# The Rates of Negative Outcomes for Underweight Patients Undergoing Posterior Lumbar Interbody Fusion Rival or Exceed those of Morbidly Obese Patients

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INTRODUCTION:

In pre-operative risk analysis of surgical patients, Body Mass Index (BMI) is a routinely considered factor. The risks for overweight and obese patients in orthopedic surgery have been extensively documented, but patients on the other end of the BMI spectrum have not received nearly as much attention, especially in spine surgery. This may be due to perceived easier surgeries for underweight patients, and that while overweight and obese categories approximate three quarters of the US population, underweight patients make up less than 2%. Therefore, small/single-center studies would be too underpowered to detect differences in outcomes. Nonetheless, there is a growing body of evidence demonstrating that those who are underweight may be at serious risk of adverse outcomes with various surgeries, potentially emulating those of higher BMI patients. In this study, we compared such outcomes (major complications, length of stay, readmissions, and discharge location) following single-level posterior lumbar interbody fusion surgery among different BMI cohorts.

METHODS:

A retrospective analysis of data collected in the National Surgery Quality Improvement Program (NSQIP) was performed to select patients aged 18+ who underwent a single-level posterior lumbar interbody fusion (PLIF), using CPT code 22630, from 2010 to 2020. We did not include any other lumbar fusion types to promote homogeneity of the study population. The database was queried for age, sex, BMI, post-operative major complications, length of stay (LOS), 30-day-readmission, and destination of discharge.

For analysis, we divided the weight classifications based on WHO criteria (underweight: <18.5, healthy: 18.5-24.9, overweight: 25-29.9, obese I: 30-34.9, obese II: 35-39.9, obese III: 40+). We further divided the healthy BMI group into lower-healthy BMI (healthy I: 18.5-19.9) and upper-healthy BMI (healthy II: 20-24.9) groups to investigate the validity of the widely accepted underweight cutoff (18.5) in predicting various negative post-operative outcomes, as it was established in 1995 using mortality data alone.

*Statistics:* The rates of major complications, 30-day readmissions, and the location of discharge were compared between the groups using contingency table analysis. The mean LOS was compared using ANOVA. A multivariate logistic regression was performed using the non-modifiable independent variables age and sex.

RESULTS:

*Demographics:* Of the 17,639 PLIF patients identified, approximately 0.86% were in the underweight BMI range, 1.2% in healthy I, 15.7% in healthy II, 32.0% in overweight, 28.1% in obese I, 14.2% in obese II, and 7.9% in obese III.

*Major Complications:* 3.3% of patients in the sample suffered at least one major post-operative complication (Figure 1). In underweight patients, this rate was significantly higher ($p < 0.04$) than all BMI categories aside from obese III, where there was no significant difference.

*Readmission:* The overall rate of 30 day readmissions was 4.6%. The rate for underweight patients was 5.3%; there were no significant differences between the BMI groups (Figure 2).

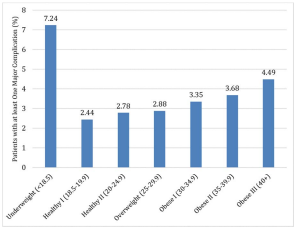
*LOS:* In the ANOVA analysis, underweight patients had significantly longer lengths of stay than every other BMI category ($p < 0.03$) (Figure 3).

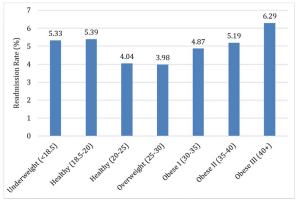
*Discharge Location:* The underweight population had the highest percentage transferring to another acute care facility at 1.34% ($p < 0.005$), along with the highest expiration rate ($p < 0.07$), with significance assessed on multivariate analysis (Table 1). Despite not reaching significance likely due to the low number of patients in this category, the 30-day death rate in underweight patients - 0.67% - far exceeded that of any other BMI group; the next largest was 0.21% for obese III patients.

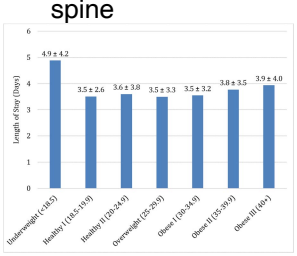
DISCUSSION AND CONCLUSION:

This study demonstrates that underweight patients undergoing PLIF procedures have a significantly increased risk of major complications relative to all but those with BMIs above 40. They are more likely to have increased lengths of stay. They are also more likely to be discharged to another acute care facility and possibly have higher mortality rates. While increased complications in obese patients may be due to greater surgical difficulty associated with the size of the patient, this would not be true for underweight patients. It is more likely that underweight patients have diminished physiologic

reserves, and are therefore unable to compensate for the stresses of surgery as well as normal or mildly obese patients. The WHO cutoff for underweight status was demonstrated to be a valid measure for assessing increased risk after PLIF procedures. As BMI is a modifiable risk factor, efforts should be taken to address this issue before proceeding with elective spine surgery.




| | Underweigh | Healthy I | Healthy II | Overweigh | Obese I | Obese II | Obese III |
|---|---|---|---|---|---|---|---|
| Home | 81.21 | 86.5 | 87.68 | 87.55 | 85.86 | 84.24 | 79.2 |
| Facility | 16.78 | 13.5 | 12.02 | 11.92 | 13.73 | 15.55 | 20 |
| Acute Car | 1.34 | 0 | 0.22 | 0.47 | 0.25 | 0.16 | 0.58 |
| Expired | 0.67 | 0 | 0.07 | 0.05 | 0.16 | 0.04 | 0.22 |