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Correlation of Clinical Frailty Scale Assessment and in-Hospital Mortality in Elderly Critically Ill Patients Admitted to Intensive Care Units of Private Sector Tertiary Care Hospital

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ABSTRACT

Frailty is a complex geriatric condition marked by increased vulnerability to adverse health events. In intensive care unit patients, there is a clear correlation between the Clinical Frailty Scale and higher short- and long-term mortality rates. **Objectives:** To evaluate the prognostic importance of frailty, measure the risk of death in the Intensive Care Unit for all Clinical Frailty Scale scores, and methodically evaluate the association between frailty and Intensive Care Unit mortality. **Methods:** This cross-sectional study was conducted over 1 year (Jan 2023 to July 2023) at the Department of Medical Intensive Care Unit of Ziauddin University Hospital, Karachi Pakistan. Irrespective of gender, all patients of age more than 60 years admitted to the Medical Intensive Care Unit were included. In this study, individuals ≥60 years of age had their pre-admission frailty and hospital mortality compared using the Clinical Frailty Scale. **Results:** The median age was 75 years. The overall mortality rate was 9.9%. The Clinical Frailty Scale score indicated that 29.7% of patients were classified as non-fragile, 18.7% as vulnerable or pre-fragile, and 51.6% as frail. A significant association of Clinical Frailty Scale assessment was observed with gender, age, outcome, Acute Physiology and Chronic Health Evaluation score and invasive (mechanical ventilation). According to multivariate logistic regression, patients on mechanical ventilators have a higher mortality rate. **Conclusions:** It was concluded that the findings demonstrated a strong correlation between mortality and the Clinical Frailty Scale among critically sick patients admitted to the intensive care unit.

INTRODUCTION

As individuals advance in age, they exhibit an increasing susceptibility to adverse outcomes, including mortality. The condition known as frailty is characterized by a diminished capacity to recover from stressors, resulting from declines in physiological reserves and dysfunction across multiple organ systems [1]. Frailty constitutes a complex geriatric condition marked by heightened vulnerability to detrimental health events, including an elevated incidence of falls, nursing home placements, and an increased risk of mortality [2]. The incidence of intensive care unit (ICU) admissions among older adults is substantial, with 41.3% of individuals aged 65 and older, and 65.2% of those aged 80 and above, being admitted to the ICU [3]. Evidence suggests that while older patients often receive greater relative benefits from intensive care interventions compared to younger patients, these benefits are not uniformly observed across the entire population of elderly ICU patients [4]. Research indicates that patients with elevated Clinical Frailty Scale (CFS) score significantly increase their likelihood of dying within 30

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days and requiring intensive care services. For instance, a prospective cohort study identified that the 30-day survival rates of older ICU patients were independently predicted by their level of frailty, defined as a CFS score of ≥5, with frail patients demonstrating considerably poorer outcomes than their non-frail counterparts [5]. Furthermore, the CFS has been shown to provide additional prognostic value beyond traditional severity scores, such as the Acute Physiology and Chronic Health Evaluation (APACHE) II, in predicting in-hospital mortality [6]. According to a large ecological study conducted in 21 European countries, frailty is identified as an independent predictor of both ICU mortality and 30-day mortality among older patients, with frail individuals exhibiting markedly lower survival rates [7]. Moreover, frailty's predictive power is comparable to, and at times exceeds, that of traditional ICU severity scores like APACHE II and SOFA [8]. Research indicates that frail ICU survivors are more likely to experience functional decline and increased mortality within six months' post-discharge [6]. A study conducted by Baldwin et al. revealed that among ICU survivors aged 65 and older, pre-discharge frailty was associated with a threefold increase in six-month mortality and a higher prevalence of disability [10]. Similarly, Cuenca *et al.* demonstrated that frail ICU patients experienced significantly higher mortality rates at one and six months following discharge compared to their non-frail peers [11]. Moreover, research by Geense *et al.*, indicated that frailty levels varied in the year following ICU admission, with a considerable proportion of unplanned ICU survivors becoming progressively frail by the one-year mark [12].

