Bali Medical and Wellness Journal
bmw-journal.com
ISSN 3089-2902 e-ISSN 3064-4577

Article

Body Mass Index and Postoperative Lumbar Pain Relief Following Surgery for Degenerative Lumbar Spine Disease: A Correlative Study

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ABSTRACT

Background: The prevalence of obesity and overweight is consistently rising. An increase in body mass index (BMI) above the normal range heightens the risk of chronic diseases, including musculoskeletal conditions such as lumbar degeneration and low back pain. The association between elevated BMI and postoperative lumbar pain remains debated.
Objectives: This study aims to assess the correlation between BMI and the improvement of postoperative lumbar pain.
Method: In this correlational study, 48 adults meeting specific inclusion and exclusion criteria were observed at a spine surgery clinic in Semarang, Central Java, Indonesia. BMI was calculated by dividing weight (kg) by height squared (m²). Pain levels were assessed using a visual analogue scale (VAS). The study controlled for variables such as age, gender, diabetes mellitus, osteoporosis, and type of surgery.
Results: A positive correlation exists between increased BMI and elevated pain scale scores post-lumbar surgery in patients with lumbar degeneration ($r = 0.654$, $p = 0.001$). Additionally, the type of surgery and the presence of osteoporosis were found to correlate with pain levels.
Conclusion: Patients with higher BMIs exhibited more pronounced postoperative pain compared to those with lower BMIs.

Keywords: Body Mass Index, Pain Scale, Obesity, Lumbar Degeneration, Lumbar Surgery

Citation: Siallagan, R. M., Probosari, E., Brotoarianto, H. K., Muis, S. F., Murbawani, E. A. Body Mass Index and Postoperative Lumbar Pain Relief Following Surgery for Degenerative Lumbar Spine Disease: A Correlative Study. Bali Medical and Wellness Journal 2025, 2 (2), 1-8.DOI: https://doi.org/10.71341/bmwj.v2i2.33

Submitted: June, 18 2025
Revised: August, 31 2025
Accepted: September, 14 2025
Published: September, 23 2025

INTRODUCTION

Obesity has evolved into a significant global health issue, with its prevalence markedly increasing since 1980. According to World Health Organization (WHO) data, by 2016, approximately 1.9 billion adults aged 18 and over were classified as overweight, with 650 million of these individuals being obese (Chooi et al., 2019). This data reveals that about 39% of the world's adult population falls into the overweight or obese category. The prevalence of obesity and overweight individuals rose considerably, from 26.5% in 1980 to 39% in 2015, marking an increase of nearly 50% over 35 years (Müller & Geisler, 2017).

In Indonesia, the country with the third-largest population globally, a similar trend is observed. Data from Riskesdas 2018 indicated a rise in the number of overweight and obese adults aged over 18 from 2013 to 2018 (Kemenkes, 2018). Specifically, the prevalence of overweight individuals increased from 11.5% in 2013

to 13.6% in 2018. The percentage of obese individuals rose from 14.8% to 21.8% during the same period. Additionally, there has been a steady rise in central obesity, which heightens the risk of metabolic syndrome, from 26.6% in 2013 to 31% in 2018 (Harbuwono et al., 2018).

Obesity is a significant risk factor linked to a variety of chronic diseases. These include type 2 diabetes mellitus, cardiovascular diseases, neurological disorders such as dementia and Alzheimer's, respiratory conditions like obstructive sleep apnea (OSA) and asthma, and metabolic and immune system disorders. Additionally, obesity is associated with gastrointestinal issues such as non-alcoholic fatty liver disease (NAFLD), fertility problems, musculoskeletal disorders, and psychosocial conditions (Chooi et al., 2019; Müller & Geisler, 2017). Body Mass Index (BMI) is used to differentiate between obesity and overweight status, while central obesity is assessed by measuring abdominal circumference. It is important to note that the criteria for BMI and abdominal circumference differ between the World Health Organization (WHO) and the Asia Pacific standards (Onyekwelu et al., 2017).

Despite the well-established links between obesity and various chronic health conditions, there is a notable gap in understanding how obesity, specifically measured by BMI, impacts postoperative outcomes related to lumbar pain. While research has extensively documented obesity's role in exacerbating musculoskeletal disorders, few studies have explored its correlation with the recovery process following lumbar surgery (Dario et al.,2015). Furthermore, existing studies often overlook how variations in BMI might influence pain improvement post-surgery (Knutsson et al.,2013). Understanding this relationship is crucial, as it could inform preoperative patient assessments and postoperative care plans. This study seeks to fill this gap by investigating the correlation between BMI and the level of improvement in postoperative lumbar pain, potentially leading to more personalized and effective treatment strategies for individuals undergoing lumbar procedures.

