Nursing home residents: The dimension of frailty

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Abstract

Background: Frailty is a state of increased vulnerability with multisystem loss of physiologic reserves and decreased response to stressors, predicting adverse health outcomes. The phenotype of frailty is characterized by: Unintentional weight loss, self-reported exhaustion, weakness (low grip strength), slow walking speed, and low physical activity. This study aimed at assessing the prevalence and characteristics of frailty in a sample of institutionalized older people in order to identify a target intervention group. **Methods:** This is a descriptive cross sectional and correlational study. Participants were 226 men and women living in nursing home facilities. Frailty was assessed using the phenotype of frailty. Socio-demographic, health status, physical and cognitive function and depression data was collected. Relations between variables were analyzed using parametric (T-test, Pearson coefficient) and non-parametric (Chi-square and Spearman's coefficient) tests. A multiple linear regression model was applied to assess the relationship between the frailty criteria and a set of predictor variables. **Results:** Assessment of frailty was possible in 35.3% of the subjects and 41.5% were found frail, 52.1% pre-frail and 6.4% non-frail. Three frailty criteria had higher prevalence: Weakness (76.6%), low physical activity (61.7%) and low walking speed (52.1%). The number of frailty criteria per subject was significantly correlated with cognitive status and depressive symptoms and there was weak, though significant, correlation with the Barthel Index. Participants in frailty tests had a better functional and cognitive state than those unable to participate. No significant difference in depressive symptoms was found between these two groups. The multiple regression model explained only 21.6% of the variation of frailty. **Conclusions:** Subjects revealed low social status, advanced age comorbidity and multifactorial incapacity. Frail and pre-frail elderly stand out like a "stronger" subset in the sample, as opposed to the usual findings in community dwelling older adults. These

facts should help to recognize them as a target intervention group, as frail elderly are vulnerable and their needs might be underestimated and underrecognized. . Targeted interventions may improve their condition and prevent adverse health events.

Key words: Older people, frailty, institutionalization.

Background:

Institutionalization as a means of social support for older people is a growing resource when families and other social responses fail to meet their needs. Thus it's possible that some older people enter nursing homes for social reasons, rather than due to incapacity or health conditions. The identification of age related changes in organs and systems can contribute to better targeted interventions.

Frailty is a state of increased vulnerability with multisystem loss of physiologic reserves and decreased response to stressors (Rockwood, Fox et al. 1994, Fried, Tangen et al. 2001) predicting adverse health outcomes such as falls, disability, hospital or nursing home admission and death (Fried, Bradley et al. 2001). These outcomes have been confirmed by several prospective studies (Ensrud, Ewing et al. 2008, Sarkisian, Gruenewald et al. 2008, Romero-Ortuno, Walsh et al. 2010, Freiheit, Hogan et al. 2011). Defining and assessing frailty has motivated much discussion and research since the recognition of a pattern of vulnerability provided a "unifying diagnosis" (Heppenstall, Wilkinson et al. 2009). Frailty is a distinguished entity from disability and comorbidity although there is some overlap (Fried, Tangen et al. 2001, Fried, Ferrucci et al. 2004). Disability refers to difficulty or dependence in Activities of Daily Living (ADL) being one of the consequences of frailty. Comorbidity is defined by the presence of two or more diseases and its burden increases with age (Fried, Ferrucci et al. 2004). The pathophysiological mechanism of frailty is a complex multisystem process, with similarities with ageing. Chronic inflammation, impaired immunity, neuroendocrine and metabolic alterations seem to play an important role in the establishment of frailty ((de Vries, Staal et al. 2011). This process is not yet fully understood but specialists agree that this state of vulnerability results from impairments in multiple systems that "lead to decline in homeostatic reserve and resiliency" (Bergman, Ferrucci et al. 2007).

(Bergman et al, 2011) and differs from the ageing process (Abellan van Kan, Rolland et al. 2008). Researchers have been using different concepts and consensus is still lacking (Walston et al, 2006). Some authors focus on physiologically-based definitions while others use a more holistic approach (Heppenstall et al, 2009) including physical characteristics, function, cognition, psychological and psychosocial factors (Walston et al, 2006). The lack of consensus extends to the assessment tools. A literature review identified twenty frailty instruments but authors could not elicit a preferred tool stating that the choice depends on the aims and conditions of assessment (de Vries, Staal et al. 2011). Despite the controversies, all authors seem to agree that frailty can be prevented and treated and this may be the key implication for clinical practice.

