The Relationship Between Body Mass Index (BMI) and Pain Intensity in Patients With Lumbar Nucleus Pulposus Hernia (HNP)

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Abstract.

Lumbar Herniated Nucleus Pulposus (HNP) is one of the main causes of low back pain that can reduce the quality of life of sufferers. Risk factor that affect the intensity of pain in HNP patients include body mass index (BMI). An increase in BMI can cause additional mechanical stress on the lumbar spine, alter posture, and exacerbate pain. The purpose of this study was to determine the relationship between BMI and pain intensity in patients with lumbar HNP at Budhi Asih General Hospital. This study used an analytical observational research method with a cross-sectional approach. The study sample consisted of 54 patients. BMI data obtained from measuring the patients' height and weight were classified according to WHO categories, while pain intensity was measured using the Visual Analog Scale (VAS) instrument. Data analysis using the Chi-Square test showed a significant relationship between BMI and pain intensity in patients with lumbar HNP (P < 0.029). These findings indicate that obesity increases the mechanical load on the lumbar spine, thereby exacerbating pain in HNP patients. In conclusion, there is a significant relationship between BMI and pain intensity in lumbar HNP patients. Therefore, weight control through a healthy lifestyle and appropriate rehabilitation programs is expected to reduce pain intensity and improve patients' quality of life.

Keywords: *Hernia Nucleus Pulposus; Body Mass Index; Pain Intensity; Visual Analog Scale and Budhi Asih Regional General Hospital.*

I. INTRODUCTION

Herniated nucleus pulposus (HNP) is a common spinal disorder that occurs when the nucleus pulposus protrudes through a tear in the annulus fibrosus, leading to compression of spinal nerve roots (Lim et al., 2014). The vertebral column, which consists of 33 interconnected vertebrae supported by intervertebral discs, plays a crucial role in maintaining body stability, facilitating movement, and protecting the spinal cord. Intervertebral discs, composed of the nucleus pulposus and annulus fibrosus, function as shock absorbers and allow flexibility of the spine. Damage to these structures, particularly degeneration or rupture of the annulus fibrosus, can result in disc herniation and subsequent neurological symptoms.Several studies have identified both individual and occupational risk factors associated with HNP. Individual factors include increased body mass index (BMI), smoking habits, genetic predisposition, and aging, which contributes to reduced elasticity and hydration of the intervertebral discs. Occupational factors, such as repetitive lifting, prolonged sitting, and frequent bending, further increase mechanical stress on the spine and significantly elevate the risk of HNP (Wahlström et al., 2025). Clinically, patients with HNP commonly present with low back pain that may radiate to the lower extremities, accompanied by sensory disturbances and, in severe cases, muscle weakness (Ikhlasun, 2025).HNP is a major contributor to global health burden, particularly as a leading cause of low back pain (LBP).

According to the Global Burden of Disease (GBD) 2021 study, approximately 577 million cases of low back pain were reported in 2020, with projections reaching 843 million cases by 2050 (GBD 2021 Low Back Pain Collaborators, 2023). HNP accounts for 30% to 80% of LBP cases and predominantly affects the lumbosacral region, especially at the L4–L5 and L5–S1 levels (Veresciagina et al., 2007; Yelmaiza et al., 2022). The condition is most frequently observed in individuals aged 30 to 50 years, with a higher

prevalence in males compared to females (Rusmayanti & Kurniawan, 2023). In Indonesia, the prevalence of HNP remains substantial, highlighting its clinical and public health significance (Aco, 2022). One of the key modifiable risk factors associated with HNP is body mass index (BMI). BMI is a widely used indicator of nutritional status, calculated as body weight in kilograms divided by height in meters squared (Cantika et al., 2024). Elevated BMI reflects increased body fat composition, which contributes to greater mechanical load on the spine and increased biomechanical stress on intervertebral discs.

This condition accelerates disc degeneration and increases the likelihood of disc herniation, particularly in the lumbar region (Purnamasari, 2010; Wang et al., 2025).Pain is the primary clinical manifestation in patients with HNP and is defined by the International Association for the Study of Pain (IASP) as an unpleasant sensory and emotional experience associated with actual or potential tissue damage. Pain in HNP is typically chronic, dull, and may radiate to the gluteal region or lower extremities, depending on the affected nerve roots (Tanderi et al., 2017). The intensity of pain varies among individuals and is influenced by structural damage, inflammation, and individual pain perception. Pain intensity is commonly assessed using standardized instruments such as the Visual Analog Scale (VAS), which is widely recognized for its validity and reliability in measuring pain severity (Aoki et al., 2012; Bijur et al., 2001).Despite the established role of BMI as a risk factor for spinal disorders, evidence regarding its relationship with pain intensity in patients with lumbar HNP remains limited and inconsistent. Understanding this relationship is important for improving clinical management and preventive strategies. Therefore, this study aims to analyze the relationship between body mass index and pain intensity in patients with lumbar herniated nucleus pulposus. Thus, the research question of this study is: **Is there a relationship between body mass index and pain intensity in patients with lumbar herniated nucleus pulposus at Budhi Asih Regional General Hospital?**

