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Original Article

Prognostic Value of Frailty Index and Handgrip strength in Predicting 90-Day Outcome in Elderly Patients Admitted under Medicine Dept

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ABSTRACT

Background: Frailty and reduced muscle strength are common in elderly patients admitted with acute medical illnesses and are associated with adverse outcomes. Simple bedside tools that can predict short-term outcomes are clinically valuable in routine medical practice.
Objectives: To evaluate the prognostic value of frailty index and handgrip strength assessed at admission in predicting 90-day outcomes among elderly patients admitted under the Department of Medicine.
Methods: This prospective observational study included 50 patients aged ≥60 years admitted to the Department of Medicine at a tertiary care hospital. Frailty was assessed using a deficit accumulation Frailty Index, and handgrip strength was measured using a handheld dynamometer within 48 hours of admission. The primary outcome was a composite poor outcome at 90 days, defined as death, hospital readmission, or functional decline. Logistic regression analysis was performed to identify independent predictors of adverse outcomes.
Results: At 90 days, 26% of patients experienced a composite poor outcome. The proportion of poor outcomes increased across frailty categories, with the highest rates observed among frail patients. Patients with poor outcomes had significantly lower baseline handgrip strength compared with those with good outcomes. Both higher frailty index and lower handgrip strength were independently associated with increased odds of adverse 90-day outcomes after adjustment for age, sex, and comorbidity burden.
Conclusion: Frailty index and handgrip strength assessed at hospital admission are independent predictors of adverse 90-day outcomes in elderly medical inpatients. Incorporation of these simple bedside assessments may improve early risk stratification and guide targeted inpatient and post-discharge care.

Keywords*: Frailty index, Handgrip strength, Elderly patients,90-day outcomes, Internal medicine hospitalization.*

INTRODUCTION

The ageing population has resulted in an increasing number of older adults being admitted to hospitals for acute medical illnesses. These patients often have multiple chronic conditions, reduced physiological reserve, and impaired functional status. Predicting short-term outcomes in this group remains challenging in routine internal medicine practice.

Frailty has gained recognition as a key determinant of adverse outcomes in older adults. It represents the cumulative effect of comorbidities, functional impairment, and vulnerability to stressors. A multimorbidity-based frailty index has been shown to predict mortality and hospitalization in older populations, emphasizing its prognostic value beyond chronological age alone [1]. Evidence from systematic reviews also suggests that frailty is highly prevalent among unplanned hospital admissions and is associated with increased mortality, readmission, and functional decline [6].

In hospitalized older adults, several frailty assessment tools have been evaluated. Comparative studies have demonstrated that frailty measured at the time of admission is strongly associated with both short- and long-term outcomes, regardless of the specific tool used [3]. These findings support the relevance of frailty assessment in general medicine wards.

Handgrip strength is a simple and objective measure of muscle strength. It serves as a surrogate marker of sarcopenia and overall functional reserve. A systematic review and meta-analysis showed that low handgrip strength is associated with higher risks of mortality and hospitalization in adults aged 60 years and older [2]. Reduced muscle strength is also closely linked to disease-related malnutrition and catabolic states, which negatively influence clinical outcomes [4].

Hospital readmission is a major concern in geriatric care. Functional impairment, nutritional deficits, and frailty-related factors have been identified as important predictors of readmission in elderly patients [5]. Despite this, limited data are available on the combined prognostic role of frailty and handgrip strength in elderly patients admitted under internal medicine services, particularly in resource-limited settings.

This study was therefore undertaken to evaluate the prognostic value of the frailty index and handgrip strength in predicting 90-day outcomes among elderly patients admitted under the Department of Medicine.

OBJECTIVES

Primary Objective

To evaluate the prognostic value of the frailty index and handgrip strength assessed at hospital admission in predicting 90-day clinical outcomes among elderly patients admitted under the Department of Medicine.

Secondary Objectives

1. To determine the association between frailty index categories and 90-day composite poor outcome, including mortality, hospital readmission, and functional decline.
2. To assess the relationship between baseline handgrip strength and 90-day clinical outcomes using both continuous values and sex-specific cut-off categories.
3. To examine whether frailty index and handgrip strength independently predict adverse 90-day outcomes after adjustment for relevant clinical covariates.

METHODS

Study Design and Setting

This was a prospective observational study conducted in the Department of Medicine at Mahabodhi Medical College & Hospital, Nakknupa, Bihar. The study was carried out over a period of one year, from January 2025 to December 2025.

