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The impact of being overweight or obese on 12 month clinical recovery in patients following lumbar microdiscectomy for radiculopathy

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ABSTRACT

BACKGROUND CONTEXT: The proportion of patients who undergo lumbar microdiscectomy due to lumbar radiculopathy who are also overweight or obese is high. However, whether high body mass index (BMI) affects clinical outcomes is not well-studied.

PURPOSE: To investigate the difference in the clinical course between normal weight, overweight, and obese patients with radiculopathy who underwent lumbar microdiscectomy followed by physical therapy and to evaluate whether high BMI is associated with poor recovery.

STUDY DESIGN/SETTING: A prospective cohort study with a 12-month follow-up was conducted in a multidisciplinary clinic.

PATIENT SAMPLE: We included 583 patients (median (IQR) age: 45 (35-52) years; 41.0% female) with clinical signs and symptoms of lumbar radiculopathy, consistent with magnetic resonance imaging findings, who underwent microdiscectomy followed by post-operative physical therapy.

OUTCOME MEASURES: Outcomes were leg pain and back pain intensity measured with a visual analogue scale, disability measured with the Roland Morris Disability Questionnaire at 3 and 12-month follow-ups, and complications.

METHODS: Patients were classified as being normal weight (46.9%), overweight (38.4%), or obese (14.7%). A linear mixed-effects model was used to assess the difference in the clinical course of pain and disability between the three BMI categories. The association between BMI and outcomes was evaluated using univariable and multivariable logistic regression analyses.

RESULTS: All three patient groups experienced a significant improvement in leg pain, back pain, and disability over 3 and 12-month follow-up. Patients who were overweight, obese, or normal weight experienced comparable leg pain (p=0.14) and disability (p=0.06) over the clinical course (p=0.14); however, obese patients experienced higher back pain (MD = -6.81 [95%CI: -13.50 - -0.14]; p=0.03). The difference in back pain scores was not clinically relevant.

CONCLUSION: In the first year following lumbar microdiscectomy, patients demonstrated clinical improvements and complications that were unrelated to their preoperative BMI.

Keywords: Obesity**,** Lumbar surgery, Body Mass Index, Disc herniation, Rehabilitation, Prognosis, Sciatica

Introduction

Lumbar radiculopathy is the most persistent and disabling low back pain condition [1]. Being overweight or obese is associated with a higher risk of lumbar radiculopathy [2]. Moreover, overweight or obese patients with lumbar radiculopathy are less likely to have a positive clinical outcome when treated conservatively [3-8]. Furthermore, the proportion of patients undergoing lumbar microdiscectomy due to lumbar radiculopathy who are overweight or obese is higher than the general population [9-11].

Several studies have demonstrated that a higher body mass index (BMI) has a negative impact on surgical outcomes for lumbar radiculopathy [4, 9-20]. In particular, higher BMI is associated with higher rates of perioperative complications, such as deep-vein thrombosis, embolism, superficial wound infection, increased operative time, blood loss, and length of hospital stay [9-16, 20].

Obese patients have also demonstrated less favorable clinical outcomes for leg pain and back pain along with higher disability scores following lumbar microdiscectomy [4, 17, 19, 21]. However, other studies indicate obese patients experience similar improvements after lumbar microdiscectomy in comparison to patients with a normal weight [15, 18, 22]. Thus, the influence of obesity on the clinical course following lumbar microdiscectomy has shown mixed results [4, 15, 17-19, 21, 22]. Better insights into the possible impact of pre-operative bodyweight may assist clinicians in formulating more accurate prognoses and setting more appropriate postoperative expectations.

There is a lack of longitudinal research on this topic as previous work was based on retrospectively retrieved data or has largely compared postoperative outcomes rather than tracking patients from prior to surgery through 12-month follow-up [4, 17-20].

In clinical settings, patients are often advised to lose weight before surgery to enhance postoperative outcomes [23, 24]. This could lead to additional patient suffering. Moreover, there is conflicting evidence on whether overweight or obese patients are less likely to experience relief from leg pain or disability after lumbar microdiscectomy surgery and whether patients truly need to lose weight before surgery [4, 15, 17-19, 21, 22]. Existing research on degenerative spine surgeries suggests that preoperative weight changes have minimal impact on long-term clinical outcomes [25]. High-quality prospective research is essential to determine if there are differences in clinical outcomes among various BMI categories, warranting the need for further investigation in this field.

Therefore, the primary objective of this study was to investigate the differences in the clinical course between normal weight, overweight, and obese patients with lumbar radiculopathy who underwent lumbar microdiscectomy followed by physical therapy. Furthermore, we aimed to evaluate whether being overweight or obese is associated with poor recovery at 3 and 12 months and complication rate within 12 months of surgery.

