Impact of Frailty on Healthcare Utilization in Older Patients Admitted to Medical Wards: A Study from a Large Medical School in a Middle-income Setting

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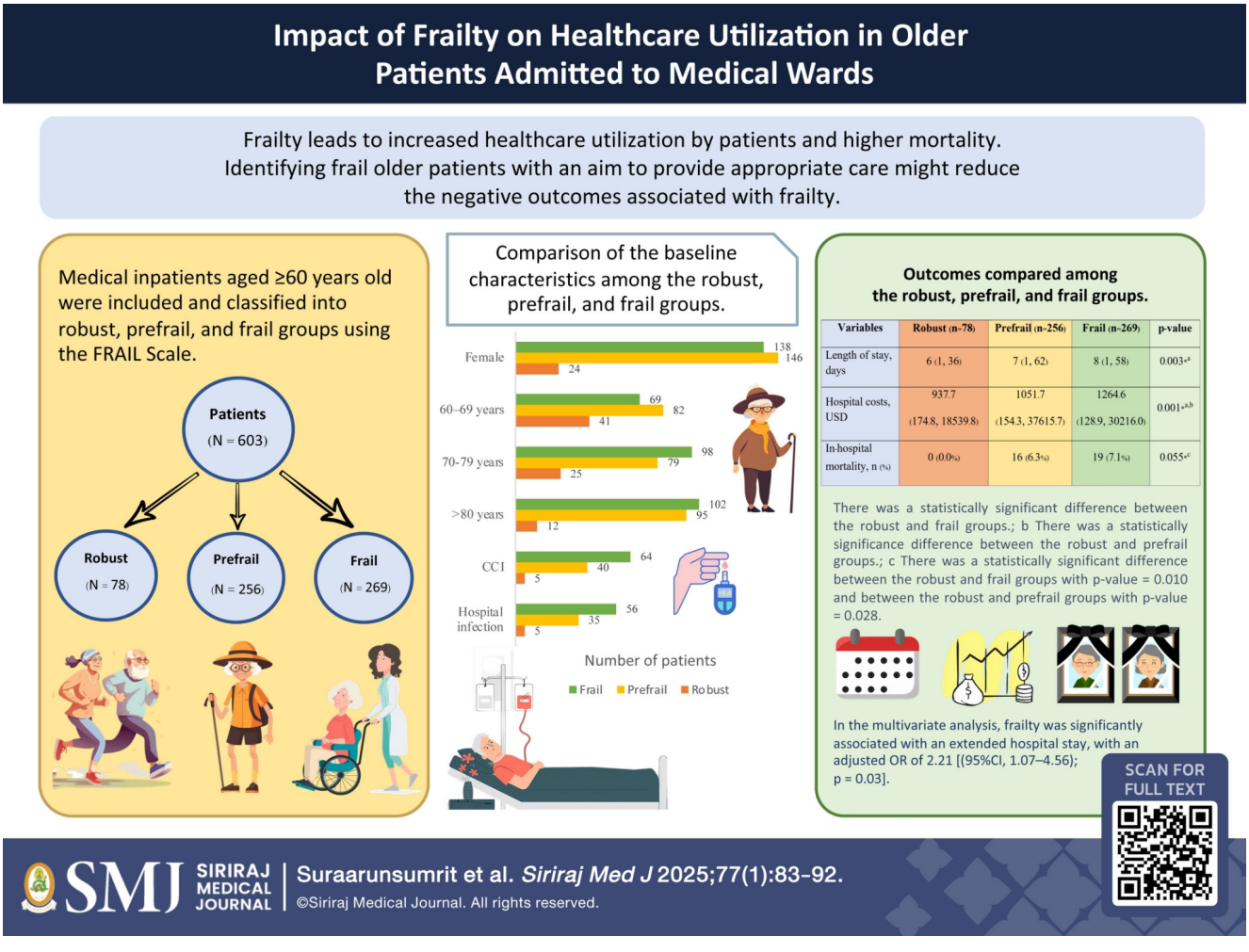

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ABSTRACT

Objective: The study aimed to evaluate healthcare utilization and mortality in patients stratified by frailty status and explore the factors associated with a prolonged length of hospital stay (LOS).

Materials and Methods: This retrospective cohort study included medical inpatients aged ≥60 years old. They were classified into robust, prefrail, and frail groups using the FRAIL Scale. The primary outcome was LOS, while the secondary outcomes were hospital costs, in-hospital mortality, and factors associated with a prolonged LOS. Multivariate analysis was used to explore the factors that influenced the prolonged LOS, and the results were expressed using an adjusted odds ratio (AOR).

