



A comparison between physical and biopsychosocial measures of frailty: Prevalence and associated factors in Brazilian older adults



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ABSTRACT

Purpose: To estimate the prevalence of frailty, according to Tilburg Frailty Indicator (TFI) and CHS index, to investigate the correlation between both instruments and to identify the factors associated with this condition in older users of primary health care.

Methods: This is a sectional study with 302 individuals aged 60 years or more of Rio de Janeiro/Brazil. Sociodemographic, health, functional dependence and lifestyle variables were collected. Frailty was evaluated by the TFI (biopsychosocial frailty) and the CHS index (physical frailty).

Results: The prevalence of frailty estimated by the TFI was 35.8% and by the CHS index was 23.5%, while 19.2% were considered frail by both instruments. Significant correlations were observed between the two measures ($r = 0.675$, $p < 0.001$) and between the CHS index and the physical ($r = 0.744$, $p < 0.001$) and psychological domains ($r = 0.322$, $p < 0.001$) of the TFI. Considering the TFI, sex, age, healthy lifestyle, osteoarticular diseases, stroke/ischemia and functional dependence in IADL were associated with frailty. By the CHS index, marital status, satisfaction with housing environment, osteoarticular diseases, medication, functional dependence in ADL and IADL were associated with frailty.

Conclusion: Our study demonstrates that the CHS index and the TFI identify different groups of frail older adults, and the factors associated with physical frailty and biopsychosocial frailty, also differ. Both instruments seem suitable to be used by primary health care professionals in Brazil. Nevertheless, we believe that a fully self-rated assessment is more practical to be applied routinely in this level of attention in the country.

1. Introduction

Frailty is an important issue in the discussions about aging due to its impact on the health of older adults, since it is recognized as a predictor of health adverse outcomes such as falls, hospitalization, increased use of health services, functional dependency and death (Fried et al., 2001; Gobbens & van Assen, 2012; Gobbens, van Assen, Luijkx, & Schols, 2012; Santiago et al., 2018). In recent years, experts have been striving to reach consensus on the best operational definition of this condition and thus identify the appropriate way to diagnose it.

In 2013, the “Frailty Operative Definition- Consensus Conference

Project” was held, with the participation of selected experts in different fields of knowledge (geriatricians, non-geriatrician physicians, other health professionals, basic scientists, social and non-governmental workers) and localities (Europe, Canada, USA and Mexico). Although the conference failed to define an operationalization of frailty that was satisfactory for all participating experts, there was consensus on the need to consider the clinical contexts and to establish a clear conceptual framework. In addition, there was still great agreement on some aspects related to the condition: considered a clinical syndrome; different from disability; raises vulnerability to stressors; can be reversed or attenuated when performing interventions; early diagnosis essential and;

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useful in primary health care (Rodríguez-Mañás et al., 2013).

Currently, two distinct conceptual approaches are considered for the evaluation of frailty: the unidimensional or physical frailty; and the multidimensional or biopsychosocial, which also aggregates psychological and social, besides physical characteristics. From these approaches, numerous assessment instruments have emerged. According to Morley et al. (2013), some instruments are well validated, having been tested in cohorts of different locations, as to their validity of content, construct and criterion. Among the instruments that meet the validation criteria, we have the Cardiovascular Health Study index (CHS index), created by Fried et al. (2001) with a physical approach, and the Tilburg Frailty Indicator (TFI), created by Gobbens, Luijckx, Wijnen-Sponselee, and Schols, (2010) which evaluates the physical, psychological and social domains (Morley et al., 2013).

It is recognized that the prevalence of frailty is distinct when considering the two types of conceptualization. There are studies that compare physical and biopsychosocial concepts and their differences, as well as the applicability of the instruments based on the two approaches, on populations of older people around the world (Blodgett, Theou, Kirkland, Andreou, & Rockwood, 2015; Coelho, Santos, Paúl, Gobbens, & Fernandes, 2015; Harmand et al., 2017; Hoogendijk et al., 2013; Jung et al., 2014; Li et al., 2015; Rockwood, Andrew, & Mitnitski, 2007; Roppolo, Mulasso, Gobbens, Mosso, & Rabaglietti, 2015; Theou, Brothers, Mitnitski, & Rockwood, 2013). Few of these publications specifically compared the CHS index and the TFI, none of them in the context of a country with characteristics like those of Brazil.

