

The Impact of Obesity on Traumatic Rib Fracture Injuries

Ryan Beard, DO PGY-IV, Hilla Sang PhD, Sheryl Sahr MD, Megan Bowen MD
Sanford Health – Fargo, ND

University of North Dakota School of Medicine and Health Sciences – Grand Forks, ND

Background

- Obesity has become a significant public health concern in the United States over the past four decades.
- As this population of individuals increases, there will be an expected increase in the number of obese patients involved in trauma.
- Rib fractures are a common injury seen in trauma and carry significant morbidity and mortality leading to both short- and long-term disability.
- Despite numerous admissions for rib fractures every year, the association between obesity and rib fracture outcomes remains an understudied subject.
- The goal of this study was to examine the effect of body mass index (BMI) on outcomes after traumatic rib fracture injury (TRFI).

Methods

- Retrospective cohort study examining the relationship between patient BMI and clinical outcomes.
- Level I trauma center between January 2016 and October 2021.
- Main outcome: mortality
- Secondary outcomes:
 - Number of ventilator days
 - ICU length of stay (LOS)
 - Hospital length of stay (LOS)
 - Discharge disposition
 - Hospital associated complications
- BMI was categorized in accordance with the Centers for Disease Control and Prevention.
- Univariate and multivariate regression were used to identify statistically significant predictors of clinical outcomes of TRFI among the BMI categories.

Results

- 1368 patients were included in the study
- Almost four out of five patients had one or more co-morbidities:
 - Hypertension (most common)
 - Tobacco abuse
 - Diabetes mellitus.
- Falls and traffic accidents were the most common mechanisms of injury.
- Mean injury severity score was 15.93.
- 62.8% of patients had fractured 3-4
 - 5.8% of patients had flail chest
- Obese patients did not have a statistically significant association with mortality, number of ventilator days, or ICU LOS.
- Patients in the obese classes had **longer hospital LOS** ($p < 0.01$) and **more intubation days** ($p = 0.025$) than non-obese patients
- Obese patients were **more likely** to discharge to a rehab or care facility than non-obese patients ($p < 0.01$).
- Results of multivariate regression indicated that regardless of BMI, patients who had **more comorbidities** ($p < 0.01$) as well as a deep vein thrombosis ($p = 0.025$) and superficial surgical site infection ($p < 0.01$) had a **longer hospital LOS**.

Discussion

- There was no association between increased body mass index and mortality, number of ventilator days, or ICU LOS.
- Patients with obesity did have longer hospital LOS and lower likelihood of discharge to home.
- Regardless of BMI, patients with more co-morbidities had longer hospital LOS.
- The multi-organ system dysfunction that arises from obesity pre-disposes patients to increased complications while recovering from rib fractures and hinders recovery time.
- Obesity is a non-modifiable risk factor in TRFI patients; therefore, it is important to optimize other aspects of care to minimize both short- and long-term disability.
- This is in concordance with other works of literature, though few studies currently exist.
- Further research into this subject is recommended, as the number of obese trauma patients continues to increase.

