge	0	3	0	1	0.470
L4-L5 Bulge	1	23	1	1	0.036
L5-S1 Bulge	0	14	1	1	0.001

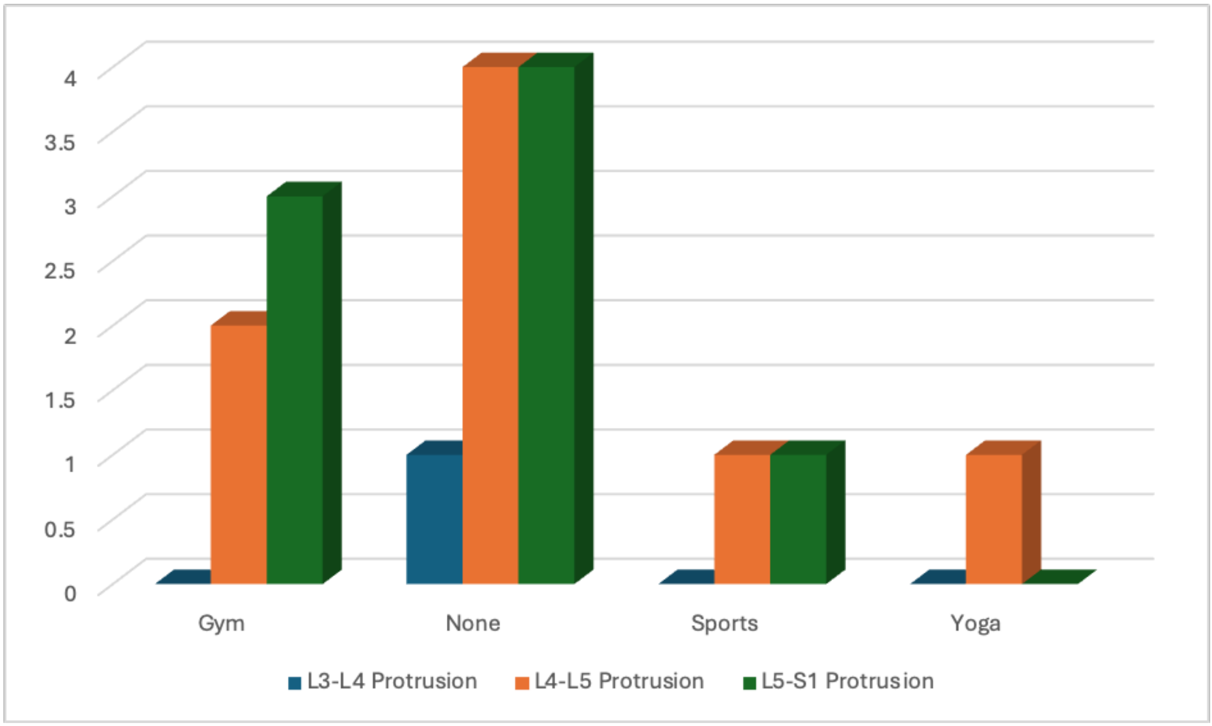


23b. Exercise vs. MRI Protrusion Findings

Exercise habits were further analyzed for their relationship with disc protrusion findings. At the L3–L4 level, a protrusion was noted in 1 case among non-exercisers, with no occurrences among gym, sports, or yoga participants (p=0.597). At the L4–L5 level, protrusions appeared in 2 cases among gym-goers, 4 cases in non-exercisers, 1 case in sports participants, and 1 case in yoga practitioners (p=0.035). At the L5–S1 level, protrusions were observed in 3 gym-goers, 4 non-exercisers, and 1 sports participant, with no cases among yoga practitioners (p=0.047). The prevalence of protrusions at the L4-L5 and L5-S1 levels shows borderline significance, suggesting a potential correlation between disc changes at these levels and exercise.

Table 23b: Exercise vs. MRI Protrusion Findings

MRI Level	Exercise				
	Gym	None	Sports	Yoga	P value
L3-L4 Protrusion	0	1	0	0	0.597
L4-L5 Protrusion	2	4	1	1	0.035
L5-S1 Protrusion	3	4	1	0	0.047

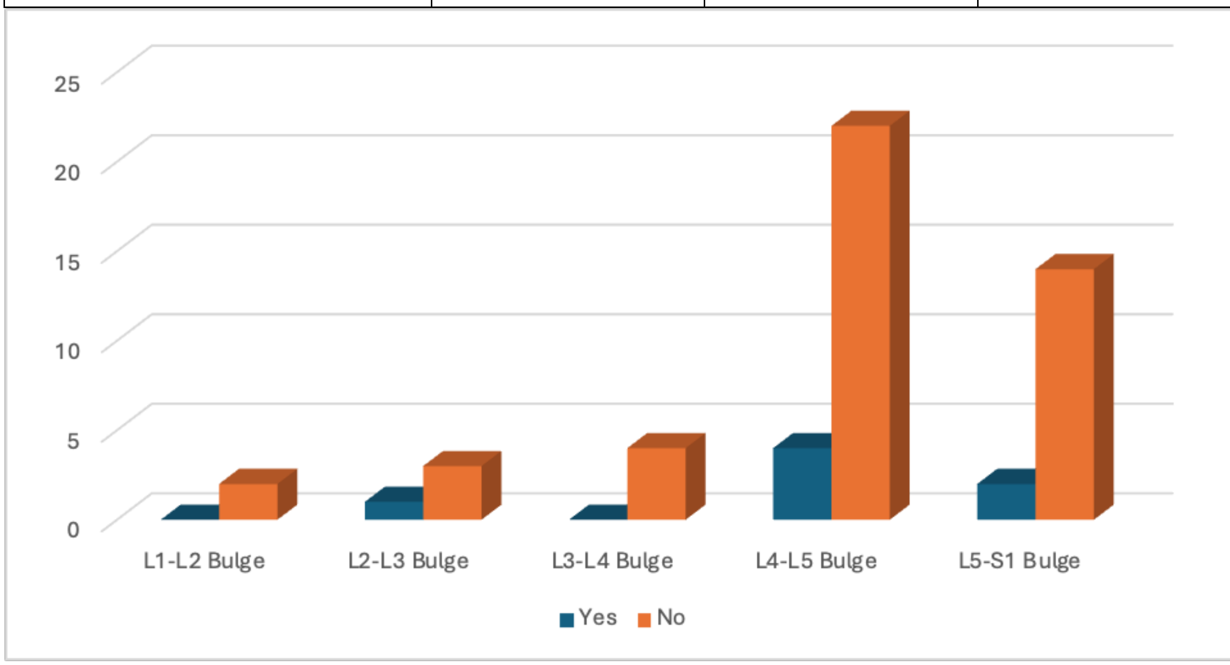


24a. Smoking vs. MRI Bulge Findings

The relationship between smoking status and disc bulge findings was assessed, revealing notable differences. At the L1–L2 level, no bulges were detected in smokers, whereas 2 cases were seen in non-smokers (p=0.572). At L2–L3, 1 smoker and 3 non-smokers exhibited bulges (p=0.048). At L3–L4, bulges were present in 0 smokers and 4 non-smokers (p=0.047). At L4–L5, 4 smokers and 22 non-smokers had bulges (p=0.036), while at L5–S1, 2 smokers and 14 non-smokers showed bulges (p=0.021). These results suggest smoking may be associated with disc bulge prevalence. However, the ratio of smokers to non-smokers in the study does not reflect that of the general population, raising questions about the applicability of these findings.

