Frailty and Mortality in a Hospital from Monterrey, Mexico

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ABSTRACT

Objective: To determine the association between frailty and mortality in a Mexican hospital.

Material and Methods: This prospective study was conducted in Monterrey, Mexico, that included hospitalized subjects of 65 years and older. Frailty was assessed through direct questioning to patient or caregiver about: during the last weeks did you have difficulty to rise from a chair after being seated during long time? Have you lost 5 kg or more in the last year and have you lack of energy? The frail individuals were considered as frail when they had at least two conditions and not frail with less than two conditions. Mortality was assessed during their hospitalization through their discharge.

Results: The frailty status and a score below 65 in the Barthel index were independently associated with higher hospital-mortality after adjusting for covariates. Age, gender, number of co-morbidities, geriatric syndromes, previous hospitalizations and number of acute pathologies were not.

Conclusion: Frailty and a score below 65 in the Barthel index were independently associated with higher hospital mortality.

Keywords: Elderly, frailty, hospital, Mexicans, Mexico, mortality

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INTRODUCTION

The demographic and epidemiological transition associated with the increase in life expectancy have important implications for health systems worldwide. One is the ageing population. In Mexico, between 2005 and 2050 the elderly population will increase by about 26 million, although more than 75% of this increase will occur starting from 2020.

Due to this rapid growth, it is estimated that the population aged 60 or more, which to date represents almost one in 13 Mexicans (7.6%), in 2030 will represent one in six (17.1%) and in 2050 more than one in four [27.7%] (1). This increase in the number of seniors is expected to generate an increase in economic burden on health systems, because it is often associated with a greater number of chronic diseases and disabilities. For example, in the United States, older adults consume about 60% of health expenditure, covering 35% of hospital discharges and using 45% of hospital stay days (2, 3). In Mexico, it is considered that the older population will require more medical care that will be complemented by increase in healthcare costs projected for the next few years (4), principally there will be an increase of diseases associated with age (2), including frailty syndrome (5, 6).

Frailty is a geriatric syndrome characterized by a status of extreme vulnerability to stress associated with adverse health events, such as hospitalizations, falls, and other geriatric syndromes (7), even death (8–11). There are different ways for measuring frailty (8–10,12–20), although it lacks a worldwide accepted operational definition (21, 22).

Nowadays, the most common used definition of frailty was given by Fried *et al* (9). This definition was obtained from the Cardiovascular Health Study that proposes a phenotype, in which the presence of three or more of the following five components is required: unintentional weight loss (4.5 kg or more per year), sensation of exhaustion,

weakness (measured by grip strength with a dynamometer), slow walking speed (based on a distance of 4.6 m) and low physical activity (less than 400 calories per week). This phenotype was associated with the development of adverse events such as falls, hospitalizations, disability and mortality (9). However, addressing frailty through this methodology used in research studies is impractical in the clinical settings of Mexico for several reasons. First, most medical centers do not have a dynamometer to measure grip strength. Second, there are no validated questionnaires to measure physical activity. Third, both the walking speed and grip strength require their percentile distribution within the population and adjusted for gender and body mass index. Finally, weight loss, whether intentional or unintentional, has been associated with increased risk of disease in the elderly (23, 24).

On the other hand, there exists an index to measure frailty, which was designed by Rockwood *et al*. This index is based on the number of deficits in health, which may be signs, symptoms, diseases, disabilities, radiographic, electrocardiographic and laboratory abnormalities and depending on the number of deficits suffered by the elderly will be the probability to be frail (15). This index was compared with the phenotype of frailty (16), in the Cardiovascular Health Study showed that the frailty index (15) is capable to identify mortality better than the fenotype (9), but it has the disadvantage that it is not a simple application in terms of logistics for the medical scenario in Mexico, as it has to include 34 items in its evaluation and a complete geriatric assessment (18) is requiered whose characteristic is time-consuming and demands to carry out training.

Recently the phenotypic index from Fried *et al* (9) was compared with one proposed by Ensrud *et al* (19, 20), which classifies as elderly frail having at least two of the

following three criteria: weight loss, inability to rise from a chair five times without using the arms and a reduced energy level. The results were analysed in both men and women with operating curves from the receiver and the corresponding areas under the curve to predict falls, disability, nonspine fractures, hip fracture and death. Both rates were similarly effective for predicting these adverse outcomes (19, 20). However, the index proposed by Ensrud and colleagues is simple, fast and economical.

