



## Research Letter

## Nonalcoholic fatty liver disease does not predict worse perioperative outcomes in bariatric surgery



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## ABSTRACT

Nonalcoholic fatty liver disease (NAFLD) occurs in 84–95% of obese individuals. Bariatric surgery (BS) is an effective treatment of obesity, with a potential sustained weight loss of 21–45%. The safety and efficacy of BS among NAFLD patients is not well established. The aim of this study was to determine outcomes for patients with NAFLD undergoing BS compared to patients without.

**Methods:** All adults undergoing BS were identified from the National Inpatient Sample 2012–2015 and stratified based on the presence of NAFLD using ICD-9/CPT codes. Primary outcomes included inpatient mortality, length of stay (LOS), and total hospital charges (THC). Secondary outcomes included infection, bleeding, improper wound healing and surgical revision.

**Results:** 302,306 patients underwent BS, of which 15,607 had NAFLD and 286,699 did not (non-NAFLD). NAFLD patients had 35% lower inpatient mortality and shorter LOS, but slightly greater THC. NAFLD patients had smaller risk of improper wound healing and post-operative infection. There was no difference in bleeding, or incidence of surgical revision between groups.

**Conclusion:** NAFLD patients had lower mortality and complication rates following BS. A significant post-surgical weight loss should attenuate liver inflammation and fibrosis, and therefore has the potential to stop or even reverse progression of liver disease.

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## Introduction

Currently one third of the US population is obese, with nonalcoholic steatohepatitis (NASH) and nonalcoholic fatty liver disease (NAFLD) occurring in 25–55% and 84–95% of obese individuals respectively [1]. Approximately 30% of hepatic steatosis progresses to NASH and 25% of NASH progresses to cirrhosis [1,2].

The mainstay of treatment for NAFLD is weight loss. Data has shown that loss of 5% total body weight (TBW) shows histologic improvement in hepatic steatosis and loss of 7–10% decreases inflammation and reverses fibrosis [3,4].

Bariatric surgery (BS) is an effective treatment modality, resulting in significant weight loss. In the STAMPEDE trial, comparing 150 obese patients randomized to bariatric surgery plus intensive medical therapy or intensive medical therapy alone, surgically managed patients lost 21–24% of TBW, [5] thereby far exceeding the 7–10% needed to begin reversing liver damage.

Due to the concern for postoperative liver decompensation, NAFLD, and particularly NASH cirrhosis, may be viewed as a relative contraindication to BS. However, the safety and efficacy of BS among NAFLD patients is not well established. The aim of our

study is to evaluate perioperative outcomes and complications in patients with NAFLD undergoing BS compared to those without.

## Methods

The National Inpatient Sample (NIS) database for 2012–2015, which accounts for over 7 million discharges across 44 states and 4378 hospitals, was analyzed. All adult patients with an ICD-9/CPT code for BS were identified from the NIS for the period of January 1, 2012 to September 30, 2015. Patients were grouped according to the presence of NAFLD using ICD-9 code 571.8 into NAFLD and non-NAFLD groups.

Primary outcomes included inpatient mortality, LOS, and total hospital charges. Secondary outcomes included postoperative infection, bleeding, improper wound healing, and surgical revision.

Statistical analysis was performed with SAS<sup>®</sup> statistical programming. Multivariate logistic regression models were used to compare primary and secondary outcomes for each group while controlling for demographic variables.

## Results

A total of 302,306 patients underwent BS. Division of patients based on the presence of NAFLD yielded 15,607 patients in the NAFLD group and 286,699 in the non-NAFLD group. Inpatient mortality was 35% less likely in the NAFLD group (OR 0.65, 95% CI

**Abbreviations:** NAFLD, nonalcoholic fatty liver disease; NASH, nonalcoholic steatohepatitis; TBW, total body weight; BS, bariatric surgery; LOS, length of stay; NIS, National Inpatient Sample.

