

The Modified 5-item frailty Index, Mortality,
and Hospital Length of Stay in Geriatric Traumatic Fall Injuries.

By
Daniel Antonson
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Date _____

(Signature of Advisor)
Michael J. Mello, MD MPH, Advisor

Date _____

(Signature of Reader - if applicable)
Stephanie Lueckel MD, Reader

Date _____

Michael J. Mello, MD MPH
Director, Master of Science in Population Medicine

Approved by the Graduate Council

Date _____

Thomas A. Lewis, Dean of the Graduate School

Preface and Acknowledgments

Welcome to my thesis project titled "The Modified 5-item Frailty Index, Mortality, and Hospital Length of Stay in Geriatric Traumatic Fall Injuries." This endeavor marks the culmination of my research journey within the Primary Care Population Medicine program at Brown University.

I am deeply appreciative of the learning opportunities afforded by this project and indebted to the comprehensive experience provided by the PCPM program.

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**The modified 5-item frailty index, mortality, and hospital length of stay in geriatric
traumatic fall injuries.**

**Daniel Antonson¹, Julie Bromberg^{1,2}, Stephanie Lueckel MD^{1,2}, Michael J. Mello, MD
MPH^{1,2}**

Warren Alpert Medical School of Brown University¹ and Rhode Island Hospital²

Introduction:

Geriatric adults, defined here as individuals aged 65 years and older, constitute an increasingly significant segment of the United States population. Traumatic falls represent a critical public health concern due to their association with significant morbidity and mortality in this population.¹ In 2020 alone, falls resulted in more than 36,000 fatalities, triggered over 3 million emergency department visits, and incurred medical costs exceeding \$50 billion.¹ Beyond the immediate physical consequences, falls can precipitate a decline in functional independence, increasing the risk for institutionalization, especially among frail patients.²

Given the prevalence of poor outcomes after fall related injuries, methods to risk stratify geriatric patients admitted to trauma surgery is of particular interest. While there is no standard for risk stratification, the concept of frailty has emerged as important consideration and has shown to be associated with adverse postoperative outcomes across several surgical domains, including geriatric trauma.^{4,6}

Frailty can be conceptualized as a decrease in physiological reserve that results from impairments in multiple organ systems and can be distinguished from the aging process and

comorbidity.³ Several methods can quantify frailty, but the modified five-item frailty index score (mFI-5) has gained traction due to its simplicity and strong predictive value.³ It is calculated based on five parameters shown in Table 1.

Table 1.
Components of the mFI-5

Modified Five-Item Frailty Index Score (mFI-5)
Congestive Heart Failure
Diabetes Mellitus
Chronic Obstructive Pulmonary Disease (COPD)
Dependent functional status
Hypertension

Despite its simplicity, the mFI-5 has proven to be equally predictive as compared to other frailty index scores, such as the longer 11-item index score.³ The mFI-5 could potentially be a simple tool to help surgeons, patients, and family members on decisions to proceed with surgery or not. Previous studies have investigated the relationship between mFI-5 and outcomes in various surgical domains but no research has directly evaluated its predictive value in traumatic falls in geriatric patients.⁴ This study seeks to meet this gap in knowledge.

Methods:

We conducted a retrospective analysis using data from the Trauma Registry at Rhode Island Hospital that encompassed all adult trauma patients admitted between January 1, 2014, and December 31, 2019, who met specific inclusion criteria. Lifespan IRB reviewed and provided approval of the study protocol.

The trauma manager provided the data in the form of an Excel spreadsheet. Inclusion criteria required patients to be over the age of 65 at the time of admission and to have presented with fall-related injuries during their hospitalization.

The dataset included various demographic and clinical variables, such as age, gender, race, ethnicity, ICD-10 diagnosis codes, e-codes for injury mechanisms, injury severity scores (ISS), preexisting comorbidities, indication for surgical intervention, hospital length of stay (LOS), discharge disposition, functional status upon admission, and patient medical record numbers (MRN).

Upon receipt of the dataset, the research team securely transferred it to the Injury Prevention Center for analysis.

The primary outcomes of interest were in-hospital mortality and hospital length of stay (LOS).

After receiving the data set, the modified 5-item frailty index was used to retrospectively determine each patient's frailty level. Patients were assigned a score based on the presence of five predefined conditions within the preexisting comorbidities category of the data set:

1. Documented history of congestive heart failure
2. Documented history of diabetes mellitus.
3. Documented history of chronic obstructive pulmonary disease
4. Documented history of hypertension
5. Partial or total dependency in functional health status at the time of admission.

Each condition, if present, was assigned a score of '1' within Excel. The total mFI-5 score was calculated by summing the individual scores using Excel, with a potential range from 0 (least frail) to 5 (most frail).

Logistic regression models were employed to assess the relationship between the mFI-5 scores and mortality. For evaluating the correlation between mFI-5 scores and hospital LOS, we utilized linear regression. Additionally, the association of injury severity score (ISS) and mFI-5 was investigated with ANOVA analysis with post-hoc pairwise comparisons. All analyses were adjusted for potential confounders, including age, race, and gender. Results were presented with odds ratios (ORs), coefficients, and 95% confidence intervals (CIs). We set our significance value to 0.05.