This study aims to investigate the relationship between pre-admission frailty, as measured by the CFS, and hospital mortality in patients aged 60 and older. The primary objectives comprise evaluating the predictive significance of frailty, assessing ICU mortality risk across the complete range of CFS scores, and systematically examining the association between frailty and ICU mortality. By incorporating frailty into existing risk stratification models, this study aims to mitigate the potential costs of over-medicalization while improving morbidity and mortality outcomes for this vulnerable population.

METHODS

This cross-sectional study was conducted over one year, with a data collection period spanning six months, from January 2023 to July 2023, at the Medical Intensive Care Unit (MICU) of Ziauddin University Hospital in Karachi, Pakistan. The study commenced following the receipt of ethical approval from the Ziauddin University Hospital Research and Ethics Committee (Reference No: 5750722SMCCM). Utilizing a prevalence estimate of 65% [3], a confidence level of 95%, and a margin of error of 5%, a required sample size of 283 was determined using the WHO sample size calculation software. Data were collected through a convenient sampling method. Following an explanation of the study's objectives and clarification that it was non-interventional, informed consent (both written and verbal) was secured from participants or their family representatives. Inclusion criteria encompassed all patients aged over 60 years who were admitted to the MICU. To maintain a focused and homogeneous study population, specific exclusion criteria were implemented. Patients with a duration of hospitalization of fewer than 24 hours were excluded, as their limited stay did not yield adequate clinical data or meaningful outcomes for analysis. Additionally, individuals with neurological conditions such as advanced dementia or those in a vegetative state were excluded due to the significant impact of these conditions on prognosis, which could potentially confound the study's results. Patients admitted for surgical reasons, including trauma, surgical procedures, or accidents unrelated to chronic medical conditions, were similarly excluded. Their outcomes are predominantly influenced by acute surgical interventions rather than the medical factors central to this investigation. Furthermore, individuals with a history of significant organ transplantation were excluded, as their outcomes are substantially affected by transplantation-related factors such as immunosuppression and post-transplant care, which diverge from the general population being examined. These exclusions were intended to minimize confounding variables and reduce selection bias, thereby ensuring a more accurate analysis of the targeted medical conditions. Data collected included demographic information such as age, gender, and the reason for ICU admission. The severity of organ dysfunction was assessed within the initial 24 hours of ICU admission using the cumulative Sequential Organ Failure Assessment (SOFA) score, which ranges from 0 to 24, with higher scores indicating greater dysfunction. Frailty was characterized as a condition marked by reduced physical and psychological reserves, which leads to increased clinical vulnerability. The Clinical Frailty Scale (CFS), a judgment-based assessment tool originally developed for the Canadian Study of Health and Aging, was utilized to evaluate frailty. The 9-point CFS categorizes patients based on their level of physical activity, functional ability, burden of chronic diseases, and cognitive state, with classifications including fit or non-frail (scores 1–3), vulnerable or pre-frail (score 4), frail (scores 5–8), and terminally ill but not otherwise frail (score 9). The necessary data for this assessment were collected from patient records, proxies, or directly from the patients themselves. Follow-up measures were established to

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document in-hospital mortality as the primary outcome. Secondary outcomes included severity of illness, which was assessed using the SOFA and APACHE-II scores, as well as the need for organ support during the hospital stay. All data were gathered by the principal investigator utilizing a pre-designed proforma. To mitigate confounding variables and bias, there was strict adherence to inclusion and exclusion criteria, along with appropriate stratification procedures. Patient information was securely stored and made accessible exclusively to authorized personnel. The statistical analysis was performed using IBM SPSS Statistics version 27.0. The Shapiro-Wilk test was employed to assess the normality of the data. Qualitative data were expressed as frequencies and percentages, while quantitative variables were analyzed as mean ± standard deviation or median with interquartile range. Relationships between qualitative variables were examined using the chi-square test or Fisher's exact test. Odds ratios were computed through univariate and multivariate binary logistic regression models, with a p-value of less than 0.05 considered statistically significant.