Results: Of the 603 enrolled participants, 269 (44.6%) were classified as frail, 256 (42.5%) as prefrail, and 78 (12.9%) as robust. The frail group had longer hospital stays than the robust group (8 days [1,58] vs. 6 days [1,36]; p=0.003). Healthcare costs in the frail and prefrail groups were higher than in the robust group (1264.6 USD [128.9, 30216.0], 1051.7 USD [154.3, 37615.7], and 937.7 USD [174.8, 18539.8], respectively; p=0.001). Frail and prefrail patients were also more likely to die in hospital than the robust ones (7.1% vs. 0.0%, p=0.010; 6.3% vs. 0.0%, p =0.028, respectively). The multivariate analysis also revealed that frailty was associated with a prolonged LOS [AOR of 2.21(95%CI, 1.07–4.56); p=0.031].

Conclusion: Frailty leads to increased healthcare utilization by patients and higher mortality. Identifying frail older patients with an aim to provide appropriate care might reduce the negative outcomes associated with frailty.

Keywords: Frailty; length of hospital stay; healthcare cost; mortality; older patients (Siriraj Med J 2025; 77: 83-92)

INTRODUCTION

Frailty is a clinical condition caused by the age-related deterioration of various systems in the body.[1] The syndrome increases a person's vulnerability to stress, which can lead to them experiencing more severe conditions and delays in the resolution of acute illnesses.[1,2] Frailty is more prevalent in hospitalized older patients, accounting for 13%-41% of those population.[3,4] Frailty is related to unfavorable health outcomes, including functional impairment and disability[5,6], as well as increased mortality[5,7,8], and increased healthcare utilization by such patients.[9,10]

Existing evidence on the impact of frailty has mostly been gathered from studies conducted in high-income countries (HICs). Those studies have found higher medical costs, higher rates of complications, and higher mortality rates among prefrail and frail older people compared to robust groups of similar aged people.[11-13] Frailty is also a significant concern in low- and middle-income countries (LMICs), with the number of frail older individuals growing with the aging population in many countries.[14,15] In such countries, high medical costs could be an important barrier to accessibility to healthcare services at the individual level. The increasing healthcare expenditure of dealing with such a group can also be a critical challenge for society, particularly in resource-limited settings. In this regard, quantifying the impact of frailty on medical expenses in LMICs might provide more insights into the issue and enable better decision-making by policymakers to assist healthcare planning.

Thailand is an upper-middle-income country, in which the proportion of older people is rising and is projected to significantly increase over the next decade.[16] The Thailand Development Research Institute (TDRI) has estimated that medical costs could triple from 0.68 to 2 trillion baht in 15 years as the country becomes an aging society.[17] This emphasizes the tremendous effect of the increasing number of older people on the healthcare costs of Thai society. However, in-depth studies of the medical costs for different segments of older people are limited to date, and, to the best of our knowledge, none has yet explored the frailty status in Thailand.

Thus, the present study aimed to investigate the healthcare utilization (length of hospital stay (LOS) and healthcare costs) and mortality rate of robust, prefrail, and frail older inpatients at a university hospital in Thailand. Furthermore, factors affecting a prolonged LOS were also investigated to explore potential amendable and preventable factors that could reduce the need for a lengthy LOS.

MATERIALS AND METHODS

Study design and participants

This retrospective cohort study was carried out at Siriraj Hospital, a university hospital in Thailand.

The inclusion criteria were consecutive patients over 60 years old who resided in the local vicinity and were admitted to general medical wards from September 2019 to December 2020. The assessment of frailty was attempted in all patients from the local area near the hospital. The study flow is demonstrated in Fig 1.

Frailty assessment

The Thai version of the FRAIL Scale, validated in the Thai context and with excellent accuracy[18], was applied to screen older patients prospectively. The tool consists of 5 questions covering: Fatigue, Resistance, Ambulation, Illnesses, and Loss of Weight. Each question needs a self-reported answer in the form of a rating as 0 or 1 point, depending on the presence of certain characteristics in each criterion. The total score thus ranges from 0 to 5, with a higher score indicating more frailty characteristics. A cutoff point of 3 or above is classified as frailty, while a score of 1 to 2 indicates prefrail and 0 indicates a robust status, respectively. Here, well-trained research assistants assessed the patients using the FRAIL Scale to evaluate the patients and classified them into robust, prefrail, and frail groups.

Data collection

The patients' demographic data, including age, gender, comorbidities, and Charlson comorbidity index (CCI)[5], as well as admission laboratory results, were retrieved from the hospital databases for all the patients who underwent a frailty assessment. The 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) codes used to compute the CCI are shown in Additional file 1 (Appendix 1). Data on the length of hospital stay (LOS), reasons for admission (Appendix 2), in-hospital complications (Appendix 3), in-hospital mortality, and 1-month readmissions at Siriraj

