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RESEARCH ARTICLE

Prevalence and predictors of frailty in a high-income developing country: A cross-sectional study

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ABSTRACT

Background: Frailty is a state of vulnerability and a decreased physiological response to stressors. As the population ages, the prevalence of frailty is expected to increase. Thus, identifying tools and resources that efficiently predict frailty among the Saudi population is important. We aimed to describe the prevalence and predictors of frailty among Saudi patients referred for cardiac stress testing with nuclear imaging.
Methods: We included 876 patients (mean age 60.3 ± 11 years, women 48%) who underwent clinically indicated cardiac nuclear stress testing between January and October 2016. Fried Clinical Frailty Scale was used to assess frailty. Patients were considered frail if they had a score of four or higher. Multivariate adjusted logistic regression models were used to determine the independent predictors of elderly frail patients.
Results: In this cohort, the median age of the included patients was 61 years, and the prevalence of frailty was 40%. The frail patients were older, more frequently women, and had a higher body mass index. Additionally, frailty was associated with a higher prevalence of cardiovascular risk factors: hypertension (85% vs. 70%) and diabetes (75% vs. 60%). In a fully adjusted logistic regression model, women, hypertension, and obesity (BMI ≥ 30 kg/m^2) were independent predictors of elderly frail patients.
Conclusions: With the aging of the Saudi population, frailty prevalence is expected to increase. Elderly, obesity, hypertension, and female gender are risk factors of frailty. Interventions to reduce frailty should be focused on this high-risk population.

Keywords: Fried clinical frailty scale, frail elderly, cardiac nuclear stress testing, cardiovascular predictors

INTRODUCTION

Rapid progression of medical knowledge has allowed investigators to address many gaps in cardiac sciences[1–2] through improving cardiac care provided and achieving higher standards of management.[3–6] Targeted medical therapies and focused care reduced major adverse cardiac event rates in the last decade.[7–10] As a result, global life expectancy has increased significantly, and the number of elderly patients in need of cardiac care increased dramatically.[3] However, these elderly patients are underrepresented in the vast majority of recent cohort studies and randomized clinical trials. Many were excluded because of significant physical and cognitive disability as well as associated comorbidities.[11–12]

Frailty assessment is often a difficult task.[13] Multiple assessment tools are used to assess the physical, social, and psychological status of this population.[14–15] However, frailty prevalence is influenced by developmental and financial factors of nations,[16–17] which might affect its distribution based upon variations in cardiovascular risk factors.[14] Additionally, frailty evaluation and quantification is a complex task that is only partially related to conventional coronary artery risk assessment. However, frailty has a significant impact on therapeutic clinical decisions in coronary artery disease.[18–19]

Saudi Arabia, as a developing country, stated a goal to increase its life expectancy by 5 years within the coming decade.[20] As the population ages, the prevalence of frailty and comorbid conditions, including coronary artery disease and other cardiac pathologies, are expected to increase. Therefore, identifying tools and resources that efficiently detect frailty among Saudi elderly patients is important. Thus, this study aims to describe the prevalence and predictors of frailty among Saudi patients referred for cardiac stress testing with nuclear imaging.