Using secondary data from the Survey of Health, Aging, and Retirement in Europe (SHARE), which includes individuals aged 50 years and over (mean age = 65.3 years SD = 10.5), from eleven European countries, a study was conducted to compare eight scales of frailty and their content validity, feasibility, prevalence, and ability to predict all-cause mortality. In this study, versions of the CHS index (CHS score ≥ 3 points) and the TFI (TFI score ≥ 5 points) were included to assess frailty, observing prevalence equal to 11.3% and 29.2% of frail people, respectively. Agreement between these scales, examined using the Cohen kappa statistic, was 0.37 (Theou et al., 2013). In the study of Roppolo et al. (2015), which compared the frequency of frailty and analyzed the differences in the functional status of 267 community-dwelling older Italian (mean age 73.4 years, SD = 6.0 years), the researchers identified a prevalence of frail people of 12.7% by CHS index (score ≥ 3 points), and 44.6% by TFI (score ≥ 5 points) (Roppolo et al., 2015). In the study performed to validate the Portuguese version of the TFI, the authors compared their version of the TFI with the CHS index and the Groningen Frailty Indicator (GFI) to examine the criterion validity of the instrument, in a sample of 252 Portuguese community-dwelling 65 years and over. The prevalence of frailty evaluated with the CHS index was 36.5%, equal to 48.4% for the GFI (score ≥ 5 points) and 54.8% for the TFI (score ≥ 6 points) (Coelho et al., 2015). In the French study with 1278 participants of the Three-City study, a prospective population-based study, to compare the predictive value of three different frailty instruments (CHS index, Rockwood's Frailty Index and TFI) for adverse outcomes, the researchers observed a prevalence of frailty of 46.5% (N = 594) by CHS index (including scores ≥ 3 points = frail and ≥ 2 points = pre-frail), and 23.7% (N = 303) by TFI (score ≥ 5 points) (Harmand et al., 2017).

To the best of our knowledge, there is no study using community-dwelling Brazilian older adults for comparing two different frailty instruments, based on two quite different approaches of frailty (biopsychosocial, physical). This study aims to estimate the prevalence of frailty, according to the instruments TFI and CHS index, to investigate the correlation between both instruments, and to identify the factors associated with this condition in older Brazilians users of primary health care.

2. Methods

2.1. Study population and data collection

This cross-sectional study is a subproject of the study "Diagnosis of frailty in the elderly in primary health care: comparison between two proposals". The Research Ethics Committee of the National School of Public Health/Oswaldo Cruz Foundation approved the study (authorization number 46244815.5.0000.5240/2015).

Individuals aged 60 years or more, enrolled in the Family Health Program of two Family Clinics of Rio de Janeiro/ Brazil were eligible for the study (about 3129 old people registered). Research assistants, duly trained to standardize the procedures, carried out 302 interviews in the households of participants. Considering the logistical difficulties (such as outdated addresses, locations that are unsafe to visit) to access the elderly and the short time and low funding resource, a convenience sample was made. All the participants signed the informed consent form.

2.2. Measures

The background characteristics of the participants included socio-demographic variables, self-reported health, lifestyle, housing environment, and life events.

Sociodemographic variables of interest were: age, sex, education, marital status, household situation, and family income (see Table 1 for the answering categories). Self-reported health was assessed with the question "How do you evaluate your health?" Self-reported lifestyle was assessed by asking "Overall, how healthy would you say your lifestyle is?". In addition, we examined the following self-reported lifestyle factors; smoking, by asking "Do you have a habit of smoking?"; alcohol consumption, by asking "Do you drink alcohol regularly?"; and physical activity, by asking "In the last 12 months, have you been doing physical activity regularly?". Housing environment was examined with the question "Are you satisfied with your home living environment?".

Chronic diseases of interest were arterial hypertension, diabetes mellitus, high cholesterol or triglycerides, osteoarticular diseases (arthritis, rheumatism or arthrosis), heart disease (angina or infarction), stroke or ischemia, respiratory diseases (asthma, bronchitis or emphysema), and cancer (except skin). Data on chronic diseases was self-reported.

Two instruments evaluated functional dependence. For measuring functional dependence in Activities of Daily Living (ADL) and in Instrumental Activities of Daily Living (IADL) we used the Katz scale (Katz, Downs, Cash, & Grotz, 1970) and the Lawton scale (Lawton, Moss, Fulcomer, & Kleban, 1982), respectively. Both scales are validated for the Brazilian population (Lino, Pereira, Camacho, Ribeiro Filho, & Buksman, 2008; Santos & Virtuoso Júnior, 2008). For each scale, we considered the individuals who reported inability or need for help to perform one or more of these activities as functional dependents.

Table 1

Correlations between unidimensional (CHS index) and multidimensional (TFI) frailty measures.

	TFI Physical	TFI Psychological	TFI Social	TFI
CHS index	0.744 ^{***}	0.322 ^{***}	0.059	0.675 ^{***}
TFI Physical		0.345 ^{***}	0.149 ^{**}	0.888 ^{***}
TFI Psychological			0.232 ^{***}	0.677 ^{***}
TFI Social				0.428 ^{***}

CHS index = Cardiovascular Health Study index; TFI = Tilburg Frailty Indicator.

