Prevalence of Frailty Indicators in Community-dwelling Older Adults From Northeastern Brazil, 2009-2015

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Prevalence of frailty indicators

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ABSTRACT

BACKGROUND: Frailty is a clinical syndrome, and its development is multifactorial and dynamic. The clinical indicators (physical measures and self-report) that characterize the syndrome tend to vary across studies. To determine the contributions of the indicators in the determination of frailty it is important to obtain data about the variations that occur among the levels of frailty. The aim of this study was to a) survey the prevalence of the frailty syndrome and of the indicators that compose the frailty phenotype in community-dwelling older adults, and b) to evaluate the contribution of each indicator in the determination frailty.

METHODS: Prevalence study carried out with 163 older adults who participated in two assessments; the first one was performed in 2009 and after 70 months the second assessment was conducted. Assessment of physical measurements was performed to constitute the frailty phenotype (gait speed and handgrip strength) alongside self-report (fatigue, unintentional weight loss, and physical activity), as proposed by Fried. We used the McNemar’s test and Pearson’s chi-square to analyze the differences between means and Multinomial Logistic Regression values.

RESULTS: There was an increase in the number of pre-frail older adults (from 47.85% to 65.03%) and frail ones (from 7.98% to 9.82%). The frailty indicators increased significantly (+8.6% for walking; +6.8% for fatigue; +6.8% for grip strength; +1.2% for physical activity), except for the “weight loss” item (-3%). The indicators with the highest predictors of frailty in 2009 were fatigue (OR = 31.41; 95%CI 11.66-84.65, p<0.001) and weight loss (OR = 28.74; 95%CI 9.20-89.84, p<0.001). In the second assessment, the items that had the highest chance for developing frailty were slow gait (OR = 23.64; 95%CI 5.38-103.83, p<0.001) and muscle weakness (OR = 79.39; 95%CI 8.58-734.24, p<0.001).

CONCLUSION: There was an increase in frail and pre-frail older adults during the two assessments and an increase in the indicators that mark the syndrome phenotype. The
EXPLANATORY MODELS OF FRAILTY CHANGED IN BOTH ASSESSMENTS. THE EVOLUTION OF FRAILTY SIGNALS THE N ECESSITY FOR INTERVENTIONS TO BE CARRIED OUT WITH OLDER ADULTS TO DELAY THE PROGRESS OF DECLINING FACULTIES THAT THREATEN THEIR HEALTH.

**Keywords:** Frail Older Adults; Older Adults’ Health; Public Health.

**BACKGROUND**

The notion of frailty can be considered new and there is no consensus on its concept in the scientific community; however, the most common understanding is that frail older adults are more vulnerable and that they are at a higher risk of unfavorable morbidities (acute or chronic diseases, falls and injuries, disabilities) and mortality. Although frailty has long been considered a synonym of disability and comorbidity, the development of studies on this issue has contributed to raising important questions within the field of older adults’ health.

Characterized as a clinical syndrome, frailty has been studied for its multifactorial nature, which takes into account a state of physiological vulnerability derived from the reduction of biological reserves. The notions of reserve and sources are central to the concepts of frailty, with the idea of the syndrome phenotype based on the hypothesis of association of clinical manifestations in a cycle being represented by a spiral, where the energy reserve of multiple systems decreases.

This study takes into account the model proposed by Fried et al., responsible for the operationalization of five frailty criteria, which are: unintentional weight loss corresponding to 5% of body weight, fatigue, low grip strength, slow gait, and low rate of weekly caloric expenditure in physical exercises and domestic activities.

The criteria are used to indicate frailty in older adults and comprise the following classifications: non-frail, pre-frail (presence of one or two indicators), and frail (presence of three or more indicators). Even though it is not a “gold standard” for assessing the syndrome,
the exposed model has been widely used in multicentric studies, with its validity and predictive value being discussed in different health outcomes in the older adults’ group\textsuperscript{6,7}.

The in-depth study of the syndrome, capable of allowing the investigation of its indicators, enables early discovery of the pre-frail state; consequently, it facilitates the treatment of older adults in a frank process of aging\textsuperscript{8,9}. However, there are few studies in Brazil that follow the evolution of the syndrome and variations in the indicators that make up the phenotype\textsuperscript{7}, especially in non-institutionalized older adults.

