Relationship between Body Mass Index and Lumbar Disc Herniation in UKI General Hospital Jakarta, Indonesia

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Background: Nucleus Pulposus Herniation (NPH) is a disease in which the annulus fibrosus ruptures, causing the nucleus pulposus to protrude or bulge and press against the spinal canal, causing sciatic pain. One of the risk factors for Nucleus pulposus herniation was Body Mass Index (BMI).
Objective: This study aim the relationship between BMI and the incidence of Lumbar Disc Herniation (LDH) patients at UKI General Hospital from January to June 2020.
Methods: The subjects of the study were 24 patients with lumbar disc herniation who were treated at UKI General Hospital from January to June 2020 that were taken from medical records.
Results: 63 samples were analyzed that obtained 24 (38.0%) patients with lumbar disc herniation, and patients with lumbar disc herniation with BMI ≥ 23 as many as 18 subjects (75.0%).
Conclusion: There is no significant relationship between BMI and LDH patients at UKI General Hospital.

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1. INTRODUCTION

Low Back Pain (LBP) is a condition of discomfort or pain at the bottom of the marginal costa and at the top of the inferior gluteal fold, which may or may not is accompanied by leg pain [1]. LBP is also a problem in the health sector that often occurs and can affect various populations but is often considered trivial. LBP can interfere with a person's quality of life and work performance and is the most common cause of medical consultation. LBP ranks first worldwide in Years Lived with Disabilities (YLDs) or living with disabilities, these results are consistent from 1990 – 2016 [2]. The incidence of YLDs worldwide in 2016 was 40.8 to 75.8 million people. In Indonesia, in 2017, disability caused by LBP amounted to 855 people per 100,000 cases [3].

One of the causes of LBP is Nucleus Pulposus Herniation (NPH). NPH is a disease in which the annulus fibrosus ruptures, which causes the nucleus pulposus to bulge and press toward the spinal canal, causing pain in the vertebrae [4]. 1-2% of the total population suffer from NPH, and most age is 30-50 years [5]. LDH most often occurs in the lumbosacral region of the L4 – S1 intervertebral disc. It is because L4 – S1 is the body's fulcrum [6].

One of the risk factors for NPH is Body Mass Index (BMI). BMI is a picture of nutritional status measured by body weight and height [7]. The BMI category is underweight, normal, and overweight [8]. An increase in BMI can result in HNP because there is an increased burden on the spine and increased compression on the discs, which can lead to herniation of the lumbar disc [9]. High BMI conditions can also cause compression on the spine and trigger the spine to become unstable. The condition of an unstable spine is very easy to get damaged, especially in the lumbar vertebral region [10].

2. LITERATURE REVIEW

The spine or vertebral column is a flexible structure made up of a series of bones called vertebrae. Between the vertebrae are cartilage pads. Spine length 57 – 67 cm in adults. The total number of vertebrae is 33, divided into seven cervical vertebrae, 12 thoracic vertebrae, five lumbar vertebrae, five sacral vertebrae, and four coccygeal vertebrae. There are only 26 vertebrae in an adult because 24 are separate bones, and the other nine vertebrae fuse to form 5 sacral vertebrae and four coccygeal vertebrae [11,12].

The intervertebral disc is located between the two vertebral bodies and is the connecting joint between the vertebral bones. The intervertebral disc is formed by the nucleus pulposus, annulus fibrosus, and two end plates. The nucleus pulposus is centrally located and contains much water and type II collagen. Water and proteoglycans contained in the nucleus pulposus can help transmit the load to the vertebra below (compressive limit), and the tension in the annulus fibrosus fibers can absorb the radial load (tensile load). The annulus fibrosus is a ring structure composed of 10 to 12 layers of concentric connective tissue and fibrocartilage, supported anteriorly by the anterior longitudinal ligament and posteriorly supported by the posterior longitudinal ligament. The annulus fibrosus is at the edges and contains type I and type II collagen. The two end plates are composed of hyaline cartilage superiorly and inferiorly. Changes in the collagen content contained in the intervertebral discs occur naturally based on an aging process called intervertebral disc degeneration [13-16].