Material and methods

Study design

We conducted a prospective cohort study with a 12-month follow-up. Ethical approval was granted by the Medical Ethics Review Board of the Elisabeth Hospital in XXXXXX, XXXXXX. The recommendations for reporting cohort studies by the

Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) were followed [26]. All patients provided written informed consent before study participation.

Participants

Patients were recruited from a multidisciplinary XXXXXX between 2012 and 2019. We included patients over the age of 18 with clinical signs and symptoms of lumbosacral nerve root compression who were scheduled for lumbar microdiscectomy. Patients were excluded if they were pregnant or displayed signs and symptoms of specific pathological conditions, such as cauda equina syndrome, neoplasm, or fracture. A lumbar microdiscectomy was performed by a neurosurgeon and two orthopedic surgeons. They used a microscope to guide the removal of the disc herniation, thus relieving pressure on the lumbar nerve root. Directly after surgery, all patients received a physical therapy session consisting of information about the postoperative process and low-dose exercises. After discharge, all patients underwent a postoperative physical therapy session at the clinic. This session included information on recovery, home-care guidelines, and prescribed exercises. Upon discharge, each patient was given a physical therapy treatment plan to be carried out with a primary care physical therapist. The main objectives of this plan were to enable patients to resume daily activities, work, and sports. These goals were to be achieved through enhanced knowledge and understanding, improved mobility, increased muscle strength and endurance, and the ability to perform functional activities such as walking and cycling. The treatment plan did not specify a maximum number of sessions or a fixed duration for the treatment.

Outcome measurements

Leg pain, back pain, and disability scores were measured at baseline, 3 and 12 months postoperatively. Leg pain and back pain intensity were measured separately with a visual analogue scale (VAS) which ranged from 0 to 100 [27]. Disability was measured with the Roland Morris Disability Questionnaire (RMDQ). The RMDQ contains 24 yes/no items, and the score is calculated by adding the number of "yes" answers. The scale ranges from 0 (no disability) to 24 (maximum disability) [28]. The VAS scale and RMDQ are frequently used measures to evaluate changes in surgical outcomes and have good measurement properties [27, 29, 30]. Complication rates during and within the first year after surgery were extracted from patient records.

Criteria for recovery

For the secondary aim, pain, and disability scores were dichotomized into "good recovery" and "poor recovery". We operationally defined a "poor recovery" based on the minimal clinically important difference scores for pain and disability. For each outcome, a recovery of less than 30% improvement was considered a "poor recovery" for that outcome [31].

Body Mass Index

Weight and height were measured during the preoperative consultation with a manual weighing scale (Seca 761) and stadiometer (Seca 231). Following the National Institute of Health (NIH) and the World Health Organization (WHO) definitions, patients were classified into the following BMI categories: normal weight: BMI of 18.5 to 24.9 kg/m^2, overweight: BMI of 25 to 29.9 kg/m^2, and obese: BMI greater than or equal to 30 kg/m^2 [32]. The logistic regression analysis analyzed BMI as a categorical variable (normal weight, overweight, and obese).

Potential confounding factors

Potential confounding factors for the association between BMI and poor recovery were selected based on the literature and availability of routinely collected baseline characteristics of the patients [33, 34]. The variables age, sex, comorbidity (e.g., diabetes, cardiovascular disease, chronic obstructive pulmonary disease, hyperthyroid), and baseline pain intensity (for the outcome pain) or disability (for the outcome disability) were considered potential confounding factors for the association between BMI and poor recovery from pain and disability [33, 34]. As leg pain differed significantly between the BMI categories at baseline, leg pain was also considered a confounder for back pain and disability.

Data collection

All baseline variables, including baseline assessments of leg pain, back pain, and disability, were collected one week preoperatively. The outcome variables were collected using an internet-based platform (XXXXXX, XXXXXX). Reminders were sent to the patients who had not responded at 7 and 14 days after the due date. Patients who did not or only partly completed the questionnaires were approached once by telephone and encouraged to complete the questionnaires.

Statistical analysis

Descriptive analyses were performed to report patients' characteristics at baseline. The normal distribution of data was checked by visual inspection of the histograms, Q-Q plots, and box plots, and was tested by the Shapiro-Wilks test. Central tendencies were presented as means and standard deviation (SD) or as median and interquartile ranges (IQR). Chi-square tests with post-hoc analysis (for nominal data) and one-way ANOVAs with post-hoc tests (for continuous data) were performed to assess potentially significantly different baseline characteristics between the BMI categories (normal weight, overweight, and obese). The residuals were checked for normality by visual inspection of the histograms, Q-Q plots, and box plots, and were tested by the Shapiro-Wilks test.

Bonferroni correction was used to calculate the adjusted P-values (0.05/3). Missing value analyses were performed by using Little's MCAR-test by assuming the missing at random assumption; briefly, baseline characteristics were compared by using chi-square and independent T-tests to observe whether there were any differences between participants with missing values and participants with complete data sets.