It is important the identification of frailty syndrome in hospitalized older adults, since it is a factor that predisposes to development of acute diseases that lead to the hospitalization, and it is one of the most important determinants of health status and function of the elderly (7, 25), [regardless the instrument used for measuring (26–30)], even it is a prognostic factor during hospitalization (31), which raises the objective of this study: to determine the association between frailty syndrome and hospital mortality at general hospital in Monterrey, Mexico.

MATERIAL AND METHODS

This prospective cohort study was conducted at Hospital General de Zona No. 17 (a general hospital that provides care to the insured population of the western region of the city) from the Instituto Mexicano del Seguro Social in Monterrey, Mexico. This study included hospitalized individuals aged 65 or older from September 1, 2010 to January 31, 2011. Patients who completed clinical conditions with a high level of stress and accompanied by cachexia (a syndrome resembling the frailty (32)), which accelerate the muscle mass loss,

such as those who were treated in the intensive care unit, chronic liver disease child B or C, chronic renal replacement therapy with haemodialysis or peritoneal dialysis, advanced dementia, end stage patients and those without caregivers were excluded.

Variables

All participants were assessed after admission to the hospital. In order to develop the fragility index three questions were included: 1) Due to health problems, do you have difficulty to rise from a chair after sitting down for long time? For a positive answer one point was given when answering “yes”, "I can not" or "I can not do it". No score was given when there was no such difficulty (value 0). The question was included as a self-report, because of multiple-hospital clinical conditions contraindicate vigorous physical activity to explore the contractile force group from the thigh (which is essential to maintain adequate mobility (33)), such as risk of falls, *etc*. This self-report replaced the one used by Ensrud *et al* (19, 20), who researched about the inability to rise from a chair five times. 2) Have you had much energy? This question was taken as a positive answer when they replied "no" and one point was given. No score (value 0) was given when they said “yes,” and 3) Compared to 2 years ago, do you weigh: 5 kg more or 5 kg less or your weight is more or less the same? A point was given as a positive response when they answered: "5 kg less". No score (value 0) was given when he answered “yes” to any of the other two options. The categorization of this frailty index was developed as follows: When the patients have two or more points, the result was “frail status” and otherwise they were classified as not frail. To complete the assessment, the following confounding variables

were included for the analysis: gender, age, the number of chronic diseases and comorbidities that represents the sum of self-reports or previous diagnoses of diabetes mellitus, hypertension, Parkinson's disease, chronic lung disease, heart failure, coronary heart disease, cancer in remission and peripheral vascular disease, organized quantitatively and representing values between 0–8. Also, the variable number of geriatric syndromes was formed from the sum of: a record of falls in the past six months, dementia, sensory deficits (visual and/or auditory), depression, insomnia, urinary and/or fecal incontinence, immobility, delirium and polypharmacy, representing values ranged from 0 to 9.

A functional assessment was also included with a score obtained by applying the Barthel´s index (34) and Lawton´s index (35), as well as the number of hospitalizations in the last six months. Mortality and survival time in days, were recorded during hospital follow-up and taken as dependent variables. Written informed consent was obtained from all the participants to be assessed during their hospitalization. Revision and approval of the project was given by the local Research and Ethics Committee.

Statistical analysis

Numerical variables were represented with mean and standard deviation or median and interquartile range according to the type of distribution. For qualitative variables, absolute frequencies and percentages were used. Data were compared with Chi-squared to determine difference between qualitative variables and Student's *t*-test or Mann-Whitney U to show difference between quantitative variables. Association was measured with multivariate logistic regression analysis with forward stepwise method. Survival was measured by

Kaplan Meier method and compared with the log rank test. Sample size was estimated identify a difference in proportions of an in-hospital mortality between 0.36 and 0.1 with an alpha of 0.05, power of 0.9, ratio between frail and not frail participants of one to two, for a minimum of 44 and 88 per group, respectively. The sampling method was a non-probabilistic one, using consecutive cases.

RESULTS

A total of 137 participants were included, 45 of them belong to the frail group and 92 to the non-frail ones. The participants were older, more functionally dependent (Table. 1), had a higher number of: co-morbidities, hospitalizations in the last six months and acute conditions.

Table: 1. Clinical characteristics for hospitalized older adults according to frailty status.