The functions of the vertebral column include protecting the spinal cord and spinal nerves, supporting the weight of the body posteriorly to the pelvis, providing a flexible axis or rigidity to the body parts and an extended base for the head and center of rotation, and playing an important role in body posture and locomotion or movement shift [17]. The vertebral column has four curves or arches when viewed from the lateral side. The cervical and lumbar regions have a lordotic curve, which is curved forward, while the thoracic and sacral regions have a kyphotic curve, which is curved backward. These curves increase the vertebral column's strength, maintain body balance, reduce shocks to the body, and prevent vertebral fractures [18].

The International Association for the Study of Pain defines LBP or low back pain as the sensation of pain in the superior area which is bounded by an imaginary transverse line that passes through the end of the spinous process of the last thoracic vertebra, in the inferior area which is bounded by an imaginary transverse line through the end of the spinous process of the

sacral vertebrae first and in the lateral area bounded by the vertical line from the lateral margin of the lumbar spine [19]. LBP is a condition of discomfort or pain that is felt below the marginal ribs and above the inferior gluteal folds, with or without leg pain. It is characterized by pain, such as burning, being stabbed by a sharp or blunt object, being well-defined or vague, and having a mild to severe intensity. Pain can appear suddenly or develop gradually [20].

According to Global Burden Diseases in 2016, as much as 40% of musculoskeletal disorders are caused by LBP, which has a prevalence of 511 million people and an incidence of 250 million people in 2016. This figure has increased by 18% compared to the number of LBP sufferers in 2006 and increased by 42% compared to 1990. 60 – 80% of the world's population has experienced LBP or lower back pain in their lifetime [3]. A multi-center study conducted by the pain study group of the Indonesian Association of Neurologists at 14 teaching hospitals throughout Indonesia in 2002 reported that the number of pain sufferers was 4.456 people or 25% of the total visits, 1.589 of whom had LBP or 35.86%. The average value of the visual analog scale is 5.46, which places LBP in second place after headaches [21].

A hernia is defined as a protrusion or protrusion of a portion of an organ or tissue through an abnormal opening. The nucleus pulposus is a semi-liquid mass containing water and proteoglycans located in the intervertebral disc's center [9]. NPH, or intervertebral disc herniation or what is commonly called lumbar disc syndrome or lumbosacral radiculopathies, is a disease in which the soft pads between the vertebrae (soft gel discs or nucleus pulposus) experience compression on the posterior or lateral parts so that they break and decay and cause a bulge through the annulus fibrosus into the spinal canal and compresses the nerve roots.

NPH can be caused by degenerative changes that result in thinning and decreased flexibility of the nucleus pulposus with age. Changes occur in the annulus fibrosus due to continuous use, causing the annulus fibrosus in the lumbar region to rupture [22]. NPH can also be caused by repetitive moderate-grade trauma that affects the intervertebral discs, causing tears in the annulus fibrosus. Most patients experience symptoms of brief trauma, and these symptoms result because the disc injury does not show up for months or years. In the generation of the disc capsule, it pushes toward the spinal cord or ruptures, causing the nucleus pulposus to be pushed against the dorsal sac or spinal nerves as they emerge from the spinal column [23]. Risk factors that may affect NPH are age, gender, body mass index, smoking, occupation, body posture, and traumatic injury [24].

NPH is divided into four stages: protrusion, prolapse, extrusion, and sequestration [25]. Common clinical manifestations include pain in the lower back and the muscles around the lesion and tenderness. Central HNP causes symptoms of paresthesia, flaccid paraparesis, and urinary retention. Meanwhile, lateral NPH will cause symptoms of pain and tenderness in the lower back, buttocks, and calves, from behind the heels to the soles of the feet. Fifth toe extension strength is reduced, as well as negative achilles reflex. L5-S1 lateral NPH causes pain and tenderness in the lower back, lateral buttocks, lateral lower legs, and dorsum pedis. Impaired Achilles reflex and sensory deficits of the lateral malleolus and foot.