** p < 0.01.

*** p < 0.001.

2.2.1. Frailty

Frailty was assessed with the Brazilian version of the Tilburg Frailty Indicator (TFI) (Santiago, Luz, Mattos, Gobbens, & van Assen, 2013; Santiago, Luz, Mattos, & Gobbens, 2012) and the Cardiovascular Health Study index (CHS index) (Fried et al., 2001).

The TFI consists of fifteen self-referred questions, distributed in the physical (eight), psychological (four) and social (three) domains. Eleven of the questions that make up the TFI are answered with yes or no and the other questions are answered with yes, sometimes or no; its result is a score ranging from zero to 15 points. Higher scores mean a higher level of frailty or, alternatively, scores ≥ 5 points indicate the presence of the condition (Gobbens, Luijckx et al., 2010). Previous research suggests that the TFI is a valid and reliable instrument for measuring of frailty (2012, 2018, Gobbens, van Assen, Luijckx, Wijnen-Sponselee, & Schols, 2010; Santiago et al., 2013; Sutton et al., 2016). In the present study the reliability (Cronbach's alpha) of the TFI was 0.74.

The CHS index consists of five measures of physical frailty. In the present study, the variables Shrinking (self-reported unintentional loss of 4.5 kg in the last year), Weakness (evaluated by grip strength test, adjusted for gender, with cut-off points determined by the percentile 20 of the distribution, using the electronic hand dynamometer E-Clear, model EH101) and Poor endurance and energy (self-reported exhaustion, identified by two questions from the Center for Epidemiologic Studies Depression Scale (CES-D scale), "moderate time" or "most of the time" response to "I felt that everything I did was effortless" or "I could not continue") were measured as proposed by Fried et al. (2001). Due to operational issues, the adaptations of the *Salud, Bienestar y Envejecimiento* (SABE) group, which included Brazilian elderly in their study, were chosen for the evaluation of the variables Slowness (considered self-reported difficulties in walking 100 m and/or climbing a set of stairs) and Low physical activity level (negative answer to the question "Have you exercised regularly or participated in vigorous physical activities such as sports, dance or heavy housework three or more times a week in the past 12 months?") (Alvarado, Zunzunegui, Béland, & Bamvita, 2008). Older adults with a score of 3 or more points were considered frail. The CHS index is considered a valid instrument in its ability to predict adverse health outcomes, being widely tested (Chang & Lin, 2015; Ensrud et al., 2009; Fried et al., 2001; Theou et al., 2013). In this study, the internal consistence (Cronbach's alpha) was used to test the reliability. The coefficient for the CHS index was 0.45.

2.3. Data analysis

First, descriptive analysis of the distribution of the variables was conducted using measures of central tendency and dispersion for continuous variables, and frequency distributions for categorical variables.

Correlations between the CHS index and the TFI total and its domains (physical, psychological and social) were investigated with Pearson's correlation coefficient, considering a significance level ≤ 0.05 .

For each instrument, using the categorical criterion of classification of frailty, prevalence ratios (PR) were calculated to assess associations between frailty and the independent variables (background characteristics, adverse health outcomes). Multivariate analysis was performed using Poisson regression, to a ≤ 0.05 level of statistical significance. All variables that presented statistical significance in the bivariate analysis were tested in the multivariate model, and those that remained with significance were maintained.

Statistical analyses were performed using the statistical software STATA, version 10.0 (StataCorp LP).

3. Results

The mean age of the participants was 70.4 years (median 68.0, SD = 7.6), most females (65.9%), with low schooling (72.8%), and approximately 50.0% were married or living with a partner.

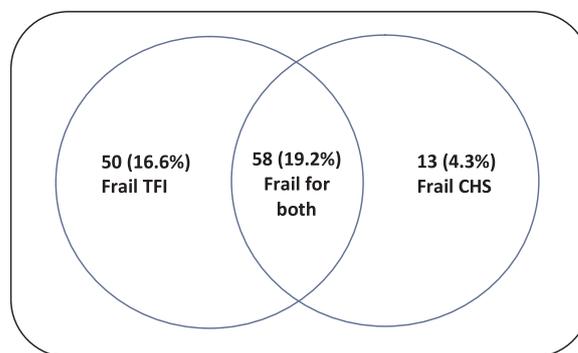


Diagram 1. Diagnosis of frailty*, according to the TFI and the CHS index.

* Older people with a TFI score ≥ 5 and CHS score ≥ 3 were considered frail.

The mean score of the study population by the CHS index was 1.7 points (median 1.0, SD = 1.1) and by the TFI was 3.9 points (median 3.0, SD = 2.0). Considering the domains of the TFI, the mean score of the TFI physical was 1.8 points (median 1.0, SD = 2.0), of the TFI psychological was 0.9 points (median 1.0, SD = 0.7) and of the TFI social was 1.2 points (median 1.0, SD = 1.0). Most individuals (N = 181) were not classified as frail by either instrument, when we considered the scores ≥ 5 points for the TFI and ≥ 3 points for the CHS index. Using this criterion, the prevalence of frailty estimated by the TFI was 35.8% (N = 108) and by the CHS was equal to 23.5% (N = 71), while 19.2% (N = 58) were considered frail by both instruments (Diagram 1).