Variable	**With frailty n = 45**	**Without frailty n = 92**	***p*[a]**
Age (years)	77 ± 8	72 ± 5	< 0.001
Male	25 (55, 6%)	42 (45, 7%)	0.276
Number of co-morbidities[b]	3 (2-5)	2 (1-4)	0.001
Geriatric syndromes[c]	4 (1-7)	0 (0-2)	< 0.001
Number of hospitalizations[d]	1 (0-3)	0 (0-0)	< 0.001
Length of hospital stay (days)	8 (7-9)	5 (4-8)	< 0.001
Functionality			
Barthel Index score	60 (20-85)	90 (80-100)	< 0.001
Lawton-Brody score	0 (0-2)	4 (2-6)	< 0.001
Number of acute conditions[e]	2 (2-3)	1 (0-2)	< 0.001

a.-The data represent mean ± standard deviation, median (interquartile range) and absolute frequencies and percentages are compared with the Student *t*-test, Mann-Whitney U test, and Chi-squared, respectively.

b .- Number of co-morbidities represents the sum of diabetes mellitus, hypertension, parkinson's disease, chronic lung disease, heart failure, coronary heart disease, peripheral vascular disease and cancer.

c .- The number of geriatric syndromes represents the sum of falls, dementia, Sensory deficits (visual and / or auditory), depression, sleep problems, urinary incontinence and / or fecal incontinence, immobility, delirium and polypharmacy.

d.- In the last six months.

e.- Number of acute pathologies represents the sum of: electrolyte disorder, infections, non-infectious lung disease, heart disease or an acute exacerbation from a pre-existing heart disease, and ischaemic or haemorrhagic stroke.

After a median follow-up of 12 days (95% CI 10.8 to 13.1), frail older adults had a mortality of 60% (27), with a median survival of nine days (95% CI 7.4, 10.5), compared with a 9.8% mortality (9) and survival of 12 days (95% CI 9.1, 14.8) in non-frail participants [$p < 0.002$] (Fig. 1).

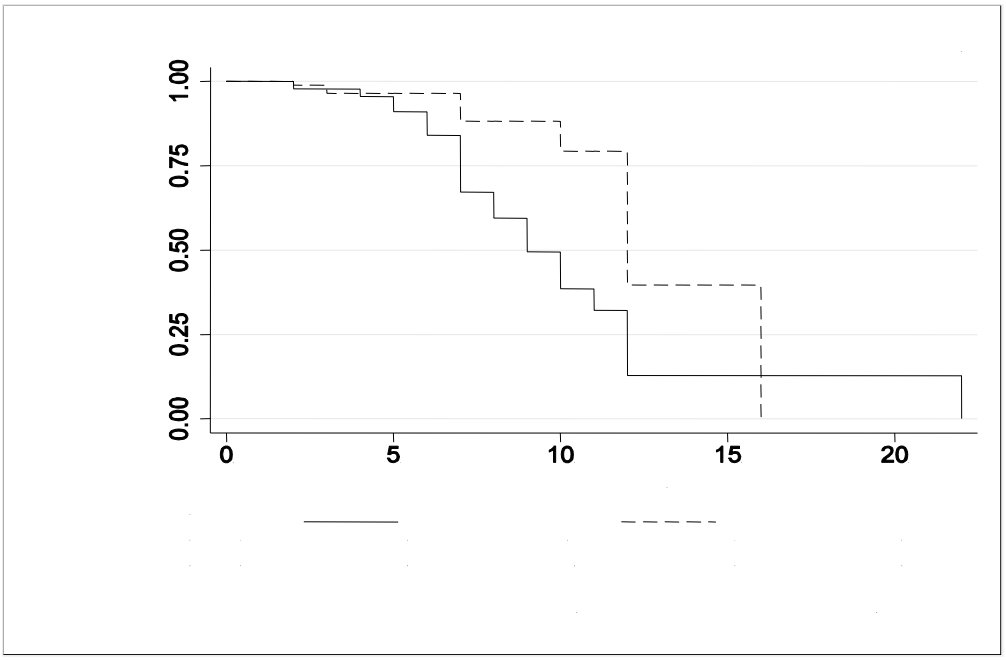

Figure: 1. Survival time according to frailty status.

When comparing the clinical characteristics between patients who died and those who survived during their hospitalization (Table 2), it is noted that the former were older, a number of geriatric syndromes, previous hospitalizations, length stay in days, acute problems and low functional score.

Table: 2. Clinical characteristics for older adults related to mortality.