METHODS

Study Design

This study employed a cross-sectional observational design to evaluate the relationship between BMI and postoperative lumbar pain.

Participants

Participants were recruited through consecutive sampling at the Spine Surgery Polyclinic at Dr. Kariadi General Hospital, Semarang, from January to March 2022. Inclusion criteria comprised adult patients aged 18–59 years who had undergone lumbar spine surgery, performed by spine surgeons at our institution, for indications such as central and foraminal stenosis, degenerative disc disease, or herniated nucleus pulposus. Patients were excluded if they had incomplete medical records or refused consent. Data were obtained from outpatient electronic medical records and patient interviews during clinic visits.

Measures

BMI was calculated as weight (kg) divided by height squared (m^2). We utilized the Asia Pacific criteria for classification: underweight (<18.5 kg/m^2), normal (18.5–22.9 kg/m^2), overweight (23.0–24.9 kg/m^2), obesity stage I (25–29.9 kg/m^2), and

obesity stage II (≥30 kg/m²). Participants' ages were recorded during interviews, confirming they were within the 18–59-year range per Indonesian definition, with gender categorized as male or female. Surgical procedures were categorized into conventional (open surgery) and minimally invasive techniques, based on operative reports. Conventional surgery involved long incisions accessing affected areas, whereas minimally invasive procedures used smaller incisions with microsurgical, percutaneous, or endoscopic approaches. History of DM was obtained through patient interviews and verified via hospital records. Presence confirmed through magnetic resonance imaging (MRI) history documented in medical records. Pain severity was measured using the Visual Analogue Scale (VAS), a 100-mm line representing pain intensity from mild to severe. Patients completed the VAS during outpatient visits. Patients' demographic information, BMI, comorbidities, type of surgery, and pain scores were recorded at the outpatient visit.

Data Collection

Data were collected through patient interviews and review of electronic medical records during outpatient visits. All measurements, including height, weight, and pain scores, were obtained following standard clinical procedures.

Data Analysis

Normality of continuous variables (BMI, age, VAS scores) was assessed using the Kolmogorov–Smirnov test. Categorical variables (gender, comorbidities) were analyzed with chi-square tests. Bivariate correlations between BMI and postoperative pain were examined using Spearman's rank correlation coefficient. Multivariate linear regression analysis was conducted to determine the association between BMI and pain scores, adjusting for confounders such as osteoporosis and type of surgery. Statistical significance was set at $p<0.05$.

Ethical Considerations

This study was conducted in accordance with ethical standards and was approved by the Institutional Review Board (approval number 1117). Informed consent was obtained from all participants. Confidentiality and data privacy were maintained throughout the study.

RESULTS

Characteristics of patients

Table 1 summarizes the baseline characteristics of 48 patients undergoing lumbar spinal surgery. The average age was 49.5 years (range 25–60), with a mean height of 162.5 cm and weight of 64.1 kg. The mean BMI was 24.22 kg/m², with 31% having normal weight, 38% overweight, and 31% obese. The average pain score was 4.64 on the VAS, mostly moderate pain (65%). Males comprised 56%, females 44%. Most surgeries were minimally invasive (71%), while 29% had open procedures. Additionally, 37.5% had osteoporosis and 37.5% had diabetes mellitus.

Tabel 1. The baseline characteristics of the 48 patients who underwent lumbar spinal surgery

Variable	n	%	Mean ± SD	Min-Max
Age	48	100	49.48 ± 9.43	25-60
Height	48	100	162.46 ± 5.76	150-172
Weight	48	100	64.06 ± 7.78	50-82
BMI (Kg/m^2)			24.22 ± 2.12	19.78-28.37
Normal	15	31		
Overweight	18	38		
Obesity	15	31		
Pain scale (VAS)			4.64 ± 1.29	3.00- 7.00
Mild	13	27		
Moderate	31	65		
Severe	4	8		
Gender				
Male	27	56		
Female	21	44		
Type of surgery				
Conventional	14	29.2		
Minimal invasive	34	70.8		
Osteoporosis	18	37.5		
Diabetes mellitus	18	37.5		

Bivariate analysis

Table 2 shows that BMI had a strong, positive correlation with pain scores (r=0.654, p=0.001), indicating higher BMI was associated with increased pain. Osteoporosis also showed a significant positive correlation (r=0.552, p=0.002), and the type of surgery had the strongest association (r=0.691, p<0.001). These results suggest BMI, osteoporosis, and surgery type significantly influenced postoperative pain outcomes.

