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Feature Article

Biopsychosocial factors associated with the frailty and pre-frailty among older adults

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ABSTRACT

Frailty is a multidimensional geriatric syndrome associated with specific biopsychosocial factors in each population. This was a cross-sectional observational study designed to determine the biopsychosocial factors associated with frailty and pre-frailty in older adults in a community in Salvador, Brazil. The stages of frailty were collected in 413 older adults: 34.9% frail, 54.5% pre-frail, 10.6% robust. In the multinomial regression model, age (p = .018), functionality for instrumental activities of daily living (p = .026), risk for falls (p = .006), family functionality (p = .031) and the physical domain of quality of life (p = .004) had an independent association with frailty. Risk for falls (p = .004), family functionality (p = .004) and the environment domain of quality of life (p = .037) were independently associated with pre-frailty. The findings provide support to interventions in a way that contributes to prevention or reversal of frailty.

Introduction

Frailty is a multidimensional geriatric syndrome characterized by an imbalance of homeostasis and multisystemic declines capable of producing vulnerability in different domains in the life of the older adults and greater risk for institutionalization, falls and hospitalization.[1,2] In 2001, Fried et al. defined a frailty phenotype according to the presence of non-intentional weight loss, exhaustion, muscle weakness, low levels of physical activity and slow gait. The phenotype has three levels of classification, with pre-frailty serving as an intermediate condition between the robust and the frail state.[1] There are transitions between the stages of frailty, signalling the possibility of reversing these conditions.[3,4]

The complexity of frailty involves a range of associated biopsychosocial factors that interrelate and lead to clinical and functional manifestations in older adults.[2] Frailty may be associated with factors such as advanced age, female gender, presence of comorbidities, cognition, functionality, schooling, socioeconomic status, falls, and other conditions.[2,4–7] These factors can be considered causes as well as consequences of the homeostatic imbalance characteristic of frailty.[8,9]

Brazil, like other developing countries, presents rapid and disorderly population ageing with specific environmental, multicultural, economic and social characteristics in each region.[10,11] Frailty has not yet been studied with specific conditions of older adults from a low income and low level of schooling in the city of Salvador. Based on these conditions, it was hypothesized that frail older adults from this community would probably be older, with comorbidities, limited for activities of daily living and worse quality of life. It was expected that evidence from this study would help with the identifications and elaboration of multiprofessional actions for the frail and pre-frail older adults either on health and social contexts.[2,4,12,13] The analytical epidemiology could support these actions and should consider the stages of frailty syndrome and its associated factors, like the biopsychosocial conditions as parameters for the choosing of preventive, rehabilitative and palliative approaches.[4,14] Thus, the objective of this study was to determine the biopsychosocial factors associated with frailty and pre-frailty among the older adults living in a community in Salvador, Brazil.

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Methods

Study design

This was a cross-sectional observational study carried out with urban older adults from the outpatient community of a reference health care centre for the older adults in the city of Salvador, Bahia, Brazil. This study was approved by the Research Ethics Committee of the Obras Sociais Irmã Dulce (CAAE: 55354116.0.0000.0047), and all the 416 individuals approached in this study agreed to participate (no one refused) and signed the consent form. The consent forms for the older adults with cognitive decline were signed by their legal guardians.

The sample was calculated by estimating the prevalence of frailty (8.7%)[7] in a population of 52,072 older adults—total attendance at this clinic in 2015. A confidence level of 95% ($z = 1.96$), statistical power of 90% ($z = 1.28$) and loss of 10%[15] resulted in a total of 369 older adults. Older adults over 60 years were included in the study ($n = 416$), and those residing in long-term institutions for older adults were excluded ($n = 3$).