The Phenotype of Frailty (Fried et al, 2001) and the Frailty Index (FI) (Rockwood et al, 1999; Rockwood et al, 2005) stand out as the most divulged instruments in the literature (Fairhall et al, 2011). Some studies have compared them and found convergence and correlations despite their differences (Rockwood et al, 2007; Hubbard, O'Mahony and Woodhouse, 2009). The phenotype identified by Fried et al (2001) is operationalized by five frailty indicators: unintentional weight loss, weak grip strength, self-reported exhaustion, slow gait speed and low activity level. This definition provides a feasible tool for clinical practice (Van Kan et al, 2008) and has been extensively applied (Freiheit et al, 2011). Although criticized for the restriction to physical aspects these criteria are reproducible, coherent (Hubbard, O'Mahony and Woodhouse, 2009) and express an underlying biological complex process (Bergman et al, 2007). Originally, in the CHS (Fried et al, 2001), people with dementia or using anti-depressants were excluded, but many subsequent studies have included cognition and mood. Frailty has been found to be associated with depression (Romero-Ortuno et al, 2010; Bilotta et al, 2010; Kamaruzzaman et al, 2010) and the same happened with

cognitive impairment (Cesari et al, 2006; Sarkisian et al, 2008; Ensrud et al, 2008; Hubbard, O'Mahony and Woodhouse, 2009; Romero-Ortuno et al, 2010; Bilotta et al, 2010; Kamaruzzaman et al, 2010). Ávila-Funes et al (2009) found that frail people cognitively impaired were significantly more likely to develop disability and concluded that adding cognition to frailty improves predictive validity for adverse health outcomes. Bergman and colleagues (2007) stated that cognition and mood should be critical domains of frailty, because they may be affected by the same biological process.

The original frailty criteria were developed with community-dwelling older people (Fried et al, 2001) and most studies have used community samples. No studies were found exclusively related to institutionalized elderly. Freiheit et al (2011) assessed residents in assisted-living facilities and the prevalence of frailty, dementia and depression were considerably higher than in the community. Institutionalized older persons are expected to have greater incidence of cognitive impairment (Gaugler et al 2007; Luppa et al, 2010) and depression (McDougall et al, 2007) so, the simplifications proposed by Fairhall et al (2008) might facilitate the assessment of frailty in this population.

This study aimed at identifying nursing home residents able to participate in frailty assessment and to characterize their frailty status. Social, functional, cognitive and mood characteristics of participants in frailty assessment were compared with those unable to participate in the tests to better understand their differences.

Material and Methods:

Participants

Data from a convenience sample of 266 elderly residents in eight nursing homes in the region of Lisbon, Portugal were collected after their informed consent was

obtained. The test group included 94 subjects able to participate in frailty assessment, which required ability to walk (with or without a walking aid) and to communicate.

Frailty assessment

Frailty status was ascertained using the phenotype validated by Fried et al (2001) and the model defined by Fairhall et al (2008): a) Unintentional weight loss of more than 4.5 kg or greater than 5% of body weight in the past year. b) Self-reported exhaustion using two statements from the Center for Epidemiologic Studies-Depression Scale (CES-D) (Radloff, 1977): "I felt that everything I did was an effort" and "I could not get going" and asking the participant to indicate how often in the last week he/she felt this way; 0 = rarely/ never, 1= a little of the time (1–2 days), 2 = a moderate amount of the time (3–4 days), 3 = most of the time (5-7 days). A score of 2 or 3 was considered a positive answer. c) Grip strength was measured with a Baseline® dynamometer (Fabrication Enterprises Incorporated, USA). The best of three attempts in the dominant hand was recorded. Weakness was considered present when male participants scored 30 kg or less and female participants scored 18 kg or less. d) Slow walking speed was determined by the time to walk four meters and six seconds or more was classified as positive. e) Low physical activity level was considered positive if, in the past three months, the participant did not perform weight-bearing physical activity, spent more than four hours per day sitting, and went for a short walk once per month or less. Participants were classified as frail in the presence of three or more positive criteria, pre-frail when one or two criteria were present and non-frail in the absence of positive criteria.

We assessed the prevalence of frailty criteria and relationship of frailty with gender, education, physical function, cognition and mood. The remaining 172 subjects formed the non-test group.

Social, functional and mood assessment

Socio-demographic, health and functional characteristics of both groups were compared. Functional, cognitive and mood state were assessed with the Barthel Index (BI) (Mahoney and Barthel, 1965) Mini Mental State Examination (MMSE) (Folstein, Folstein and McHugh, 1975) and the Geriatric Depression Scale (EDG) (Sheikh and Yesavage, 1986) respectively.