For the primary aim, the difference in the clinical course of leg pain and back pain and disability between the BMI categories was assessed with a linear mixed model analysis which was fitted by restricted maximum likelihood [35-37]. We tested the following models: a fixed effect model (crude), a random effect model (crude), and a model corrected with confounders (adjusted). For the fixed effect model, BMI categories, time, and the interaction between BMI categories and time were added as a fixed effect. We modeled the fixed effect using the "variance component" structure. The random effect (crude) model included fixed effects, a random intercept, and a random slope. BMI categories, time, and the interaction between BMI categories and time were added as fixed and random effects. We used an "unstructured" variance model for the random effect model. The likelihood ratio test was used to select the best-fitting model. The best-fitting model was corrected for the confounder age, sex, comorbidity, and leg pain at baseline. For each outcome measure at both follow-up times, group-specific means or proportions with 95%CI and between-group differences in means (MD) or proportions with 95%CI were calculated. The relationship between BMI categories and complication rates was assessed using Chi-square Fisher's exact test.

For the secondary aim, univariable and multivariable logistic regression analyses were performed to evaluate whether BMI (categorical) was associated with "poor recovery". Multivariate imputation by chained equations (MICE) method with predictive mean matching (PMM) was used for missing data in the predictors and outcome variables when data were missing at random [38, 39]. Twenty-four imputed datasets were generated corresponding to the highest missing value percentage. The linear relationship between BMI and the log of the odds ratios of poor recovery outcomes was checked. Crude and Adjusted Odds ratios (95%CI) and Betas are presented. Statistical analyses were performed with SPSS version 28.0 (IBM Corp., Armonk, New York, USA).

Results

Study population

Of the 618 patients who were scheduled for lumbar microdiscectomy, 578 patients were included in the study. Figure 1 shows the participant flow diagram and Table 1 summarizes the baseline characteristics stratified by BMI category. The median BMI was 25.2 (IQR 23.0-27.8). The median age at baseline was 45 (IQR 35-52), and n=239 (41.0%) were women. A total of n=271 (46.9%) patients had a normal weight, n=222 (38.4%) were overweight, and n=85 (14.7%) patients were obese. At baseline, sex and leg pain scores were significantly different between the BMI categories. Post-hoc analyses showed that only baseline leg pain scores in obese patients were significantly higher than in normal and overweight patients (Table 1).

Lost to follow up

The maximum percentage loss to follow-up was 19.4% for disability (RMDQ) at 3 months, and 24.5% for leg pain at 12 months (Figure 1). There were no significant differences at baseline between the full cases and those who were lost to follow-up at the two follow-up time points, except for patients who had previous injection therapy on the three outcomes and patients with younger age on the outcome disability. The missings were (completely) random.

Clinical course differences

The differences in the clinical course for the three BMI categories (normal weight, overweight, and obese) are presented in Figure 2. A main effect of time was found for all outcome scores (leg pain, back pain, and disability) ($p \leq 0.001$). Patients in all three BMI categories reported a significant improvement ($p \leq 0.001$) in leg pain, back pain, and disability scores from baseline to 3 months (leg pain MD = 51.86 [95%CI: 47.7 - 56.00], back pain MD = 28.73 [95%CI: 24.65 - 33.00], disability MD = 8.82 [95%CI: 8.00 – 9.65]) and 12-months follow-up (leg pain MD = 52.52 [95%CI: 48.22 - 56.83], back pain MD = 26.39 [95%CI: 21.95 - 30.82], disability MD = 9.95 [95%CI: 9.00 – 10.89]) (Table 2). There was no main effect of the group for leg pain ($p=0.14$) and disability ($p=0.07$). A significant difference in the clinical course was observed between the three BMI categories for back pain ($p=0.03$), implying a main effect for the group. Post-hoc analysis showed that there was a significant difference in back pain scores ($p=0.03$), where obese patients experienced higher back pain scores (MD = -6.81

[95%CI: -13.50 - -0.14]) on average over the first postoperative year in comparison to patients with normal weight (Table 2). Furthermore, no interaction effects were found for the three outcomes.

Association between BMI and poor recovery

Multivariable and univariable logistic regression revealed no significant associations between the BMI categories and poor recovery from back pain, leg pain, and disability (Table 3). The potential confounders did not considerably change the association between BMI and poor recovery. Crude and Adjusted Odds ratios with the 95%CI and Betas are reported in Table 3.

Association between BMI and complications

In total, 18 complications were registered within 12 months. Five were operative: dural tear (n=3) and compression neuropathy (n=2). The 13 postoperative complications were reherniation (n=5), wound infection (n=2), bladder retention (n=3), postoperative spinal puncture headaches (n=1), fibrosis (n=1), and emboli (n=1). No significant association was found between BMI categories and either postoperative complications.