Data collection

Data were collected from June 2016 to May 2017, and the sample consisted of urban older adults from the city of Salvador. On each day of collection, participants were selected through simple random that was performed according to the daily schedule of the professionals involved in this reference health care centre. All patients on the daily schedule were entered into a single list and randomized in Microsoft Excel 2010. Six physiotherapists who were previously trained to apply the instruments performed the data collection. Initially, a practical demonstration took place with guidelines on the use of the collection tools; then, the physiotherapists' concerns about application were addressed. The following data were collected:

- Sociodemographic and clinical data—information on age, sex, education, marital status, clinical diagnosis and medications in use was obtained from the patient's electronic medical record. The presence of two or more diseases was considered comorbidity. The patient or his companion (caregiver or relative) was asked about the occurrence of falls in the last three months.
- State of frailty—operationalized according to the five components of the phenotype identified by Fried et al.[1]
- Weight loss was assessed by body mass index (BMI <22 kg/m^2—low weight).[16,17] BMI was calculated by anthropometric measures (weight and height) or estimated by the formula developed by Chumlea et al. when the patient was unable to perform orthostatism.[18]
- Exhaustion was reported by the older adults through two questions from the Center for Epidemiological Studies Depression Scale (CES-D): "How often, in the last week, did you feel that you had to make a great effort to deal with the usual tasks?" and "How often, in the last week, have you not been able to carry out your tasks?".[19,20] The older adult was considered exhausted when he or she reported "moderate amount of time" (3–4 days) or "most of the time" (5–7 days) on any of the issues.[1]
- Low level of physical activity was evaluated by the short version of the International Physical Activity Questionnaire (IPAQ), and values below 600 METS-minutes / week represented a low level of activity.[21–24]
- Muscle weakness was assessed by the Saehan dynamometer[25] according to the American Society of Hand Therapists (ASHT) measurement recommendations.[26] Three measurements were performed on the dominant hand, and the highest value was recorded. The cut-off points for muscle weakness were defined by Fried et al.[1] The Saehan dynamometer generates results equivalent to those obtained with the Jamar dynamometer.[25]
- Slowed walking was measured by the time required to travel 4.6 m at a usual speed. The test was performed for a distance of 8.6 m, eliminating the time to acceleration and deceleration of the march, corresponding to the two initial metres and two final metres.[27,28] The cut-off points defined by Fried et al. were used.[1]

The presence of one or two components characterized the older adult as pre-frail and the presence of three or more components as frail.[1] Older adults with physical, cognitive or communication limitations that impeded the performance of the test were automatically scored for the assessed component.

- Cognitive status—evaluated by the Mini-Mental State Examination (MMSE)[29,30] with cut-off points adjusted according to the educational level of the older adult: ≤ 13 points—illiterate; ≤ 18 points—1 to 7 years of schooling; ≤ 26 points—more than 8 years of schooling.[31]
- Depressive symptoms—the Geriatric Depression Scale (GDS-15) was used to screen for depression. Scores between 0 and 5 indicated no signs of depression, between 6 and 10 indicated signs of mild depression, and between 11 and 15 indicated signs of severe depression.[32,33]
- Functional status—activities of daily living (ADL) were assessed by the Modified Barthel Index[34,35] and instrumental activities of daily living (IADL) by the Instrumental Activities of Daily Living Scale of Lawton and Brody.[36,37]
- Risk for falls—older adults who completed the Timed Up and Go (TUG)[38] test in a time greater than 14 s were considered at risk for falling.[39]
- Fear of falls—Falls Efficacy Scale-International-Brazil (FES-I-Brazil) was used to identify concerns about falling. A score of 16 represents no concern about falls, greater than or equal to 23 represents concern about sporadic falls, and scores greater than 31 indicate concern about recurrent falls.[40,41]
- Family functionality—the Family APGAR instrument was used to investigate the family social support network of the older adult. Scores between 13 and 20 represent good family functionality, between 9 and 12 represent moderate dysfunction, and between 1 and 8 represent high familial dysfunction.[42,43]
- Quality of life—the quality of life questionnaire WHOQOL-BREF[44,45] and the complementary module WHOQOL-OLD were used.[46,47] The scoring methods recommended by the respective questionnaire manuals were used. Each domain was analysed by means of the percentage, and the higher the percentage was, the better the quality of life.