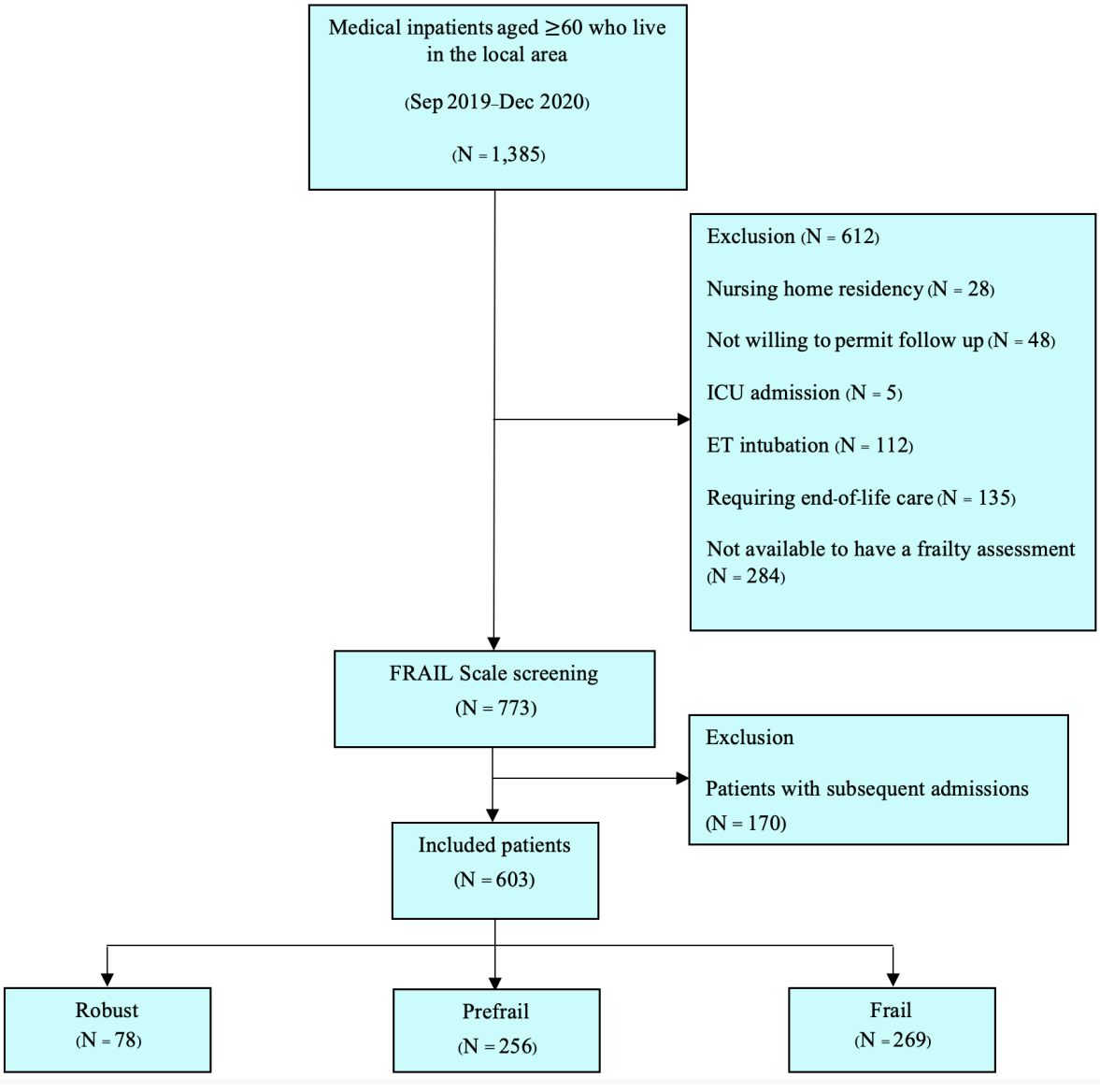

Fig 1. Study flow

Hospital were also collected from the same databases. The direct medical costs of the entire index admissions were also collected from the hospital database. The accreditation teams carried out the data quality control procedure to ensure accurate details were used for the ICD-10 codes after the medical residents had written the discharge summary. Moreover, all the medical records were reconfirmed by the attending staff to make sure that the information in the medical database was correct.

Factors associated with prolonged LOS

With regard to defining what constitutes a prolonged LOS, we utilized the mean LOS in our study, which was in accordance with a previous study in an acute care setting that defined LOS as ≥10 days.[19] Several studies exploring the factors associated with prolonged LOS were identified.[20-23] We chose factors related to an extended LOS that were relevant to our context to explore in our analysis. We identified several factors, namely, age ≥70 years old, female gender, CCI more than 5, comorbidities, frailty status, laboratory values (low serum albumin and hematocrit level), and reasons for admission, to be investigated in our analysis.

Statistical analysis

The patients' demographic data, reasons for admission, hospital complications, readmissions, and in-hospital mortality are reported herein as numbers and percentages for the categorical variables. Continuous variables, including CCI, albumin level, hematocrit level, LOS, and total costs, are presented using the mean ± SD or median (minimum, maximum) for normal and non-normal distributions when appropriate.