Discussion

Principal findings

We found that patients in all three BMI categories (normal weight, overweight, and obese) experienced improvements in leg pain, back pain, and disability at 3 and 12-month follow-ups. Obese patients experienced more back pain, on average, compared to patients with normal weight. However, the difference in pain scores, though statistically significant, was not clinically meaningful and there was not an increased odds of poor recovery in the obese group compared to people with normal weight. Thus, patients in all weight categories experienced similarly successful trajectories of improvement in pain and disability scores.

Comparison with the literature

More than half of the patients (53.1%) who underwent a lumbar microdiscectomy were overweight (38.4%) or obese (14.7%). This finding is in line with a Danish study that showed that 18% were obese (BMI>30) and an Iranian study that showed that 49% were classified as overweight or obese (BMI>25)[15, 40]. Other research shows an even higher percentage (up to 80%) of overweight or obese patients who underwent spinal surgery [9, 10]. However, these studies included a wide range of spinal surgeries, not solely focusing on lumbar microdiscectomy, and were performed in the United States where rising body weight is even a higher public health concern than in other countries [41].

Our findings show that obese patients experienced a higher leg pain score but no higher back pain, or disability scores at baseline. This is partially in contrast to earlier research which showed higher baseline scores on all outcomes [4]. Higher baseline scores in that study could be explained by a significantly higher percentage of obese patients with higher BMI scores and more severe complaints who undergo surgery compared with nonobese patients [4].

Patients in all BMI categories (normal weight, overweight and obese) experienced a significant improvement in the clinical course of leg pain, back pain, and disability after lumbar microdiscectomy for lumbar radiculopathy. Our findings are in line with earlier research which showed a clinically relevant long-term improvement in the outcome of leg pain, back pain, and disability, supporting the favorable effect of lumbar microdiscectomy [42, 43]. Furthermore, our study shows that obese, overweight, and normal-weight patients were as likely to improve on the outcome of leg pain and disability which is comparable with earlier published research [3, 10]. Conversely, other research found less improvement in clinical outcomes in obese patients compared to patients with a normal weight [4]. However, that research was conducted in a comparative rather than longitudinal design and thus could not adequately consider the influence of preoperative status on postoperative outcomes [4].

Existing research highlights that individuals with higher body weight tend to experience more complications both during and post-surgery [9-16, 20]. However, our study found no significant association between complication rate and BMI category. This difference could be explained by variations in surgical indications (herniation vs. stenosis), surgical methods (minimally invasive vs. open), surgical approaches (posterior vs. lateral), study population, or different postoperative care protocols [9-16, 20].

Although relief of radicular leg pain is the most common indication for lumbar microdiscectomy, back pain and disability scores are also outcomes of interest [44, 45]. Our results showed statistically significant differences in low back pain scores for obese patients in comparison with patients with normal weights (back pain MD = -6.81 [95%CI: -13.50 - -0.14]. However, these changes did not exceed the smallest difference that patients and clinicians perceive to be worthwhile (VAS = 24 points) when measuring the change in low back pain [46]. Therefore, these results were not considered clinically meaningful.

In our study population, there was no association between BMI and poor recovery outcomes. This suggests that overweight or obese patients are equally likely to experience relief from leg pain and disability, which are often the primary reasons for undergoing these surgeries

Limitations

This study has some limitations. Our study indicated a maximum loss to follow-up of 24.5% for leg pain at 12-month which could have influenced our results. However, we did not find significant differences in most of the baseline variables between the full cases and those who were lost to follow-up. Moreover, the randomness of the missing data suggests that this has had a minimal impact on our overall results.

Another limitation is that our cohort only included three individuals with morbid obesity (BMI>35), making it impossible to create a meaningful subgroup with morbid obesity. Therefore, we could not draw any conclusions on the clinical course of patients with morbid obesity after lumbar microdiscectomy.

All patients underwent post-operative physical therapy at the hospital. After discharge, the patients received a treatment plan and were recommended to follow primary care physical therapy aimed at resuming daily activities, work, and sports. While a standard plan was provided, the treatment was customized to meet each patient's individual goals and needs, leading to variations in treatment strategies. The content of the treatment plan and number of sessions was not further evaluated.

BMI was only assessed at baseline and not at different postoperative time points during the clinical course. By measuring BMI at follow-up, we could have better understood the interaction effect of surgery on BMI.

Finally, BMI is only based on height and weight without considering other important factors, such as body composition [47]. Therefore, using BMI as a measure of overweight or obesity may have misclassified some people [48].

In conclusion, in our study population improvements in clinical outcomes and complication rates within the first year after lumbar microdiscectomy are not influenced by preoperative BMI.