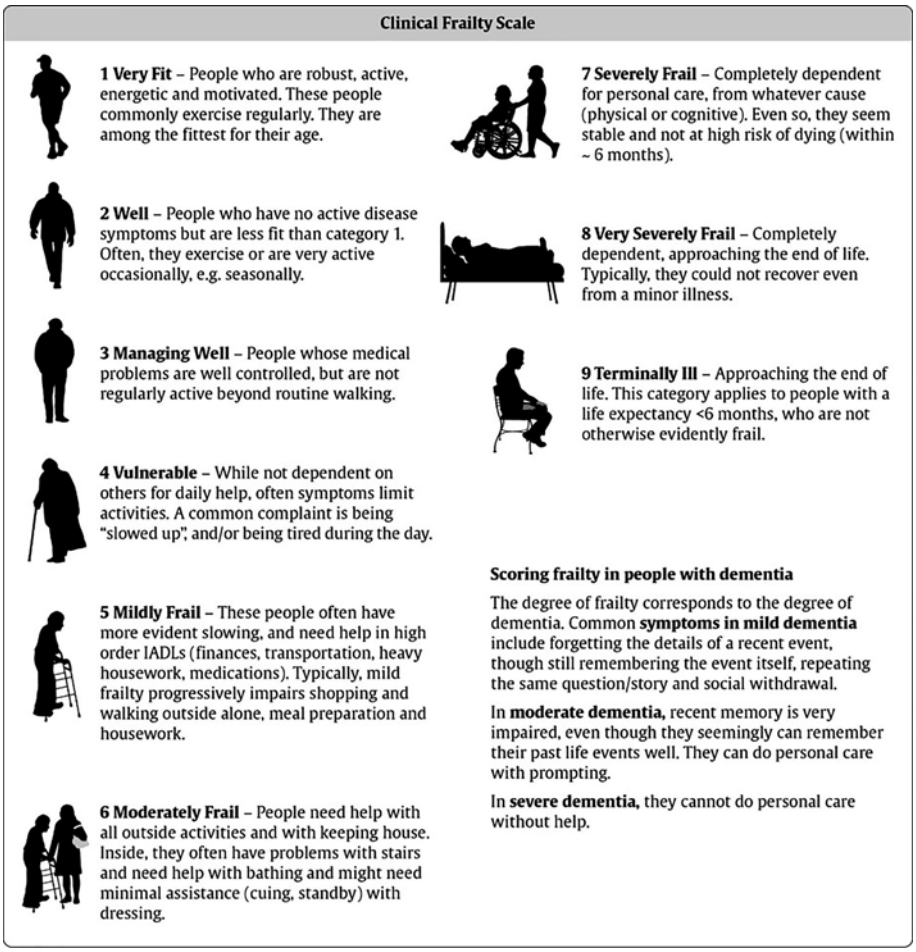

Figure 1. Canadian Study of Health and Aging Clinical Frailty Scale, adapted from Moorhouse and Rockwood[35].

Table 1. Baseline characteristics of the study cohort.

	Overall population (n = 876)	Frailty status		p
		Nonfrail (60.05%)	Frail (39.95%)	
Age (years)	60.28 ± 11.45	57.04 ± 11.09	65.14 ± 10.22	<0.001
Female	423 (48.29%)	41.25%	58.86%	0.002
Height (cm)	161.29 ± 9.76	163.43 ± 9.38	158.22 ± 9.49	<0.001
Weight (kg)	83.32 ± 17.72	83.45 ± 17.15	83.15 ± 18.55	0.851
BMI (kg/m^2)	31.81 ± 7.14	30.91 ± 6.40	33.18 ± 7.94	<0.001
Cardiovascular risk factor				
Hypertension	664 (75.80%)	69.58%	85.14%	<0.001
Diabetes	574 (65.53%)	59.51%	74.57%	<0.001
Dyslipidaemia	405 (46.23%)	46.39%	46.00%	0.910
Asthma	74 (8.45%)	7.03%	10.57%	0.065
Smoking	84 (9.59%)	10.84%	7.71%	0.124
Previous TIA/stroke	36 (4.11%)	3.04%	5.71%	0.051
Chronic renal failure	133 (15.18%)	12.93%	18.57%	0.023
Chronic heart failure	42 (4.79%)	3.80%	6.29%	0.092
Previous PCI	161 (18.38%)	19.58%	16.57%	0.260
Previous CABG	78 (8.90%)	8.56%	9.43%	0.657
Medications				
Angiotensin-related medications	469 (53.54%)	50.57%	58.00%	0.031
Beta blockers	391 (44.63%)	42.40%	48.00%	0.102
Calcium channel blockers	294 (33.56%)	30.42%	38.29%	0.016
Diuretics	219 (25.00%)	18.44%	34.86%	<0.001

BMI, body mass index; TIA, transient ischemic attack; PCI, percutaneous coronary intervention; CABG, coronary artery bypass grafting.
All the data were presented as frequencies or mean (± standard deviation), as appropriate. Chi-square test and student's t-test were used as indicated.