Analysis

The data were analysed in the statistical program R version 3.0.2. The variables were analysed by descriptive statistics for the characterization of the sample, and the associations with the frailty phenotype were verified by univariate analysis with the Pearson X^2 test or Fisher's exact test. The relevant associations to the frailty syndrome in the community-dwelling older adults that presented statistical significance of 20% were entered into a multinomial regression model that considered the robust/non-frail as reference category. The multinomial regression model was used due to the nature of the variables - ordinary and multiple categories. The initial multinomial model was composed of the following variables: age, sex, education, depressive symptoms, stroke, obesity, hypothyroidism, functionality for instrumental activities of daily living, risk for falls, fear of falling, family functionality and quality of life. In this model, the variables that presented higher p-values were withdrawn one by one to obtain a final

multinomial model. A significance level of 5% ($p < .05$) and a 95% confidence interval were considered.

Results

A total of 413 older adults participated. The older adults in this community were predominantly female (84.3%), had a low educational level (they were illiterate or had up to 7 years of education (77.7%), used more than five medications (62.5%) and had associated comorbidities (93.1%). In this sample, 34.9% were classified as fragile, 54.5% as pre-frail and 10.6% as robust. Table 1 presents the univariate description and analysis of sociodemographic, clinical, and cognitive factors and depressive symptoms according to frailty phenotype.

Regarding physical functionality, total independence in ADL (55.2%) and partial dependence in IADL (51.1%) were predominant. Most older adults did not report falls in the last three months (81.6%); however, they presented a higher risk for falls (54.2%), although they were not worried about falling (38.7%). Table 2 presents the univariate description and analysis of functional status, falls, risk for falls and fear of falls in these older adults according to frailty phenotype.

The majority of the older adults reported good family functionality (78%) and presented mean percentages of the domains of quality of life above 50%. The description of family functionality and quality of life in the respective univariate analyses according to phenotype are presented in Table 3.

Table 4 shows the final multinomial regression model of biopsychosocial factors associated with age-adjusted pre-frailty and frailty, instrumental activities of daily living, risk for falls, family functionality, and quality of life domains. For frailty, we observed independent associations for age ($p = .018$), functionality for instrumental activities of daily living ($p = .026$), risk for falls ($p = .006$), family functionality ($p = .031$) and the physical domain of quality of life ($p = .004$), whereas for pre-frailty, the risk for falls ($p = .004$), family functionality ($p = .004$) and the environment domain of quality of life ($p = .037$) were the biopsychosocial factors with independent associations.

Discussion

Among the community-dwelling older adults of this study, family functionality, risk for falls and quality of life were the biopsychosocial factors with independent associations with frailty and pre-frailty. Age and functionality for instrumental activities of daily living also presented an independent association with frailty. The identification of these associated biopsychosocial factors allows the development of health and socioenvironmental actions in the different domains that comprise the frailty syndrome.

Family functionality maintained its association with frailty and pre-frailty in the multinomial regression; thus, it is considered a factor with an independent association with these conditions. The family is an essential component of social support,[48] and dysfunctional family arrangements can negatively influence adaptive responses to stress situations.[49] Family relationships are capable of influencing individuals' ability to perform a task, which, in turn, has a positive or negative influence on the actions of the older adults as members of society.[48] Recognition and identification of the dynamics of family functioning among the frail and pre-frail older adults conducting to frailty syndrome is a social phenomenon[14] and makes it possible to carry out social actions aimed at delaying or preventing the progression of these conditions.[50]

The risk for falling was also associated with both frailty and pre-frailty. Just as frailty can result in falls due to increased vulnerability and a low capacity to withstand stress factors, a single fall can lead to the development of the frailty syndrome, with adverse outcomes in

Table 1
Description and univariate analysis of sociodemographic, clinical, and cognitive factors and depressive symptoms according to frailty phenotype in the study population, Salvador, Brazil, 2017.