Table 24a: Smoking vs. MRI Bulge Findings

	Smoking		
MRI Level	Yes	No	P value
L1-L2 Bulge	0	2	0.572
L2-L3 Bulge	1	3	0.048
L3-L4 Bulge	0	4	0.047
L4-L5 Bulge	4	22	0.036
L5-S1 Bulge	2	14	0.021

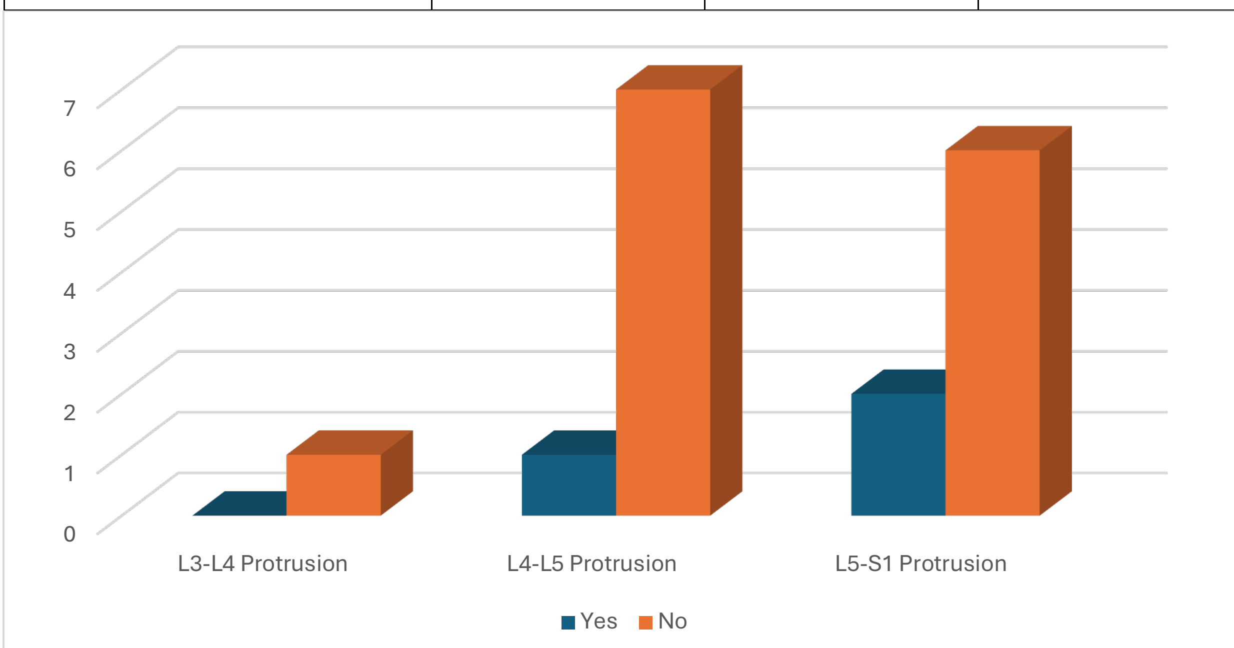


24b. Smoking vs. MRI Protrusion Findings

The analysis of smoking status in relation to disc protrusion revealed differential patterns. At the L3–L4 level, no protrusions were observed among smokers, while 1 case was found in non-smokers (p=0.691). At the L4–L5 level, 1 smoker and 7 non-smokers exhibited protrusions, yielding a significant difference (p=0.012). For the L5–S1 level, 2 smokers and 6 non-smokers showed protrusions (p=0.031). These findings suggest that smoking may influence the incidence of disc protrusions at certain lumbar levels, although the overall impact appears limited. Additional future research will provide insights.

Table 24b: Smoking vs. MRI Protrusion Findings

	Smoking		
MRI Level	Yes	No	P value
L3-L4 Protrusion	0	1	0.691
L4-L5 Protrusion	1	7	0.012
L5-S1 Protrusion	2	6	0.031

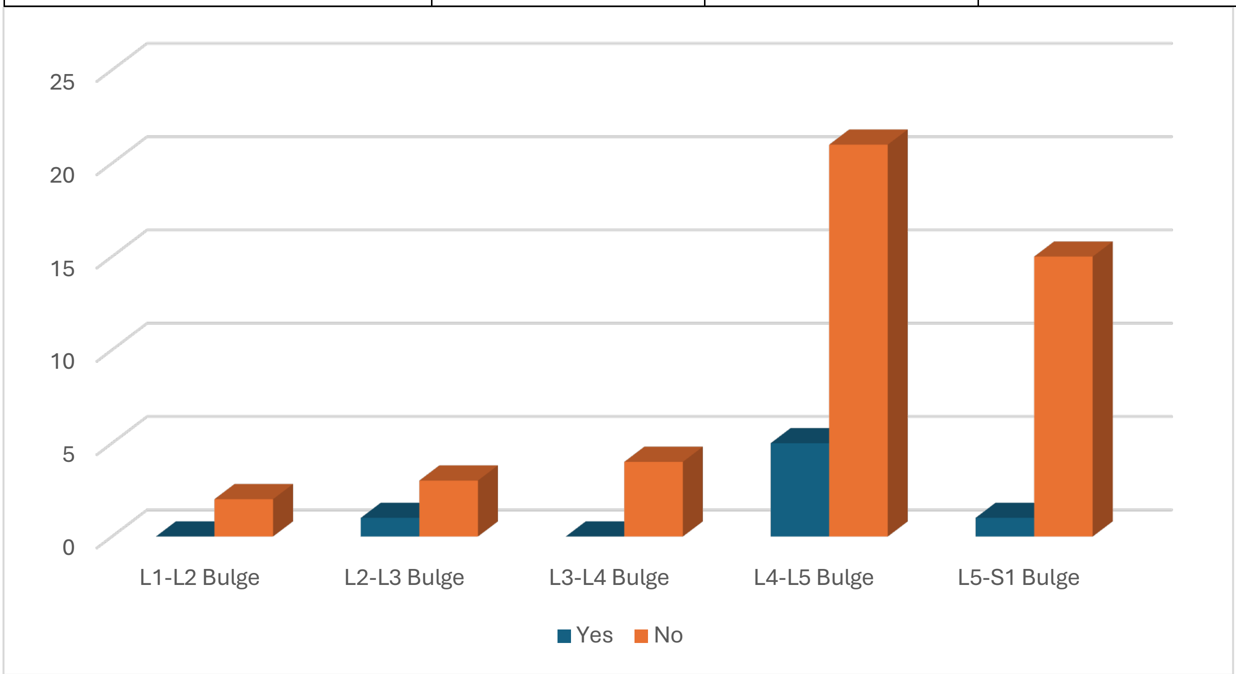


25a. Diabetes vs. MRI Bulge Findings

The relationship between diabetes status and disc bulge findings was evaluated among the 89 participants. At the L1–L2 level, no diabetic patients exhibited a bulge, while 2 non-diabetic individuals did (p=0.024). At L2–L3, 1 diabetic and 3 non-diabetics showed bulges (p=0.013). For the L3–L4 level, no bulges were observed in diabetic patients compared to 4 non-diabetics (p=0.582). At L4–L5, 5 diabetic individuals and 21 non-diabetics presented with bulges (p=0.003), while at L5–S1, 1 diabetic and 15 non-diabetics exhibited bulges (p=0.931).

Table 25a: Diabetes vs. MRI Bulge Findings

	Diabetes		
MRI Level	Yes	No	P value
L1-L2 Bulge	0	2	0.024
L2-L3 Bulge	1	3	0.013
L3-L4 Bulge	0	4	0.582
L4-L5 Bulge	5	21	0.003
L5-S1 Bulge	1	15	0.931