Declaration of Usage of Generative AI and AI-Assisted Technologies in the Writing Process:

During the preparation of this work, the author(s) utilized Grammarly to enhance grammar and improve reading flow. Following the use of this service, the author(s) meticulously reviewed and adjusted the content as necessary. The author(s) bear full responsibility for the final content of the publication.

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Figure legend

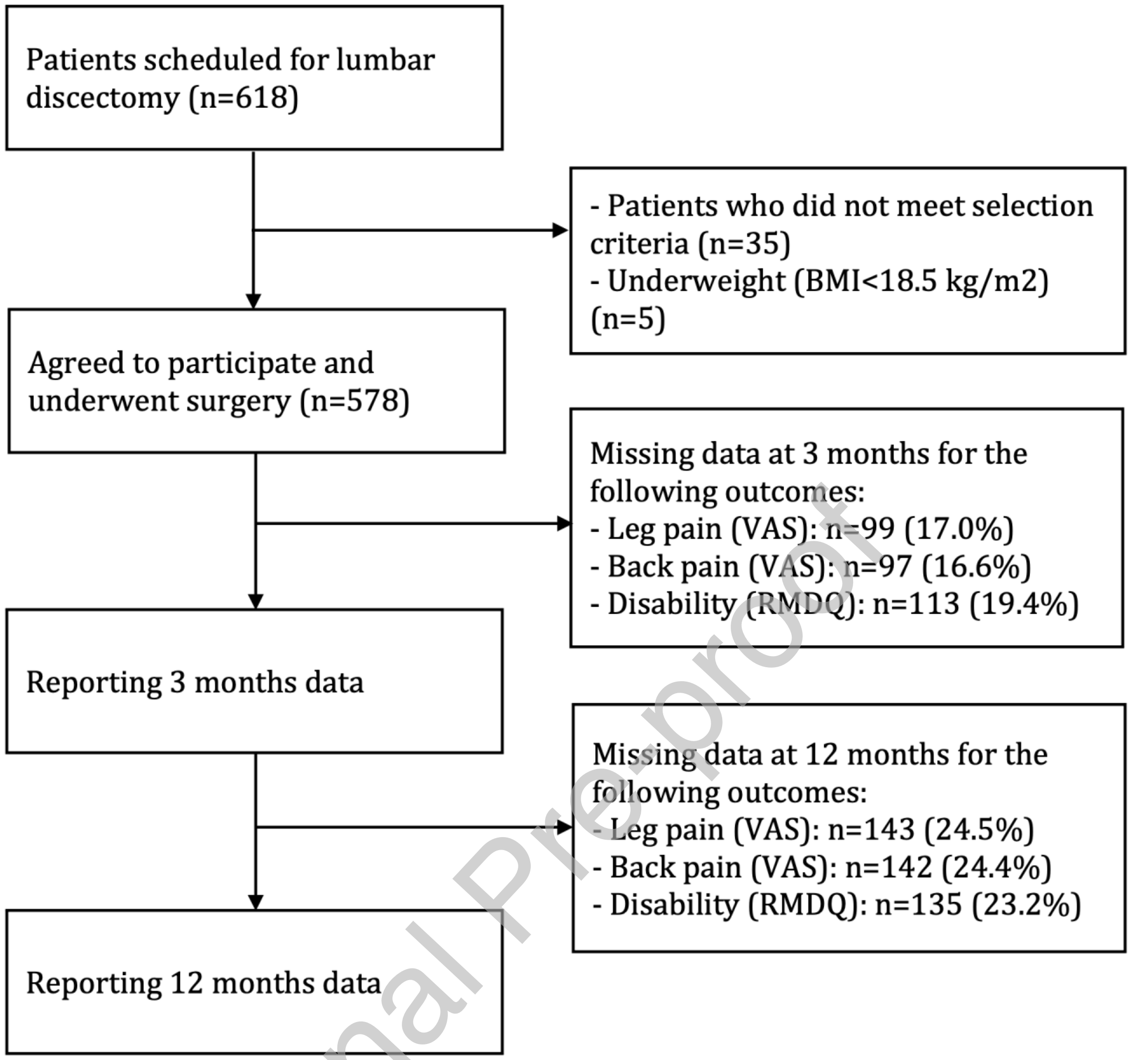

Figure 1. Patients flow diagram. n = number of patients. VAS = Visual Analogue Scale (0-100 mm), RMDQ = Roland Morris DIsability Questionnaire (0-24 point)