RESULTS

The study involved 283 patients in total among which 154 (45.6%) patients were male and 129 (54.4%) of whom were female. The median age of patients was 75 years with the majority (54.4%) being older than 75 years. The mean length of stay at MICU was 3.37 ± 2.796 days (Table 1).

Table 1: Gender-Based Study (n=283)

Variables	Frequency (%)
Male	154 (45.6%)
Female	129 (54.4%)
Patients Older Than 75 Years	(54.4%)
Median	75 Years
Mean	3.37 ± 2.796 Days

Electrolyte imbalance is the most common diagnosis, accounting for 35.3% of the patients, emphasizing the critical need for managing electrolyte disturbances in this population. Acute Kidney Injury (AKI) follows, affecting 16.6% of the patients, while aspiration pneumonia accounts for 15.5%, highlighting the frequent occurrence of renal impairment and respiratory complications. Congestive cardiac failure (CCF) and community-acquired pneumonia (CAP) affect 13.8% and 13.4% of patients, respectively, underscoring the burden of cardiovascular and respiratory diseases. Diabetic ketoacidosis (DKA) represents 11.7% of diagnoses, with atrial fibrillation affecting 8.5%. The remaining diagnoses, such as metabolic acidosis (6.0%), hypernatremia (5.7%), and ischemic stroke (5.3%), along with others, reflect less frequent yet significant conditions (Figure 1).

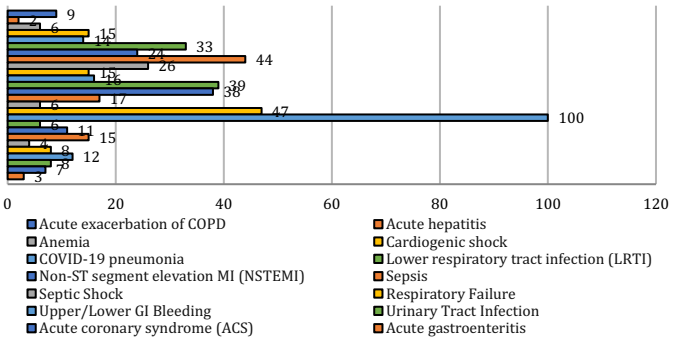

Figure 1: Diagnosis of Patients with Different Diseases

Hypertension is the most common condition, affecting 219 individuals, followed by chronic pulmonary disease with 168 cases. Congestive heart failure is the third most prevalent, with 80 individuals affected. Conditions such as asthma, depression, and Type II diabetes show moderate prevalence, ranging from 15 to 28 cases each. On the other hand, chronic kidney disease (CKD) requiring dialysis, dyslipidemia, and hyperthyroidism have the lowest occurrence, with only 3 to 4 cases reported for each. Overall, cardiovascular and pulmonary conditions appear to have the highest impact on this population (Figure 2).

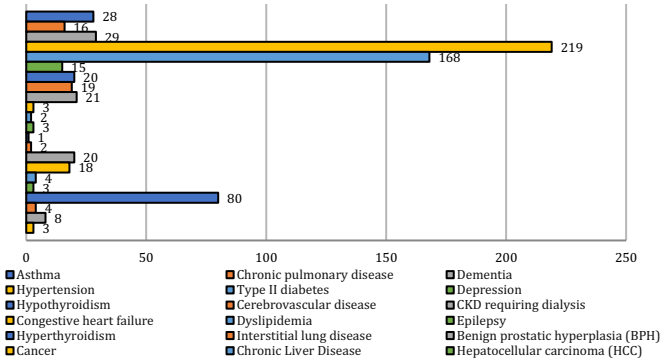

Figure 2: Comorbid Patients with Different Diseases

Among 283 patients, the overall death rate was 9.9%. Among 255 patients who were survived, 14.9% were discharged and transferred to home. The rest of the patients were transferred to other wards of the hospital. Among patients who were transferred to the ward, 27.5% were transferred to HDU, 0.8% were transferred to the ICU, 45.9% were transferred to a non-critical care ward, and 1.6% were transferred to another hospital (Figure 3).