It is considered that studying and monitoring variations in the conditions of frailty and its predictor variables, through prevalence studies and with a longitudinal cut, in addition to identifying factors related to declining faculties and mortality in older adults, make it possible to estimate the relationship between protective factors that contribute to the stability and delay in the progress of the syndrome\textsuperscript{3,10}. Thus, the present study aimed at surveying the prevalence of frailty syndrome and the indicators that compose the frailty phenotype in community-dwelling older adults, as well as to evaluate the contribution of each indicator in determining frailty, after 70 months of the first assessment (2009-2015).

\textbf{METHODS}

This is a prevalence study conducted through two assessments with the same group of older adults. The research was approved by the Research Ethics Committee (REC) of the State University of Paraíba (\textit{Universidade Estadual da Paraíba}), under Opinion 20599513.9.0000.5187. The guidelines established for research with human beings were complied with, in accordance with Resolution 466/2012 of the Brazilian National Health Council (\textit{Conselho Nacional de Saúde}).
Participants

Initially, we intended to perform the assessment of 403 older adults selected by convenience, from the database of the FIBRA Study (Portuguese acronym for Frailty in Brazilian Older Adults), a multicenter study conducted in 2009 which sought to identify conditions of frailty in community-dwelling older adults, aged 65 or over. The State University of Paraíba was part of the study group led by the University of Campinas (UNICAMP, *Universidade de Campinas*).

However, from the total number of participants, it was only possible to collect data from 163 older adults. The number of losses was due to deaths (n = 66), physical and cognitive disabilities (n = 37), addresses that were lost, changes and/or not located (n = 108) and refusals (n = 29). We worked with a paired database, so that only the older adults from the first FIBRA study who also participated in the second moment of assessment remained in the database.

In the first assessment, conducted in 2009, the 163 participants had an average age of 72.64 years (±5.92); in the assessment carried out in 2015, the same 163 participants had an average age equal to 79.36 years (±5.85). Other sociodemographic data of the sample in both years can be observed as shown in Table 1.
Table 1. Description of demographic data in the two assessment periods (2009-2015).

|                          | First Assessment (2009) | Second Assessment (2015) |
|--------------------------|-------------------------|--------------------------|
|                          | Absolute frequency      | Relative frequency       | Absolute frequency      | Relative frequency       |
| Gender                   |                         |                          |                          |                          |
| Male                     | 39                      | 23.9                     | 39                      | 23.9                     |
| Female                   | 124                     | 76.1                     | 124                     | 76.1                     |
| Marital Status           |                         |                          |                          |                          |
| Married or living with a |                         |                          |                          |                          |
| partner                 | 80                      | 49.1                     | 65                      | 39.9                     |
| Single                   | 11                      | 6.7                      | 15                      | 9.2                      |
| Divorced, separated      | 06                      | 3.7                      | 7                       | 4.3                      |
| Widowed                  | 66                      | 40.5                     | 76                      | 46.6                     |
| Currently working        |                         |                          |                          |                          |
| Yes                      | 27                      | 16.6                     | 12                      | 7.4                      |
| No                       | 136                     | 83.4                     | 151                     | 92.6                     |
| Retired                  |                         |                          |                          |                          |
| Yes                      | 125                     | 76.5                     | 129                     | 79.1                     |
| No                       | 38                      | 23.5                     | 34                      | 20.9                     |
| Literate                 |                         |                          |                          |                          |
| Yes                      | 106                     | 65.0                     | 106                     | 65.0                     |
| No                       | 57                      | 35.0                     | 57                      | 35.0                     |
| Living alone             |                         |                          |                          |                          |
| Yes                      | 22                      | 13.5                     | 19                      | 11.7                     |
| No                       | 141                     | 86.5                     | 144                     | 88.3                     |

The following exclusion criteria were considered: a) older adults with severe cognitive impairment; b) older adults in wheelchairs and/or who were temporarily or permanently bedridden; c) bearers of severe sequelae of Encephalic Vascular Accident (EVA); d) patients with Parkinson’s disease in severe or unstable stages; e) bearers of severe hearing or vision deficits; f) terminally ill patients.

Research instruments

Sociodemographic data

We used a structured questionnaire on sociodemographic conditions (gender, age, marital status, housing arrangement- living alone, education, retirement) of older adults.
Measurements of frailty

Frailty was assessed according to the phenotype proposed by Fried et al.\textsuperscript{4}. The presence of three or more of the five criteria characterizes frailty and the fulfillment of one or two of the criteria means pre-frailty.