Variable	**Death n = 36**	**Survival n = 101**	***p*[a]**
Age (years)	77 ± 9	73 ± 5	< 0.001
Male	21 (58, 3%)	46 (45.5%)	0.188
Number of co-morbidities[b]	3 (2-5)	2 (1-4)	0.066
Geriatric syndromes[c]	5 (1.5-7)	1 (0-2)	< 0.001
Frailty	27 (75%)	18 (17.8%)	
Number of hospitalizations[d]	1 (0-3)	0 (0-0)	< 0.001
Length of hospital stay (days)	7 (6-10)	6 (4-8)	0.006
Functionality			
Barthel Index score	40 (10-80)	90 (80-100)	< 0.001
Lawton-Brody score	0 (0-2)	4 (2-6)	< 0.001
Number of acute conditions[e]	3 (2-4)	1 (0-2)	< 0.001

a.- The data represent mean ± standard deviation, median (interquartile range) and absolute frequencies and percentages are compared with the Student *t*-test, Mann-Whitney U and Chi-squared respectively.

b.- Number of co-morbidities represents the sum of diabetes mellitus, hypertension, parkinson's disease, chronic lung disease, heart failure, coronary heart disease, peripheral vascular disease and cancer.

c .- The number of geriatric syndromes represents the sum of falls, dementia, sensory deficits (visual and / or auditory), depression, sleep problems, urinary incontinence and / or fecal incontinence, immobility, delirium and polypharmacy.

d.- In the last six months.

e.- Number of acute pathologies represents the sum of: electrolyte disorder, infections, non-infectious lung disease, heart disease or an acute exacerbation from a pre-existing heart disease, and ischaemic or haemorrhagic stroke.

Frailty was most common among those who died and it was associated with a relative risk of death unadjusted 4.20 (95% CI 2.65 to 6.66 $p < 0.001$), which after

adjusting for covariates by stepwise logistic regression retained its statistical significance (Table 3).

Table 3. Clinical variables and their association with hospital mortality by multivariate logistic regression analysis.

Variables	***p***	**OR[a]**	**CI 95% [b]**	
Non Frail		1		
Frail	0.008	4.495	1.481	13.641
Barthel index score < 65	< 0.001	11.496	3.403	38.839

a.- Odds ratio

b.- 95% Confidence interval

The following variables were eliminated through the step-forward logistic regression analysis because they lacked of statistical significance: age, gender, edad, sexo, Lawton-Brody scale score, sum of co-morbidities, number of geriatric syndromes, lenght of hospital stay, number of hospitalizations in the last year and the number of acute conditions.

DISCUSSION

The aim of this study was to determine the association between the frailty syndrome and hospital mortality in a general hospital in Monterrey, Mexico. The association between frailty and mortality had an important clinical significance and it is consistent with the results obtained by other researchers in different populations (26–31, 36). The impact of frailty on mortality resulted as it was expected, since, by definition, frail patients have a decrease in the physiological reserve, in the ability to maintain homeostasis and to respond to stress conditions, which results phenotypically as a poor ability to move, gait and consequently the patients suffer longer bedridden time, which is associated with increased complications and subsequently, mortality (37). Frailty was associated with worse health in general, reflected in a greater number of co-morbidities, geriatric syndromes, previous hospitalizations, acute pathologies and increased functional dependence, showing that status of frailty is a common path between multiple clinical conditions that trigger death,

so it is important to consider it as a clinical marker of an underlying disorder.

The association found between frailty and mortality may be also caused by the low functional performance that frail older adults often suffer (38, 39) and it is associated with increased mortality which is consistent with previous studies (36, 37).

This study has some limitations. Firstly, most of the medical comorbidities of the population, frailty and activities of daily living were assessed as self-reports on the status of pre-existing condition, which sometimes were obtained from a caregiver. Although, several studies have found consistency between self-reports and direct measurement (40). Secondly, the fact of not including patients who had chronic renal failure, chronic liver disease, in terminal stage, and those who were admitted to critical care unit, could have produced selection bias, and since these individuals were in a more severe critical condition, more frail (possibly secondary to the state of cachexia accompanied by its disease (32)) and most likely to die, having created a survival bias (41). Thirdly, the strategy used to measure frailty (11), is not the most frequently used nor the original proposed by Ensrud *et al* (19, 20), as the item "can you rise from a chair five times with arms crossed?" was replaced by a self-report: "Due to health problems, do you have difficulty to raise from a chair after being seated for long time?". This substitution was justified due to patients' condition, it is not recommendable that they engage in exhausting physical activity and it is not ethical to compromise their safety because of complex and strenuous measures. Despite these limitations, this study has many strengths, including its prospective design, the ability to evaluate multiple medical conditions and factors previously reported with an association with hospital mortality, plus it is the first study that evaluates such association in Mexico (although there are many studies out there (5, 8, 17),

none have been conducted at the hospital level), in a simple and economical way. New studies in Mexico and worldwide are required to confirm the association found in this analysis.

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