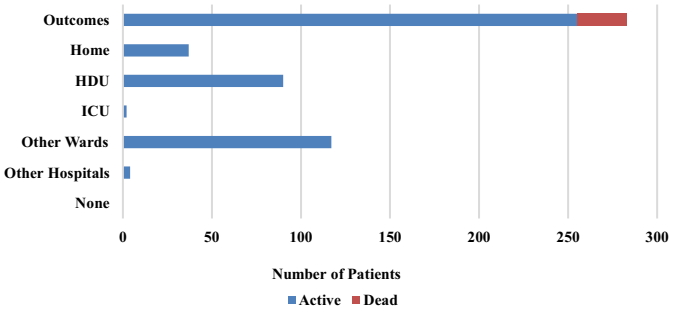

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Figure 3: Outcome of Patients Based on Home, HDU, OCU

The most crucial finding is the strong association between younger age (≤75 years) and a significantly lower likelihood of frailty, as measured by the CFS ≥5. Patients aged 75 years or younger were found to be markedly less frail compared to older patients but have high significance, with an adjusted odd ratio (AOR) of 0.227 (95% CI: 0.124-0.415, p<0.001). This indicates that younger patients have about one-quarter the risk of frailty as those over 75, emphasizing the profound influence of age on frailty status in clinical settings. Additionally, gender played a role, with males showing lower adjusted odds of frailty compared to females is highly significant (AOR=0.371, 95% CI: 0.207-0.664, p=0.009), and other factors like lower APACHE scores and the absence of mechanical ventilation were also associated with reduced frailty, though age remained the most pronounced determinant of frailty across the cohort (Table 2).

Table 2: Association of CFS, Odds Ratio for CFS score (CFS)≥5

Variables	CFS			p-value	Odds ratio			
	Non-Frail	Vulnerable or Pre-Frail	Frail		Un-Adjusted	(95% CI)	Adjusted	(95% CI)
Gender								
Male	56 (66.7)	31 (58.5)	67 (45.9)	0.008*	9.826	0.485 (0.285-0.826)	0.009	0.371 (0.207-0.664)
Female[R]	28 (33.3)	22 (41.5)	79 (54.1)					
Age Group								
≤75 Years	64 (76.2)	32 (60.4)	58 (39.7)	0.000*	30.535	0.258 (0.145-0.458)	1.667	0.227 (0.124-0.415)
>75 Years[R]	20 (23.8)	21 (39.6)	8 8(60.3)					
APACHE Score								
<15	52 (61.9)	25 (47.2)	63 (43.2)	0.021*	17.462	0.000 (0.0000)	-	-
15-19	22 (26.2)	18 (34)	41 (28.1)					
20-28	10 (11.9)	9 (17)	32 (21.9)					
>28[R]	0 (0)	1 (1.9)	10 (6.8)					
SOFA Score								
<6	67 (79.8)	34 (64.2)	97 (66.4)	0.062	5.809	0.489 (0.266-0.897)	0.058	0.516 (0.261-1.023)
>10[R]	17 (20.2)	19 (35.8)	49 (33.6)					
Invasive (Mechanical Ventilation)								
Mechanical vent	9 (10.7)	12 (22.6)	36(24.7)	0.035*	7.335	2.649 (1.234-5.686)	21.197	1.956 (0.837-4.569)
Self-vent[R]	75 (89.3)	41 (77.4)	110(75.3)					
Vasopressors Support								
Yes	16 (19)	10 (18.9)	31 (21.2)	0.894	0.224	1.103 (0.579-2.100)	- -	- -
No[R]	68 (81)	43 (81.1)	115 (78.8)					
Hemodialysis								
Yes	5 (6)	0 (0)	5 (3.4)	0.191	5.021	0.407 (0.115-1.446)	- -	- -
No[R]	79 (94)	53 (100)	141 (96.6)					
Outcome								
Alive	80 (95.2)	50 (94.3)	125 (85.6)	0.033*	7.191	0.365 (0.122-1.086)	- -	- -
Expired[R]	4 (4.8)	3 (5.7)	2 1(14.4)					