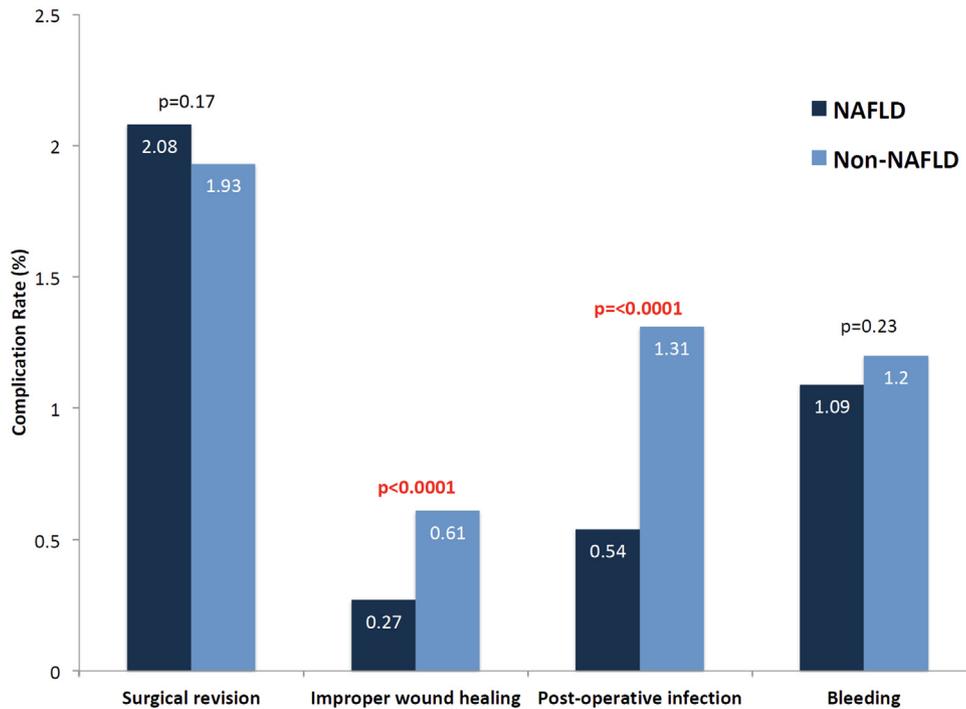
**Table 1**  
Primary outcomes from multivariate models controlling for patient and hospital characteristics.

	NAFLD	Non-NAFLD	p-value	Odds ratio (95% CI)
Inpatient mortality n (%)	55 (0.35%)	1553 (0.54%)	0.001 <sup>a</sup>	0.65 (0.50–0.85)
Mean LOS, days (SE)	3.2 (1.0)	3.7 (1.0)	<0.0001 <sup>b</sup>	–
Mean total charges, \$ (SE)	34,574 (1.0)	27,675 (1.0)	<0.0001 <sup>b</sup>	–

SE = standard error.

<sup>a</sup> Multivariate Logistic Regression.

<sup>b</sup> Multivariate Linear Regression.



**Fig. 1.** Postoperative outcomes from multivariate models controlling for patient and hospital characteristics.

0.50–0.85). NAFLD patients had shorter LOS but slightly greater total charges, even when controlling for LOS (Table 1). Secondary outcomes were also evaluated between the NAFLD and non-NAFLD groups (Fig. 1). There were no differences in occurrence of surgical revision or bleeding, however NAFLD patients were 56% less likely to have improper wound healing (OR 0.44, 95% 0.33–0.60), and 60% less likely to have post-operative infection (OR 0.40 95% CI 0.33–0.51). The cumulative complication rate, including all post-operative outcomes was lower in the NAFLD group (3.98% versus 5.05%).

**Discussion**

The 2018 guidelines from the American Association for the Study of Liver Disease recommends that BS can be considered in obese patients with NAFLD but should not be done to specifically to treat NAFLD [6]. The guidelines further state that patients with cirrhosis should be evaluated on a case-by-case basis for eligibility for BS [6]. These recommendations are based on the limited data on outcomes of BS in NAFLD patients. The results from our study suggest that NAFLD patients do not have increased perioperative risk for bariatric surgery.

Due to the significant sustained weight loss effects, BS has the potential to halt progression of NAFLD by decreasing inflammation and fibrosis in the liver. A prospective study by Vilar-Gomez et al suggested that the amount of weight loss is correlated with

the degree in histologic improvement of liver disease [3]. They also reported that patients with ≥10% TBW loss had higher rates of NASH resolution and regression of fibrosis [3]. Based on these data, BS should be much more effective in treatment and prevention of NASH given the substantially larger percentage of TBW loss achieved in surgically managed patients compared to medically managed. Furthermore, earlier consideration of bariatric surgery in NAFLD has the potential to decrease the rising number of liver transplants performed for NASH-related cirrhosis.

The main strength of this study is its size, including all encounters across the US for bariatric surgery from 2012–2015. Using the NIS database, we are limited by the fidelity of coding. Data points are limited to ICD-9 diagnoses and we were unable to account for coding errors or under-coding. NAFLD is represented by only one ICD-9 code (571.8), without a means to differentiate hepatic steatosis from NASH or NASH-related cirrhosis. Additionally, our data reflects outcomes that occurred during the initial hospitalization for bariatric surgery. Any events occurring after discharge from the index encounter were not captured.

**Conclusion**

Patients with NAFLD had lower mortality and fewer perioperative complications compared to non-NAFLD patients. This suggests that BS is safe in patients with NAFLD. Given that benefits of BS

in this special population likely outweigh the risks, it should be considered in the paradigm for management of NAFLD.

### Disclosures

The authors have no financial, professional or personal conflicts of interest related to this work.

### Financial support

There was no financial support provided for this work.

### Ethical Statement

The authors have no ethical issues related to this work. This project has been performed in accordance with ethical standards set forth by the *Obesity Research and Clinical Practice* journal.

### Conflict of interest

The authors have no financial, professional or personal conflicts of interest related to this work.

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