Statistic analysis

This is a descriptive, cross sectional and correlational study and statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS 19). To analyze relations between variables, parametric (T-test, Pearson coefficient) and non-parametric (Chi-square and Spearman's coefficient) tests were applied. A multiple linear regression model was used to assess the relationship between the number of frailty criteria and a set of predictor variables. For all tests a significance level of $p \leq 0.05$ was used.

Results:

From the total sample 35.3% were able to participate in the frailty tests and results are shown in Table 1. Comparison between the test group and the non-test group are presented in Table 3. In the test group mean age was 82.04 years (range 65-100) and 76.6% were female. Frailty assessment found 41.5% frail participants, 52.1% pre-frail and 6.4% non-frail. Two participants were unable to self-rate subjective exhaustion. They were considered frail because all other criteria were positive.

Men were mostly pre-frail (63.6%), while women were similarly frail (47.2%) and pre-frail (48.6%). Considering the incidence of each criterion 76.6% had weak grip strength (predominant in both genders but more expressive in males); 61.7% had low

activity level (predominantly women); 52.1% showed slow walking speed (mostly women). Subjective exhaustion (23.4%) and weight loss (10.4%) were less frequent. Most participants had two (35.1%) or three (26.6%) positive criteria, the border-line values between being pre-frail and frail. Based on the number of criteria, associations of frailty with age, education, IB, MMSE and GDS were assessed. There was a negative weak correlation with the IB score (r= -0.262; *p*= 0.011). Correlation with the MMSE was negative (r= -0.343; *p*= 0,001) and with the GDS correlation was positive (r= 0 .395; *p*= 0.001) (Table 1).

Table 1- Assessment of frailty (n=94).

Variable	**Test group (total)**	**Women**	**Men**
Sex	-	72 (76,6%)	22 (23,4%)
Age (mean sd)	82,04 ±8,145	83,23±8,133	78,23±7,084
Frailty status			
non-frail	6 (6,4%)	3 (4,2%)	3 (13,6%)
pre-frail	49 (52,1%)	35 (**48,6**%)	14 (**63**%)
frail	39 (41,5%)	34 (**47,2**%)	5 (**22,7**%)
Frequency of criteria			
Weight loss	9 (9,6%)	8 (11,1%)	1(4,5%)
Subjective exhaustion	22 (23,4%)†	18 (26,15)	3 (13,6%)
Low activity	58 (**61,7**%)	49 (69%)	9 (40,9%)
Weakness	72 (**76,6**%)	54 (**75**%)	18 (**81,8**%)
Slow gait	49 (52,1%)	42 (58,3%)	7 (31,8%)
Criteria per participant	**Frequency (%)**		
0	6 (6,4%)		
1	17 (18,1%)		
2	33 (35,1%)		
3	25 (26,6%)		
4	11 (11,7%)		
5	2 (2,1%)		
Correlations of frailty (nºcriteria)	**r (*p-value*)**		
Age (Pearson C.)	ns		
Education (Spearman C.)	ns		
IB score (Pearson C.)	-0,262 (0,011)*		
MMSE score (Pearson C.)	-0,343 (0,001)**		
EDG score (Pearson C.)	0,395 (0,001)**		

† 2 missing answers; * significant for p≤0,05; **significant for p≤0,01; ns: non-significant

A multiple linear regression model was used, after testing model assumptions, to assess the relationship between the number of criteria (dependent variable) and a set of independent variables: Sex, age, education, incontinence, physical activity, BI, MMSE and GDS. The model was significant (0,005) for $p \leq 0.05$, but explained just 21.6% of the variation of frailty. Only the GDS had a significant contribution to the model (p= 0,004) (Table 2).

Table 2- Application of the multiple regression model

Model summary

Model	R	R^2	Adj. R^2	Estimated standard error
1	,561[a]	,314	**,216**	,97193

Sig =0,005 (Regression ANOVA)

Coefficients[a]

Model		Non- Standard. B	Std. Error	Standard. **Beta**	**t**	**Sig.**
1	(Constant)	1,836	1,471		1,248	,217
	Age	,015	,016	,109	,894	,375
	Sex	,409	,307	,165	1,333	,188
	Education	,031	,257	,014	,119	,906
	Incontinence	,089	,295	,037	,303	,763
	Physical activity	-,116	,275	-,053	-,420	,676
	MMSE	-,040	,024	-,215	-1,710	,093
	Barthel	-,010	,010	-,154	-1,016	,314
	GDS	,096	,032	,338	2,974	**,004**

a- Dependent variable: Number of positive criteria

The characteristics of the test group and the non-test group were compared (Table 3). Most socio-demographic variables (age, gender, marital status and social contacts) showed a similar distribution in both groups.