1) Unintentional weight loss, according to self-report - Consisting of a dichotomous item and a structured response item by the older adults, both self-reported\textsuperscript{4}.

2) Fatigue assessed by self-report - Comprised of items 7 and 20 of Center of Epidemiologic Studies – Depression (CES-D)\textsuperscript{11}, with 4 points each, both self-reported.

3) Handgrip strength - Execution measurement by a portable hydraulic dynamometer, Jamar type, Model J00105, held on the dominant hand. Performed with three attempts.

4) Level of physical activity assessed by self-report - Use of the adapted Minnesota Leisure Activity Questionnaire\textsuperscript{12,13} - 37 items of self-reported, dichotomous and structured response by the older adults.

5) Gait speed - Execution measurement on a 4.6m course in a straight line, marked with 8.6m colored adhesive tape placed under the surface. Three attempts timed with a digital hand timer\textsuperscript{14,15}.

Data collection procedures

In the first assessment, data collection took place in centers near the participants’ homes, after clarification about the research objectives, guidance on data confidentiality, availability to participate, and signature of the Informed Consent Form (ICF) by the older adults who agreed to participate in the research. The data collection sessions were carried out by
trained teams, distributed between the coordinator and the undergraduate students who were part of the Study and Research Group on Aging and Health (GEPES).

Seventy months after the first assessment, a second one was carried out with the same group of older adults, following the same collection protocol. During the second assessment, the older adults were visited at home, informed about the objectives of the study and then asked about their willingness to participate in it. After acceptance and signature of the Informed Consent Form (ICF), the collection instruments were applied. Data collection was conducted by students of the psychology and physiotherapy courses, all participants of GEPES and duly trained for data collection.

Data analysis

The data were tabulated and analyzed using the software SPSS, version 25.0. Descriptive analyzes were performed (absolute and relative frequencies, mean, median, standard deviation and amplitude). We used the McNemar test to verify the difference between matched pairs regarding the qualitative variables (frailty indicators and frailty levels); the frailty outcome was assessed by the “frail” and “non-frail” categories, and the association between the prevalence of frailty indicators (weight loss, fatigue, grip strength, physical activity, gait, classified frailty) in the two assessment moments was based on Pearson’s chi-square test.

The evaluation of the influence of each phenotype item was done by Multinomial Logistic Regression analysis. Five models were run for each item individually in the final frailty classification, with the dependent variable able to take the values frail or pre-frail. Three Multinomial Logistic Regression models were drawn for combinations of items: one grouping weight loss and fatigue, another grouping low level of physical activity, muscle strength, and slow gait, and finally a model grouping all five items together. In the second evaluation (2015) it was not possible to repeat the model grouping the five items together.
For all analyzes, a significance level of 5% was used.

RESULTS

The two assessments pointed out statistically significant differences in the prevalence for classified frailty, in which there was an increase of approximately 18% pre-frail older adults. Among the frailty indicators, only the gait speed resulted in statistically significant differences \((p = 0.040)\). There was a small decrease in weight loss; but the remaining indicators increased (Table 2).

Table 2. Comparison of prevalence of frailty indicators (2009-2015).

| Frailty Indicators          | Year          | P-value* | Odds Ratio [95%CI] |
|-----------------------------|---------------|----------|-------------------|
|                             | 2009          | 2015     |                   |
| Weight loss                 |               |          |                   |
| Non-frail                   | 80.37% (n=131)| 83.44% (n=136)| 0.472  | 0.81 [0.46 ; 1.43] |
| Frail                       | 19.63% (n=32) | 16.56% (n=27) |        |                   |
| Fatigue                     |               |          |                   |
| Non-frail                   | 67.48% (n=110)| 60.74% (n=99) | 0.204  | 1.34 [0.85 ; 2.11] |
| Frail                       | 32.52% (n=53) | 39.26% (n=64) |        |                   |
| Grip strength               |               |          |                   |
| Non-frail                   | 89.57% (n=146)| 82.82% (n=135)| 0.077  | 1.78 [0.93 ; 3.40] |
| Frail                       | 10.43% (n=17) | 17.18% (n=28) |        |                   |
| Level of Physical Activity  |               |          |                   |
| Non-frail                   | 78.53% (n=128)| 77.30% (n=126)| 0.789  | 1.07 [0.64 ; 1.81] |
| Frail                       | 21.47% (n=35) | 22.70% (n=37) |        |                   |
| Gait Speed                  |               |          |                   |
| Non-frail                   | 87.12% (n=142)| 78.53% (n=128)| 0.040  | 1.85 [1.02 ; 3.34] |
| Frail                       | 12.88% (n=21) | 21.47% (n=35) |        |                   |
| Classified Fraility         |               |          |                   |
| Non-frail                   | 44.17% (n=72) | 25.15% (n=41) |        |                   |
| Pre-frail                   | 47.85% (n=78) | 65.03% (n=106)| 0.001  | ---               |
| Frail                       | 7.98% (n=13)  | 9.82% (n=16)  |        |                   |
| Total                       | 100.00% (n=163)| 100.00% (n=163)|        |                   |