METHODS

Data collection and patients characteristics

This is a cross-sectional study that included all consecutive patients who underwent a clinically indicated cardiac positron emission tomography (PET) at a tertiary care center between January and October 2016. This center provides advanced cardiovascular care, including advanced imaging techniques for cardiac patients.[21] Prior to the cardiac PET assessment, patients' baseline characteristics, cardiovascular risk factors, laboratory results, and medications used were collected. Patients were excluded if he or she refused to be enrolled in the study.

Frailty assessment and evaluation

The frailty assessment was completed at the time of the PET procedure by a trained nurse using the Canadian Study of Health and Ageing Clinical Frailty Scale or in short "Fried Scale."[22] This scale is a semi-objective scale describing patients' frailty status according to quick and direct questions about patients' activities of daily living (ADLs) and interaction with surroundings. Patients were asked about their life dependence, need for assistance on any ADLs, instrumental ADLs, outside home activity, frequency of exercise, and current medical problems. Then, their level of frailty was established (Figure 1). Demented and terminally ill patients were excluded. Patients were considered to be frail if they had a score of four or higher on the Fried scale.

Study definitions

Patients using antihyperglycemic medications or with a prior history of diabetes were reported as diabetics. Hypertension was defined as prior hypertension history or the use of any blood pressure-lowering medications. Patients with a prior diagnosis of lipid abnormality or using lipid-lowering therapies were considered to have dyslipidemia.

Statistical analysis

Continuous data were presented as mean with standard deviation and categorical data as percent

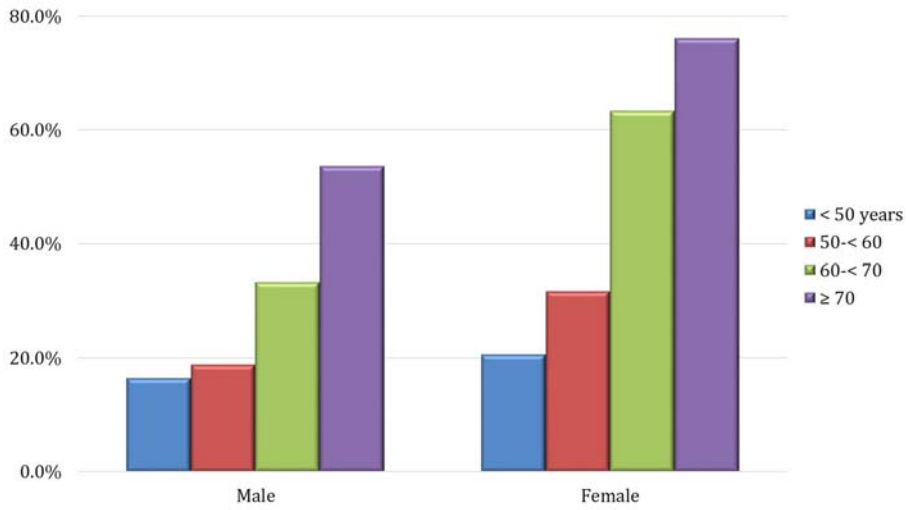

Figure 2. Prevalence of frailty across different age groups.

frequencies. Students' *t*-test and chi-square or Fisher's exact tests were used for group comparison, as appropriate. Multivariate logistic regression models were used to predict frail patients. The regression model consisted of patients' baseline characteristics, conventional cardiovascular risk factors, and cardiac-related medications. All analyses were conducted using Stata 14 software (StataCorp. 2015. *Stata Statistical Software: Release 14.* College Station, TX: StataCorp LP).[23] Statistical significance was considered if $p \leq 0.05$.

RESULTS

A total of 876 patients (mean age 60.3 ± 11 years; 48.3% were women) were included. The prevalence of frailty was 40%. The prevalence of conventional cardiovascular risk factors including hypertension, diabetes, dyslipidemia, and smoking were 76%, 66%, 46%, and 9.6%, respectively. Many patients had a previous cardiac history: stroke 4.1%, percutaneous coronary intervention 18.4%, coronary artery bypass grafting 8.9%, and chronic heart failure 4.8%. Cardiac-related medications and angiotensin-related medications were used in every other patient, while beta-blockers and calcium channel blockers were used in one-third of the study cohort, and a quarter of the cohort were using diuretics (Table 1).