References

- Haththotuwa RN, Wijeyaratne CN, Senarath U. Chapter 1 - Worldwide epidemic of obesity. In: Mahmood TA, Arulkumar S, Chervenak FA, eds. *Obesity and Obstetrics* (Second Edition). Elsevier; 2020:3-8. doi:10.1016/B978-0-12-817921-5.00001-1
- CDC. Disability and Obesity | CDC. Centers for Disease Control and Prevention. Published September 6, 2019. Accessed October 17, 2023. <https://www.cdc.gov/ncbddd/disabilityandhealth/obesity.html>
- CDC. Effects of Overweight and Obesity. Centers for Disease Control and Prevention. Published September 24, 2022. Accessed October 9, 2023. <https://www.cdc.gov/healthyweight/effects/index.html>
- Peek J, Bekes RB, Hietbrink F, et al. Epidemiology and outcome of rib fractures: a nationwide study in the Netherlands. *Eur J Trauma Emerg Surg*. 2022;48(1):265-271. doi:10.1007/s00068-020-01412-2
- Tang X, Liu G, Kang J, et al. Obesity and Risk of Hip Fracture in Adults: A Meta-Analysis of Prospective Cohort Studies. *PLoS One*. 2013;8(4):e55077. doi:10.1371/journal.pone.0055077
- Finkelstein EA, Khavjou OA, Thompson H, et al. Obesity and severe obesity forecasts through 2030. *Am J Prev Med*. 2012;42(5):563-570. doi:10.1016/j.amepre.2011.10.026
- quick start guide [Zotero Documentation]. Accessed September 30, 2023. https://www.zotero.org/support/quick_start_guide
- Kinder F, Giannoudis PV, Boddice T, Howard A. The Effect of an Abnormal BMI on Orthopaedic Trauma Patients: A Systematic Review and Meta-Analysis. *J Clin Med*. 2020;9(5):1302. doi:10.3390/jcm9051302
- Ejima S, Holcombe S, Zhang P, et al. The Effect of Rib Fracture Patterns in the Obese. Published online 2017.
- Ziegler DW, Agarwal NN. The morbidity and mortality of rib fractures. *J Trauma*. 1994;37(6):975-979. doi:10.1097/00005373-199412000-00018

	Normal/ Under weight (N=399)	Overweig ht (N=435)	Obese class 1 (N=314)	Obese class 2 (N=142)	Obese class 3 (N=78)	Total (N=1368)	p value
Vent days							0.795
Mean (SD)	6.98 (8.80)	7.60 (8.56)	8.38 (10.34)	8.65 (8.46)	10.12 (14.19)	7.98 (9.63)	
Median (Q1, Q3)	4.00 (1.00, 10.75)	4.00 (2.00, 10.25)	5.50 (1.00, 12.00)	6.00 (2.00, 12.00)	5.00 (2.00, 11.00)	4.00 (2.00, 11.00)	
ICU LOS							0.025
Mean (SD)	6.14 (8.21)	5.63 (5.90)	6.99 (7.82)	6.29 (5.74)	8.71 (7.93)	6.38 (7.15)	
Median (Q1, Q3)	3.00 (2.00, 7.00)	3.00 (2.00, 6.75)	4.00 (3.00, 9.00)	4.00 (2.00, 10.75)	7.00 (3.50, 12.00)	3.50 (2.00, 8.00)	
Hospital LoS							< 0.001
Mean (SD)	7.07 (8.49)	7.40 (7.76)	8.35 (9.42)	8.77 (8.29)	12.45 (12.63)	7.95 (8.84)	
Median (Q1, Q3)	5.00 (3.00, 8.00)	5.00 (3.00, 9.00)	6.00 (3.00, 10.75)	6.00 (3.00, 11.75)	9.00 (5.00, 17.00)	5.00 (3.00, 10.00)	

Table 2: Statistical analysis results ($p < 0.05$)

	Overall (N=1368)
Age	
Mean (SD)	57.31 (19.97)
Median (Q1, Q3)	59.00 (42.00, 73.00)
Age group	
24 and under	84 (6.1%)
25 to 44	300 (21.9%)
45 to 64	452 (33.0%)
65 to 74	233 (17.0%)
75+	299 (21.9%)
Sex	
Male	900 (65.8%)
Female	468 (34.2%)
Race	
Indigenous American	139 (10.2%)
Asian	0 (0.0%)
Black or African American	13 (1.0%)
Native Hawaiian or Pacific Islander	0 (0.0%)
White	1188 (86.8%)
Unknown	28 (2.0%)
BMI class	
Normal/Under weight	399 (29.2%)
Overweight	435 (31.8%)
Obese class 1	314 (23.0%)
Obese class 2	142 (10.4%)
Obese class 3	78 (5.7%)
BMI	
Mean (SD)	29.12 (6.69)
Median (Q1, Q3)	28.05 (24.41, 32.70)

Table 1: Demographic data