The Kruskal–Wallis test was used to analyze the LOS and direct medical costs among the robust, prefrail, and frail groups for continuous outcomes. Differences between the two groups were calculated using Dunn's test. Chi-square and Bonferroni tests were used for assessing the mortality outcomes to estimate the differences between the three groups. To investigate the factors associated with prolonged LOS, we used 10 days as the cutoff point. This figure was derived from a prior study that provided care in contexts similar to the circumstances in our study.[19] The Mann–Whitney U test or Independent t-test was used to investigate the continuous data in the univariate analysis. Chi-square or Fisher's exact test was used to analyze the significant differences between the categorical variables. The possible factors related to prolonged LOS are reported using the odds ratio (OR) and 95% confidence interval (95%CI) in the univariate logistic regression models. The potentially contributing factors were considered regarding their clinical relevance and a statistical consistency of $P < 0.20$ from the univariate analysis and were put into a multiple logistic regression model. The associations between a prolonged LOS and the related factors are presented as an adjusted OR along with 95%Cl. P-value < 0.05 was considered as indicating a statistically significant difference. All the analyses were done using SPSS 26 (SPSS, Inc., Chicago, IL, USA).

The sample size was calculated using nQuery Advisor 6.0.1 software. A prior study reported a mean LOS ranging from 8 ± 8.6 days for non-frail, to 11.2 ± 12.2 days for prefrail, and 13 ± 12 days for frail older patients.[5] Therefore, with 90% power, it was determined that 148 participants were needed per group.

RESULTS

Overall, 1,385 older patients were admitted to the medical wards of Siriraj Hospital during the study period (Fig 1). Among those, 773 were interviewed using the FRAIL Scale. After excluding the patients with subsequent admissions during the study period, 603 participants were enrolled and categorized into 3 groups according to their frailty status; specifically, 78 (12.9%) were assigned to the robust group, 256 (42.5%) to the prefrail group, and 269 (44.6%) to the frail group, respectively. Table 1 shows the baseline characteristics of the participants. The participants in the prefrail and the frail groups were more likely to be female, older, and to have a higher CCl than those in the robust group. Infection was the most common reason for admission among the 3 groups. During hospitalization, the prefrail and frail patients were more likely to experience hospital infections compared to the robust patients. The percentage of 1-month readmissions in the frail group was higher than that in the prefrail and the robust groups, although the difference among them was not statistically significant.

Table 2 lists the primary outcomes, showing that frail patients had a longer LOS than the robust ones (8 days (1, 58) vs. 6 days (1, 36); $p = 0.003$). Moreover, the direct medical costs in the frail and prefrail groups were significantly higher than in the robust group (1264.6 USD [128.9, 30216.0], 1051.7 USD [154.3, 37615.7], and 937.7 USD [174.8, 18539.8], respectively; $p = 0.001$). Additionally, post-hoc analysis revealed that prefrail and frail patients were more likely to die in hospital than patients with a robust status, although this difference was not statistically significant (6.3%, 7.1%, and 0.0%; $p = 0.055$; and 6.3% vs. 0.0%, $p = 0.028$, and 7.1% vs. 0.0%, $p = 0.010$ for the individual comparisons, respectively).

Table 3 lists the factors associated with a prolonged LOS. In the univariate analysis, the factors significantly

TABLE 1. Comparison of the baseline characteristics among the robust, prefrail, and frail groups.

Variables	Total (n=603)	Robust (n=78)	Prefrail (n=256)	Frail (n=269)	p-value
Female	308 (51.1%)	24 (30.8%)	146 (57.0%)	138 (51.3%)	<0.001*
Age, years					<0.001*
60–69	192 (31.8%)	41 (52.6%)	82 (32.0%)	69 (25.7%)	
70–79	202 (33.5%)	25 (32.1%)	79 (30.9%)	98 (36.4%)	
>80	209 (34.7%)	12 (15.4%)	95 (37.1%)	102 (37.9%)	
Charlson comorbidity index(CCI) > 5	109 (18.1%)	5 (6.3%)	40 (15.2%)	64 (24.6%)	<0.001*
Comorbidity					
Myocardial infarction	10 (1.7%)	0 (0.0%)	6 (2.3%)	4 (1.5%)	0.40
Congestive heart failure	22 (3.6%)	4 (5.1%)	5 (2.0%)	13 (4.8%)	0.13
Cerebrovascular disease	26 (4.3%)	5 (6.4%)	11 (4.3%)	10 (3.7%)	0.57
Dementia	37 (6.1%)	2 (2.6%)	18 (7.0%)	17 (6.3%)	0.38
Type 2 diabetes	275 (45.6%)	29 (37.2%)	108 (42.2%)	138 (51.3%)	0.03*
Reasons for admission[a]					
Infection	114 (18.9%)	8 (10.3%)	52 (20.3%)	54 (20.1%)	0.12
Organ failure	77 (12.8%)	9 (11.5%)	34 (13.3%)	34 (12.6%)	0.92
Emergency events	26 (4.3%)	1 (1.3%)	9 (3.5%)	16 (5.9%)	0.14
Serum albumin, g/dl	2.99 ± 0.58	3.06 ± 0.68	3.02 ± 0.59	2.95 ± 0.55	0.61
Hematocrit, %	30.31 ± 6.38	32.35± 6.01	30.38 ± 5.98	29.68 ± 6.73	0.06
Hospital complications[b]					
Infection	96 (15.9%)	5 (6.4%)	35 (13.7%)	56 (20.8%)	0.004
Organ failure	61 (10.1%)	5 (6.4%)	31 (12.1%)	25 (9.3%)	0.29
Emergency events	30 (5.0%)	5 (6.4%)	15 (5.9%)	10 (3.7%)	0.43
Delirium	36 (6.0%)	1 (1.3%)	16 (6.3%)	19 (7.1%)	0.15
1-month readmission	104 (17.2%)	12 (15.4%)	38 (14.8%)	54 (20.1%)	0.26