Frail patients were older, more often women, and had a higher body mass index (Table 1). In addition, they had a higher prevalence of hypertension (85.1% vs. 69.6%; $p < 0.001$), diabetes (74.6% vs. 59.5%; $p < 0.001$), previous stroke (5.7% vs. 3.0%; $p = 0.051$), and chronic kidney disease (6.3% vs. 3.8%; $p = 0.023$). They were more often on beta-blockers, angiotensin-converting enzymes, and diuretics (Table 1). Furthermore, frailty prevalence increased with increasing age across male and female groups (Figure 2). Surprisingly, patients younger than 60 years old had a high prevalence of frailty. Every other female patient older than the sixth decade was

Table 2. Multivariate logistic regression predict frail patients among study cohort.

	Odds ratio	*p*	95% confidence interval
Age	1.09	<0.001	(1.08 – 1.11)
Female	2.19	<0.001	(1.56 – 3.08)
Body mass index	1.05	<0.001	(1.03 – 1.08)
Diabetes	1.57	0.011	(1.11 – 2.22)
Renal disease	3.09	<0.001	(1.90 – 5.03)
Diuretics	1.57	0.017	(1.08 – 2.27)

The model consists of baseline characteristics (age, gender [female], and body mass index), cardiac risk factors (hypertension, diabetes, stroke, and kidney disease), and medications (angiotensin-related medications, calcium channel blockers, and diuretics).

Table 3. Baseline characteristics for subgroup (65 years and older).

	Overall population (n = 332)	Frailty status		p
		Nonfrail (40.66%)	Frail (59.34%)	
Age (years)	71.34 ± 5.42	70.15 ± 4.54	72.16 ± 5.82	<0.001
Female	144 (43.37%)	29.63%	52.79%	<0.001
Height (cm)	160.55 ± 9.22	163.65 ± 7.59	158.68 ± 9.63	<0.001
Weight (kg)	79.74 ± 15.60	78.68 ± 13.91	80.38 ± 16.55	0.453
BMI (kg/m^2)	31.06 ± 6.35	29.60 ± 5.16	32.06 ± 6.88	<0.001
Cardiovascular risk factor				
Hypertension	275 (82.83%)	80.00%	84.77%	0.257
Diabetes	237 (71.39%)	67.41%	74.11%	0.184
Dyslipidaemia	166 (50.00%)	52.59%	48.22%	0.434
Asthma	29 (8.73%)	8.15%	9.14%	0.754
Smoking	27 (8.13%)	5.19%	10.15%	0.104
Previous TIA/stroke	17 (5.12%)	2.96%	6.60%	0.140
Chronic renal failure	45 (13.55%)	12.59%	14.21%	0.672
Chronic heart failure	17 (5.12%)	5.19%	5.08%	0.965
Previous PCI	62 (18.67%)	19.26%	18.27%	0.821
Previous CABG	45 (13.55%)	15.56%	12.18%	0.378
Medications				
Angiotensin-related medications	199 (59.94%)	59.26%	60.41%	0.834
Beta blockers	165 (49.70%)	52.59%	47.72%	0.383
Calcium channel blockers	141 (42.47%)	41.48%	43.15%	0.763
Diuretics	100 (30.12%)	25.93%	32.99%	0.168

BMI, body mass index; TIA, transient ischemic attack; PCI: percutaneous coronary intervention; CABG, coronary artery bypass grafting.
All the data were presented as frequencies or mean (± standard deviation), as appropriate. Chi-square test and student's *t*-test were used as indicated.

frail, and almost one-third of male patients in the same age group were frail, too.

Using a multivariate logistic regression model within the study cohort, we found that age, female gender, body mass index, diabetes, renal disease, and diuretics use were independently predictive of frail patients (Table 2).