II. METHODS

This study used an analytic observational design with a cross-sectional approach, in which data on body mass index (BMI) and pain intensity in patients with lumbar herniated nucleus pulposus (HNP) were collected simultaneously at a single point in time (Setiadi, 2013). The study was conducted at Budhi Asih Regional General Hospital, with data collection carried out in November 2025. The study population included all patients diagnosed with lumbar HNP at the hospital. The sample consisted of hospitalized patients with lumbar HNP during the period from January 2024 to December 2025 who had complete medical records and met the inclusion and exclusion criteria.The inclusion criteria were patients diagnosed with lumbar HNP at levels 1–5 and whose diagnosis had been confirmed through clinical examination and supporting imaging, such as magnetic resonance imaging (MRI) or computed tomography (CT) scan, as documented in their medical records (Ikhsanawati et al., 2015). Patients were excluded if they had a history of spinal surgery in the same region prior to the current diagnosis, had systemic diseases that could affect pain perception such as severe peripheral neuropathy or active rheumatic disease, or had incomplete medical records.The independent variables in this study were body mass index (BMI), age, and sex, while the dependent variable was pain intensity in patients with lumbar HNP.

BMI was calculated using the formula weight in kilograms divided by height in meters squared (kg/m^2) and classified into underweight, normal, overweight, and obese categories according to World Health Organization criteria for Asian populations (World Health Organization, 2000). Pain intensity was assessed using the Visual Analog Scale (VAS), a valid and reliable instrument for measuring pain severity (Aoki et al., 2012; Bijur et al., 2001).Data were obtained from patients' medical records and anthropometric measurements. Body weight was measured using a calibrated scale, while height was measured using a microtoise. Pain intensity data were collected from VAS scores recorded in the medical records. Data processing was carried out through several stages, including editing, coding, entry, cleaning, and tabulation (Notoatmodjo, 2018). Editing ensured data completeness and consistency, coding assigned numerical values to each variable, data entry was performed using statistical software, and cleaning was conducted to identify errors or outliers. Tabulation was then performed to organize the data into frequency distributions and summary statistics. Data analysis was conducted using statistical methods. Univariate analysis was used to

describe the characteristics of each variable, while bivariate analysis was performed to examine the relationship between BMI and pain intensity. Statistical testing was conducted using appropriate methods based on the type and distribution of the data (Dahlan, 2014).

III. RESULT AND DISCUSSION

Patient Characteristics

Data were collected from the medical records of Budhi Asih Regional General Hospital, with a total sample of 54 patients who met the inclusion criteria. Data analysis was performed using univariate analysis to describe the baseline characteristics of patients with lumbar herniated nucleus pulposus (HNP), and bivariate analysis to assess the relationship between body mass index (BMI) and pain intensity.

Table 3.1. Characteristics of Patients with Herniated Nucleus Pulposus at Budhi Asih Regional General Hospital

Variable	Frequency (n)	Percentage (%)
Sex		
Male	23	42.6
Female	31	57.4
Mean Age (years)	58.59 ± 14.307	
BMI		
Underweight	6	11.1
Normal	15	27.8
Overweight	7	13.0
Obese	26	48.1
Pain Intensity (VAS)		
No pain	0	0
Mild	22	40.7
Moderate	25	46.3
Severe	7	13.0

Based on Table 3.1, a total of 54 patients were included in the study. The distribution of sex showed that female patients were more prevalent than male patients, with 31 individuals (57.4%) compared to 23 individuals (42.6%). The mean age of the patients was 58.59 ± 14.307 years, indicating that most patients were in the adult to elderly age group. In terms of BMI, the majority of patients were classified as obese, accounting for 26 individuals (48.1%). Patients with normal BMI comprised 15 individuals (27.8%), followed by overweight patients with 7 individuals (13.0%), and underweight patients with 6 individuals (11.1%).Regarding pain intensity measured using the Visual Analog Scale (VAS), most patients experienced moderate pain, with 25 individuals (46.3%). Mild pain was reported by 22 patients (40.7%), while severe pain was observed in 7 patients (13.0%). No patients reported absence of pain.

Association Between BMI and Pain Intensity

Table 3.2. Association Between BMI and Pain Intensity in Patients with Lumbar HNP at Budhi Asih Regional General Hospital.

BMI (kg/m²)	Pain Intensity (VAS)				P value
	No Pain	Mild	Moderate	Severe	
<18,5	0	5	1	0	0,029
18,5-22,9	0	5	5	5	
23,0-24,9	0	4	3	0	
≥ 25,0	0	8	16	2	
Total	0	22	25	7	