Table 2. The bivariate analysis using the Spearman rank correlation test

Variable	Pain Scale	P
BMI	r = 0. 654	0.001**
Age	r = 0. 130	0.676
Gender	r = 0. 009	0.876
Osteoporosis	r = 0.552	0.002**
Type of surgery	r = 0.691	<0.001*

Multivariate analysis for confounding factors

Table 3 presents the results of the multivariate analysis, which included BMI, osteoporosis, and type of surgery. The model showed that these factors explained 61.3% of the variation in pain scores. The regression equation indicated that osteoporosis and the type of surgery significantly affected pain levels, with coefficients of 0.201 and 0.250, respectively. After adjusting for age and gender, these variables remained significant, suggesting they influence postoperative pain outcomes.

Table 3. Multivariate analysis for adjusting confounding factors

	R^2	Linier Regression	P	Exclusion variables
Groups	0.613	VAS: 0.220 + 0.201 x osteoporosis + (0.250) x Type of surgery	0.201 (osteoporosis) 0.101 (type of surgery)	Age & gender

DISCUSSION

BMI showed a strong positive correlation with pain scores, indicating that increased BMI was linked to greater pain. Osteoporosis and the type of surgery also demonstrated significant relationships with pain outcomes, suggesting these factors may influence recovery. These findings highlight the importance of considering body weight, bone health, and surgical approach in managing postoperative lumbar pain.

The relationship between BMI and low back pain is complex and debated. While increased BMI influences lumbar pain, it also plays a role in conditions like spondylosis, disc herniation, and immobilization (Cushnie et al., 2018; Kobayashi et al., 2018). Obesity can cause back pain through several mechanisms (Mesfin et al., 2013), including: 1) loss of muscle mass and strength, 2) increased mechanical load and stress on the spine, and 3) chronic inflammation.

Accumulated adipose tissue exerts pressure on the lumbar joints and triggers inflammation in bone and joint tissues (Castle-Kirszbaum et al., 2017). Although both muscle and fat mass increase with higher body weight, muscle volume remains relatively low and often insufficient to support the increased load. Obese individuals tend to have lower muscle strength—particularly in the quadriceps and lumbar muscles—when compared to individuals with normal weight (Buerba et al., 2014). To compensate for excess weight, obese individuals often alter their walking and movement patterns, which can weaken lower limb support and impair joint function due to increased friction and persistent pressure, further contributing to lower back pain and joint degeneration (Lener et al., 2018).

Repeated stress on the joints damages the articular cartilage and can lead to joint deterioration, especially in weight-bearing areas. Increased body weight also weakens the muscles responsible for controlling joint movement (Onyekwelu et al., 2017). In obesity, intramuscular muscles are loaded with excess fat, which is linked to higher levels of systemic pro-inflammatory biomarkers (Auffinger et al., 2014). Over time, the combined effects of excessive fat accumulation, mechanical stress, and abnormal movement or posture contributes to inflammation in bones and joints, ultimately leading to pain and degenerative changes (Castle-Kirszbaum et al., 2017; Sheng et al., 2017). Obesity is now recognized as a state of low-grade systemic inflammation, characterized by increased levels of biomarkers such as interleukin (IL)-1β, IL-6, tumor necrosis factor-alpha (TNF-α), and C-reactive protein (CRP) (McGuire et al., 2014). These inflammatory markers are associated with obesity and play a role in promoting inflammation within the joints, contributing to pain and tissue degeneration.

The study demonstrates that BMI, osteoporosis, and the type of surgery significantly affect postoperative lumbar pain. These factors should be carefully

considered during preoperative assessment to identify patients at higher risk of poor pain outcomes. Healthcare providers should emphasize weight management programs for obese patients before surgery, including diet and physical activity interventions, to potentially reduce pain and improve recovery. Additionally, screening for osteoporosis and implementing appropriate bone health measures can help minimize postoperative complications and pain. Surgeons might consider the type of procedure—minimally invasive versus open surgery—based on individual patient risk profiles to optimize outcomes. Overall, a personalized approach that incorporates these factors could enhance pain relief and functional recovery in lumbar surgery patients.

Limitations

This study had a small sample size and was conducted at a single hospital, which limits the generalizability of the results. Its cross-sectional design also prevents establishing causality between the identified factors and pain outcomes. Further research with larger, multicenter, longitudinal studies is necessary to validate these findings and to evaluate the long-term impact of BMI, osteoporosis, and surgical approach on postoperative pain and recovery.

CONCLUSION

This study found that higher BMI, osteoporosis, and the type of surgery significantly influence postoperative lumbar pain. These factors should be considered in preoperative assessment and patient management to optimize pain relief and recovery. Implementing weight control strategies, screening for bone health issues, and choosing appropriate surgical techniques can improve surgical outcomes. Further research is needed to confirm these findings and develop targeted interventions for patients with risk factors for persistent pain after lumbar surgery.

CONFLICT OF INTEREST

The authors stated there is no conflict of interest in this study.

FUNDING

There is no funding support in this study.

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