Research Paper
Frailty as a Predictor of Mortality in Elderly Iranians Residing in Nursing Home Facilities

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ABSTRACT

Background: Frailty is a common geriatric syndrome associated with adverse health outcomes in older adults. This study aimed to examine the association between frailty index and mortality in elderly residents of nursing homes in Iran.

Methods: This historical cohort study used data extracted from the Sina Electronic Health Record System (SinaEHR®, Iran) and the national cause of death registry in Iran. The study population included 9199 adults aged ≥60 assessed for frailty in nursing homes across Iran from April 2021 to June 2022. They were followed up until August 2022. Frailty was defined as a score >3 on Fried's 5-item index. We used multivariable logistic regression to determine adjusted odds ratios (ORs) with 95% confidence intervals (CIs) for mortality-related factors. The chi-square test compared mortality across groups. Data were analyzed using Stata software, version 11 with $P<0.05$ as the significance level.

Results: Of 9199 subjects, 3566(38.7%) were frail, and 5643(61.3%) were non-frail. During follow-up, 3354(36.5%) deaths occurred. Frailty was associated with 2.49 times higher odds of mortality (95% CI, 2.27%, 2.74%; $P<0.001$) compared to the non-frail state after adjustment for covariates. Older age ($P<0.001$), female sex ($P<0.001$), and comorbidities ($P<0.001$) were also significant predictors of mortality.

Conclusion: Frailty index strongly predicts mortality risk in Iranian elderly nursing home residents. Assessing and managing frailty may help reduce adverse outcomes in this vulnerable population.

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Highlights

- Frailty was assessed in over 9000 Iranian nursing home residents aged 60+.

- About 39% of the assessed older people were frail based on Fried's five-item index.

- Frail seniors had 2.5 times higher odds of mortality than non-frail ones.

- Around 36.5% of the assessed group died during follow-up.

- Older age, female gender, and comorbidities also predicted mortality.

- Routine frailty screening may identify high-risk seniors in this population.

- Research is needed on interventions to prevent or treat frailty in this group.

Plain Language Summary

Frailty is a condition that makes older adults weak and vulnerable to health problems. We aimed to find out whether frailty predicts the risk of death in Iranian seniors living in nursing homes. We studied over 9000 adults aged 60+ living in nursing homes across Iran. About 39% were frail based on a scale that assesses fatigue, resistance, ambulation, illness, and weight loss. We followed them up for over a year to track mortality among them. It was found that frail seniors had over 2 times higher odds of dying compared to non-frail seniors. Older age, female gender, and comorbidities increased mortality risk. About 36% of the elderly died during follow-up. This result shows assessing frailty could identify Iranian seniors at high risk of death. Managing frailty may help lower its risks. More research on preventing and treating frailty in this group is needed.

Introduction

The world population is aging rapidly. The proportion of adults aged 65 years and older is projected to increase from 13% in 2019 to 20% by 2050 (United Nations, 2019). The absolute number of older adults aged 65 years and over is expected to triple from 703 million in 2019 to nearly 1.5 billion by 2050 (United Nations, 2019). Approximately 80% of adults over 65 have at least one chronic condition, and 23% of the global disease burden is related to disorders in those aged 60 and older (Prince et al., 2015; Global Health Estimates, 2018). As the population ages, frailty has emerged as a significant health issue.

Frailty is characterized by decreased physiological reserve and vulnerability to stressors due to accumulated deficits from aging (Clegg et al., 2013). Frail individuals are at higher risk of falls, fractures, hospitalizations, nursing home admissions, disability, poor quality of life, and dementia (Kojima, 2015). Two common tools to assess frailty are the Fried phenotype model with 5 criteria and the Rockwood frailty index with 9 criteria (Fried et al., 2001; Rockwood et al., 2005). The Fried model classifies frailty based on exhaustion, weakness, slow walking speed, low activity, and weight loss (Fried et al., 2001). The Rockwood scale categorizes individuals as non-frail to severely frail based on a 9-point scale (Rockwood et al., 2005). The prevalence of frailty increases with age, reaching 15.7% in those 80-84 years and 26.1% in those over 85 years (Ofori-Asenso et al., 2019). A systematic review estimated the prevalence to be 12% using Fried's scale and 24% using Rockwood's scale in adults over 50 globally (Siriwardhana et al., 2018).