Data are presented by n (%) or mean±SD.

* Indicates statistical significance (<0.05).

[a] Reasons for admission are described in Appendix 2.; [b] Hospital complications are described in Appendix 3.

TABLE 2. Outcomes compared among the robust, prefrail, and frail groups.

Variables	Robust (n=78)	Prefrail (n=256)	Frail (n=269)	p-value
Length of stay, days	6 (1, 36)	7 (1, 62)	8 (1, 58)	0.003*[a]
Hospital costs, USD	937.7 (174.8, 18539.8)	1051.7 (154.3, 37615.7)	1264.6 (128.9, 30216.0)	0.001*[a,b]
In-hospital mortality, n (%)	0 (0.0%)	16 (6.3%)	19 (7.1%)	0.055*[c]

* Indicates statistical significance (<0.05); [a] There was a statistically significant difference between the robust and frail groups.; [b] There was a statistically significance difference between the robust and prefrail groups.; [c] There was a statistically significant difference between the robust and frail groups with p-value = 0.010 and between the robust and prefrail groups with p-value = 0.028.
(All costs were calculated in Thai Baht (THB) and converted to USD using the average exchange rate of 1 USD = 36.73 THB (31 Dec 2020 mean exchange rate)).

TABLE 3. Factors associated with a prolonged hospital stay

Variables	Univariate analysis Crude OR (95%CI)	p-value	Multivariate analysis Adjusted OR (95%CI) (Backward Stepwise Likelihood Ratio)	p-value
Frailty				
Robust	1		1	
Prefrail	1.54 (0.85-2.81)	0.16	1.77 (0.85-3.69)	0.13
Frail	2.06 (1.14-3.72)	0.02*	2.21 (1.07-4.56)	0.03*
Sex		0.01*		
Male	1			
Female	1.69 (1.19-2.39)			
Age, years				
60–69	1			
70–79	1.03 (0.66-1.59)	0.90		
>80	1.48 (0.97-2.58)	0.07		
Comorbidity				
Charlson Comorbidity Index > 5	1.58 (1.03-2.43)	0.04*		
Myocardial infarction	2.17 (0.62-7.59)	0.22		
Congestive heart failure	2.21 (0.94-5.20)	0.07	3.39 (1.09-10.57)	0.04*
Cerebrovascular disease	1.36 (0.60-3.05)	0.46		
Dementia	1.37 (0.67-2.64)	0.42		
Type 2 diabetes	0.92 (0.66-1.30)	0.65		
Laboratory results at admission				
Albumin level	0.54 (0.38-0.77)	<0.001*	0.54 (0.37-0.77)	0.001*
Hematocrit	1.00 (0.97-1.03)	0.82		
Reasons for admission				
Infection	1.99 (1.32-3.03)	0.001*		
Organ failure	1.84 (1.13-2.99)	0.01*		
Emergency events	0.78 (0.32-1.89)	0.58		

[a] Reasons for admission are described in Appendix 2.
* Indicates statistical significance (<0.05).
** Adjusted frailty, sex, age, congestive heart failure, albumin level, infection, and organ failure.

associated with a prolonged LOS were frailty status, with an OR of 2.06 [(95%CI, 1.14–3.72); p = 0.02]; female gender, with an OR of 1.69 [(95%CI, 1.19–2.39); p = 0.01]; congestive heart failure (CHF), with an OR of 2.21 [(95%CI, 0.94–5.20); p = 0.07]; albumin level, with an OR of 0.54 [(95%CI, 0.38–0.77); p < 0.001]; infection, with an OR of 1.99 [(95%CI, 1.31–3.03); p = 0.001]; and organ failure, with an OR of 1.84 [(95%CI, 1.13–2.99); p = 0.014]. In the multivariate analysis adjusted for gender, age, CHF, albumin level, infection, and organ failure, frailty was significantly associated with an extended hospital stay, with an adjusted OR of 2.21 [(95%CI, 1.07–4.56); p = 0.03]. Also, patients with CHF had a prolonged LOS, with an adjusted OR of 3.39 [(95%CI, 1.09–10.57); p = 0.04]; whereas patients with high albumin levels were less likely to experience extended hospitalization, with an adjusted OR of 0.54 [(95%CI, 0.37–0.77); p = 0.001].