In Table 1, we can observe the significant correlations between the two frailty instruments ($r = 0.675$, $p < 0.001$) and between the CHS index and the physical ($r = 0.744$, $p < 0.001$) and psychological domains ($r = 0.322$, $p < 0.001$) of the TFI. There was no significant correlation between the CHS index and social frailty.

Table 2 shows the distribution of the variables by frailty condition, according to the TFI classification. In the bivariate analysis (column 4), it is possible to observe numerous factors associated to frailty. These factors were sex, age group, marital status, healthy lifestyle, satisfaction of housing environment, self-rated health, and all self-reported chronic diseases(except cancer), medication use, and functional dependence in ADL and IADL. However, in the multivariate model (column 5), only the variables sex (PR = 1.45 CI 95% 1.02–2.04), age group (PR = 1.19 CI 95% 1.02–1.40), healthy lifestyle (PR = 2.01 CI 95% 1.55–2.61), osteoarticular diseases (arthritis, rheumatism or arthrosis) (PR = 1.84 CI 95% 1.35–2.51), stroke or ischemia (PR = 1.72 CI 95% 1.15–2.59) and functional dependence in IADL (PR = 2.00 CI 95% 1.39–2.91) maintained the statistical significance in the model.

Table 3 presents the distribution of the variables by frailty condition, according to the CHS index. Only the variables smoking, consumption of alcoholic beverage, high cholesterol or triglycerides, stroke or ischemia and cancer were not associated with frailty in bivariate analysis (column 4). In the multivariate analysis (column 5), only the variables marital status (PR = 1.76 CI 95% 1.23–2.52), satisfaction with housing environment (PR = 2.29 CI 95% 1.60–3.27), osteoarticular diseases (arthritis, rheumatism or arthrosis) (PR = 1.86 CI 95% 1.30–2.67), medication use (PR = 3.01 CI 95% 1.04–8.71), functional dependence in ADL (PR = 2.24 CI 95% 1.66–3.02) and IADL (PR = 4.79 CI 95% 2.44–9.55) maintained a significant statistical association with frailty.

4. Discussion

The importance of frailty in older adults has turned this syndrome into one of the main topics on health in aging. While efforts are being made to reach a consensus on the most appropriate way to operationalize frailty and, consequently, to assess this condition, a format

Table 2
Sociodemographic, lifestyle and health characterization of the study population, due to the frailty condition assessed by the TFI (N = 302).

Variables	Not frail N ⁺ (%)	Frail N ⁺ (%)	PR crude (CI 95%)	PR adjusted** (CI 95%)
Sex	78 (40.2)	25 (23.1)	1	1
Male	116 (59.8)	83 (76.9)	1.72 (1.17-2.51)	1.45 (1.02-2.04)
Female				
Age group	120 (61.9)	42 (38.9)	1	1
60-69 years	54 (27.8)	39 (36.1)	1.62 (1.14-2.30)	1.19 (1.02-1.40)
70-79 years	20 (10.3)	27 (25.0)	2.21 (1.55-3.17)	
80 years or more				
Education	60 (30.9)	22 (20.6)	1	
> five years at school	134 (69.1)	85 (79.4)	1.44 (0.97-2.15)	
≤ five years at school				
Marital status	106 (54.3)	46 (42.6)	1	
Married/cohabiting	88 (45.4)	62 (57.4)	1.36 (1.00-1.86)	
Single/divorced/widowed	106 (54.9)	55 (50.9)	1	
Smoking	87 (45.1)	53 (49.1)	1.11 (0.82-1.50)	
Never smoked				
Smoker in the past/current smoker				
Consumption of alcoholic beverage	97 (50.0)	50 (46.3)	1	
Never had the habit	97 (50.0)	58 (53.7)	1.10 (0.81-1.49)	
Habit in the past/ current habit				
Regular physical activity	42 (21.6)	19 (17.6)	1	
Yes	152 (78.4)	89 (82.4)	1.18 (0.79-1.78)	
No				
Healthy lifestyle	187 (96.4)	66 (61.1)	1	1
Yes	7 (3.6)	42 (38.9)	3.28 (2.59-4.16)	2.01 (1.55-2.61)
No				
Satisfaction of housing environment	179 (92.3)	79 (73.1)	1	
Yes	15 (7.7)	29 (26.9)	2.15 (1.62-2.85)	
No				
Self-rated health	193 (99.5)	88 (82.2)	1	
Very good/good/regular	1 (0.5)	19 (17.8)	3.03 (2.48-3.71)	
Poor/very poor				
Arterial hypertension	71 (36.6)	26 (24.1)	1	
No	123 (63.4)	82 (75.9)	1.49 (1.03-2.16)	
Yes				
Diabetes Mellitus	147 (75.8)	69 (63.9)	1	
No	47 (24.2)	39 (36.1)	1.42 (1.05-1.92)	
Yes				
High Cholesterol or Triglycerides	170 (87.6)	78 (72.2)	1	
No	24 (12.4)	30 (27.8)	1.77 (1.30-2.39)	
Yes				
Arthritis, rheumatism or arthrosis	152 (78.4)	45 (41.7)	1	1
No	42 (21.6)	63 (58.3)	2.62 (1.94-3.55)	1.84 (1.35-2.51)
Yes				
Heart disease (Angina or Infarction)	181 (93.3)	80 (74.1)	1	
No	13 (6.7)	28 (25.9)	2.23 (1.69-2.94)	
Yes				
Stroke or ischemia	185(95.4)	95 (88.0)	1	1
No	9 (4.6)	13 (12.0)	1.74 (1.18-2.56)	1.72 (1.15-2.59)
Yes				
Asthma, bronchitis or emphysema	187 (96.4)	96 (88.9)	1	
No	7 (3.6)	12 (11.1)	1.86 (1.27-2.72)	
Yes				
Cancer (except skin)	188 (96.9)	107 (99.1)	1	
No	6 (3.1)	1 (0.9)	0.39 (0.06-2.44)	
Yes				
Use of medication	54 (27.8)	9 (8.3)	1	
No	140 (72.2)	99 (91.7)	2.90 (1.55-5.41)	
Yes				
Functional dependence in ADL	193 (99.5)	89 (82.4)	1	
No	1 (0.5)	19 (17.6)	3.01 (2.46-3.67)	
Yes				
Functional dependence in IADL	123 (63.4)	27 (25.0)	1	1
No	71 (36.6)	81 (75.0)	2.96 (2.04-4.30)	2.00 (1.39-2.91)
Yes				