Comorbidity was predominant (71.7% in the non-test group and 62.8% in the test group). The incidence of sensory deficits was especially prevalent in the non-test group and significantly different in the two groups (audition: p=0,002; vision: p=0,013). The incidence of urinary incontinence was different in both groups and highly significant

(*p*= 0.000). BMI could only be assessed in people able to stand on a scale and included just 40 members of the non-test group. Prevalence of weight above normal was most expressive in the test group (63.8%). The test group excluded people who could not walk or used wheelchair (65% of the non-test group). Participants in frailty tests used walking aids (45.8%) or no aid at all (54.3%) and were significantly more active (*p*=0,000). The BI was significantly different in both groups (t(254)= 14,788; *p*= 0,000). Impaired cognitive state was found in 30% of the participants in frailty tests with a mean score of 21.64± 6.219. In comparison, 63.5% of the non-test group had impaired cognition with a mean score of 14.85± 9.743. This difference was highly significant (t(234,47)= 6,564; *p*= 0,000). Signs of depression were found in 52.9% of the participants in frailty tests, showing severity in 14.3% of these cases. Comparatively, the non-test group had a higher incidence of depression (63.0%) and higher severity (20.6%), but with no statistically significant difference.

Table 3- Comparison between the test group and the non-test group

Variable	Test group (n=94)	Non-test group (n=172)	
Age (mean, sd)	82,04% (±8,145)	83,01% (±10,737)	
Sex (% fem)	76,6%	74,4%	
Marital status			
Single	44,1%	37,3%	
Married	8%	6,8%	
Divorced/separated	11,8%	11,2%	
Widowed	40,9%	43,5%	
Education			
None	24,5%	31,9%	
Able to read/write	22,3%	15,3%	
1st cicle (4 years)	40,4%	40,5%	
2nd cicle (6 years)	5,3%	6,7%	
Highschool (11 years)	6,4%	3,7%	
University	1,1%	1,8%	
Previous occupation			
No specific qualification	73,9%	60,6%	
Specific qualification	10,9%	14,7%	
(technical/superior qualif.)	(4,4%)	(7,3%)	
Never worked	15,2%	**24,7%**	
Visits/contacts (yes**)**	67,7%	69,6%	
Comorbidity	62,8%	71,7 %	
Sensory deficit			**Q-square**
Audition	35,1%	**50,4%**	*p*= 0,002**
Vision	32,6%	**49,2%**	*p*= 0,013*
Urinary Incontinence	29,8%	**74,4%**	*p*= 0,000**
Body Mass Index		**(n=40)**	
Low	4,8%	20,0%	
Normal	31,3%	37,5%	
Overweight	32,5%	30,0%	
Obesity	31,3%	12,5%	
(Total above normal)	**(63.8%)**	(42,5%)	
Ambulation			
Unable	0%	31,9%	
Wheelchair	0%	33,1%	
Walking aid	**45.8**%	20.5%	
No aid	**54.3**%	14.5%	
Regular physical activity	**54.3%**	11.8%	0,000**
Barthel Index			***T-test***
			t(254)= 14,788
Mean score, sd	84,97 ±17,956	37,73± 33,139	*p*= 0.000**
Depression (GDS)	**(n=70)**	**(n=73)**	
No signs	47,1%	37,0%	
Positive signs	52,9%	**63,0**%	
(Severe)	(14,3%)	(**20,6**%)	
Mean score,sd	6,01±3,759	7,03± 3,420	t (138,42)= -1,684
			p= 0,094 ***

*significant for $p \leq 0,05$; ** significant for $p \leq 0.01$; *** non-significant.

Discussion

The sample revealed advanced age, predominance of women, low education and low social status, comorbidity and multifactorial incapacity, with only 35.3% being able to participate in frailty assessment. People using wheelchairs may be considered a particular case as they were excluded due to the nature of some tests, independently of their capacity. This situation has not been considered in the literature reviewed.