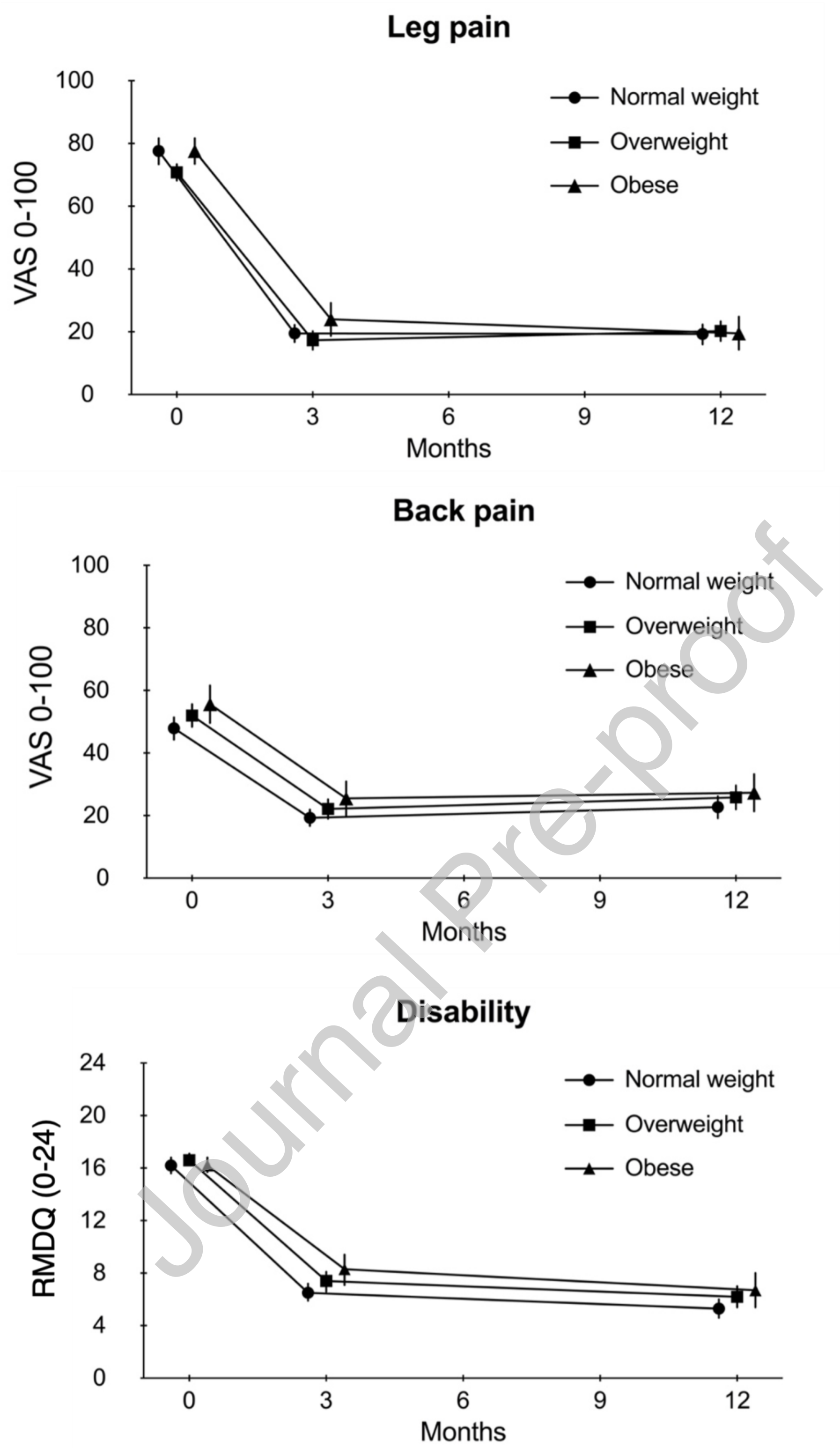

Figure 2. The clinical course per BMI category

Mean (95%CI). VAS = Visual Analogue Scale (0-100 mm), RMDQ = Roland Morris Disability Questionnaire (0-24 points).

Table 1. Baseline characteristics of patients stratified by BMI categories (kg/m²)