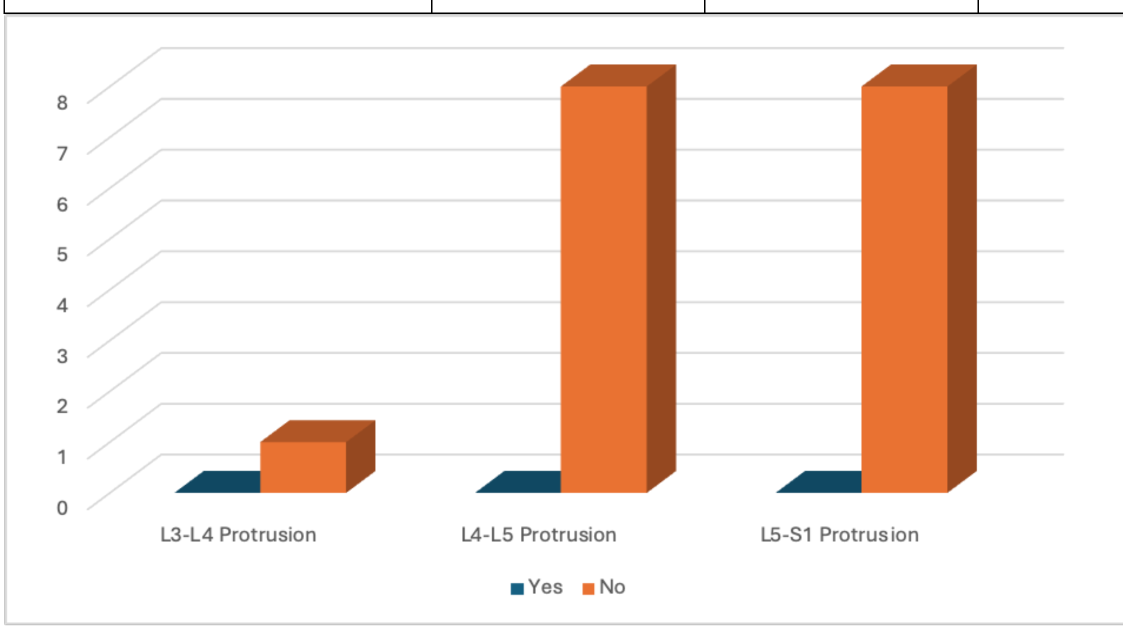


25b. Diabetes vs. MRI Protrusion Findings

The association between diabetes and disc protrusion was examined in this study. At the L3–L4 level, no diabetic patients exhibited protrusions, while 1 non-diabetic did (p=0.787). At the L4–L5 level, protrusions were absent in diabetics but observed in 8 non-diabetics (p=0.042). Similarly, at the L5–S1 level, no protrusions were found in diabetic patients compared to 8 non-diabetic individuals (p=0.042). These findings suggest that while diabetes is present in a small proportion of the cohort, it does not appear to be strongly associated with disc bulges and protrusion, although significant differences at certain levels warrant further investigation into this relationship. Overall, minimal association.

Table 25b: Diabetes vs. MRI Protrusion Findings

	Diabetes		
MRI Level	Yes	No	P value
L3-L4 Protrusion	0	1	0.787
L4-L5 Protrusion	0	8	0.042
L5-S1 Protrusion	0	8	0.042

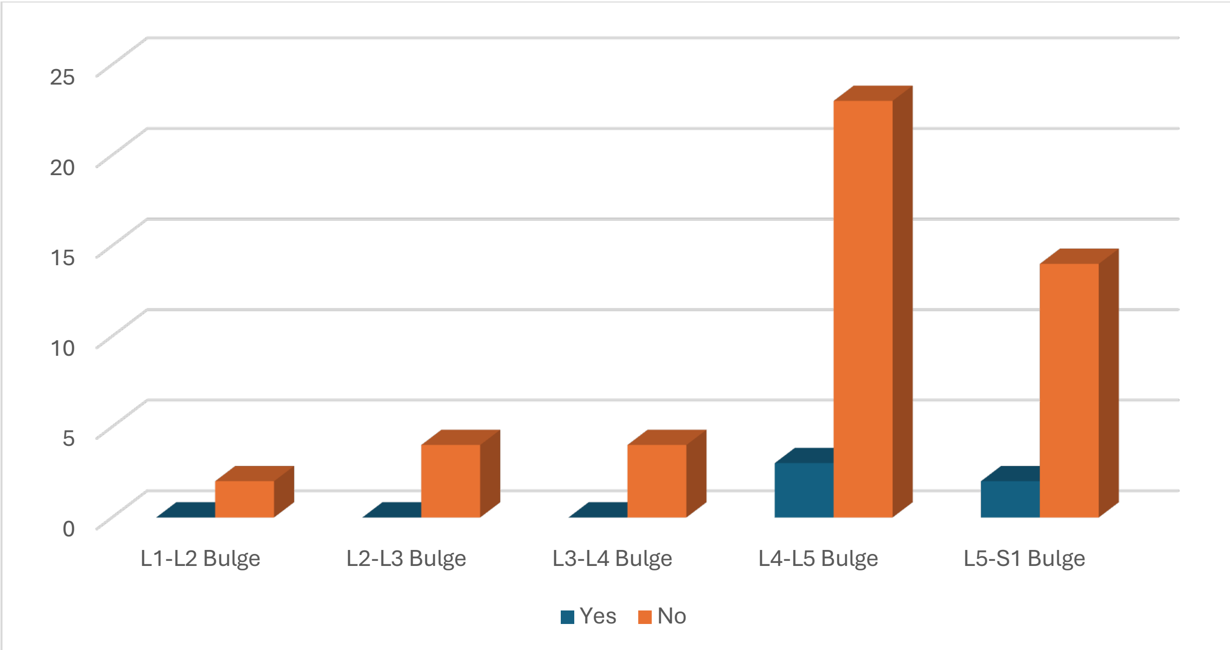


26a. Hypertension vs. MRI Bulge Findings

Hypertension status was analyzed in relation to disc bulge findings among the 89 participants. At the L1–L2 level, no hypertensive individuals exhibited bulges, while 2 non-hypertensive individuals did (p=0.789). At L2–L3 and L3–L4 levels, no bulges were observed in hypertensives compared to 4 cases in non-hypertensives (p=0.702 for both). At the L4–L5 level, 3 hypertensive and 23 non-hypertensive participants showed bulges (p=0.006), and at L5–S1, 2 hypertensives versus 14 non-hypertensives exhibited bulges (p=0.025). These findings suggest that hypertension may be associated with increased disc bulge occurrence at lower lumbar levels. This association highlights impact of blood pressure on spinal integrity.

Table 26a: Hypertension vs. MRI Bulge Findings

	Hypertension		
MRI Level	Yes	No	P value
L1-L2 Bulge	0	2	0.789
L2-L3 Bulge	0	4	0.702
L3-L4 Bulge	0	4	0.702
L4-L5 Bulge	3	23	0.006
L5-S1 Bulge	2	14	0.025

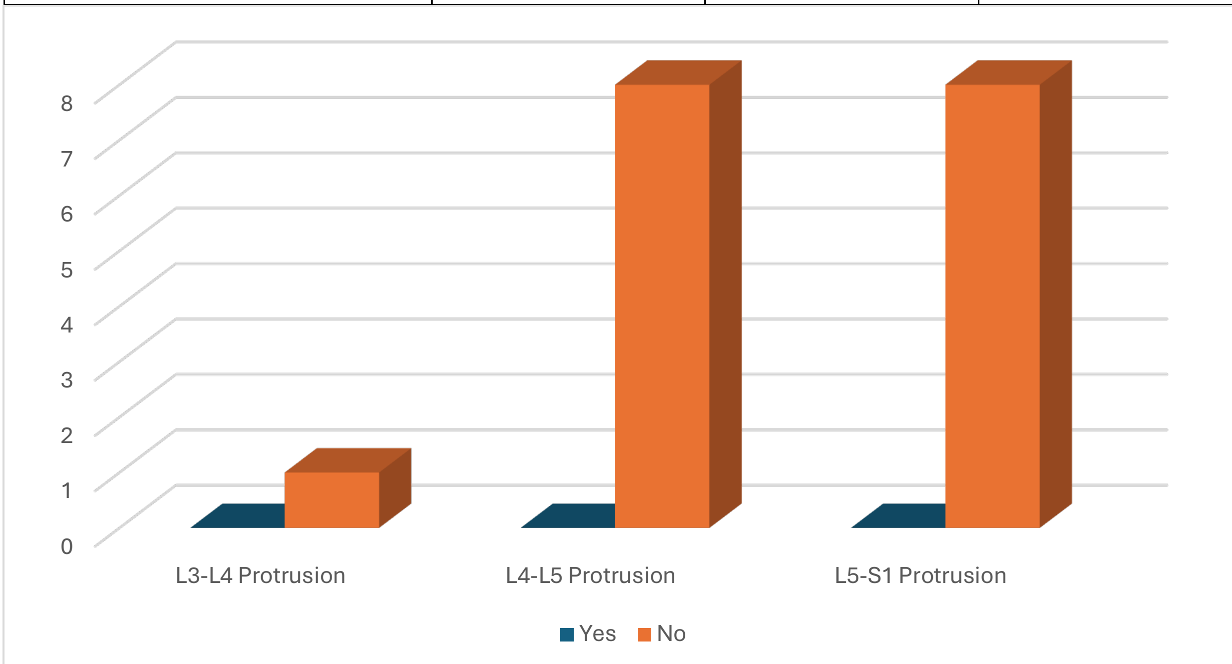


26b. Hypertension vs. MRI Protrusion Findings

Hypertension was further evaluated for its association with disc protrusion findings. At the L3–L4 level, 0 hypertensive and 1 non-hypertensive individual exhibited a protrusion (p=0.024). At the L4–L5 level, no hypertensive participants showed protrusions, while 8 non-hypertensive individuals did (p=0.001). At the L5–S1 level, again, no protrusions were found in hypertensive patients compared to 8 non-hypertensives (p=0.039). These results indicate that while hypertension is infrequent in this cohort, its presence may be linked to a lower occurrence of disc protrusions at certain lumbar levels, though further investigation is necessary.