Factors associated with higher frailty risk include older age, female gender, malnutrition, physical inactivity, functional impairment, low socioeconomic status, multimorbidity, persistent pain, and sensory loss (He et al., 2019; Apóstolo et al., 2017; Gordon et al., 2017; Talaee et al., 2020; Delbari et al., 2020). Consuming dairy, fruits, and vegetables is associated with lower frailty risk (Artaza-Artabe et al., 2016; Apóstolo et al., 2018). Frailty is a significant predictor of mortality (Jiang et al., 2017). In Iran, frailty prevalence ranges from 10.4% to 40.4% (Talaee et al., 2020; Delbari et al., 2020). However, no studies have examined the frailty-mortality association in the Iranian population. This study investigated the relationship between frailty and mortality risk in a large nationally representative sample of elderly Iranians residing in nursing home facilities.

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Materials and Methods

This retrospective cohort study used data extracted from the Sina Electronic Health Record System (SinaEHR®, Iran) and the registration and classification system of the causes of death in Iran. All nursing homes across the country under the supervision of the Ministry of Health and Medical Education of Iran were included. Frailty was identified using the 5-item Fried frailty phenotype (Fried et al., 2001), which was assessed at these facilities between April 2021 and June 2022 by trained staff from the National Social Services Agency, and the data were collected during this period. The study population comprised all 9199 elderly adults aged ≥60 years who had a complete frailty assessment during that period. No additional direct contact with nursing home residents was made. Frailty and mortality data up until August 2022 were extracted from the centralized databases. Other variables like demographics and comorbidities were obtained from the Sina Electronic Health Record System.

The frail scale has five components: Fatigue, resistance, ambulation, illness, and loss of weight, and its scores range from 0 to 5 (one point for each component). The scores range from 0=best to 5=worst and represent frail (3–5), pre-frail (1–2), and robust health status (0). This frailty assessment tool has been widely validated and highly reliable across diverse populations (Li et al., 2019; Macklai et al., 2013). The psychometric evaluation of the Persian version of this checklist has been determined by Tavan and Asadollahi (2021).

The subjects were categorized into frail (scores >3, n=3556) and non-frail (scores ≤3, n=5643) groups. The outcome was all-cause mortality, that was determined from death registry data. Demographic data on age, sex, and comorbidities were also obtained. The chi-square test compared mortality across frailty status, age groups, sex, and comorbidities. Multivariable logistic regression analysis was performed to determine adjusted odds ratios (ORs) with 95% confidence intervals for mortality-related factors. Data were analyzed using Stata software, version 11 software with $P<0.05$ defining statistical significance.

Results

Of 9199 subjects, 3566(38.7%) were frail, and 5643 (61.3%) were non-frail after frailty assessment. There were 3677(40%) males and 5522(60%) females. The majority (n=8439; 91.07%) had no comorbidities, while 628(6.8%) had one comorbidity, and 132(1.4%) had two or more. There were 3354(36.5%) deaths during follow-up (Table 1).

Table 1. Baseline characteristics and univariate analysis of variables associated with mortality in the elderly nursing home residents

Variables		Mortality, No. (%)		P*
		No	Yes	
Frailty classification	Non-frail	4119(75.5)	1524(45.4)	<0.001
	Frail	1726(29.5)	1830(54.6)	
Age (y)	60-69	1542(26.4)	336(10)	<0.001
	70-79	1783(30.5)	765(22.8)	
	80-89	1665(28.5)	1187(35.4)	
	90 and more	855(14.6)	1066(31.8)	
Gender	Male	2380(40.7)	1297(38.7)	<0.001
	Female	3465(59.3)	2057(61.3)	
Comorbidity	No disease	5444(93.1)	2995(89.3)	<0.001
	One disease	338(5.8)	290(8.6)	
	Two or more diseases	63(1.1)	69(2.1)	

*Chi-square test.

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Univariate analysis revealed that frailty status, age group, gender, and comorbidities were significantly associated with mortality (P<0.001). Based on multivariable logistic regression, frailty was associated with 2.49 times higher odds of mortality (95% CI, 2.27%, 2.74%) compared to the non-frail group after adjusting for covariates. Older age, female gender, and comorbidities were independent mortality predictors (Table 2).

