The Modified Five-Item Frailty Index, Mortality, and Hospital Length of Stay in Geriatric Traumatic Fall Injuries

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ABSTRACT

This study investigates the association between frailty, measured by the modified five-item frailty index (mFI-5), with inpatient mortality and hospital length of stay for geriatric patients with fall-related injuries. Despite falls being major contributors to morbidity and mortality in those over 65, the interaction between frailty and post-fall outcomes remains underexplored. Data for patients aged 65 and above, admitted between 2014–2020 to Rhode Island Hospital’s trauma service for fall-related injuries, were extracted from its Trauma Registry. Frailty scores were retrospectively assigned using mFI-5. Logistic- and linear-regression analyses examined the relationship between mFI-5 scores, mortality, and hospital length-of-stay. Among 6,782 patients (mean age: 81.7 ± 8.66 years), higher frailty scores correlated with increased inpatient mortality (OR: 1.259; 95% CI: 1.14–1.39; P<0.000) and longer hospital stays (Coeff.: 0.460; 95% CI: 0.35–0.57, P<0.000). Notably, age showed a negative association with hospital length of stay but no significant association with inpatient mortality.

KEYWORDS: frailty, geriatrics, falls, modified five-item frailty index [mFI-5]

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. 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. Beyond the immediate physical injury consequences, falls can precipitate a decline in functional independence, increasing the risk for institutionalization, especially among frail patients.

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

Frailty can be conceptualized as a decrease in physiological reserve that results from impairments in multiple organ systems leading to increased vulnerability. 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.

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. The mFI-5 could potentially be a simple tool to help surgeons, patients, and family members on discussion regarding treatment decisions and goals of care. 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. This study seeks to meet this gap in knowledge.

Table 1. Components of the mFI-5

<table>
<thead>
<tr>
<th>Modified Five-Item Frailty Index Score (mFI-5)</th>
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<tr>
<td>Congestive Heart Failure</td>
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<tr>
<td>Diabetes Mellitus</td>
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<tr>
<td>Chronic Obstructive Pulmonary Disease (COPD)</td>
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<tr>
<td>Dependent functional status</td>
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<td>Hypertension</td>
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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. Inclusion criteria required patients to be over the age of 65 at the time of admission and to have presented for evaluation and treatment of fall-related injuries. Lifespan IRB reviewed and provided approval of the study protocol.

The trauma registry provided the data in the form of an Excel spreadsheet. The dataset included demographic and clinical variables including 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 in days (LOS), discharge disposition, functional status upon
admission, and patient medical record numbers (MRN). The primary outcomes of interest were in-hospital mortality and hospital length of stay in days.

After receiving the data set, the modified five-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: documented history of congestive heart failure, diabetes mellitus, chronic obstructive pulmonary disease, hypertension, and partial or total dependency in functional health status at the time of admission.

Each condition, if present, was assigned a score of ‘1’. The total mFI-5 score was calculated by summing the individual scores using Microsoft Excel (Microsoft Corporation 2019), with a potential range from 0 (least frail) to 5 (most frail).

R-studio was used for statistical analysis of the data set.4 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. 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.

Additionally, the association of ISS and mFI-5 was investigated using the Kruskal-Wallis Test. Post-hoc comparisons with pairwise Wilcoxon rank sum tests were conducted to identify specific group differences following a significant Kruskal-Wallis test result. Bonferroni correction was applied to adjust the p-values for multiple comparisons to control the family-wise error rate. Results are presented with a chi-squared value, degrees of freedom (df), and p-values. The significance value was similarly set 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 mFI-5 scores among the study population are shown in Table 3, with most patients scoring 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) in the study sample. 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).

The Kruskal-Wallis test revealed that there were overall differences in ISS scores across the different levels of mFI-5 (chi-squared = [12.513], df = [5], p-value = [0.0284]). Post-hoc pairwise comparisons using Wilcoxon rank sum tests with Bonferroni correction revealed significant differences in ISS scores between an mFI-5 of 0 compared with an mFI-5 of 2 and 3. This suggests, 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 an association between an increased mFI-5 score and elevated inpatient mortality, along with prolonged hospital stays for older adults with traumatic fall injuries. 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. They may be incorporated at different levels of patient care, including during a primary care provider’s visit for health maintenance, to assist with future goals of care and treatment discussions.

Interestingly, while age is often viewed as a marker of vulnerability after injury, our results spotlight the potential of mFI-5 as a possible superior predictor. Notably, age alone did not demonstrate a significant correlation with increased mortality and was even negatively correlated with hospital length of 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, such as insurance status or prior living situation. Another potential explanation would be that older patients may already have significant resources in place at the time of their injury which could facilitate discharge. 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 ISS 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 provides data 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 or may have died prior to admission. 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, female 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.

Other frailty indices such as the TSFI, FS, and RFS are similarly being evaluated for their predictive value in trauma patients. One study suggests that the TSFI and RFS are better predictors of outcomes for geriatric trauma patients compared with the mFI-5 and the FS; however, additional studies may be necessary to definitely conclude the superiority of one index of another.

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

CONCLUSIONS
Our study provides supporting 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. Further, more expansive studies should investigate this relationship to better understand the predictive value of the mFI-5. Notably, in our study the mFI-5 emerged as a more reliable indicator than age, suggesting that frailty, rather than chronological age, could play a pivotal role in determining patient outcomes.

References


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Disclosures
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