Table 26b: Hypertension vs. MRI Protrusion Findings

	Hypertension		
MRI Level	Yes	No	P value
L3-L4 Protrusion	0	1	0.024
L4-L5 Protrusion	0	8	0.001
L5-S1 Protrusion	0	8	0.039

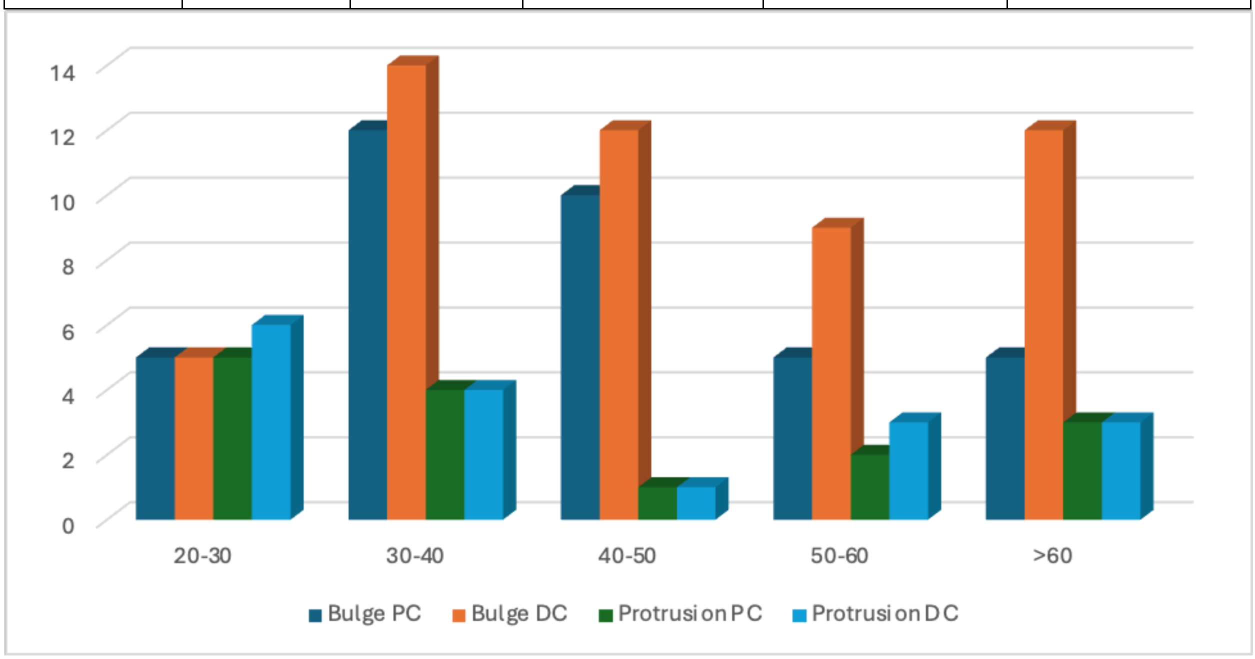


27a. Age Group vs. Disc Findings (Bulge & Protrusion)

Analysis by age group for disc findings as Person count (PC) and Disc Count (DC) revealed patterns in both bulge and protrusion classifications. In the 20–30 years group, there were 5 bulges categorized as PC and 5 as DC, with 5 protrusions classified as PC and 6 as DC (p=0.856). The 30–40 years group showed 12 PC and 14 DC bulges, with 4 PC and 4 DC protrusions (p=0.025). In the 40–50 years group, 10 PC and 12 DC bulges and 1 PC and 1 DC protrusions were noted (p=0.001). The 50–60 and >60 groups exhibited increasing bulge counts (specially DC) with significant p-values, indicating age-related progression in disc pathology.

Table 27a: Age Group vs. Disc Findings

Age Group	Bulge PC	Bulge DC	Protrusion PC	Protrusion DC	p value
20-30	5	5	5	6	0.856
30-40	12	14	4	4	0.025
40-50	10	12	1	1	0.001
50-60	5	9	2	3	0.000
>60	5	12	3	3	0.000

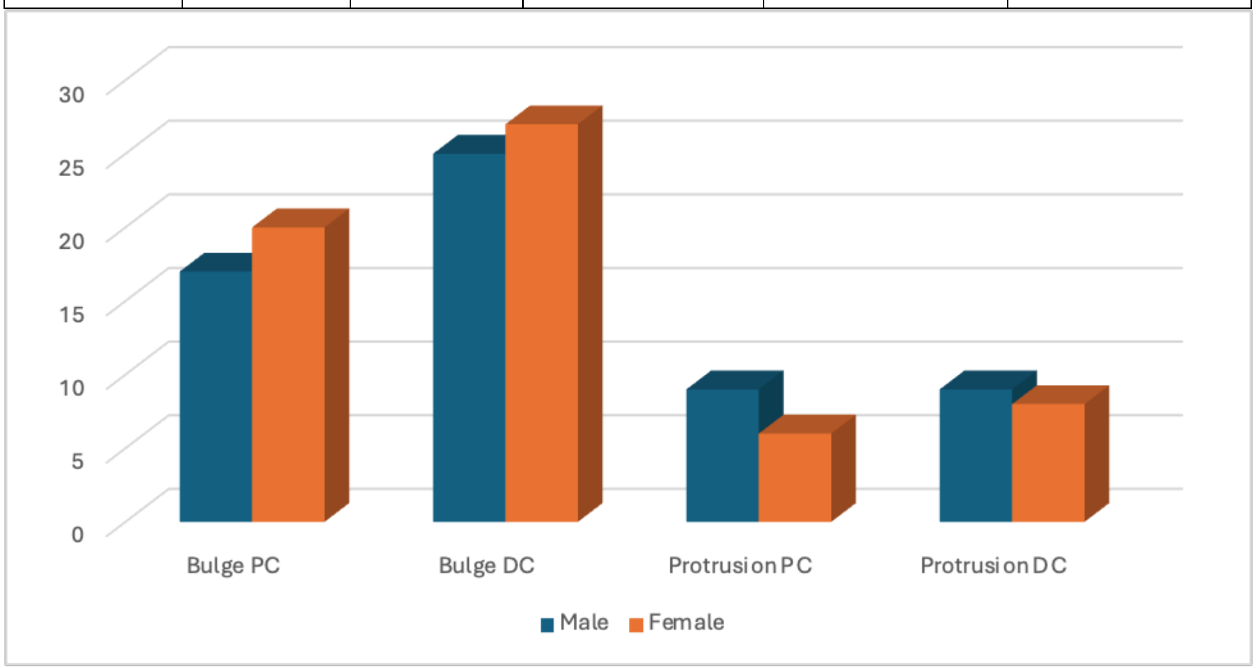


27b. Gender vs. Disc Findings

Gender-based analysis of disc findings (PC and DC) demonstrated significant differences in both bulge and protrusion occurrences. In the male group, 17 bulges were classified as PC and 25 as DC, with 9 protrusions noted as PC and 9 as DC (p=0.000). In contrast, the female group exhibited 20 PC and 27 DC bulges, along with 6 PC and 8 DC protrusions (p=0.000). The statistical significance in both gender comparisons suggests that sex plays a role in the manifestation of disc pathology. These findings underscore the need for gender-specific considerations in the evaluation and management of lumbar disc abnormalities. Gender differences are significant.