The odds of mortality were 1.99 times higher (95% CI, 1.65%, 2.25%) in those aged 70-79 years, 2.99 times higher (95% CI, 2.28%, 3.45%) in those aged 80-89 years, and 5.10 times higher (95% CI, 4.37%, 5.96%) in those ≥90 years compared to the 60-69 years age group. Females had 1.39 times higher odds of mortality (95% CI, 1.26%, 1.53%) versus males. Having one comorbidity was associated with 1.37 times higher odds (95% CI, 1.15%, 1.63%), and having two or more comorbidities had 1.706 times higher odds (95% CI, 1.18%, 2.46%) compared to no comorbidities (Table 2).

The mean age was 78.06 years in the non-frail group and 82.96 years in the frail group (P<0.001), indicating that frailer individuals tended to be older.

Discussion

This research is the first study investigating the relationship between frailty and mortality in elderly Iranians residing in nursing home facilities. We found that frailty was associated with 2.49 times higher odds of mortality, indicating frail elderly had over twice the risk of death compared to non-frail seniors. This strong link between frailty status and mortality is consistent with previous studies showing that scores significantly predict mortality risk (Jiang et al., 2017; Talaee et al., 2020; Delbari et al., 2020). Some research suggests this association attenuates with very advanced age (Jiang et al., 2017; Talaee et al., 2020).

In our study, women had higher frailty prevalence and mortality risk than men. Other studies also found that women are more frequently frail but may have lower mortality than frail men (Gordon et al., 2017; Talaee et al., 2020; Delbari et al., 2020). The higher mortality in frail women here may be related to the larger sample size of women.

We observed increased frailty prevalence and mortality with older age, which agrees with earlier research (He et al., 2019; Apóstolo et al., 2017). Frailty may be a powerful predictor of cardiovascular mortality, as Li et al. (2019) demonstrated. We also found significant associations between multimorbidity and frailty. Frailty could predispose to chronic diseases or vice versa (Artaza-Artabe et al., 2016). Having comorbid illness also independently predicted mortality.

Table 2. Multivariable logistic regression analysis of factors associated with mortality in the elderly nursing home residents

Variables		Crude Odds Ratio			Adjusted Odds Ratio		
		Odds Ratio	P	Confidence Interval	Odds Ratio	P	Confidence Interval
Frailty classification	Non-frail	Reference	-	-	-	-	-
	Frail	2.86	<0.001	2.62-3.130	2.49	<0.001	2.27-2.74
Gender	Male	Reference	-	-	-	-	-
	Female	1.089	0.054	0.999-1.18	1.39	<0.001	1.26-1.53
Age (y)	60-69	Reference	-	-	-	-	-
	70-79	1.96	<0.001	1.07-2.27	1.99	<0.001	1.65-2.25
	80-89	3.27	<0.001	2.84-3.72	2.99	<0.001	2.28-3.45
	90 and more	5.72	<0.001	4.93-6.63	5.10	<0.001	4.37-5.96
Comorbidity	No disease	Reference	-	-	-	-	-
	One disease	1.56	<0.001	1.32-1.83	1.37	<0.001	1.15-1.63
	Two or more diseases	1.99	<0.001	1.41-2.80	1.706	<0.001	1.18-2.46

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Conclusion

Overall, our findings in Iranian nursing home residents support previous evidence that frailty is a significant risk factor for mortality. Routine assessment of frailty could help identify vulnerable elderly at high mortality risk. Further research is needed on interventions to prevent and manage frailty in this population. Conducting similar studies in community-dwelling elderly populations could also provide valuable insights into the frailty-mortality relationship and guide frailty prevention/management strategies more broadly among Iranian seniors.

As a strong point, this research was the first to examine the relationship between frailty, as assessed by a validated scale, and mortality among Iranian older adults residing in nursing homes. We used a large, nationally representative sample of over 9000 individuals. Mortality data allowed robust ascertainment of this critical outcome. Our multivariable regression analysis controlled for important confounding variables such as age, gender, and comorbid disease.

However, there are several limitations to a retrospective analysis of registry data. We had to rely on previously recorded frailty scores and had no input on the quality or consistency of measurements. The study design does not reveal causal implications of frailty on mortality. We could not account for all factors that impact frailty and survival, including detailed socioeconomic status, physical activity, nutrition, and medications. There may be selection bias as nursing home residents likely represent a frailer population compared to community-dwelling elderly. Still, our rigorous methodology and analysis provide initial evidence that the frailty index predicts mortality risk among Iranian nursing home elderly. Further confirmation in prospective cohort studies is recommended.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Mashhad University of Medical Sciences (Code: IR.MUMS.FHMPM.REC.1402.115).

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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