DISCUSSION

The present study demonstrated there was an association between frailty status and negative consequences, including a prolonged LOS, higher healthcare costs, and increased mortality, in older patients in acute medical wards of a university hospital in middle-income settings. Also, older patients with a prefrail status had higher healthcare costs and increased mortality compared to robust older patients. Congestive heart failure was one important clinical condition that was found to contribute to extended hospitalization, whereas a high serum albumin level, which could indicate the good nutritional status of patients, was a protective factor against a prolonged hospital stay.

Frailty can contribute to an increased mortality risk due to its pathophysiology.[13,24] Frail individuals experience a decline in multiple organ systems, leading to a loss of homeostatic capability to withstand stressors and resulting in vulnerabilities that can have adverse outcomes on such individuals when they are exposed to acute illnesses or physical stress.[24] Supporting evidence from a previous meta-analysis showed that frail and prefrail statuses were associated with a higher risk of in-hospital, medium-term, and long-term mortality compared to non-frail groups.[5] Our study demonstrated a similar association, showing higher in-hospital mortality among frail and prefrail patients.

The association between frailty and mortality in older patients has been established in several contexts in previous studies, though primarily in acute care settings, similar to in our study.[8,25,26] Most studies were conducted using the frailty index, frailty phenotype, or Clinical Frailty Scale (CFS), while limited studies have used the FRAIL Scale as the diagnostic tool for identifying frailty to predict mortality.[8,25] The FRAIL Scale has been validated in the Thai context and shown to have a good correlation with the Thai frailty index[18], making it an ideal tool for our study. Additionally, the tool requires minimal skill and time for its administration. Overall, this study included additional evidence from using the FRAIL Scale for stratifying the mortality risk among older patients admitted to an acute medical setting.

Furthermore, the study highlighted the fact that prefrail and frail patients are more likely to utilize healthcare resources than robust patients in an upper-middle-income country. This increased utilization was evidenced by their prolonged LOS and the higher costs for their treatment, which represent healthcare costs from a provider perspective. This result was in accordance with previous studies conducted in both HICs and LMICs.[5,9,10,27] It was emphasized in a prior study that multi-comorbid conditions were not the sole contributor to the higher healthcare cost and utilization found among the study's frail group.[28] Multiple deficits in other domains, such as the ability to independently ambulate, the ability to perform self-caring, and impaired cognition, which are more common in frail older persons, might contribute to a higher risk of them experiencing other geriatric syndromes, such as hospital complications, and lead to higher costs and a longer hospital stay.

In addition, a prolonged LOS was selected as a representative measure to explore the potential contributing factors to the negative consequences of frailty. It would also be beneficial if some factors were found to be potentially modifiable. This study showed that frailty was associated with extended hospitalization. Frailty has long been considered a strong indicator correlated with prolonged hospitalization, with different tools used to define frailty status.[5,29] This study contributes to the field by adding evidence from using the FRAIL Scale to strategize the risk of a prolonged LOS among older patients admitted to an acute medical setting. Moreover, our results showed that CHF independently contributed to a prolonged LOS, whereas high serum albumin was a protective factor against a prolonged LOS. These findings were similar to those of other studies with respect to their correlation with LOS.[23,30]

The study addressed the negative consequences of frailty among older inpatients. Despite the study being conducted in a large single center only, our findings could have a tremendous impact on the healthcare system in Thailand and how frailty is considered and managed. This is a serious issue for the healthcare system as the number of frail older people is increasing along with the aging

population, and this is placing an increasing burden on the healthcare system. Frail older patients should receive a comprehensive geriatric assessment (CGA) to evaluate their physical, psychological, functional, and social aspects in order to ensure they receive appropriate interventions. Interventions from a multidisciplinary team would be beneficial for helping prevent complications, which could lead to decreased healthcare utilization among frail older patients.[31-34] One of the possible solutions in the Thai context, where a guideline for caring for hospitalized older patients is not yet available, is to screen for frailty at the beginning of older patient's admission. Integrated interventions could, therefore, be implemented early on for the frail group and could ensure the healthcare provider can better utilize their workforce to ensure that vulnerable patients are identified and cared for appropriately.