Study Population

Consecutive elderly patients admitted under the Department of Medicine during the study period were screened for eligibility.

Inclusion Criteria

- Age **60 years or older**
- Admission under the Department of Medicine
- Ability to undergo frailty and handgrip strength assessment within 48 hours of admission

Exclusion Criteria

- Critical illness precluding assessment
- Severe upper limb deformity or injury preventing handgrip measurement
- Terminal illness with expected survival less than 48 hours
- Refusal to provide informed consent

A total of **50 patients** meeting the eligibility criteria were included in the final analysis.

Data Collection

Baseline data were collected within 48 hours of hospital admission. Demographic variables included age and sex. Clinical data included primary admitting diagnosis, comorbidity count, length of hospital stay, and discharge status. Baseline functional status was assessed using the Barthel Index. Laboratory parameters recorded included hemoglobin, serum albumin, and C-reactive protein.

Frailty Assessment

Frailty was assessed using a Frailty Index (FI) based on the deficit accumulation approach. The FI was calculated as the ratio of the number of deficits present to the total number of deficits considered. FI values ranged from 0 to 1, with higher values indicating greater frailty.

Patients were categorized into three frailty groups:

- **Non-frail:** FI < 0.20
- **Pre-frail:** FI 0.20–0.35
- **Frail:** FI > 0.35

Handgrip Strength Measurement

Handgrip strength was measured using a handheld dynamometer. Measurements were performed with the patient in a seated position, with the elbow flexed at 90 degrees. Three attempts were recorded for the dominant hand, and the highest value was used for analysis.

Low handgrip strength was defined using sex-specific cut-offs:

- <27 kg in men
- <16 kg in women

Outcome Measures

The primary outcome was composite poor outcome at 90 days, defined as the occurrence of any of the following:

- Death within 90 days of index admission
- Unplanned hospital readmission within 90 days
- Functional decline at 90 days compared with baseline

Secondary outcomes included individual components of the composite outcome.
Patients were followed up at 90 days through outpatient visits or telephone interviews.

Statistical Analysis

Continuous variables were summarized as mean ± standard deviation or median with interquartile range, as appropriate. Categorical variables were presented as frequency and percentage.

Associations between frailty index categories and 90-day outcomes were assessed using the chi-square test. Comparisons of continuous variables between outcome groups were performed using the independent t-test or Mann–Whitney U test, as appropriate.

Logistic regression analysis was used to evaluate predictors of poor composite outcome. Frailty index and handgrip strength were analyzed as continuous variables. Multivariable models were adjusted for age, sex, and comorbidity count. Results were expressed as odds ratios (ORs) with 95% confidence intervals (CIs).

A two-sided p-value < 0.05 was considered statistically significant. Statistical analyses were performed using standard statistical software.

Ethical Considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Committee of Mahabodhi Medical College & Hospital. Written informed consent was obtained from all participants or their legally authorized representatives.

RESULTS

1. Study Population and Baseline Characteristics

The baseline demographic, clinical, functional, and laboratory characteristics of the study population are summarized in

Table 1. The cohort represents elderly patients admitted under the Department of Medicine with a spectrum of acute medical illnesses and varying degrees of comorbidity, functional status, frailty, and nutritional and inflammatory markers at admission.

Variable	Value
Age (years), mean ± SD	72.4 ± 6.2
Age ≥75 years, n (%)	21 (42.0)
Sex, n (%)	
Male	21 (42.0)
Female	29 (58.0)
Primary admitting diagnosis, n (%)	
Pneumonia / Lower respiratory tract infection	8 (16.0)
Heart failure	7 (14.0)
Sepsis	6 (12.0)
Cerebrovascular accident	6 (12.0)

Acute exacerbation of COPD	5 (10.0)
Chronic kidney disease–related complications	5 (10.0)
Urinary tract infection	4 (8.0)
Hyponatremia	4 (8.0)
Other medical conditions*	5 (10.0)
Comorbidity count, median (IQR)	2 (1–3)
Frailty Index, mean ± SD	0.27 ± 0.08
Frailty category, n (%)	
Non-frail (FI < 0.20)	11 (22.0)
Pre-frail (FI 0.20–0.35)	28 (56.0)
Frail (FI > 0.35)	11 (22.0)
Handgrip strength (kg), mean ± SD	20.4 ± 5.4
Baseline Barthel Index, mean ± SD	69 ± 18
Hemoglobin (g/dL), mean ± SD	11.8 ± 1.9
Serum albumin (g/dL), mean ± SD	3.4 ± 0.6
C-reactive protein (mg/L), median (IQR)	18 (9–42)
Length of hospital stay (days), median (range)	7 (2–25)
Discharge status, n (%)	
Discharged home	27 (54.0)
Discharged with attendant care	16 (32.0)
Referred to higher center	4 (8.0)
In-hospital mortality	3 (6.0)

*Includes gastrointestinal bleed, diabetic emergencies, and other less frequent acute medical conditions.