		Frail		Pre-frail		Robust		Total		
Variable	Category	$n = 144$	%	$n = 225$	%	$n = 44$	%	$N = 413$	%	p
Age, mean (SD)[a]		78.88 (7.74)		74.38 (7.21)		71.5 (6.61)		75.65 (7.75)		**<0.001**
Sex										0.241
	Female	126	36.2	188	54	34	9.8	348	84.3	
	Male	18	27.7	37	56.9	10	15.4	65	15.7	
Education										**0.005**
	Illiterate	30	44.1	36	52.9	2	2.9	68	16.5	
	1 to 7 years	95	37.5	129	51	29	11.5	253	61.2	
	> 8 years	19	20.7	60	65.2	13	14.1	92	22.3	
Marital status										0.779
	Not married	30	30.9	56	57.7	11	11.3	97	23.5	
	Married	36	32.4	60	54.1	15	13.5	111	26.8	
	Widower	71	38.6	97	52.7	16	8.7	184	44.6	
	Divorced	7	33.3	12	57.1	2	9.5	21	5.1	
More than 5 medicines										0.097
	Yes	100	38.8	133	51.6	25	9.7	258	62.5	
	No	44	28.4	92	59.4	19	12.3	155	37.5	
Comorbidity										0.639
	Yes	136	35.2	208	53.9	42	10.9	386	93.5	
	No	8	29.6	17	63	2	7.4	27	6.5	
Cognitive deficit										**<0.001**
	Yes	55	51	49	21.8	5	4.6	109	26.4	
	No	89	29.2	176	78.2	39	12.8	304	73.6	
Depressive symptoms[b]										**0.022**
	No depression	47	24	121	61.7	28	14.3	196	64.3	
	Mild depression	33	35.1	50	53.2	11	11.7	94	30.8	
	Severe depression	9	60	6	40	–	–	15	4.9	

Source: Research data.
[a] Mean and standard deviation.
[b] Considered only the older adults with preserved cognition - $N = 304$.

Table 2
Description and univariate analysis of functional status, falls, risk for falls and fear of falls according to frailty phenotype in the study population, Salvador, Brazil, 2017.

		Frail		Pre-frail		Robust		Total		
Variable	Category	*n* = 144	%	*n* = 225	%	*n* = 44	%	*N* = 413	%	*p*
ADL[a]										<**0.001**
	Total dependence	2	100	–	–	–	–	2	0.5	
	Severe dependence	12	100	–	–	–	–	12	2.9	
	Moderate dependence	22	78.6	6	21.4	–	–	28	6.8	
	Slight dependence	60	42	73	51	10	7	143	34.6	
	Total independence	48	21.1	146	64	34	14.9	228	55.2	
IADL[b]										<**0.001**
	Total dependency	62	82.7	12	16	1	1.3	75	18.2	
	Partial dependency	61	28.9	132	62.6	18	8.5	211	51.1	
	Independent	21	16.5	81	63.8	25	19.7	127	30.7	
Falls										0.294
	Yes	31	40.8	40	52.6	5	6.6	76	18.4	
	No	113	33.5	185	54.9	39	11.6	337	81.6	
Risk for falls										<**0.001**
	Yes	111	49.6	109	48.7	4	1.8	224	54.2	
	No	33	17.5	116	61.4	40	21.2	189	45.8	
Fear of falls[c]										<**0.001**
	No worries	21	17.8	73	61.9	24	20.3	118	38.7	
	Fear of sporadic falls	29	32.2	50	55.6	11	12.2	90	29.5	
	Fear of recurring falls	39	40.2	54	55.7	4	4.1	97	31.8	

Source: Research data.
[a] ADL = activities of daily living.
[b] IADL = instrumental activities of daily living.
[c] Considered only the older adults with preserved cognition - *N* = 304.