* Differences between absolute numbers are due to missing values.

** Only the significant associations are presented.

has not yet been identified that would serve all the experts consulted (Morley et al., 2013; Rodríguez-Mañas et al., 2013). In this study we aimed to compare the prevalence of frailty among Brazilian older adults with two frequently used and validated instruments, the TFI and the CHS index, measuring biopsychosocial and physical frailty,

respectively. In addition, we evaluated the association between the two measures, and determined the associations of background characteristics and frailty considering each measure of frailty.

To attend the first aim, we started presenting information on the prevalence of frailty. In this study, different frequencies of frailty were

Table 3

Sociodemographic, lifestyle and health characterization of the study population, due to the frailty condition assessed by the CHS index (N = 302).

Variables	Not frail N ⁺ (%)	Frail N ⁺ (%)	PR crude (CI 95%)	PR adjusted ^{**} (CI 95%)
Sex	87 (37.7)	16 (22.5)	1	
Male	144 (62.3)	55 (77.5)	1.78 (1.07-2.94)	
Female				
Age group	138 (59.7)	24 (33.8)	1	
60-69 years	67 (29.0)	26 (36.6)	1.89 (1.15-3.09)	
70-79 years	26 (11.3)	21 (29.6)	3.01 (1.85-4.91)	
80 years or more				
Education	71 (30.9)	11 (15.5)	1	
> five years at school	159 (69.1)	60 (84.5)	2.04 (1.13-3.69)	
≤ five years at school				
Marital status	127 (55.0)	25 (35.2)	1	1
Married/cohabiting Single/divorced/widowed	104 (45.0)	46 (64.8)	1.86 (1.21-2.87)	1.76 (1.23-2.52)
Smoking	126 (54.8)	35 (49.3)	1	
Never smoked	104 (45.2)	36 (50.7)	1.18 (0.79-1.78)	
Smoker in the past/current smoker				
Consumption of alcoholic beverage	115(49.8)	32 (45.1)	1	
Never had the habit	116 (50.2)	39 (54.9)	1.15 (0.77-1.74)	
Habit in the past/ current habit				
Regular physical activity	54 (23.4)	7 (9.9)	1	
Yes	177 (76.6)	64 (90.1)	2.31 (1.11-4.80)	
No				
Healthy lifestyle	209 (90.5)	44 (62.0)	1	
Yes	22 (9.5)	27 (38.0)	3.17 (2.19-4.50)	
No				
Satisfaction of housing environment	211 (91.3)	47 (66.2)	1	1
Yes	20 (8.7)	24 (33.8)	2.99 (2.06-4.35)	2.29 (1.60-3.27)
No				
Self-rated health	224 (97.4)	57 (80.3)	1	
Very good/good/regular	6 (2.6)	14 (19.7)	3.45 (2.38-4.99)	
Poor/very poor				
Arterial hypertension	82 (35.5)	15 (21.1)	1	
No	149 (64.5)	56 (78.9)	1.76 (1.05-2.96)	
Yes				
Diabetes Mellitus	174 (75.3)	42 (59.2)	1	
No	57 (24.7)	29 (40.8)	1.73 (1.16-2.59)	
Yes				
High Cholesterol or Triglycerides	194 (84.0)	54 (76.1)	1	
No	37 (16.0)	17 (23.9)	1.44 (0.91-2.29)	
Yes				
Arthritis, rheumatism or arthrosis	170 (73.6)	27 (38.0)	1	1
No	61 (26.4)	44 (62.0)	3.06 (2.01-4.64)	1.86 (1.30-2.67)
Yes				
Heart disease (Angina or Infarction)	211 (91.3)	50 (70.4)	1	
No	20 (8.7)	21 (29.6)	2.67 (1.81-3.95)	
Yes				
Stroke or ischemia	217 (93.9)	62 (87.3)	1	
No	14 (6.1)	9 (12.7)	1.61 (0.89-2.53)	
Yes				
Asthma, bronchitis or emphysema	221 (95.7)	62 (87.3)	1	
No	10 (4.3)	9 (12.7)	2.16 (1.28-3.65)	
Yes				
Cancer (except skin)	226 (97.8)	69 (97.2)	1	
No	5 (2.2)	2 (2.8)	1.22 (0.37-4.02)	
Yes				
Use of medication	60 (26.0)	3 (4.2)	1	1
No	171 (74.0)	68 (95.8)	5.97 (1.94-18.39)	3.01 (1.04-8.71)
Yes				
Functional dependence in ADL	230 (99.6)	52 (73.2)	1	1
No	1 (0.4)	19 (26.8)	5.15 (3.95-6.72)	2.24 (1.66-3.02)
Yes				
Functional dependence in IADL	142 (61.5)	8 (11.3)	1	1
No	89 (38.5)	63 (88.7)	7.77 (3.85-15.67)	4.79 (2.44-9.55)
Yes				