Data are presented as mean ± standard deviation, median (interquartile range), or number (percentage), as appropriate. The frailty index was calculated using a deficit accumulation approach. Handgrip strength was measured in kilograms using a handheld dynamometer.

2. Distribution of Frailty Index and Handgrip Strength

The distribution of frailty index categories and handgrip strength at admission is summarized in Table 2. This analysis describes the baseline frailty burden and muscle strength profile of elderly patients admitted under the Department of Medicine.

Table 2. Distribution of frailty index categories and handgrip strength at admission (n = 50)

Variable	n (%) / Mean ± SD
Frailty Index (FI)	
Mean FI score	0.27 ± 0.08
Non-frail (FI < 0.20)	11 (22.0)
Pre-frail (FI 0.20–0.35)	28 (56.0)
Frail (FI > 0.35)	11 (22.0)
Handgrip strength (kg)	
Overall, mean ± SD	20.4 ± 5.4
Male, mean ± SD	24.8 ± 4.9
Female, mean ± SD	17.2 ± 4.1
Low handgrip strength, n (%) *	
Overall	18 (36.0)
Male	7 (33.3)
Female	11 (37.9)

*Low handgrip strength is defined as <27 kg in men and <16 kg in women.
The frailty index was calculated using a deficit accumulation approach. Handgrip strength was measured in kilograms using a handheld dynamometer, and the highest value of three attempts was recorded. Sex-specific cut-offs were applied to define low handgrip strength.

3. Ninety-Day Clinical Outcomes

The distribution of 90-day clinical outcomes in the study cohort is presented in Table 3 and illustrated in Figure 1.
At 90-day follow-up, a composite poor outcome—defined as death, hospital readmission, or functional decline—was observed in a clinically relevant proportion of patients. Among the individual outcome components, hospital readmission constituted the most frequent adverse event, followed by mortality and functional decline. A majority of patients

experienced a good outcome at 90 days, characterized by survival without readmission or significant functional deterioration.

When individual outcomes were examined, 90-day mortality occurred in a small subset of patients, while unplanned readmissions within 90 days accounted for the largest proportion of adverse events. Functional decline at 90 days, assessed relative to baseline functional status, was also observed, reflecting the vulnerability of this elderly inpatient population.

Figure 1 depicts the relative proportions of good versus poor outcomes and the distribution of individual adverse outcome components at 90 days, providing a visual overview of short-term prognosis following medical hospitalization.

Table 3. Distribution of 90-day clinical outcomes in the study population (n = 50)

90-day outcome	**n (%)**
Overall outcome status	
Good outcome*	37 (74.0)
Composite poor outcome	13 (26.0)
Components of composite poor outcome†	
Death within 90 days	3 (6.0)
Hospital readmission within 90 days	7 (14.0)
Functional decline at 90 days	3 (6.0)

*Good outcome defined as survival at 90 days without hospital readmission or functional decline. †Individual components are not mutually exclusive within the composite outcome.

Composite poor outcome was defined as the occurrence of death, unplanned hospital readmission, or functional decline within 90 days of index admission.