Baseline characteristics	All patients	Normal weight (18.5≤ BMI<25)	Overweight (25≤ BMI <30)	Obese (BMI ≥ 30)	P value
N (%)	578	271 (46.9%)	222 (38.4%)	85 (14.7%)	
BMI (median (IQR)) in kg/m²	25.2 (23.0-27.8)	22.9 (21.2-24.0)	26.9 (25.8-28.0)	31.9 (30.9-33.3)	
Age (median (IQR)) in years	45 (35-52)	43 (36-52)	45 (37-55)	45 (38-53)	0.15
Sex (female)	239 (41.0)	121 (44.6%)	76 (34.2%)	38 (44.7%)	**0.04**[c]
Comorbidity (yes)	118 (20.3)	51 (18.8%)	44 (19.8%)	23 (27.1%)	0.25
Preoperative medication use (yes)	348 (60.0)	154 (56.8%)	134 (60.4%)	56 (65.9%)	0.38
Previous injection therapy (yes)	209 (36.2)	108 (39.9%)	66 (29.7%)	32 (37.6%)	0.08
Prior back surgery (yes)	79 (13.6)	36 (13.3%)	28 (12.6%)	13 (15.3%)	0.83
Prior physical therapy (yes)	366 (62.8)	167 (61.6%)	142 (64%)	55 (64.7%)	0.76
Sitting occupation (yes)	155 (35.0)	82 (30.3%)	52 (23.4%)	20 (23.5%)	0.06
Straight Leg Raise (positive)	371 (74.2)	170 (62.7%)	148 (66.7%)	49 (57.6%)	0.28
Pain intensity leg (VAS)[b]	75.0 (60.0-85.4)	72.8 (56.5-85.7)	75.0 (60.0-83.4)	80.0 (70.0-90.0)	**0.01**[d]
Pain intensity back (VAS)[b]	54.0 (26.0-73.0)	50.0 (20.0-70.0)	59.8 (30.0-75.0)	60.0 (29.9-76.0)	0.06
Level of Disability, (RMDQ)[b]	17.0 (14.0-20.0)	17.0 (13.3-20.0)	17.0 (15.0-19.0)	18.0 (15.0-20.5)	0.16

N = number of patients, IQR = Interquartile Range. [b] Median (IQR)**;** VAS = Visual Analogue Scale (0-100 mm). RMDQ = Roland-Morris Disability Questionnaire (0-24 points). [c] Female sex: normal weight vs overweight: p=0.07, normal weight vs obese:

p=0.01, overweight vs. obese: p=0.4. [d] Leg Pain: normal weight vs overweight: p=1.0, normal weight vs obese: p≤0.01, overweight vs obese: p=0.03

Table 2 Clinical course over time for leg pain, back pain, and disability

			F		P- Value	
Model	Variables	df	Crude	Adjusted	Crude	Adjusted
Leg pain (VAS)	Time[a]	2	1107.37	552.65	**<0.001**	**<0.001**
	BMI categories	2	2.55	1.81	0.08	0.14
	BMI categories x time	4	1.91	1.63	0.11	0.21
Back pain (VAS)	Time[b]	2	189.42	151.80	**<0.001**	**<0.001**
	BMI categories[c]	2	3.87	3.83	**0.02**	**0.03**
	BMI categories x time	4	0.16	0.19	0.96	0.95
Disability (RMDQ)	Time[d]	2	680.91	413.47	**<0.001**	**<0.001**
	BMI categories[e]	2	4.38	2.76	**0.01**	0.07
	BMI categories x time	4	0.36	1.29	0.84	0.28

[a] **leg pain (VAS) time comparison** (P-Value adjusted with Bonferroni)

Crude	baseline - 3 months **p ≤0.001** MD = 52.54 (95%CI 49.34 - 55.74)	baseline-12 months **p ≤0.001** MD = 53.07 (95%CI 49.97 - 56.17)	3-12 months p = 1.0 MD = 0.53 (95%CI -2.72 - 3.78)
Adjusted [f]	baseline - 3 months **p ≤0.001** MD = 51.86 (95%CI 47.7 - 56.00)	baseline-12 months **p ≤0.001** MD = 52.52 (95%CI 48.22 - 56.83)	3-12 months p = 1.0 MD = 0.66 (95%CI -3.01 – 4.45)

[c] **back pain (VAS) time comparison** (P-Value adjusted with Bonferroni):

Crude	baseline - 3 months **p ≤0.001** MD = 29.51 (95%CI 25.73 - 33.28)	baseline - 12 months **p ≤0.001** MD = 26.54 (95%CI 22.57 - 30.52)	3-12 months p = 0.08 MD = -2.96 (95%CI -6.18 – 0.26)
Adjusted [g]	baseline - 3 months **p ≤0.001** MD = 28.73 (95%CI 24.65 - 33.00)	Baseline - 12 months **p ≤0.001** MD = 26.39 (95%CI 21.95 - 30.82)	3-12 months p = 0.24 MD = -2.34 (95%CI -5.81 - 1.13)

[c] **back pain (VAS) BMI categories comparison** (P-Value adjusted with Bonferroni):

Crude	normal weight - overweight p = 0.17 MD = -3.34 (95%CI -7.56 - 0.88)	normal weight - obese **p = 0.03** MD = -6.18 (95%CI - 12.02 - -0.34)	overweight - obese p = 0.74 MD = -2.84 (95%CI -8.76 – 3.08)
Adjusted [g]	normal weight - overweight p = 0.17	normal weight – obese **p = 0.03** MD = -6.81 (95%CI -	overweight - obese p = 0.78 MD = -2.86 (95%CI -9.76