"Chi-Square/Fisher exact test was applied". "Binary logistic regression was applied". "®Reference group". "p-value≤0.05 were considered significant". "*Significant at 0.05 levels"

The most salient finding is the significant association between elevated SOFA scores and increased mortality. Patients with SOFA scores exceeding 10 had substantially higher odds of death with high clinical significance, with an adjusted odd ratio (AOR) of 0.192 (95% CI: 0.069-0.533, p=0.002). This underscores the importance of SOFA scores as a critical prognostic indicator of mortality, reflecting the severity of organ dysfunction. Additionally, the requirement for mechanical ventilation emerged as another significant predictor of mortality. Patients who required invasive mechanical ventilation exhibited a markedly increased risk of death with high clinical significance, with an AOR of 3.680 (95% CI: 1.506-8.995, p=0.004). These findings emphasize that advanced organ failure, as measured by high SOFA scores, and the necessity for mechanical ventilation are the most powerful determinants of poor outcomes in this cohort. While factors such as age and the use of vasopressor support also indicated higher mortality risks, SOFA scores and mechanical ventilation remain the most definitive predictors of mortality in critically ill patients (Table 3).

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Table 3: Association of Outcome Along with Odds for Expired Patients

Variables	Outcome			Odds ratio		Odds ratio	
	Alive	Expired	p-value	Un-Adjusted	(95% CI)	Adjusted	(95% CI)
Gender							
Male	139 (54.5)	15 (53.6)	0.925	0.925	0.963 (0.440-2.106)	--	--
Female[R]	116 (45.5)	13 (46.4)					
Age Group							
≤75 Years	142 (55.7)	12 (42.9)	0.196	0.199	0.597 (0.271-1.313)	--	--
>75 Years®	113 (44.3)	16 (57.1)					
APACHE Score							
<15	136 (53.3)	4 (14.3)	0.000*	0.003*	0.078 (0.015-0.412)	--	--
15-19	76 (29.8)	5 (17.9)		0.034*	0.175 (0.035-0.874)		
20-28	35 (13.7)	16 (57.1)		0.789	1.219 (0.285-5.211)		
>28®	8 (3.1)	3 (10.7)		--	--		
SOFA Score							
<6	191 (74.9)	7 (25)	0.000*	0.000*	0.112 (0.045-0.275)	0.002*	0.192 (0.069-0.533)
>10®	64 (25.1)	21 (75)					
Invasive (Mechanical Ventilation)							
Mechanical Vent	41 (16.1)	16 (57.1)	0.000*	0.000*	6.959 (3.066-15.796)	0.004*	3.680 (1.506-8.995)
Self-Vent®	214 (83.9)	12 (42.9)					
Vasopressors Support							
Yes	45 (17.6)	12 (42.9)	0.002*	0.003*	3.500 (1.550-7.905)	0.522	1.364 (0.528-3.521)
No®	210 (82.4)	16 (57.1)					
Hemodialysis							
Yes	10 (3.9)	0 (0)	0.286	0.999	0.000 (0.000-0.000)	-	-
No®	245 (96.1)	28 (100)					

The Chi-Square/Fisher exact test was applied. Binary logistic regression was applied. ®Reference group. p-value≤0.05 was considered significant. *Significant at 0.05 levels