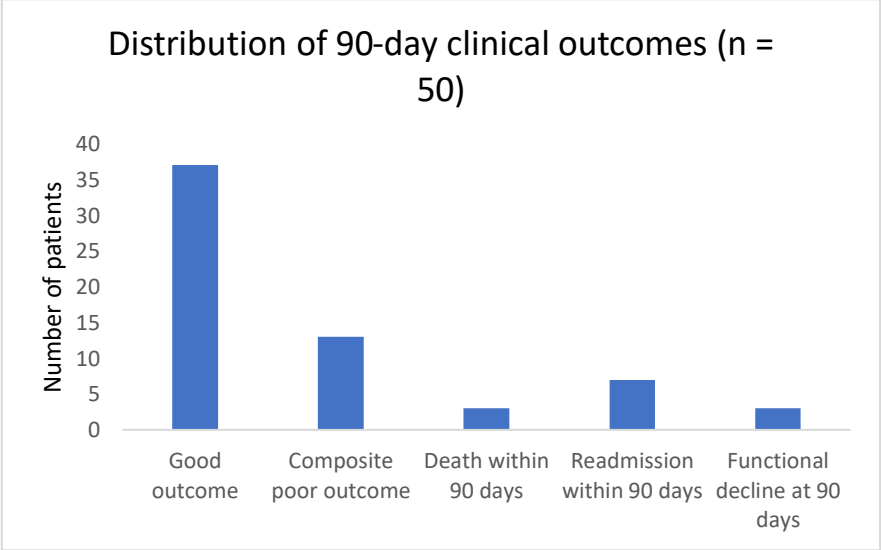

Figure 1. Distribution of 90-day clinical outcomes among elderly patients admitted under the Department of Medicine (n = 50). The bar chart depicts the number of patients with a good outcome and those experiencing a composite poor outcome at 90 days. The composite poor outcome includes death, unplanned hospital readmission, or functional decline within 90 days of the index admission. Individual components of the composite outcome are shown to demonstrate their relative frequency.

4. Association Between Frailty Index and 90-Day Outcomes

The association between Frailty Index (FI) and 90-day composite poor outcome is summarized in Table 4 and visually presented in Figure 2.

A clear gradient was observed across FI categories. The proportion of patients with a composite poor outcome increased from 9.1% (1/11) in the non-frail group to 17.9% (5/28) in the pre-frail group and 63.6% (7/11) in the frail group (χ^2 p = 0.0048) (Table 4; Figure 2). Consistent with this pattern, FI values were higher among patients who experienced poor outcomes compared with those who had good outcomes (median FI 0.35 vs. 0.25; mean FI 0.334 ± 0.079 vs 0.247 ± 0.073).

When FI was analyzed as a continuous predictor, higher FI was associated with increased odds of composite poor outcome. In unadjusted logistic regression, each 0.10 increase in FI was associated with an odds ratio (OR) of 4.55 (95% CI 1.64–12.61; p = 0.0036) for poor outcome. After adjustment for age, sex, and comorbidity count, FI remained significantly associated with composite poor outcome (adjusted OR per 0.10 FI increase: 8.54, 95% CI 1.24–58.68; p = 0.029) (Table 4).

These findings support a clinically meaningful relationship between increasing frailty burden at admission and adverse outcomes within 90 days in elderly medical inpatients.

Table 4A. Frailty category vs 90-day composite poor outcome

Frailty category	Total, n	Poor outcome, n (%)	Good outcome, n (%)
Non-frail (FI<0.20)	11	1 (9.1)	10 (90.9)
Pre-frail (0.20-0.35)	28	5 (17.9)	23 (82.1)
Frail (>0.35)	11	7 (63.6)	4 (36.4)

Table 4B. Logistic regression: FI predicting 90-day composite outcome

Model	Effect (per 0.10 increase in FI)	p-value
Unadjusted (FI only)	OR 4.55 (95% CI 1.64-12.61)	0.0036
Adjusted (FI + age + sex + comorbidity count)	OR 8.54 (95% CI 1.24 -58.68)	0.0292