	MD = -3.96 (95%CI -8.91 - 1.00)	13.50 - -0.14)	– 4.04)
[d] **Disability (RMDQ) Time comparison** (P-Value Adjusted with Bonferroni):			
Crude	baseline - 3 months **p ≤0.001** MD = 9.28 (95%CI 8.58 – 9.99)	baseline - 12 months **p ≤0.001** MD = 10.60 (95%CI 9.83 – 11.37)	3-12 months **p ≤0.001** MD = 1.33 (95%CI 0.63 – 2.02)
Adjusted [h]	baseline - 3 months **p ≤0.001** MD = 8.82 (95%CI 8.00 – 9.65)	Baseline - 12 months **p ≤0.001** MD = 9.95 (95%CI 9.00 – 10.89)	3-12 months **p = 0.03** MD = 1.12 (95%CI 0.31- 1.94)
[e] **Disability (RMDQ) Categories comparison** (P-Value Adjusted with Bonferroni):			
Crude	normal weight - overweight p = 0.11 MD = -0.74 (95%CI –1.59 - 0.10)	normal weight – obese **p = 0.03** MD = -1.33 (95%CI -2.55 - -0.11)	overweight - obese p = 0.72 MD = -0.59 (95%CI -1.83 – 0.65)
Adjusted [h]	normal weight - overweight p = 1.00 MD = -0.31 (95%CI -1.42 - -0.80)	normal weight – obese p = 0.06 MD = -1.52 (95%CI -3.09 - 0.05)	overweight - obese p = 0.21 MD = -1.21 (95%CI -2.83 – 0.40)

MD=mean difference; df = degrees of freedom; VAS = Visual Analogue Scale(0-100 mm), RMDQ = Roland Morris Disability Questionnaire (0-24 points). [a] leg pain time comparison, [b] back pain time comparison, [c] back pain BMI categories comparison, [d] disability time comparison, [e] disability BMI categories comparison, [f] adjusted for the confounders: age, sex, and comorbidities, [g] adjusted for the confounders: age, sex, comorbidities, and leg pain at baseline, [h] adjusted for the confounders: age, sex, comorbidities, and leg pain at baseline.

Table 3. Association between BMI and poor recovery for leg pain, back pain, and disability at 3 and 12 months (n=578)

	Poor recovery from leg pain (VAS) at 3 months [a]					Poor recovery from leg pain (VAS) at 12 months [a]				
BMI (Categories)	OR (95%CI)	Adj OR (95%CI)	Beta	Adj Beta	P-Value	OR (95%CI)	Adj OR (95%CI)	Beta	Adj Beta	P-Value
Normal weight (ref)	1.0					1.0				
Overweight	0.56 (0.30-1.05)	0.58 (0.30-1.11)	-0.58	-0.55	0.07	1.03 (0.60-1.78)	1.00 (0.57-1.73)	0.03	-0.04	0.91
Obese	1.37 (0.66-2.84)	1.62 (0.76-3.44)	0.31	0.48	0.40	1.10 (0.49-2.48)	1.10 (0.48-2.51)	0.10	0.10	0.81
	Poor recovery from back pain (VAS) at 3 months [b]					Poor recovery from back pain (VAS) at 12 months [b]				
Normal weight (ref)	1.0					1.0				
Overweight	0.84 (0.53-1.33)	0.96 (0.57-1.60)	-0.18	-0.04	0.46	1.00 (0.63-1.59)	1.04 (0.64-1.68)	0.02	0.04	0.99
Obese	1.28 (0.68-2.40)	1.74 (0.84-3.59)	0.24	0.55	0.45	1.23 (0.67-2.22)	1.32 (0.72-2.41)	0.20	0.28	0.50
	Poor recovery from disability (RMDQ) at 3 months [c]					Poor recovery from disability (RMDQ) at 12 months [c]				
Normal weight (ref)	1.0					1.0				
Overweig	1.14 (0.67-	1.27 (0.74-	0.1	0.2	0.6	1.00 (0.55-	1.04 (0.54-	0.0	0.0	0.9

ht	1.93)	2.19)	3	4	3	1.85)	1.96)	7	4	8
Obese	1.55 (0.77-3.10)	1.67 (0.82-3.43)	0.44	0.52	0.22	1.57 (0.78-3.18)	1.52 (0.73-3.18)	0.45	0.42	0.21

Ref = Reference category; OR = Odds Ratio; Adj =Adjusted; BMI **=** body mass index; CI **=** confidence interval; P-values refer to the Crude Model. [a] adjusted for the confounders: age, sex, comorbidity, leg pain, [b] adjusted for the confounders: age, sex, comorbidity, back pain, leg pain, [c] adjusted for the confounders: age, sex, comorbidity, disability, leg pain.