* Differences between absolute numbers are due to missing values.

** Only the significant associations are presented.

identified when comparing the estimates by the physical and biopsychosocial instruments. Convergent with previous studies, the prevalence of frailty measured by the biopsychosocial instrument, the TFI, was higher than that measured by the CHS index (35.8% versus 23.5%). In addition, 19.2% of the total frail individuals were classified by both

instruments. Compared with other studies, the prevalence of frailty estimated in this study was higher than that found in the cohort of individuals from eleven European countries Survey of Health, Aging, and Retirement in Europe (SHARE) (TFI = 29.2% e CHS index = 11.3%) (Theou et al., 2013). Differences were also observed compared

with the results of the population of community-dwelling older Italians, whose frequency of frailty was higher using the TFI (44.6%) and practically half when considering the evaluation made by CHS index (12.7%) (Roppolo et al., 2015). In the Portuguese community-dwelling older population the prevalence was higher for both measures CHS index (36.5%) and TFI (54.8%), even though the cut-off point used by the authors to consider an individual like frail was 6 points or more (Coelho et al., 2015). Although the prevalence of frailty measured by the TFI is very similar between the present study and the French study from the Three-City study cohort (23.7%), it was not possible to compare the prevalence estimated by the CHS index because the authors presented data from frail (score ≥ 3 points) and pre-frail (score 1–2 points) older adults together (44.6%), overestimating the frequency of frailty in the population (Harmand et al., 2017).

Beyond the questions related to sociodemographic and cultural variables among populations included in the studies, a possible explanation for the differences in the prevalence of frailty between the studies cited and the present study is due to the different ways of the operationalization of the items that make up the instruments in each study. In the SHARE study, data were collected for other primary objectives, therefore, several adjustments were necessary in the composition of the items of the CHS index and the TFI. In the CHS index only the item weakness was verified in the original form and for the TFI all components were modified (Theou et al., 2013). In the Italian study, just the items weakness, poor energy or endurance were measured in the same way as in the present study, and the TFI was evaluated in its original format (Roppolo et al., 2015). In the French study, to construct the CHS index, the same operationalization of poor energy or endurance was used, as in the present study. However, the components shrinking, weakness, slowness, and physical activity were different. To evaluate the individuals by the TFI, proxies of almost all components were built using available data from Three-City study (Harmand et al., 2017).

When the prevalence of frailty is investigated in countries such as Brazil, a large variation is observed, especially related to the measure used to evaluate this condition. In a recent meta-analysis performed to investigate the prevalence of frailty among community-dwelling older people in countries of Latin American and the Caribbean, a total of 29 studies and 43,083 individuals were included. The prevalence of frailty estimated was 19.6% (95% CI: 15.4–24.3%), with a range of 7.7%–42.6% in the studies reviewed. It is important to clarify that this review included studies using different instruments (CHS index, modified CHS index, Edmonton Frail scale, five physical tests), referring to different definitions of frailty. The highest prevalence was observed when two studies using the Edmonton Frail Scale (EFS) were evaluated together (35.8%, CI: 30.6–41.2). This is not surprisingly, because the EFS was the only instrument using a multidimensional approach of frailty (Da Mata et al., 2016).