In the test group half of the participants were pre-frail, prevailing over frail people, and most participants (61.7%) had two or three positive criteria, representing a borderline situation between being pre-frail and frail. Six subjects were also found non-frail. Thus we inferred that frailty status was not severe in the group. Weakness, low activity and slow gait predominated suggesting a functional similarity among participants, perhaps due to decreased activity (assisted ADL, abandon of IADL) and permanence in nursing-home premises. Studies with community-dwelling elderly also found these prevailing criteria, although with a lesser expression (Fried et al, 2001; Sarkisian et al, 2008; Freiheit et al 2011). The incidence of weight loss was low and we found high incidence of overweight and obesity. Other studies have reported exceeding weight in frail people (Walston et al, 2006; Cesari et al, 2006; Bergman et al, 2007; Sarkisian et al, 2008) and criticized the fact that obesity is underestimated in the phenotype model. The concept of "sarcopenic obesity" (Cesari et al, 2006) might explain the discrepancy between mass and strength found in frail older people (Walston et al, 2006).

Cognitive impairment was found in 30% of the participants and some showed difficulties with self-rating questions, although they were able to understand performance tests. One study developed in assisted living facilities also reported difficulties in assessing frailty, mostly related to dementia and cognitive impairment (Freiheit et al 2011). According to Kamazzuraman et al (2010) physical performance tests best explain frailty reinforcing its

relationship with physical function. This type of tests is easier to apply and may be more relevant than self- rating tests in clinical settings (De Vries et al, 2011). Gait speed may be the most expressive indicator of the integrity of several systems (De Vries et al, 2011) and with predictive value for adverse health outcomes (Cesari et al, 2006; Freiheit et al 2011).

We found only a weak correlation between frailty and the BI, reinforcing the perspective that frailty is different from incapacity (Fried et al, 2001; Fried et al, 2004; De Vries et al, 2011). A moderate correlation between frailty and the MMSE points to the association of frailty and cognitive impairment as reported by several studies (Cesari et al, 2006; Ensrud et al, 2008; Sarkisian et al, 2008; Hubbard, O'Mahony and Woodhouse, 2009; Bilotta et al, 2010; Kamaruzzaman et al, 2010). Half of the participants in the tests revealed signs of depression and a moderate correlation with frailty was found, suggesting an association between severity of depression and the number of criteria. Other studies have found a relationship between depression and frailty (Romero-Ortuno et al, 2010; De Vries et al, 2011; Bilotta et al, 2010; Kamaruzzaman et al, 2010) and some authors state that, depression and cognition should be included in the critical domains of frailty (Bergman et al, 2007; De Vries et al, 2011).

For the multiple regression model we selected independent variables based on their quantitative nature (or the possibility of dichotomization) and relation to frailty. The model was significant, but scarcely adjusted as it only explained 21.6% of the variation of frailty. Depression was the only variable with an expressive contribution to the model. Cognition highly correlated with the number of criteria, didn´t reach significance in the model.

Comparison between the test group and the non-test group found significant differences in physical and cognitive function. Participants in frailty tests showed higher capacity and independence, less sensory impairment, a superior activity level and a very significant smaller incidence of urinary incontinence. Depressive symptoms also had smaller

incidence and less severity in this group. Differences in scores of BI and MMSE had high statistical significance. According to the characteristics of the nursing home residents and with the factors of inclusion in the present study, frail and pre-frail institutionalized people (since they have been selected to carry out the frailty tests) stand out as a subgroup with better levels of functionality and independence. However it is a high risk group often neglected as they show higher performance in all activities than those with severe impairments. The prevalence of weakness, low activity and slow gait seem to illustrate an initial diagnose for physical intervention. Overweight and obesity also underline the need for increasing activity level. A significant incidence of cognitive impairment and depressive symptoms and their association with frailty, make action all the more urgent, in order to improve functionality and prevent decline. Frailty indicators may be useful in monitoring interventions.

Conclusions

Assessing frailty in institutionalized older people was challenging and the fact that one third of the original sample was able to participate, shows that diagnosing frailty in this population is relevant. Frail and pre-frail people should be recognized as an intervention group because they are vulnerable and their needs might be underestimated in a setting dominated by highly dependent people.

Study limitations comprised using a convenience sample and a small sub-sample of participants in frailty assessment. Since we found no frailty studies in nursing homes, we were unable to compare results.

Self-report questions raised some difficulties while performance tests were easier to apply and corresponded to the most prevalent frailty criteria. Further investigation may help

to clear the need for adaptation of frailty criteria to more debilitated populations and inclusion of cognitive and mood state.

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