Table 27b: Gender vs. Disc Findings

Gender	Bulge PC	Bulge DC	Protrusion PC	Protrusion DC	P value
Male	17	25	9	9	0.000
Female	20	27	6	8	0.000

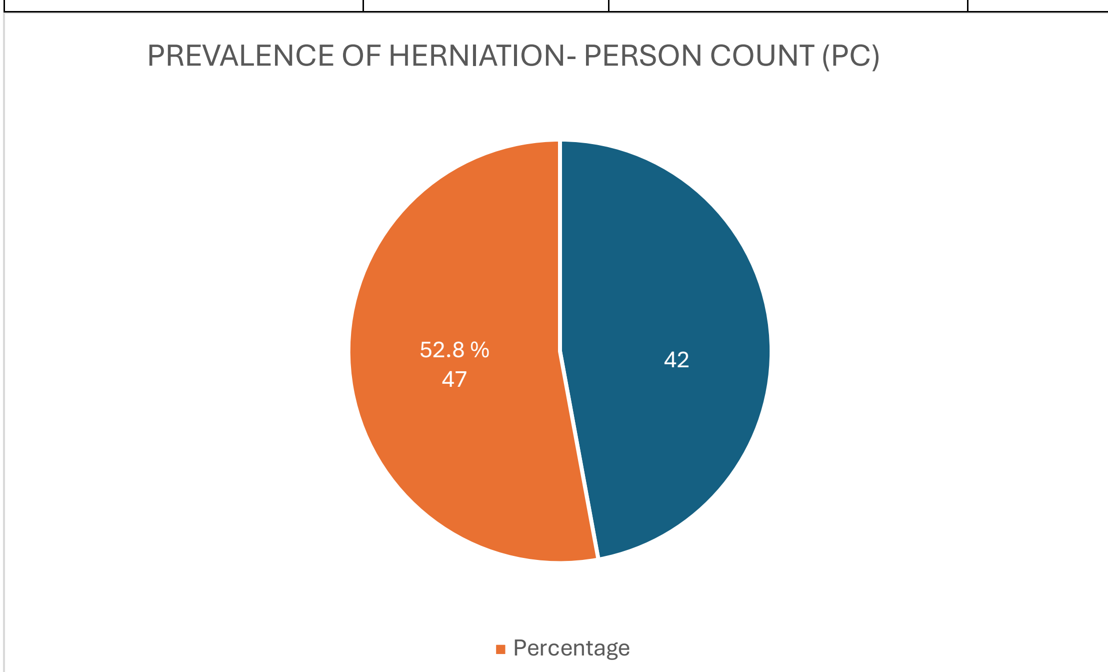


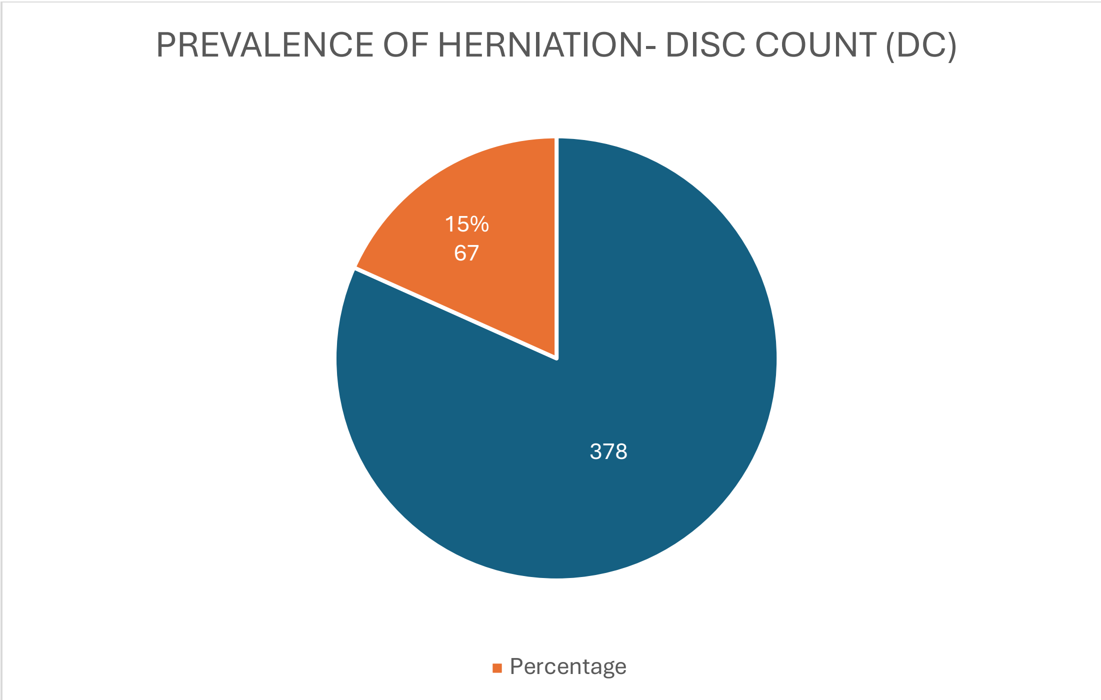
28. Total prevalence of herniations

Last categorization is prevalence of herniations in total, in terms of person count (PC) and disc count (DC). In the person count (PC) category, which included 89 participants, 47 cases of herniation were observed, resulting in a prevalence rate of 52.8%. In the disc count (DC) category, which comprised 445 discs, 67 discs were involved in herniation, yielding a prevalence rate of 15.0%. This analysis highlights the difference in herniation prevalence when categorized by person count versus disc count. The higher prevalence rate in the PC category compared to the DC category may suggest that some individuals have multiple herniated discs, which warrants further investigation.

Table 28: Total prevalence of herniations

Total Prevalence			
Herniation PC (n= 89)	Percentage	Herniation DC (n= 445)	Percentage
47	52.8	67	15.0




PREVALENCE OF HERNIATION- DISC COUNT (DC)
15%
67
378
Percentage

DISCUSSION

This study aimed to determine the prevalence and characteristics of lumbar disc herniation in asymptomatic individuals using 3T high-resolution MRI over one year. It sought to identify subtle degenerative changes in the lumbar spine, establishing a baseline of incidental findings that may not be pathological. By evaluating lumbar segments from L1–L2 to L5–S1, the study aimed to map the distribution of disc bulges and protrusions across various demographics and lifestyle factors. These findings can inform clinical decision-making by highlighting that degenerative changes can be part of normal aging and may not correlate with pain.

Section 1: Age

Our study enrolled 89 asymptomatic individuals (mean age 39.29 years; range 20–76), with 32.6% aged 20–30 years and 28.1% aged 31–40 years. Despite the younger age distribution, early degenerative markers like lower lumbar disc bulges were observed, suggesting age-related changes can begin before symptoms appear. This aligns with Sharma et al. (2014) [45], who found mechanical stress accelerates degeneration even in younger individuals (mean age 15.3 years). These early changes may mark the initial phase of a continuum leading to symptomatic pathology, emphasizing the need for preventive strategies such as lifestyle modifications and ergonomic interventions. The relatively low degenerative burden in our sample suggests these early findings may be normal variants, requiring cautious interpretation.

Section 2: Sex

In our cohort, 56.2% of participants were male and 43.8% were female, allowing for a meaningful comparison of lumbar disc morphology. Disc abnormalities such as bulges and protrusions were similar between sexes, though disc protrusion at L3–L4 was slightly more common in females. This aligns with Han and Jang (2018) [49], who reported minor gender differences in thoracic disc pathology. While subtle factors like biomechanical load or hormonal influences may contribute, our findings suggest that occupational and lifestyle factors play a more significant role in early degeneration. The absence of marked sex-related differences highlights that early disc changes may be common across genders and may not require differing clinical management in asymptomatic individuals.

Section 3: Anthropometric Parameters (Height, Weight, and BMI)

Anthropometric parameters like height, weight, and BMI provide insights into lumbar spine loading. In our study, the mean height was 168.53 cm, mean weight 69.52 kg, and average BMI 24.45 kg/m^2, placing most participants in a normal or slightly elevated BMI range. While generally healthy, even minor BMI variations may contribute to early disc changes, particularly at L4–L5 and L5–S1. Pan et al. (2019) [50] highlighted that imaging can reveal stress-related disc changes, and Banjade (2023) [52] linked higher BMI to severe disc pathology. Our homogeneous profile suggests early degeneration may stem from age and mechanical loading rather than obesity, reinforcing the value of weight management and exercise in protecting lumbar spine health.

Section 4: Occupation

Occupational activity significantly impacts spinal health due to varying mechanical stresses. In our study, 58.4% of participants were moderately active, 31.5% active, and 10.1% sedentary. This distribution suggests that while regular movement may promote spinal health, repetitive stress in active jobs or muscular deconditioning in sedentary roles can still contribute to disc abnormalities. The prevalence of L4–L5 disc bulges may reflect cumulative strain from tasks like heavy lifting or prolonged standing. This aligns with Sharma et al. (2014) [55], who linked occupational stress to greater spinal degeneration. These findings highlight the importance of ergonomic practices and regular exercise to protect lumbar spine health.