In this study, a convenience sample was used, due to the difficulties of access to the older adults of the target population, which were pointed out in the methods. This strategy especially limits the extrapolation of data on the prevalence of frailty, so it is important to carry out population-based studies to a best comparison.

Regarding the second aim of the study, the CHS index and TFI were positively correlated with each other ($r = 0.675$, $p < 0.001$). As expected, the CHS index presented a high correlation with the physical domain of the TFI ($r = 0.744$, $p < 0.001$). However, the CHS index showed a weak correlation with the psychological domain of the TFI ($r = 0.322$, $p < 0.001$) and did not present a correlation with the social domain of this instrument ($r = 0.059$, $p > 0.005$). Similar results can be observed in the study by Roppolo et al. (2015), although the correlation between the two instruments was lower ($r = 0.483$, $p < 0.001$), as well as the correlation between the CHS index and the physical domain of the TFI ($r = 0.419$, $p < 0.001$). Furthermore, the correlation between the CHS index and the psychological domain of the TFI was slightly stronger ($r = 0.369$, $p < 0.001$) and a weak

correlation with the social domain was identified ($r = 0.211$, $p < 0.001$) (Roppolo et al., 2015).

Finally, we investigated the associations between several factors and frailty. In the crude analysis, many similarities were observed in the associations between frailty and covariates. For both instruments (TFI and CHS index), positive associations were identified between frailty and most of the sociodemographic variables (sex, age group, marital status), except for the educational level for frailty measured by the TFI. The variables smoking, and consumption of alcoholic beverage were not associated with frailty assessed with the TFI as well as the CHS index. Regarding variables related to health, self-reported health, use of regular medication, history of chronic diseases (except cancer for TFI and high cholesterol/triglycerides, stroke/ischemia and cancer for CHS index), as well as functional dependence on ADL and IADL, represented a greater risk of frailty for both assessments. However, only history of osteoarticular diseases and functional dependence in IADL remained in both multivariate models, and the other frailty determinants were distinct for the TFI and the CHS index models.

In the evaluation performed by the TFI, the variables that remained associated with frailty in the multivariate model were female, age, unhealthy lifestyle (self-reported), history of osteoarticular disease and stroke or ischemia, and functional dependence on ADL. In other studies, the female is commonly referred to as a risk factor for frailty (Abizanda et al., 2011; Alcalá et al., 2010; Alvarado et al., 2008; Gala, Cooper, & Sayer, 2015; Santos-Eggimann, Cuénoud, Spagnoli, & Junod, 2009; Shamliyan, Talley, Ramakrishnan, & Kane, 2013), which is attributed to the greater longevity of women, associated with a greater number of comorbidities (Collard, Boter, Shoevers, & Voshaar, 2012; Hubbard & Rockwood, 2011). Greater age is also indicated as an important factor associated with frailty (Abizanda et al., 2011; Alcalá et al., 2010; Alvarado et al., 2008; Fried et al., 2001; Gala et al., 2015), because it is related to the reduction of functional reserves and to changes in the social functions of individuals, which increases the risk of adverse health outcomes (Tabue-Teguo et al., 2017). Although there were no associations, individually, between lifestyle habits (smoking, alcohol intake, physical activity) and frailty, having an unhealthy lifestyle (self-reported) was identified as a risk factor (Gobbens, van Assen, Luijkx, Wijnen-Sponselee, & Schols, 2010). This finding may indicate that the concept of lifestyle, that traditionally refers us to the habits mentioned, may not be enough to translate the construct, which also considers emotional and social aspects. In relation to the health problems, osteoarticular diseases can cause important motor problems, which have a direct impact on walking, balance, strength and fatigue in the older people (Hübscher, Vogt, Schmidt, Fink, & Banzer, 2010; Santos et al., 2016; Winter et al., 2010), some of the items that make up the physical part of the TFI and the CHS index, justifying its association with frailty. Problems such as hemiplegia, hemiparesis and aphasia are recognized as sequelae of stroke, directly impacting the performance of physical functions and the social participation of individuals (Aidar et al., 2011; Weimar, Ziegler, König, & Diener, 2002). Therefore, it is understandable that it is related to frailty, in a biopsychosocial approach. Finally, the performance of IADL depends on preserved cognitive and motor functions (Mattos, Carmo, Santiago, & Luz, 2014), and many studies describe the relationship between functional dependence and frailty (Abizanda et al., 2011; Gala et al., 2015; Sousa, Dias, Maciel, & Guerra, 2012).