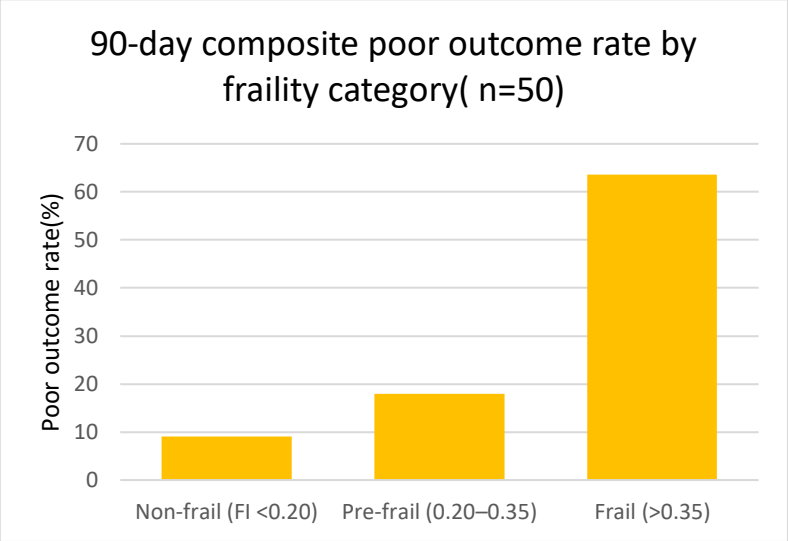

Figure 2. Ninety-day composite poor outcome rate stratified by frailty category among elderly patients admitted under the Department of Medicine (n = 50). Composite poor outcome was defined as death, unplanned hospital readmission, or functional decline within 90 days of the index admission. Frailty categories were defined using the Frailty Index as non-frail (FI <0.20), pre-frail (FI 0.20–0.35), and frail (FI >0.35). Rates are shown as percentages within each frailty category.

5. Association Between Handgrip Strength and 90-Day Outcomes

The association between handgrip strength at admission and 90-day clinical outcomes is summarized in Table 5 and illustrated in Figure 3.

Patients who experienced a composite poor outcome at 90 days had lower baseline handgrip strength compared with those who had a good outcome (Table 5A). When analyzed using sex-specific cut-offs, a higher proportion of patients with low handgrip strength developed adverse outcomes relative to those with preserved muscle strength (Figure 3).
In logistic regression analysis, handgrip strength showed a significant inverse association with composite poor outcome. Modelled as a continuous variable, increasing handgrip strength was associated with lower odds of adverse 90-day outcomes, and this association remained significant after adjustment for age, sex, comorbidity burden, and frailty index (Table 5B).

Table 5A. Baseline handgrip strength according to 90-day outcome status

Outcome at 90 days	**Handgrip strength (kg), mean ± SD**	**Low handgrip strength*, n (%)**
Good outcome (n = 37)	22.4 ± 4.6	8 (21.6)
Composite poor outcome (n = 13)	14.8 ± 3.9	10 (76.9)

Low handgrip strength was defined as <27 kg in men and <16 kg in women.
Data are presented as mean ± standard deviation or number (percentage), as appropriate.

Table 5B. Logistic regression analysis of handgrip strength for prediction of 90-day composite poor outcome

Model	Effect estimate (per 1-kg increase in handgrip strength)	p-value
Unadjusted	OR 0.59 (95% CI 0.44–0.78)	0.0006
Adjusted†	OR 0.62 (95% CI 0.42–0.91)	0.016

Odds ratios (ORs) are expressed per **1-kg increase in handgrip strength.** † Adjusted for age, sex, comorbidity count, and frailty index.

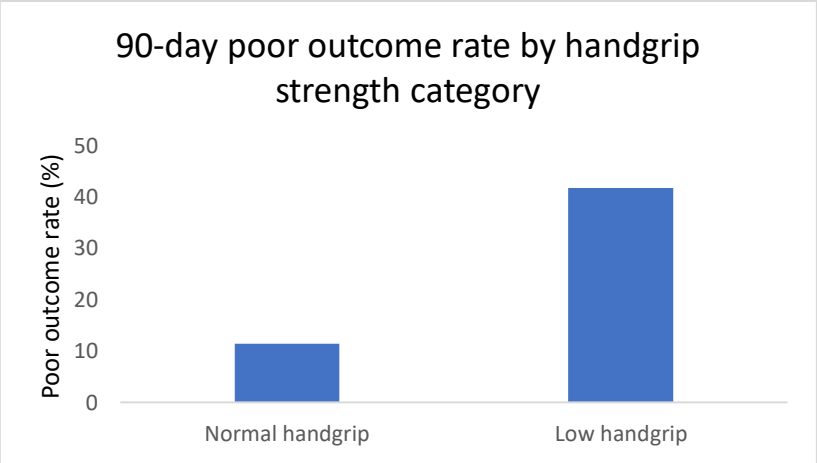

Figure 3. Ninety-day composite poor outcome rate according to handgrip strength category in elderly medical inpatients (n = 50). Low handgrip strength was defined using sex-specific cut-offs. Composite poor outcomes included death, readmission, or functional decline within 90 days.

DISCUSSION

In this prospective observational study of elderly medical inpatients, both frailty index and handgrip strength assessed at admission were significantly associated with adverse 90-day outcomes. Patients with higher frailty scores and lower handgrip strength experienced greater rates of mortality, readmission, and functional decline. These findings are supported by quantitative evidence from prior studies conducted in acute care and hospitalized older populations.