Section 5: Dietary Habits

Dietary habits can influence systemic inflammation and disc health. In our study, 65.2% followed an "all" diet, 32.6% were vegetarians, and 2.2% were vegans. While a balanced diet supports disc integrity, diets lacking anti-inflammatory components may promote degeneration. Although we did not measure inflammatory markers, systemic factors like nutrition may influence degenerative changes, as suggested by Sharma et al. (2014) [65]. The high proportion of participants with varied diets may explain the mild degeneration observed, while disc abnormalities in some vegetarians and vegans may reflect nutritional differences. This complex relationship highlights the need for further research on diet and disc health.

Section 6: Exercise

Physical activity is crucial for spinal health, yet 66.3% of our participants reported no regular exercise, while 15.7% attended gyms, 11.2% played sports, and 6.7% practiced yoga. This high sedentary rate may contribute to the observed disc bulges at L4–L5 and L5–S1, aligning with Afridi (2023) [63], who linked inactivity to lumbar disc abnormalities. Regular exercise supports disc nutrition and core strength, while inactivity may promote deconditioning and mechanical stress. Yoga may offer added benefits for spinal alignment, whereas high-impact sports could increase microtrauma risks. These findings underscore the need for targeted exercise strategies to prevent or slow disc degeneration.

Section 7: Smoking

In our study, 13.5% of participants were smokers, and 86.5% were non-smokers. Despite this low prevalence, smoking showed significant associations with disc bulges at L4–L5 and L5–S1 (p-values 0.021–0.048), suggesting even modest tobacco exposure may worsen disc degeneration. Smoking likely accelerates degeneration by reducing disc vascular supply, increasing inflammation, and inducing oxidative stress, aligning with Sharma et al. (2014) [55]. While Hurinovich and Solovyov (2015) [66] linked smoking to symptomatic disc herniation, our findings reveal that subclinical changes may already exist in asymptomatic smokers, reinforcing the value of smoking cessation in preventing disc degeneration.

Section 8: Systemic Conditions (Diabetes and Hypertension)

In our study, 6.7% of participants had diabetes and 3.4% had hypertension, both showing significant associations with disc bulges at L4–L5 ($p = 0.003$ for diabetes; $p = 0.006$ for hypertension) and L5–S1 ($p = 0.025$ for hypertension). These conditions may promote early lumbar degeneration via microvascular compromise and chronic inflammation, impairing disc nutrition. Zhong et al. (2017) [68] highlighted systemic effects on nerve function and disc integrity. Despite their low prevalence, our findings emphasize the need for blood sugar and pressure control to preserve lumbar spine health.

Section 9: MRI Findings Across Lumbar Levels

MRI findings in our study showed minimal degeneration at upper lumbar levels (L1–L2: 2.2% bulges; L2–L3: 4.5% bulges; L3–L4: 4.5% bulges, 1.1% protrusions). In contrast, lower lumbar segments had more changes (L4–L5: 29.2% bulges, 9.0% protrusions; L5–S1: 18.0% bulges, 9.0% protrusions), reflecting greater mechanical stress. No extrusions or sequestrations were observed, suggesting mild degeneration typical of early-stage changes. These results align with Hurinovich and Solovyov (2015) [66] and Banjade (2023) [62], reinforcing that lower lumbar levels are more prone to early degenerative changes.

Section 10: Associations of Demographic and Lifestyle Factors with MRI Findings

Our study revealed that age significantly influenced disc degeneration, with older individuals showing more bulges at L4–L5 ($p = 0.001$), L3–L4 ($p = 0.020$), and L2–L3 ($p = 0.025$), likely due to cumulative stress. While sex differences were minimal, disc protrusions at L3–L4 were more common in females ($p = 0.024$). Sedentary behavior correlated with increased bulges at L4–L5 ($p = 0.036$) and L5–S1 ($p = 0.001$). Smoking (13.5% of participants) was linked to bulges at several levels ($p = 0.021$–0.048). Diabetes ($p = 0.003$) and hypertension ($p = 0.006$) were associated with disc changes, emphasizing the combined impact of age, lifestyle, and systemic factors on spinal health.

Section 11: Prevalence of herniation as Person Count (PC) and Disc Count (DC)

Our study found a herniation prevalence of 52.8% by person count (PC) and 15% by disc count (DC), indicating some individuals had herniations at multiple levels. Dammers R et al. (2002) [23] noted that with aging, lumbar disc herniation often shifts to higher levels, starting at the lower lumbar segments, likely due to mechanical stress. This variation highlights the influence of genetics, activity levels, and biomechanics on multilevel herniations. Management options include conservative treatments like medication, physical therapy, and injections, or surgery based on symptom duration, patient preference, and neurological status [24].

LIMITATIONS

Despite its strengths, the study is subject to several limitations that must be acknowledged. First, the cross-sectional design limits the ability to establish causality or to track the progression of degenerative changes over time. Because the study captures a single point in time, it is difficult to determine whether the observed disc abnormalities will eventually develop into clinically significant conditions. Second, the sample size, while adequate for initial analysis, may not be large enough to fully represent general population. Additionally, the study population consisted solely of asymptomatic individuals, which, although valuable for identifying early degenerative changes, does not allow for direct comparisons with symptomatic cohorts. The reliance on self-reported data for lifestyle variables such as exercise habits, dietary patterns, and smoking status introduces the possibility of reporting bias, which could influence the accuracy of these associations. Lastly, potential confounding factors, such as genetic predisposition or occupational details beyond the general activity level, were not exhaustively explored. These limitations suggest that while the study offers valuable insights, caution is warranted when extrapolating the findings to broader clinical practice, and they highlight areas for improvement in future research endeavors.

SUMMARY

This study evaluated the prevalence and characteristics of lumbar disc herniation in 89 asymptomatic individuals using 3T high-resolution MRI over one year, examining lumbar segments from L1–L2 to L5–S1. The findings highlight that degenerative changes in the spine can be part of the normal aging process and may not necessarily correlate with pain. Participants had a mean age of 39.29 years, with early degenerative markers detectable even in younger individuals, suggesting the potential benefit of preventive measures. The prevalence of disc abnormalities was similar between sexes, indicating that sex may not significantly influence early disc degeneration. Anthropometric parameters, such as BMI, play a crucial role in lumbar disc health, emphasizing the importance of maintaining a healthy weight. Occupational activity influenced the development of subtle disc abnormalities, highlighting the impact of job-related mechanical stress on spinal health. Balanced diets potentially contributed to milder degenerative changes. Physical activity played a pivotal role in maintaining spinal health, with sedentary behavior linked to higher prevalence of disc bulges at L4–L5 and L5–S1 levels. Smoking was associated with disc bulges at multiple lumbar levels, suggesting that even modest exposure to tobacco may exacerbate degeneration. Systemic conditions like diabetes and hypertension were linked to early degenerative changes in the lumbar spine. MRI findings indicated that the lower lumbar spine bore more pronounced degenerative changes. The study emphasized a holistic approach to spinal health, including preventive strategies and lifestyle modifications to mitigate degenerative changes, and analyzed the prevalence of herniations by person count (PC) and disc count (DC), revealing some individuals had herniations at multiple levels.

Summary of Statistical Associations:

- Significant associations were found between age and disc bulges at L1–L2 ($p = 0.000$), L2–L3 ($p = 0.025$), L3–L4 ($p = 0.020$), and L4–L5 ($p = 0.001$); for disc protrusions at L3–L4 ($p = 0.019$).
- Associations with exercise, smoking, and systemic factors were also observed with various significant p-values.

CONCLUSION

This study highlights the prevalence of lumbar disc herniations in asymptomatic individuals, as detected by high-resolution MRI. Among 89 participants (mean age: 39.29 years), a balanced gender distribution and young-to-middle-aged predominance enhanced generalizability. Degenerative changes increased significantly with age, with minimal findings in upper lumbar levels (L1–L2, L2–L3) and higher prevalence of bulges and protrusions at L4–L5 and L5–S1 along with a greater frequency of herniations across multiple levels as age advances. Physical activity appeared protective against degeneration, while lifestyle factors like smoking played contributory roles. The absence of severe herniations (extrusions or sequestrations) in our study suggests that such cases may be associated with clinical symptoms and were therefore excluded from the cohort. The findings emphasize cautious interpretation of incidental MRI findings to avoid overdiagnosis. The integration of comprehensive demographic, clinical, and imaging data in this study not only enhances our understanding of the natural history of lumbar disc degeneration but also provides a baseline for future research aimed at identifying individuals at risk for progression to symptomatic disease.