Regarding the evaluation by the CHS index, individuals with no partner (single/divorced/widowed), no satisfaction with housing environment, with a history of osteoarticular disease and functional dependence in ADL and IADL presented a higher risk of being frail, in a model adjusted by all variables cited above. Studies also indicate that the absence of partners (unmarried, widowed, divorced) may be a risk factor for frailty (Alvarado et al., 2008; Chen, Wu, Chen, & Lue, 2010). Marital status can be considered one of the structural aspects of the social relationships of the individuals (Holt-Lunstad, Smith, & Layton, 2010). The association between dissatisfaction with housing

environment and the CHS index can be explained by the physical limitations of frail individuals and its interaction with environmental barriers to performing activities of daily living. Dissatisfaction with housing environment may also represent social difficulties, which favor the emergence of frailty. Tabue-Teguo et al. (2017) argue that, with the advancement of age, environmental determinants will play an important role in maintaining social connections and dealing with stress situations. However, in our study no association existed between dissatisfaction with housing environment and the TFI, including social frailty. We recommend more studies focusing on this topic. Dependence in ADL is considered the most "advanced" stage of functional disability, occurring later to dependence in IADL and being even more limiting in individuals' lives (Mattos et al., 2014). The osteoarticular diseases and functional dependence in IADL have already been discussed above.

In relation to the quantitative and qualitative differences between older adults considered frail by each instrument, we need to discuss the best method to evaluate frailty in the context of primary health care in Brazil. To implement an evaluation method, it is important to consider its feasibility and acceptability, as well as the instrument's ability to predict the adverse health outcomes related to frailty in this level of health care.

Ambagtsheer et al. (2017) determined the feasibility, acceptability and diagnostic test accuracy of several frailty screening instruments (Reported EFS; Kihon Checklist; Frail Scale, Groningen Frailty Indicator, PRISMA-7, EFS and Gait Speed Test) among community-dwelling older Australians who made an appointment to see their general practitioner. This research group evaluated the tests in three perspectives: feasibility of implementation within the context of a busy general practice environment; acceptability to health service providers; and acceptability to consumers.

Regarding the perspective of feasibility (applicability), both tests require training and standardization of techniques for research assistants. However, the CHS index involves the measurement of grip strength and that requires specific equipment (dynamometer), involving a longer training time for the correct handling and reading of the device. To apply the instruments, we believe that the evaluators must have at least a level of education equivalent to high school. However, a person that has not completed high school but had specific and exhaustive training regarding the instrument use could be able to do so.

The two assessments do not require special physical space and are quick to apply, but the need to provide a dynamometer may make the use of CHS index in primary health care financially impossible, which differs from TFI, which consists only of self-rated questions. The perspective of acceptability to consumers refers to low refusal and minimum non-response for the items of the two instruments. In our study the TFI showed no missing and the CHS index showed only three missing in the measurement of grip strength; these findings may indicate a good acceptance of both instruments concerning the evaluation of frailty by older adults themselves. We used both instruments in the same interview, and since the investigation of acceptability was not one of our initial objectives, questions about the preference of the individuals were not included. In our study, research assistants collected the data, and then it is still necessary to evaluate the acceptability of the health service providers. However, we believe that a fully self-rated evaluation is more practical to be applied in their routine.

We recommend conducting a longitudinal study to compare the performance of the CHS index and the TFI in the prediction of adverse health outcomes related to frailty, such as falls, hospitalizations, loss of functional independence and premature death among older adults' users of primary health care services, to determine the instrument that best identifies individuals at greater risk.

5. Conclusion

In this study we used both physical and biopsychosocial measures of frailty, represented by the CHS index and the TFI, respectively. The

prevalence of frailty was considerably higher in assessing frailty with the TFI than in assessing frailty with the CHS index; the difference was 123%. Based on this finding, we conclude that the measurement instruments identify two different groups of frail older adults. Our study also demonstrated a strong correlation between the CHS index and the TFI (0.675), explained by the significant correlations between the CHS index and the physical and psychological domains of the TFI. Finally, the present study showed that the instrument used (CHS index, TFI) determines which factors are associated with frailty. Both the CHS index and the TFI were associated with six of the 21 factors included in our study; only two of these factors were the same (osteoarticular diseases, functional dependence in IADL). Concerning feasibility and acceptability the CHS index as well as the TFI seem suitable to be used by primary healthcare professionals in Brazil for detecting frail older adults with the aim to reduce their frailty, prevent adverse health outcomes and enhance their quality of life. However, considering the necessity of a special equipment (dynamometer) for the evaluation of one of the items of the CHS index, which would increase the costs and would involve a longer training time for the correct handling and reading of the device, we believe that the TFI would be the a more viable alternative for implementation in the primary health care in Brazil.

Conflict of interest

The authors declare that they have no conflict of interest.

Ethical approval

All procedures performed in our study were in accordance with ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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