terms of functional dependence, hospitalization, and death.[1,51–53] The identification of the risk for falls and the multiple associated biopsychosocial and environmental factors should therefore be a prioritized strategy in primary care for community-dwelling older adults, in planning preventive and corrective actions, and in reducing the risk for falling.[54]

Quality of life was independently associated with frailty and pre-frailty, and this result confirms the influence of the older adults's perception of their life on the occurrence of frailty and pre-frailty.[55,56] Other components of frailty (psychological, social and environmental) also directly influence the older adults's self-perception.[56] Negative self-assessments of health are predictive of less involvement in self-care and less adherence to drug and rehabilitation treatments.[57]

Age and functionality for instrumental activities of daily living were factors that only presented independent associations with frailty, which confirms the involvement of aging in the development of the frailty syndrome.[1,4,12] The progressive increase in age is accompanied by functional decline and the frail older adults become more dependent due to reduced ability to deal with external stressors and to react to life events due to the loss of physiological reserve.[58,59]

The results of this study suggest that the assessment of frailty and pre-frailty should be incorporated into the multiprofessional strategies of basic health care. These conditions of the community-dwelling older adults need to be investigated from the multidimensional perspective to verify the interrelationships between the biopsychosocial and environmental factors involved. It is recommended the creation and implementation of Brazilian public policies for the older adults considering their biopsychosocial and environmental conditions. Therefore, the gerontological care in primary care may be able to avoid the multiple declines due to frailty.[14]

The authors used different measures defined by Fried et al. for assessment of weight loss and low levels of physical activity.[1] BMI

Table 3
Description and univariate analysis of family functionality and quality of life according to frailty phenotype in the study population, Salvador, Brazil, 2017.

		Frail		Pre-frail		Robust		Total		
Variable	Category	*n* = 144	%	*n* = 225	%	*n* = 44	%	*N* = 413	%	*p*
Family Functionality [a]										<**0.001**
	High family dysfunction	13	40.6	19	59.4	–	–	32	10.5	
	Moderate family dysfunction	4	11.4	30	85.7	1	2.9	35	11.5	
	Good family functionality	72	30.3	128	53.8	38	16	238	78	
Quality of life – WHOQOL-BREF[a, b]										
	Physical domain	51.16 (17.61)		63.15 (14.21)		70.87 (12.81)		60.64 (16.45)		<**0.001**
	Psychological domain	62.21 (17.58)		66.97 (14.28)		62.21 (17.58)		66.01 (15.42)		**0.01**
	Social relationships	65.73 (14.99)		70.33 (13.95)		73.29 (12.85)		69.37 (14.31)		**0.008**
	Environment	53.58 (13.56)		56.97 (13.19)		64.02 (14.4)		56.88 (13.77)		<**0.001**
Quality of life – WHOQOL-OLD[a, b]										
	Sensory functioning	61.65 (22.1)		72.74(19.44)		81.25 (17.2)		70.59 (20.92)		<**0.001**
	Autonomy	58.42 (17.06)		61.15 (17.72)		64.58 (16.55)		60.79 (17,43)		0.169
	Past, present and future activities	61.65 (18.22)		66.84 (15.94)		70.51 (14.82)		65.79 (16.71)		**0.009**
	Social participation	57.23 (17.87)		69.52 (14.8)		73.23 (14.96)		66.41 (16.84)		<**0.001**
	Death and dying	61.16 (26.92)		69.91 (23.99)		72.59 (20.3)		67.7 (24.76)		**0.01**
	Intimacy	50.07 (30.53)		52.01 (29.67)		54.16 (28.36)		51.72 (29.69)		0.758

Source: Research data.
[a] Considered only the older adults with preserved cognition - *N* = 304.
[b] Mean and standard deviation.

Table 4
Final model of multinomial regression of biopsychosocial factors associated with pre-frailty and frailty, Salvador, Brazil, 2017.