Subgroup analysis for patients 65 years and older

Since frailty impacts clinical decisions mainly in older patients, we analyzed the older cohort separately. Among patients older than 65 years, frail patients were older (72 vs. 70 years, $p < 0.001$), more often women (53% vs. 30%, $p < 0.001$), and with higher body mass index (32.1 vs. 29.6 kg/m^2, $p < 0.001$). Despite that, no apparent differences between frail and nonfrail patients in cardiovascular risk factors and cardiac-related medications were noted (Table 3). A multivariate logistics regression model was used to define possible frailty predictors in this subgroup. Patients' age, gender, and body mass index were independently associated with frailty (Table 4).

DISCUSSION

Our study described the frailty prevalence in Saudi Arabia among patients who were referred for cardiac risk assessment by nuclear stress testing. Furthermore, we identified the predictors of elderly frail patients.[24–26]

Frailty assessment tools are numerous, and most of these are time consuming, which might have limited acceptance in a busy daily clinical practice. The Canadian Study of Health and Aging clinical frailty scale or in short Fried scale has been shown to have good diagnostic and prognostic values.[9,22] It was developed over 25 years ago[15,24,27] and was essential to describe the epidemiology of cognitive impairment and other important clinical factors among this target population.

Table 4. Multivariate logistic regression predict frail patients older than 65 years.

	Odds ratio	*p*	95% confidence interval
Age	1.12	<0.001	(1.05 – 1.20)
Female	2.64	<0.001	(1.30 – 5.45)
Body mass index	1.06	0.017	(1.01 – 1.16)

The model consists of baseline characteristics (age, gender [female], and body mass index), cardiac risk factors (hypertension, diabetes, stroke, and kidney disease), and medications (angiotensin-related medications, calcium channel blockers, and diuretics).

The frailty prevalence in our study cohort was 40%, which is a little higher than other international published reports.[14,28 – 29] Few published literature have stated that frailty is not a geriatric-related problem. Some younger patients could be frail while they are chronologically young. Results from our study population come in agreement with the previous observation. One could argue that frail patients younger than 65 years share some phenotypical characteristics with older frail patients. The impacts of these findings on management decisions and outcomes of these young frail patients warrant further study.

In addition, the heterogeneity of aging was seen in our study. Many elderly patients are not frail despite advanced chronological age. Van Kan et al.,[15] suggested that frailty is a predisability stage. This implies that disability is not the cause but rather a consequence of frailty. Disability should not be included in the definition nor used as a tool for the assessment.[15,30] Thus, frailty is considered to be a separate pathophysiological condition that has its own predisposing factors.

On the other hand, cardiovascular risk predictors are essential for clinical decision making and assessment for better patients' outcomes. Identifying patients who may benefit from any cardiac-specific treatments such as major procedures and critical interventions is the pillar for survival improvement and better quality of life.[31 – 32] Despite that, traditional cardiac risk scores have their own limits. All these scores comprehend age as the main contributor without discrimination between actual and biological ages. Additionally, the generalizability of these risk scores is restricted since they always have an upper age limit. Thus, using simple frailty tools to assist in the prediction of major cardiac events might improve the predictability of coronary artery disease, management decisions, resource utilization, and hard outcomes.[23,33 – 34] One should note that congestive heart failure and chronic kidney disease were associated with frailty status. This suggests that frailty is a clinical condition that can be detected across the spectrum of cardiovascular diseases.

Limitations

This study has several limitations. Although the clinical frailty scale is easy to implement, it has some subjective aspects that are predisposed to inter-observer variability. Also, there might be an inherent selection bias. Patients with life-limiting diseases such as stroke, cancer, and end-stage renal failure have a short life expectancy. Thus, these conditions were not noted as predictors of frailty. Lastly, we did not assess the prognostic impacts of frailty on major cardiac events such as cardiac mortality, hospitalization, and revascularization.

CONCLUSIONS

With the aging of the Saudi population, frailty prevalence is expected to increase. Elderly, obesity, hypertension, and female gender are risk factors to develop frailty. Interventions to reduce frailty should be focused on this high-risk population.

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