As we get older, the disc's water content also decreases, where there are 90% in infants and 70% in old age. The fibers become rough, and hyalinization occurs, which can result in herniation of the nucleus pulposus and then pressing on the spinal nerve roots. Fibroelastic fibers are cut off, and partially damaged are replaced by collagen tissue, thus forming cavities in the annulus fibrosus. The nucleus pulposus infiltrates into the cavities and experiences a decrease in water content. There is a decrease in intradiscal pressure, with a decrease in the volume of nuclear pulposus material and an increase in the volume of the intervertebral cavity [26,27]. A tear occurs in the annulus fibrosus in the first stage circumferentially; after repeated traumatic tears will become larger, and a radial tear will appear when there is subsequent trauma, the risk of developing NPH increases. After NPH, the remaining intervertebral discs undergo lysis, so the two vertebral bodies overlap. Abnormal pressure on the nucleus can occur due to repetitive movements, such as extension, flexion, lateral flexion, rotation, and lifting weights in the wrong position. Great pressure can injure the annulus and herniate the nucleus pulposus [28].

Diagnosis of NPH is made by history, neurological examination (neurological examination, motor examination, and reflex

examination), and supporting examinations (which can be carried out to help diagnose NPH, including X-Ray, Myelogram, Magnetic Resonance Imaging, and Electromyography) [29].

Management can be done through non-pharmacological therapy (passive physical therapy and lifestyle modifications), pharmacological therapy, and operative therapy. Prevention of NPH can be done by: [30] a) regular exercise to maintain muscle ability; b) Avoid lifting heavy objects, educate them on how to lift things properly; c) Sleeping on a flat and hard place; d) Avoid activities that may cause traumatic injury; and e) Maintain ideal body weight.

BMI is one of the anthropometric examination parameters used to monitor a person's nutritional status, especially underweight and overweight. BMI is an indicator of body condition that classifies BMI into the categories of normal, underweight, and overweight through a calculation. BMI can estimate a person's body mass; knowing a person's BMI can predict the health conditions associated with body health risks [31] BMI is classified into several categories according to Asia Pacific criteria as follows:

Table 1. BMI categories according to Asia Pacific

Category	BMI (Kg/m^2)
Underweight	< 18,5
Normal	18,5 – 22,9
Overweight	≥ 23,0
Pre-obesity	23,0 – 24,9
Obesity I	25,0 – 29,9
Obesity II	≥ 30,0

3. RESEARCH METHODS

The research design used was a retrospective study to seek the relationship between BMI and the incidence of LDH in LBP patients at UKI General Hospital from January to June 2020. The study was conducted at UKI General Hospital, East Jakarta. The research instruments used were computerization and medical records at UKI General Hospital. The samples used were all patients with a diagnosis of LBP who met the established inclusion and exclusion criteria. Data processing in this study was carried out in several stages: editing, coding, tabulating and cleaning. Data analysis in this study used the Statistical Package for the Social Sciences (SPSS) version 25 for Windows. Data analysis

was carried out in stages with univariate analysis and bivariate analysis. Univariate analysis was used to determine the frequency distribution of each research variable. Using the chi-square correlation test, a bivariate analysis was used to determine the relationship between the independent variables and the dependent variable.

4. RESULTS

Data were collected at the Medical Records UKI General Hospital section on November 4-16, 2021. The total sample studied complied with the predetermined inclusion criteria, namely 63 patients.

Table 2. Frequency distribution based on diagnosis

No	LBP	Total (N)	Percentage (%)
1.	NPH	24	38,0
2.	Non-NPH	39	62,0
Total		63	100

Based on Table 2, the results obtained were 24 subjects with LBP accompanied by NPH (38.0%) and 39 subjects with LBP without NPH (62.0%).

Based on Table 3, the results obtained were that the highest frequency of NPH subjects was in the age category > 65 years, with 11 people (45.8%), while the lowest frequency of NPH subjects was in the age category 46-55 years with four subjects (16.7%). The highest frequency of Non-NPH subjects was in the age category > 65 years with 13 subjects (33.3%), while the lowest frequency of Non-NPH subjects was in the age category 17-25 years with one subjects (2.6%).

Based on Table 4, the results obtained were that HNP patients were dominated by the female, as many as 17 subjects (70.8%) compared to men, as many as 7 subjects (29.2%). Non-NPH subjects were dominated by the female, with as many as 24 subjects (61.5%), compared to men as many as 15 subjects (38.5%).

Based on Table 5, the results obtained were NPH subjects with BMI ≥ 23 had the highest frequency, namely 18 subjects (75.0%), while NPH subjects with BMI < 23 had the lowest frequency, namely six subjects (23.0%). Non-NPH subjects with BMI ≥ 23 had the highest frequency, namely 33 subjects (84.6%), while Non-NPH patients with BMI < 23 had the lowest frequency, namely six subjects (15.4%).