DISCUSSION

Frailty, as measured by the Clinical Frailty Scale (CFS), has emerged as a significant predictor of adverse outcomes in critically ill patients. The prevalence of frailty among elderly patients in the Intensive Care Unit (ICU) corroborates the findings of Arias-Rivera *et al.*, who observed a higher prevalence in individuals aged over 70, thereby establishing age as a critical risk factor for frailty within critical care environments [13]. Similarly, Wozniak *et al.*, identified that nearly 40% of long-stay ICU patients aged beyond 65 were classified as frail [14]. Furthermore, this study indicated that males exhibited lower odds of frailty in comparison to females. This observation aligns with the research conducted by Georgakopoulou *et al.*, which noted gender disparities in frailty, with females typically displaying higher frailty scores due to longer life expectancy and greater exposure to chronic diseases [15]. Additionally, Silva-Obregón *et al.*, reported a frailty prevalence of 18.6% in their study cohort, with a notably higher incidence among women [16]. Patients with elevated frailty scores were more likely to present with comorbidities such as hypertension and chronic pulmonary disease. The robust association between frailty and comorbidities is further supported by Öner *et al.*, who found that frailty, assessed using both the Edmonton Frailty Scale and the CFS, was significantly linked to malnutrition and chronic illnesses in elderly ICU patients [17]. Variations in age demographics across studies, particularly those involving a greater proportion of very elderly patients (over 80 years old), tend to report increased frailty rates, as indicated in the literature [18]. Consistently, this study revealed that older patients, particularly those aged 75 and older, were more likely to exhibit enhanced frailty scores. Additionally, frail patients demonstrated a decreased likelihood of being discharged home and an increased probability of requiring long-term care. Sankar *et al.*, observed similar results, noting that critically ill frail patients exhibited diminished functional recovery and a greater likelihood of transfer to nursing facilities [19]. The death rates recorded for frail patients in the hospital, in the ICU, and 30 days' post-discharge were found to be 56.6%,

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37.7%, and 52.8%, respectively. Such rates are comparatively higher than those reported in prior studies with similar objectives, which indicated ranges of 5% to 36.9%, 10.7% to 50%, and 40.7%, respectively [18]. The current study established a strong correlation between frailty and mortality, with patients categorized as frail (CFS ≥5) experiencing markedly worse outcomes. This finding aligns with the research conducted by Wozniak *et al.*, who identified frailty as an independent predictor of mortality among ICU patients, particularly those with prolonged stays [14]. Moreover, patients aged 75 and older exhibited a significantly elevated risk of frailty and poorer outcomes, which is consistent with the findings of Ryan *et al.*, who documented that frail patients, primarily among the elderly, faced considerably higher mortality rates and observed lower functional recovery [20]. Kroken *et al.*, reinforced the predictive value of frailty in older ICU patients, revealing that frailty scores serve as strong indicators of survival [21]. Furthermore, the Sequential Organ Failure Assessment (SOFA) score, a commonly utilized assessment tool in ICUs for evaluating organ failure, was identified as a complementary predictor alongside frailty. The current study demonstrated that patients with SOFA scores exceeding 10 had significantly higher odds of mortality, supported by an adjusted odd ratio (AOR) of 0.192 (95% CI: 0.069–0.533, p = 0.002). Theodorakis *et al.*, confirmed that the integration of SOFA with frailty assessments provides a comprehensive framework for predicting mortality in ICU settings [22]. Additionally, it was noted that frail patients admitted to the ICU faced a greater likelihood of having life-sustaining treatments halted or withheld (47.2% compared to 20.7%) [23]. The prevalence of frailty reported by Silva-Obregón *et al.*, [16] stood at 18.6%, which is slightly lower than earlier findings that employed the CFS, documenting rates between 23.5% and 43% [24]. In a study conducted within a Pakistani population involving 377 patients, Ali *et al.*, found no correlations between frailty and obesity [25]. A further study from Lahore reported that 64.9% of frail participants and 2.1% of pre-frail participants exhibited impaired functional activities. Moreover, it was found that 56.7% of participants held a fitness level scored between 0 and 6 out of 10, while 22.7% achieved fitness levels ranging from 7 to 10 (p=0.047) [26].

CONCLUSIONS

It was concluded that frailty, as measured by the CFS, is strongly associated with higher mortality, increased dependence post-discharge, and the need for long-term care. Integrating comprehensive frailty evaluations into ICU protocols can enhance patient management by enabling tailored treatment plans, setting realistic care goals, and facilitating informed discussions with patients and families about prognosis. These measures can improve resource allocation and contribute to better overall outcomes for this vulnerable population.

Authors Contribution

Conceptualization: SM, AJ
Methodology: SM, MH, AJ, AK
Formal analysis: SM, MH, GR, AK
Writing review and editing: GR, AJ, SU, AK

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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