Results:

Out of the 6,749 patients' data reviewed; all met the inclusion criteria. The mean age of the cohort was 81.7 years with a standard deviation of 8.66 years. Demographics shown in Table 2 demonstrate a homogeneous study population with more than 90% of patients identified as non-Hispanic white and 62.43% identified as female.

The distribution of the modified 5-item frailty index (mFI-5) scores among the study population are shown in Table 3, most patients scored 1 or 2.

There was a significant association between increasing mFI-5 scores and rising rates of mortality (OR: 1.259; 95% CI: 1.14-1.39; $P<0.000$). Notably, age was not a significant predictor of mortality (OR: 1.000; 95% CI: 0.99-1.01; $P=0.888$).

A higher mFI-5 score was significantly associated with a prolonged hospital stay (Coeff: 0.460; 95% CI: 0.35-0.57; $P<0.000$). Conversely, increasing age was negatively associated with hospital length of stay (Coeff: -0.044; 95% CI: -0.06 to -0.03; $P<0.000$).

Initial ANOVA analysis comparing ISS and mFI-5 found a significant difference in ISS scores among the different mFI-5 scores (F value: 4.682, $P<0.000$). Post-hoc pairwise t-tests show that the mean ISS score for an mFI-5 of 0 is significantly different from the mean ISS for scores 1,2,3,4,5. However when comparing the mean ISS score for mFI-5 scores, excluding 0, there's no significant difference.

ISS was not significantly associated with age on linear regression (Coeff: -0.005; 95% CI: -0.02 to 0.01; P=0.544)

Discussion:

The findings suggest a tangible association between an increased mFI-5 score and elevated inpatient mortality, along with prolonged hospital stays. Such outcomes accentuate the critical role of frailty in jeopardizing the life, health, and independence of geriatric individuals. Given these consequences, frailty assessments may have the potential to play a larger role in health evaluations, especially in light of the aging United States population.

Interestingly, while age is often viewed as a marker of vulnerability in geriatrics, our results spotlight the potential of mFI-5 as a possible superior predictor.⁸ Notably, age did not demonstrate a significant correlation with increased mortality and was even negatively correlated with the length of hospital stay. Since age did not correlate with a significant difference in ISS score, it is unlikely that this observed effect is due to differences in injuries.

It is unclear why age may be negatively associated; however the relatively low R-squared value indicates that age is not a strong predictor of hospital stay length by itself, and there are likely other factors not included in our model that influence the length of stay. Further, given the small size of the effect the relationship is likely not clinically significant. However, these observations further distinguish frailty from aging, bolstering the assertion that the former provides a more nuanced understanding of patient vulnerability.

Another compelling observation was the non-association between injury severity score and frailty. While more frail patients suffered worse outcomes than less frail patients, they did not suffer from more severe initial injury. This revelation further supports the idea that frailty may be a predictor of adverse outcomes regardless of what the initial injury may be.

While this study sheds light on one crucial aspect of geriatric trauma care, it comes with certain limitations. The study's focus was confined to patients registered with the trauma registry service and therefore excluded patients who were not admitted, may have died prior to admission, or were admitted to another service. The outcomes assessed were limited, and future studies might consider a broader spectrum of post-fall complications or longer-term outcomes. The retrospective nature of our study could introduce biases related to missing or incomplete data. The study did not adjust for all potential confounders, such as alternative pre-existing health conditions not accounted for by the mFI-5, which could influence outcomes. Although the study sample was large with 6,749 participants, all data was extracted from a single site. Furthermore, the study population was overwhelmingly identified as non-Hispanic white individuals. Repetition of this study at multiple locations with a more diverse patient population is needed to generalize the results to a wider population.

The mFI-5, given its simplicity and efficacy, could become a tool in clinical settings, helping physicians risk-stratify geriatric patients more effectively. This could aid in tailoring interventions, discussions about care goals, and optimizing resource allocation. Future investigations might delve deeper into the utility of prospectively integrating mFI-5 into clinical care as most studies to date have focused on retrospective analysis.

Conclusions:

Our study provides evidence that the mFI-5 may serve as a predictor for both inpatient mortality and hospital length of stay in geriatric patients presenting with traumatic falls. Notably, the mFI-5 emerged as a more reliable indicator than age, suggesting that frailty, rather than chronological age, plays a pivotal role in determining patient outcomes.

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Table 2.
Patient Demographics

Gender	Count	Percent
Female	4234	62.43%
Male	2548	37.57%
Race		
Not Disclosed	6	0.09%
American Indian/Alaskan	2	0.03%
Asian	53	0.78%
Black/African American	127	1.87%
Hawaiian/Pacific Islander	3	0.04%
Other Race	258	3.80%
White	6333	93.38%
Ethnicity		
Not Disclosed	6	0.09%
Hispanic or Latino	231	3.41%
Not Hispanic or Latino	6545	96.51%

Table 3.

mFI-5, Age, and Primary Study Outcomes

mFI-5 Score:	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Mean = 1.61	12.8%	36.6%	32.2%	14.6%	3.2%	0.6%
Average Age:	78.64	81.43	82.66	82.74	81.44	79.10
Mean = 81.7						
Average Injury Severity Score:	10.55	9.70	9.61	9.31	9.11	10.41
Mean = 9.71						
Average Length of Stay:	5.33	5.49	5.94	6.48	6.79	6.56
Mean = 5.81						
Percent Inpatient Mortality	5.86%	3.83%	4.75%	8.08%	12.84%	5.82%
Total = 5.30%						