Table 3. Frequency distribution by age

No.	Age	NPH (%)	NON-NPH (%)
1.	17-25 years old	0 (0,0%)	1 (2,6%)
2.	26-35 years old	0 (0,0%)	2 (5,1%)
3.	36-45 years old	0 (0,0%)	5 (12,8%)
4.	46-55 years old	4 (16,7%)	6 (15,4%)
5.	55-65 years old	9 (37,5%)	12 (30,8%)
6.	> 65 years old	11 (45,8%)	13 (33,3%)
	Total	24 (100,0%)	39 (100,0%)

Table 4. Frequency distribution by gender

No.	Gender	NPH (%)	NON-NPH (%)
1.	Male	7 (29,2%)	15 (38,5%)
2.	Female	17 (70,8%)	24 (61,5%)
	Total	24 (100,0%)	39 (100,0%)

Table 5. Frequency distribution based on BMI

No.	BMI	NPH (%)	NON-NPH (%)
1.	< 23	6 (23,0%)	6 (15,4%)
2.	≥ 23	18 (75,0%)	33 (84,6%)
Total		24	39

Table 6. Correlation between BMI and lumbar LDH

BMI	Diagnosis				P-Value*
	NPH		NON-NPH		
	F	%	F	%	
< 23	6	50,0	6	50,0	**0,510**
≥ 23	18	35,3	33	64,7	
Total	24	38,1	39	61,9	

Chi-square Test, p > 0,05

Based on Table 6, the chi-square correlation test shows a p-value of 0.510, meaning there is no significant relationship between BMI and Lumbar NPH. Based on the results of the chi-square test, it can be concluded that there is no significant relationship between BMI and lumbar NPH in LBP patients at UKI General Hospital from January to June 2020.

5. DISCUSSION

The results obtained were 24 LBP subjects accompanied by NPH (38.0%) and 39 subjects with LBP without HNP (62.0%). The highest frequency distribution of NPH patients based on age was in the age category > 65 years with 11 subjects (45.8%), followed by the 55-65 year age category with nine subjects (37.5%), and the lowest frequency in the 46-55 year age category as many as four subjects (16.7%), these results are following the theory which states that with age the risk of NPH increases due to a degenerative process in which the ability of the nucleus pulposus to hold water decreases progressively so that the water content in the disc decreases naturally, this causes decreased vascularity of the disc and reduced water content in the nucleus so that the disc becomes less elastic.

The frequency distribution of NPH subjects based on gender showed that NPH subjects were dominated by female, as many as 17 subjects (70.8%) compared to men, as many as seven subjects (29.2%). This result is not in line with research conducted by Yusuf et al. in 2017 Dr. Wahidin Sudirohusodo General Hospital Makassar, who reported that the incidence of NPH was dominated by male gender in 26 subjects (59.1%) compared to 18 female subjects (40.9%) samples. However, there is a theory stating that there is a decrease in postmenopausal women. Estrogen levels impact decreasing bone density so that damage to the vertebral column occurs easily.

The results of the frequency distribution of NPH subjects based on BMI showed that NPH subjects with BMI ≥ 23 had the highest frequency, namely 18 subjects (75.0%), while NPH patients with BMI <23 had the lowest frequency, namely six subjects (23.0%). These results are in line with a study conducted in Finland by Bostman et al, who reported that 27% of patients undergoing disc herniation surgery were obese, the results of a recent meta-analysis also stated that patients with excess weight had a statistically significant increased risk of being diagnosed with lumbar radiculopathy, obese patients are more at risk of recurrent disc herniations [32].

A chi-square correlation test was conducted to see the correlation between BMI and NPH. The results obtained were a p-value of 0.510 > 0.05,

so it was concluded that there was no significant relationship between BMI and lumbar NPH in LBP patients at UKI General Hospital from January to June 2020. This study's results equal with research conducted by Liyadi et al. in 2012, where the chi-square test results p = 0.708, which means there is no relationship between obesity and not obesity with the degree of nerve root suppression [33].

6. CONCLUSION

The number of LBP patients was 63, 24 (38.0%) of whom suffered from lumbar NPH. There was no significant relationship between BMI and lumbar NPH in LBP subjects at UKI General Hospital for the period January - June 2020.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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