There are several strengths of this study to note. First, we prospectively defined frailty status using the FRAIL Scale based on our setting. Second, we enrolled consecutive patients during the study period, which should minimize selection bias. Third, the data were retrieved from medical databases with a standard procedure to ensure the accuracy of the clinical information, including the use of ICD-10 code data. However, there are some limitations of our study that should be addressed too. First, the healthcare costs in our study included only direct medical expenses without taking into account direct non-medical and indirect costs. Nevertheless, it could be estimated that the healthcare costs for frail older persons would be even more than their initial expenditure, with any deficits requiring recovery after the illnesses. Second, we could not disentangle the association between frailty and the in-hospital mortality outcome using multivariate analysis as there was no mortality in the robust group during the study. Third, the study was carried out among frail older inpatients in a large tertiary hospital, which may limit the generalizability of these findings. However, considering the limited resources and workforce across the country as a whole as a resource-limited setting, it could be assumed that the care setting for older people might not be much different in other settings in Thailand, or even in other LMIC countries. The magnitude of impact might be different in other settings, but the influence of frailty should remain the same. Last, because of the nature of the retrospective study design, some potential confounders, such as socioeconomic status and functional status, were not available at the time of analysis and so were not considered. A prospective cohort study should be conducted to investigate these potential contributing factors better. Identifying modifiable factors in a resource-limited setting, where long-term care remains mostly at home for older people with multiple deficits, would also be beneficial.

CONCLUSION

Frailty status significantly increased the length of hospital stay, mortality and healthcare costs of older patients in an acute care setting. Identifying frail older patients using the FRAIL Scale, with an aim to ensure they receive CGA provided by a multidisciplinary team and transition to a proper intermediate care setting, might be an option for healthcare systems to appropriately allocate resources for caring for older patients in an aging society, particularly in resource-limited settings.

Data Availability Statement

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

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DECLARATION

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Conflict of Interest

The authors declare that they have no competing interests related to this study.

Author Contributions

PSi, PSu: study design, data analysis, and interpretation, and manuscript preparation and review. VS: study design, data interpretation, and manuscript review and revision. PP: data collection and data interpretation. SS: data management. RP: data collection and analysis. All authors approved the final version of the manuscript.

Ethics Approval

This study was a database research project and did not involve interventions or patient contact. Therefore, individual patients were not identifiable. The analyses were approved by the Human Research Protection Unit, Faculty of Medicine Siriraj Hospital, Mahidol University (reference number Si 976/2021).

Consent for Publication

Not applicable.