Table 3.2 presents the distribution of BMI categories in relation to pain intensity among patients with lumbar HNP. No patients reported absence of pain across all BMI categories. Among patients with BMI <18.5 kg/m² (underweight), the majority experienced mild pain (n = 5), followed by moderate pain (n = 1), with no cases of severe pain observed. In the normal BMI group (18.5–22.9 kg/m²), pain intensity was evenly distributed, with 5 patients each reporting mild, moderate, and severe pain.In the overweight group (23.0–24.9 kg/m²), most patients experienced mild pain (n = 4), followed by moderate pain (n = 3), with no severe pain cases. Meanwhile, in the obese group (≥25.0 kg/m²), the majority of patients experienced moderate pain (n = 16), followed by mild pain (n = 8), and severe pain (n = 2). The Chi-square test showed a

p-value of 0.029, indicating a statistically significant association between body mass index (BMI) and pain intensity measured by VAS in patients with lumbar HNP. Based on the findings presented in Table 1, the majority of patients with suspected lumbar herniated nucleus pulposus (HNP) at Budhi Asih Regional General Hospital were in the late adulthood age group. This result is consistent with the study conducted by Fatmasari (2016), which reported that the highest prevalence of HNP occurred in individuals aged 45–59 years, accounting for 42.1% of cases.

As age increases, particularly during adulthood, intervertebral discs undergo degenerative processes that involve both structural and molecular changes, thereby increasing the risk of low back pain (Wu, 2017). Degeneration of intervertebral discs is characterized by reduced flexibility and thinning of the nucleus pulposus. Continuous mechanical use leads to structural alterations in the annulus fibrosus, including decreased elasticity and hydration, making it more susceptible to rupture. In addition, aging is associated with reduced water content within the intervertebral discs (Utami et al., 2023). The results of this study also showed that the majority of patients with lumbar HNP were female, accounting for 31 individuals (57.4%). This finding is in line with the study by Desyauri et al. (2021), which reported that lumbar HNP was more prevalent in females (73.3%) compared to males (26.7%). This phenomenon may be explained by hormonal factors, particularly fluctuations in estrogen levels during menstruation, pregnancy, and menopause, which can weaken connective tissue strength in intervertebral discs. Estrogen plays a role in regulating bone remodeling by inhibiting bone resorption and maintaining the integrity of ligaments, collagen, and intervertebral discs. A decline in estrogen levels, especially during menopause, may accelerate degenerative changes in spinal structures (Sihombing et al., 2012).

However, this finding contrasts with the study by Wahlström et al. (2023), which reported a higher prevalence of HNP among males. This discrepancy may be related to differences in lifestyle and occupational exposure. Male individuals are more frequently involved in physically demanding activities, such as heavy lifting over prolonged periods, which can accelerate intervertebral disc degeneration (Wahlström et al., 2023). In terms of body mass index (BMI), the present study found that obesity was the most common category among patients with lumbar HNP, accounting for 26 individuals (48.1%). This finding is consistent with the study by Utami et al. (2025), which reported that 58.1% of lumbar HNP patients were classified as obese. Obesity contributes to biomechanical alterations in posture, including increased forward flexion during sitting and standing positions, which increases the load on intervertebral discs. Changes in BMI also shift the body's center of gravity, increasing mechanical stress on the lumbar spine and altering spinal curvature, thereby contributing to low back pain (Kong et al., 2014).Furthermore, in obese individuals, fat accumulation in the abdominal region leads to an imbalance between abdominal and back muscles. Weak abdominal muscles and increased tension in the lumbar musculature, particularly at the L5–S1 level which supports approximately 75% of body weight, result in sustained muscle strain.

Prolonged muscle tension can lead to fatigue and mechanical stress, increasing the susceptibility of surrounding tissues to injury and pain. Muscle fatigue occurs due to continuous contraction, which eventually depletes energy reserves in muscle fibers (Rahmanto et al., 2019). Regarding pain intensity, the majority of patients in this study experienced moderate pain, with 25 individuals (46.3%). The Chi-square analysis showed a p-value of 0.029, indicating a statistically significant association between BMI and pain intensity in patients with lumbar HNP. This finding is consistent with previous studies that reported a significant relationship between BMI and pain intensity in patients with low back pain (Utami et al., 2025).The relationship between obesity and increased pain intensity can be explained through both mechanical and biological mechanisms. Mechanically, excess body weight increases the load and pressure on the spine and intervertebral discs, thereby exacerbating pain. Biologically, obesity is associated with chronic low-grade inflammation, characterized by elevated levels of proinflammatory cytokines such as tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6). These inflammatory mediators enhance pain sensitization, making obese individuals more susceptible to experiencing higher pain intensity (Siddiqui et al., 2022).Overall, the findings of this study indicate that BMI is significantly associated with pain intensity in patients with lumbar HNP. This highlights the importance of weight management as part of the clinical approach to reducing pain severity and improving patient outcomes.

IV. CONCLUSION

Based on the analysis of patient characteristics, the majority of patients with lumbar herniated nucleus pulposus (HNP) were in the adult to elderly age group, with a mean age of 58.59 ± 14.307 years. The distribution by sex showed that female patients were more predominant (57.4%). In terms of body mass index (BMI), most patients were classified as obese (48.1%), and the majority experienced moderate pain intensity (46.3%). The findings of this study indicate that there is a significant relationship between body mass index and pain intensity in patients with lumbar HNP. The Chi-square test demonstrated a p-value of 0.029 (<0.05), confirming that BMI is significantly associated with pain intensity.

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