Frailty and short- to medium-term outcomes

The prognostic value of frailty observed in our study aligns closely with findings reported by Chong et al. In their prospective cohort of 210 hospitalized geriatric patients with a mean age of 89.4 years, frailty prevalence ranged from 50.0% to 87.1% depending on the frailty tool used [7]. Frailty assessed using the Frailty Index was strongly associated with 12-month mortality, with mortality rates of 30.6% in frail patients compared with 3.7% in non-frail patients ($p < 0.001$). Similarly, the Clinical Frailty Scale conferred a nearly six-fold increased risk of 12-month mortality (OR 5.78, 95% CI 3.19–10.48). Although our follow-up period was shorter, we observed a comparable graded increase in adverse outcomes with increasing frailty, supporting the consistency of frailty as a prognostic marker across different time horizons.

The relationship between frailty and hospital course has also been demonstrated in acute medical settings. Juma et al. reported that severely frail patients admitted to an acute medicine unit had significantly longer lengths of stay compared with non-frail patients (12.6 ± 12.7 days vs 4.1 ± 2.1 days, $p = 0.014$) [9]. Readmission rates were also higher among frail patients, reaching over 30% in severely frail individuals. In our cohort, frail patients similarly demonstrated higher readmission and composite poor outcome rates at 90 days, reinforcing frailty as a marker of prolonged vulnerability beyond the index admission.

Handgrip strength and adverse outcomes

Handgrip strength was a strong and independent predictor of poor outcomes in our study. This finding is consistent with quantitative evidence from Kilgour et al., who demonstrated that patients in the lowest handgrip strength percentile (≤10th percentile) had a more than three-fold higher risk of mortality compared with those in the ≥50th percentile (hazard ratio 3.2, 95% CI 2.0–5.1) [8]. These patients also had significantly lower hemoglobin levels (−19.7 g/L) and albumin levels (−4.99 g/L), and markedly higher odds of sarcopenia (OR 9.53). These biological associations support the interpretation that low handgrip strength reflects systemic illness severity and reduced physiological reserve.

The link between reduced muscle strength and hospital-related outcomes is further supported by evidence on sarcopenia. In a systematic review and meta-analysis, Zhao et al. reported that sarcopenia was associated with a 75% increased risk of hospital readmission among hospitalized older adults (RR 1.75, 95% CI 1.01–3.03) [10]. Our observation that patients

with low handgrip strength had substantially higher rates of readmission and functional decline at 90 days is consistent with these pooled estimates.

Functional decline following hospitalization

Functional decline formed a key component of the composite poor outcome in our study. This is clinically important, as functional loss is often persistent and impacts quality of life. Helvik et al. demonstrated that medical inpatients aged 65 years and older experienced a significant worsening in activities of daily living one year after hospitalization, with a mean deterioration in personal ADL score of 0.5 points ($p < 0.01$) [11]. Importantly, functional decline was independently associated with cognitive impairment and poor physical quality of life. Our findings suggest that frailty and low muscle strength identify patients at risk of early functional deterioration, even within 90 days of discharge.

Prediction of short-term mortality

Short-term mortality prediction in older adults has traditionally relied on acute physiological parameters. Hofman et al. reported a 90-day mortality rate of 10.5% among older patients discharged from the emergency department, with predictors including age, abnormal vital signs, and laboratory testing [12-15]. While these parameters reflect acute illness severity, they do not account for baseline vulnerability. Our results suggest that frailty and handgrip strength provide complementary prognostic information by capturing pre-morbid health status.

Clinical implications

The numerical consistency between our findings and prior studies supports the clinical utility of bedside frailty and handgrip strength assessment. These measures align with the principles of comprehensive geriatric assessment, which aims to move beyond disease-oriented models of care [13]. Early identification of frail patients or those with reduced muscle strength may allow targeted interventions such as nutritional optimization, physiotherapy, and structured discharge planning.

Strengths and limitations

The strengths of this study include prospective assessment and use of clinically meaningful outcomes. However, the sample size was modest and derived from a single center. Frailty and handgrip strength were measured only at admission. Changes over time were not assessed. The study was not designed to derive or validate predictive cut-off values.

CONCLUSION

In elderly patients admitted under internal medicine services, higher frailty index scores and lower handgrip strength at admission were associated with significantly worse 90-day outcomes. These findings are consistent with quantitative evidence from prior studies and support the routine use of simple bedside assessments for early risk stratification in acute medical settings.

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