REFERENCES

1. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. Lancet. 2013;381(9868):752-62.
2. Dent E, Martin FC, Bergman H, Woo J, Romero-Ortuno R, Walston JD. Management of frailty: opportunities, challenges, and future directions. The Lancet. 2019;394(10206):1376-86.
3. Gómez Jiménez E, Avendaño Céspedes A, Cortés Zamora EB, García Molina R, Abizanda P. [Frailty prevalence in hospitalized older adults. A systematic review.]. Revista espanola de salud publica. 2021;95.
4. Suraarunsumrit P, Pathonsmith C, Srinonprasert V, Sangarunakul N, Jiraphorncharas C, Siriussawakul A. Postoperative cognitive dysfunction in older surgical patients associated with increased healthcare utilization: a prospective study from an upper-middle-income country. BMC Geriatr. 2022;22(1):213.
5. Cunha AIL, Veronese N, de Melo Borges S, Ricci NA. Frailty as a predictor of adverse outcomes in hospitalized older adults: A systematic review and meta-analysis. Ageing Res Rev. 2019; 56:100960.
6. Chang SF, Cheng CL, Lin HC. Frail Phenotype and Disability Prediction in Community-Dwelling Older People: A Systematic Review and Meta-Analysis of Prospective Cohort Studies. The journal of nursing research : JNR. 2019;27(3):e28.
7. Srinonprasert V, Chalermsri C, Aekplakorn W. Frailty index to predict all-cause mortality in Thai community-dwelling older population: A result from a National Health Examination Survey cohort. Archives of gerontology and geriatrics. 2018;77: 124-8.
8. Kojima G, Iliffe S, Walters K. Frailty index as a predictor of mortality: a systematic review and meta-analysis. Age Ageing. 2018;47(2):193-200.
9. Hajek A, Bock JO, Saum KU, Matschinger H, Brenner H, Holleczek B, et al. Frailty and healthcare costs-longitudinal results of a prospective cohort study. Age Ageing. 2018;47(2): 233-41.
10. García-Nogueras I, Aranda-Reneo I, Peña-Longobardo LM, Oliva-Moreno J, Abizanda P. Use of Health Resources and Healthcare Costs associated with Frailty: The FRADEA Study. J Nutr Health Aging. 2017;21(2):207-14.
11. Bock J-O, König H-H, Brenner H, Haefeli WE, Quinzler R, Matschinger H, et al. Associations of frailty with health care costs – results of the ESTHER cohort study. BMC Health Services Research. 2016;16(1):128.
12. Comans TA, Peel NM, Hubbard RE, Mulligan AD, Gray LC, Scuffham PA. The increase in healthcare costs associated with frailty in older people discharged to a post-acute transition care program. Age and ageing. 2016;45(2):317-20.
13. Vermeiren S, Vella-Azzopardi R, Beckwée D, Habbig AK, Scafoglieri A, Jansen B, et al. Frailty and the Prediction of Negative Health Outcomes: A Meta-Analysis. J Am Med Dir Assoc. 2016;17(12):1163.e1-.e17.
14. Ara R, Monisha UK, Nova TJ, Chowdhury S, Nabi MH, Hawlader MDH. Potential nonpharmacological interventions to prevent frailty among elderly in low-and middle-income countries: A protocol for systematic review. Medicine. 2022;101(4).
15. Gray WK, Richardson J, McGuire J, Dewhurst F, Elder V, Weeks J, et al. Frailty Screening in Low- and Middle-Income Countries: A Systematic Review. J Am Geriatr Soc. 2016;64(4):806-23.
16. Foundation of Thai Gerontology Research and Development institute (TGRI). Situation of Thai Elderly 2020. In: Foundation of Thai Gerontology Research and Development Institute, editor. Bangkok2021.
17. TDRI study report. Estimate public health expenditure in the next 15 years. 2562. Available from: htttps://tdri.or.th/2019/12/public-healthcare-evaluation/.
18. Sriwong W, Mahavisessin W, Srinonprasert V, Siriussawakul A, Aekplakorn W, Limpawattana P, et al. Validity and reliability of the Thai version of the simple frailty questionnaire (T-FRAIL) with modifications to improve its diagnostic properties in the preoperative setting. BMC geriatrics. 2022;22(1):161.
19. Subramaniam A, Tiruvoipati R, Green C, Srikanth V, Soh L, Yeoh AC, et al. Frailty status, timely goals of care documentation and clinical outcomes in older hospitalised medical patients. Intern Med J. 2021;51(12):2078-86.
20. Toh HJ, Lim ZY, Yap P, Tang T. Factors associated with prolonged length of stay in older patients. Singapore medical journal. 2017;58(3):134-8.
21. Bo M, Fonte G, Pivaro F, Bonetto M, Comi C, Giorgis V, et al. Prevalence of and factors associated with prolonged length of stay in older hospitalized medical patients. Geriatr Gerontol Int. 2016;16(3):314-21.
22. Marfil-Garza BA, Belaunzarán-Zamudio PF, Gulias-Herrero A, Zuñiga AC, Caro-Vega Y, Kershenobich-Stalnikowitz D, et al. Risk factors associated with prolonged hospital length-of-stay: 18-year retrospective study of hospitalizations in a tertiary healthcare center in Mexico. PLoS One. 2018;13(11): e0207203.
23. Liu T, Xuan H, Wang L, Li X, Lu Z, Tian Z, et al. The association between serum albumin and long length of stay of patients with acute heart failure: A retrospective study based on the MIMIC-IV database. PLoS One. 2023;18(2):e0282289.
24. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci. 2001;56(3):M146-56.
25. Kojima G. Frailty Defined by FRAIL Scale as a Predictor of Mortality: A Systematic Review and Meta-analysis. J Am Med Dir Assoc. 2018;19(6):480-3.
26. Hao Q, Zhou L, Dong B, Yang M, Dong B, Weil Y. The role of frailty in predicting mortality and readmission in older adults in acute care wards: a prospective study. Sci Rep. 2019;9(1):1207.
27. Ambagtsheer RC, Moussa RK. Association of frailty with health service utilisation and health care expenditure in sub-Saharan Africa: evidence from Côte d'Ivoire. BMC Geriatr. 2021;21(1):446.
28. Lujic S, Randall DA, Simpson JM, Falster MO, Jorm LR. Interaction effects of multimorbidity and frailty on adverse health outcomes in elderly hospitalised patients. Sci Rep. 2022;12(1):14139.
29. Xia F, Zhang J, Meng S, Qiu H, Guo F. Association of Frailty

With the Risk of Mortality and Resource Utilization in Elderly Patients in Intensive Care Units: A Meta-Analysis. Front Med (Lausanne). 2021;8:637446.
30. Tal S. Length of hospital stay among oldest-old patients in acute geriatric ward. Archives of Gerontology and Geriatrics. 2021; 94:104352.
31. Ekdahl AW, Sjöstrand F, Ehrenberg A, Oredsson S, Stavenow L, Wisten A, et al. Frailty and comprehensive geriatric assessment organized as CGA-ward or CGA-consult for older adult patients in the acute care setting: A systematic review and meta-analysis. European Geriatric Medicine. 2015;6(6):523-40.
32. Ellis G, Gardner M, Tsiachristas A, Langhorne P, Burke O, Harwood RH, et al. Comprehensive geriatric assessment for older adults admitted to hospital. Cochrane Database Syst Rev. 2017;9:CD006211.
33. Chen Z, Ding Z, Chen C, Sun Y, Jiang Y, Liu F, et al. Effectiveness of comprehensive geriatric assessment intervention on quality of life, caregiver burden and length of hospital stay: a systematic review and meta-analysis of randomised controlled trials. BMC Geriatr. 2021;21(1):377.
34. Jirakulsawat A, Noocharoen N, Somnuke P. Prehabilitation in Clinical Practice: A Review of Concepts and Implementation in Enhancing Post-operative Outcomes. Siriraj Med J. 2024; 76(9):646-54.