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ANNEXURES- I

INFORMED CONSENT FORM

"PREVALENCE OF LUMBAR INTERVERTEBRAL DISC HERNIATION IN ASYMPTOMATIC INDIVIDUALS ON MAGNETIC RESONANCE IMAGING: A ONE YEAR HOSPITAL BASED CROSS-SECTIONAL STUDY"

Name of Student/Principal Investigator: REG NO.- BS0122012

Introduction: you are being invited to participate in this study to estimate the prevalence of lumbar disc herniation in asymptomatic individuals using MRI spine scan.

Explanation of procedure: If, you agree to be part of the research study, you will be asked

the relevant history and you will be subjected to relevant clinical examination

and investigations.

Withdrawal from participation in the study: Participation in this study in voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will/will not get any benefits by participating in this study. The data gathered will help population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person to identify you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.
Cost of investigations done during the course of study will be paid by the **principal investigator / Participant.** (Strike out which is not applicable)

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purpose and or presented to scientific groups.

However, your identity will never be revealed.

Questions: In case of any questions with regard to this study, you are free to contact: REG NO.- BS0122012

Postgraduate

Department of Radiodiagnosis

Jawaharlal Nehru Medical College

KAHER, Belagavi – 590010

Karnataka

Legal rights: By signing this consent form, we are not waving any of your legal rights

CONSENT STATEMENT

I am making a voluntary decision to participate in the study **“PREVALANCE OF LUMBAR INTERVERTEBRAL DISC HERNIATION IN ASYMPTOMATIC INDIVIDUALS ON MAGNETIC RESONANCE IMAGING: A ONE YEAR HOSPITAL BASED CROSS-SECTIONAL STUDY”**. My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE- II

PREVALENCE OF LUMBAR INTERVERTEBRAL DISC HERNIATION IN ASYMPTOMATIC INDIVIDUALS ON MAGNETIC RESONANCE IMAGING

Questionnaire

A) BIODATA

Name						
Contact details						
Scan no						
Age	20-29	30-39	40-49	50-59	60-69	70-80
Sex	Male	Female				
Height						
Weight						
BMI	<18.5 (underweight)	18.5- 24.9 (normal)	25.0- 25.9 (overweight)	30.0- 34.9 (obesity-I)	35.0- 39.9 (obesity-II)	>40.0 (obesity-III)

B) RISK FACTORS

1. Occupation: sedentary/moderately active/ active
2. Dietary habits: vegetarian/ vegan/ all
3. Exercise: gym/ yoga/ sports/ none
4. Smoking: yes/ no
5. Diabetes: yes/ no
6. Hypertension: yes/no
7. Medication:
8. Surgical history:
9. Family history:
10. COVID-19 infection:
11. Other past medical conditions (nutrient deficiency/chronic infection or inflammation)

C) MRI FINDINGS

LEVEL	Bulge	Protrusion	Extrusion	Sequestration
LI-L2				
L2-L3				
L3-L4				
L4-L5				
L5-S1				

ANNEXURES- III- FIGURES

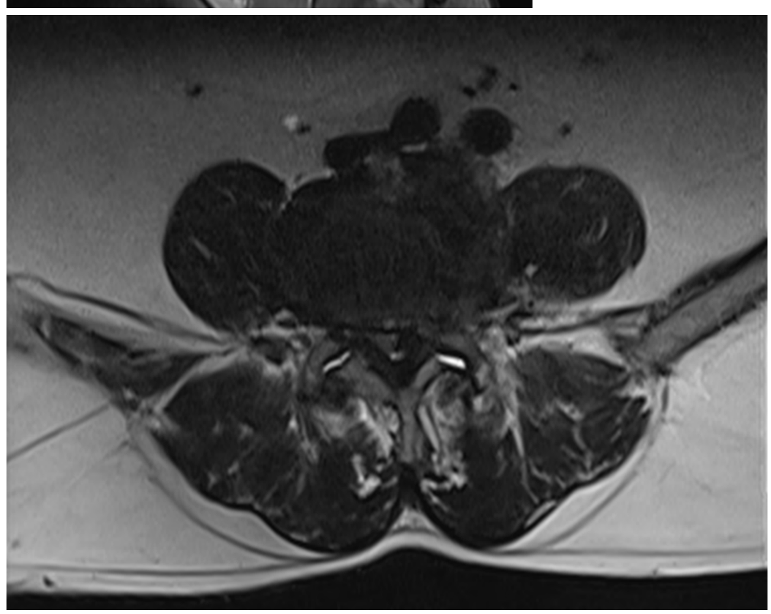
3.0 Tesla Siemens MRI machine (Mangnetom Spectra) used for the study

CASE 1

A 77 year old male labourer with history of heavy weight lifting came with complaints of neck pain radiating to right shoulder. Lumbar spine MRI images T2WI sagittal [a] & axial [c] and T1WI sagittal [b] images show disc bulges at L4-L5 and L5-S1 level with ligamentum flavum hypertrophy on both sides. In combination with grade I anterolisthesis of L4 over L5, the disc bulge is resulting in spinal canal narrowing at L4-L5 level

[b]

[a]



[c]

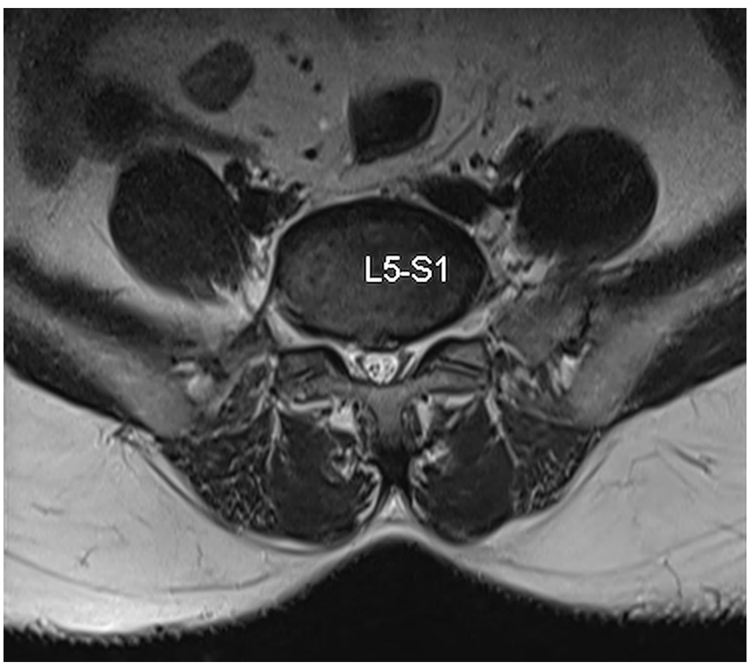
CASE 2

A 56-year-old female with a moderately active lifestyle and no engagement in additional exercise presented with complaints of chronic occipital headache. MRI screening of the spine was advised to evaluate for cervical myelopathy.

T2-weighted axial [a] and sagittal [b] images revealed a posterocentral disc protrusion at the L5-S1 level with an associated focal annular fissure.

[b]

[a]



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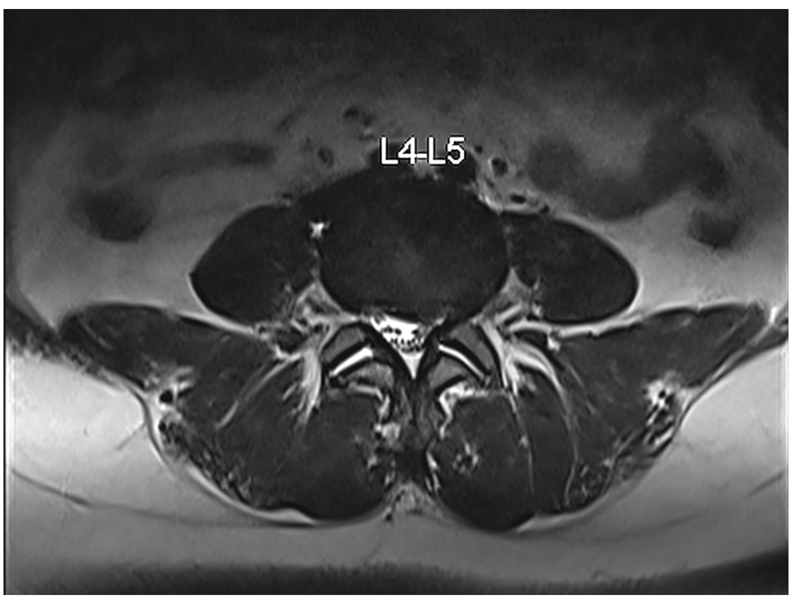
CASE 3

A 36 year female with desk job who does heavy workouts at gym came with complaints of tingling sensation in bilateral upper limbs and was advised MRI spine. Lumbar MRI T2WI axial [a] and sagittal [b] images shows posterocentral & left paracentral disc protrusion at L4- L5 level with focal annular fissures involving both discs.