	Variable	Category	Odds Ratio (CI 95%)	*p*
Pre-frail				
	Age		1.05 (0.98–1.12)	0.164
	Sex	Female	1	0.245
		Male	0.55 (0.2–1.51)	
	Education	>8 years	1	
		1 to 7 years	2.83 (0.7–11.36)	0.143
		Illiterate	2.75 (0.33–22.69)	0.349
	IADL	Independent	1	0.398
		Dependent	1.43 (0.63–3.26)	
	Risk for falls	Absent	1	**0.004**
		Present	5.47 (1.72–17.46)	
	Family functionality	Good functionality	1	**0.004**
		Family dysfunction	23.38 (2.71–202.02)	
	QoL - physical domain		0.99 (0.95–1.03)	0.582
	QoL - psychological domain		1.02 (0.99–1.06)	0.221
	QoL - social relations		1.02 (0.98–1.06)	0.419
	QoL - environment		0.95 (0.91–1)	**0.037**
Frail				
	Age		1.09 (1.02–1.17)	**0.018**
	Sex	Female	1	0.149
		Male	0.41 (0.12–1.38)	
	Education	>8 years	1	
		1 to 7 years	1.25 (0.43–3.65)	0.687
		Illiterate	2.74 (0.43–17.40)	0.285
	IADL	Independent	1	**0.026**
		Dependent	3.14 (1.15–8.56)	
	Risk for falls	Absent	1	**0.006**
		Present	5.67 (1.63–19.71)	
	Family functionality	Good functionality	1	**0.031**
		Family dysfunction	12.14 (1.26–116.75)	
	QoL - physical domain		0.94 (0.9–0.98)	**0.004**
	QoL - psychological domain		1.02 (0.98–1.06)	0.372
	QoL - social relations		1 (0.96–1.05)	0.905
	QoL - environment		0.97 (0.92–1.02)	0.174

Source: Research data.
Note: Reference category: robust. IADL = instrumental activities of daily living. QoL = quality of life. CI = confidence interval.

$< 22\ kg / m^2$ (low weight) was considered a cut-off because its value was related to higher adverse health outcomes in the older adults of the community.[17] The IPAQ was used to assess the level of physical activity because it is more adequate and easily applied instrument for the Brazilian population than is the Minnesota Questionnaire.[10]

The strength of this study is in the multinomial regression model that allowed a more accurate analysis, and factors such as education, depressive symptoms, stroke, obesity, hypothyroidism and fear of falls lost their significance. The loss of statistical significance of these biopsychosocial factors confirms their interdependence and reaffirms the involvement of multiple systems in the frailty syndrome.[2]

The study presents limitations due to the lack of investigation of other biopsychosocial factors, such as the older adults's race and income, that could contribute to the development of frailty and pre-frailty. In addition, the social network of the older adults was not fully explored, as the number of family members was not recorded to better understand the association of family functionality with these conditions. It is also important to enhance that the sample investigated in this study is of a reference centre not being a representative sample of the city of Salvador, Brazil.

The design of this study showed only associations and it did not allow the establishment of a causal relation between factors. Despite this, this study presents another strengthening point which provides support for the planning of interventions aimed at the care of frail and pre-frail older adults contributing to prevention or reversal of frailty. Therefore, longitudinal studies should be performed to better understand these factors in the process of the development of frailty and pre-frailty.

Conclusions

Risk for falls, family functionality and quality of life were the biopsychosocial factors with independent associations with frailty and pre-frailty. Age and functionality for instrumental activities of daily living also presented independent associations with frailty. Understanding this phenomena may allow a better care of the frail and pre-frail older adults since actions, which promote the reduction of the risk for falls, cognitive stimulation, participation of the older adults in instrumental activities of daily living and others social activities, including the family support, should arise. Through these socioenvironmental and health interventions, the prevention or reversal of these conditions is expected.

Declaration of Competing Interest

The authors declares no conflicts of interest.

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