There is also seen a disc bulge at D11- D12 level in image [b]

[b]

[a]



ANNEXURES IV

KEY TO MASTER CHART	
S No	Serial number
F	Female
M	Male
Ht	Height (cm)
Wt	Weight (Kg)
Occu	Occupation
Act	Active
M act	Moderately active
Sed	Sedentary
Diet	Dietary habits
Veg	Vegetarian
Vgn	Vegan
Exs	Exercise
N	None
Smk	Smoking
DM	Diabetes mellitus
Htn	Hypertension
Med	Medications
Sx	Surgical history
Fam	Family history
CoV- 2	COVID-19 infection
Oth	Other medical conditions
L1-2 B	L1-L2 Bulge
L1-2 P	L1-L2 Protrusion

L1-2 E	L1-L2 Extrusion
L1-2 S	L2-L3 Sequestration
L2-3B	L2-L3 Bulge
L2-3 P	L2-L3 Protrusion
L2-3 E	L2-L3 Extrusion
L2-3 S	L2-L3 Sequestration
L3-4 B	L3-L4 Bulge
L3-4 P	L3-L4 Protrusion
L3-4 E	L3-L4 Extrusion
L3-4 S	L3-L4 Sequestration
L4-5 B	L4-L5 Bulge
L4-5 P	L4-L5 Protrusion
L4-5 E	L4-L5 Extrusion
L4-5 S	L4-L5 Sequestration
L5-S1 B	L5-S1 Bulge
L5-S1 P	L5-S1 Protrusion
L5-S1 E	L5-S1 Extrusion
L5-S1 S	L5-S1 Sequestration

S No	Age	Sex	Ht	Wt	BMI	Occu	Diet	Ex	Smk	DM	Htn	Med	Sx	Fam	CoV-2	Oth	L1-2 B	L1-2 P	L1-2 E	L1-2 S	L2-3 B	L2-3 P	L2-3 E	L2-3 S	L3-4 B	L3-4 P	L3-4 E	L3-4 S	L4-5 B	L4-5 P	L4-5 E	L4-5 S	L5-S1 B	L5-S1 P	L5-S1 E	L5-S1 S
1	46	F	165	65	23.9	m act	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
2	33	F	164	63	23.4	m act	Veg	yoga	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
3	50	F	161	64	24.3	m act	Veg	N	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
4	37	F	166	62	22.6	m act	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no
5	26	M	181	75	22.9	act	all	sprt	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no
6	23	M	178	79	24.7	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
7	54	F	162	68	25.9	m act	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
8	24	M	174	75	24.8	act	all	gym	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no
9	22	F	169	62	21.7	act	all	gym	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
10	37	M	165	70	25.7	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
11	42	M	176	76	24.5	act	all	gym	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
12	34	M	183	81	24.9	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no	no	no	no	no
13	26	M	168	70	24.8	m act	all	gym	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
14	49	F	162	68	25.9	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no
15	46	F	164	65	24.2	m act	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no
16	35	F	159	64	25.3	m act	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
17	35	M	179	70	21.8	sed	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
18	53	F	160	70	27.3	m act	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	yes	no	no	no
19	35	F	164	64	23.8	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no
20	41	M	170	75	25.9	act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
21	62	F	160	64	25.1	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
22	76	M	172	72	24.3	sed	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
23	49	F	160	64	25.1	act	Veg	N	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
24	40	F	159	58	22.9	m act	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
25	26	M	168	75	26.6	sed	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
26	20	M	170	70	24.2	m act	all	sprt	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
27	40	M	178	78	24.6	act	all	sprt	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
28	63	M	168	72	25.5	m act	all	N	yes	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	yes	no	no	no
29	35	M	173	75	28.2	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
30	74	M	170	68	23.5	m act	all	N	no	no	no	no	no	no	no	no	yes	no	no	no	yes	no	no	no	yes	no	no	no	no	yes	no	no	no	no	no	no
31	42	M	169	69	24.2	act	all	sprt	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no
32	40	F	162	67	25.5	m act	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	yes	no	no
33	20	M	174	72	23.8	act	all	sprt	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
34	26	F	163	60	22.6	m act	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
35	27	F	164	64	23.8	m act	Veg	gym	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	yes	no	no
36	27	F	168	68	24.1	m act	all	yoga	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
37	52	M	170	75	26.1	m act	Veg	N	yes	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
38	27	F	164	65	24.2	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
39	26	M	177	75	23.9	act	all	gym	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
40	46	F	160	60	23.4	act	all	N	no	yes	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
41	40	F	162	66	25.1	act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
42	26	M	180	75	23.1	act	all	sprt	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
43	51	F	158	62	25.1	m act	vgn	N	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
44	28	M	175	71	23.2	m act	Veg	gym	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no

S No	Age	Sex	Ht	Wt	BMI	Occu	Diet	Ex	Smk	DM	Htn	Med	Sx	Fam	CoV-2	Oth	L1-2 B	L1-2 P	L1-2 E	L1-2 S	L2-3 B	L2-3 P	L2-3 E	L2-3 S	L3-4 B	L3-4 P	L3-4 E	L3-4 S	L4-5 B	L4-5 P	L4-5 E	L4-5 S	L5-S1 B	L5-S1 P	L5-S1 E	L5-S1 S
45	25	M	170	72	24.9	m act	Veg	N	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no
46	25	M	179	74	23.1	act	all	sprt	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no
47	56	M	163	62	23.3	act	Veg	yoga	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no
48	76	M	170	86	29.8	m act	all	yes	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no	yes	no	no	no	yes	yes	no	no	yes	no	no	no
49	35	F	162	54	20.6	act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	yes	no	no	yes	no	no	no
50	26	F	164	58	21.6	sed	all	sprt	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
51	56	F	165	52	19.1	sed	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	yes	no	no	no	no	yes	no	no
52	41	M	163	63	23.7	act	all	N	yes	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
53	40	F	156	84	34.5	m act	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	yes	no	no	no
54	36	F	160	67	26.2	m act	all	N	no	no	no	no	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no
55	20	F	166	60	21.8	act	all	sprt	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
56	45	M	169	75	26.3	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
57	45	M	180	85	26.2	m act	vgn	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no
58	36	M	170	85	29.4	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
59	62	M	178	82	25.9	m act	all	N	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no
60	50	F	156	62	25.5	sed	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
61	48	F	163	62	23.3	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no
62	49	F	165	68	24.9	m act	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
63	46	M	169	72	24.9	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
64	56	F	152	68	29.4	sed	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	yes	no	no	yes	yes	no	no	no	no	no	no
65	33	F	168	64	22.7	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no
66	28	M	176	82	26.5	act	all	gym	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
67	35	F	160	54	18.9	act	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
68	18	M	178	75	23.9	act	all	sprt	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
69	41	M	176	84	27.1	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
70	29	M	179	70	21.8	act	all	gym	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
71	29	F	158	52	20.8	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no
72	30	M	170	71	24.6	m act	all	gym	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
73	22	M	182	84	25.4	act	all	gym	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no
74	70	M	164	72	26.8	sed	Veg	N	no	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	yes	no	no	no
75	40	F	166	64	23.2	m act	all	yoga	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
76	36	M	176	80	25.8	m act	all	N	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
77	41	M	162	68	25.9	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
78	45	M	176	72	23.2	act	all	N	yes	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
79	65	F	164	68	25.3	sed	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
80	28	M	166	60	21.8	act	Veg	yoga	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
81	27	M	178	72	22.7	act	all	gym	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
82	26	F	169	64	22.1	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
83	50	M	179	77	24	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
84	38	M	176	75	24.2	m act	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no	no	no	no	no	no
85	33	M	178	76	23.7	act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no
86	36	M	175	75	24.5	m act	all	gym	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
87	34	F	161	61	23.5	m act	Veg	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
88	40	M	174	75	24.8	m act	all	N	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no
89	29	M	174	70	22.1	act	all	gym	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	no	yes	no	no