*Chi-square test

The assessment of the evolution of frailty according to each indicator, depending on each case, revealed evidence of a statistical difference of the years under study with frailty in gait, that is, we have an increase in the percentage of frailty from the year 2009 to 2015 regarding the gait speed indicator (Table 3).
Table 3. Association between prevalence in frailty indicators between the two assessment time periods (2009-2015).

| Variables               | 2009          | 2015          | Total          | P-value* |
|-------------------------|---------------|---------------|----------------|----------|
|                         | Non-frag      | Frail         |                |          |
| Frailty in weight loss  | Non-frag      | 84.73% (n=111)| 15.27% (n=20) | 100.00% (n=131) | 0.551    |
|                         | Frail         | 78.13% (n=25) | 21.88% (n=7)  | 100.00% (n=32)  |
| Frailty in fatigue      | Non-frag      | 67.27% (n=74) | 32.73% (n=36) | 100.00% (n=110) | 0.200    |
|                         | Frail         | 47.17% (n=25) | 52.83% (n=28) | 100.00% (n=53)  |
| Frailty in grip strength| Non-frag      | 86.30% (n=126)| 13.70% (n=20) | 100.00% (n=146) | 0.061    |
|                         | Frail         | 52.94% (n=9)  | 47.06% (n=8)  | 100.00% (n=17)  |
| Frailty in physical activity | Non-frag | 92.19% (n=118)| 7.81% (n=10)  | 100.00% (n=128) | 0.815    |
|                         | Frail         | 22.86% (n=8)  | 77.14% (n=27) | 100.00% (n=35)  |
| Frailty in gait speed   | Non-frag      | 80.28% (n=114)| 19.72% (n=28) | 100.00% (n=142) | 0.044    |
|                         | Frail         | 66.67% (n=14) | 33.33% (n=7)  | 100.00% (n=21)  |

* McNemar's test

Logistic regression analyses were performed in order to identify the predictive value of indicators for classified frailty in 2009. Fatigue (R2 = 0.38) and weight loss (R2 = 0.26) were the items that, in standalone, had the most explanatory power for frailty, within individual models. Older adults who were positive for fatigue (OR = 23.25 95%CI 8.56-63.16, p < 0.001) were more likely to become frail (Table 4).
Table 4. Ordinal multinomial logistic regression analysis of frailty in 2009.

| Bivariate analysis                  | Pseudo $R^2$ - Nagelkerke | $\beta$ | Standard Error | Test statistics | OR          | 95%CI EXP (\(\beta\)) |
|-------------------------------------|---------------------------|--------|----------------|----------------|------------|----------------------|
|                                     |                           |        |                | Wald's chi-square | DF | P-value | L.L | U.L   |
| Weight loss (Yes)                   | 0.26                      | 2.90   | 0.51           | 32.45          | 1 | <0.001  | 18.26 | 6.72 | 49.60 |
| Fatigue (Yes)                       | 0.38                      | 3.15   | 0.51           | 38.07          | 1 | <0.001  | 23.25 | 8.56 | 63.16 |
| Grip strength (Yes)                 | 0.20                      | 3.04   | 0.54           | 31.72          | 1 | <0.001  | 20.89 | 7.25 | 60.15 |
| Physical activity level (Yes)       | 0.21                      | 2.27   | 0.42           | 29.95          | 1 | <0.001  | 9.73  | 4.31 | 21.97 |
| Gait speed (Yes)                    | 0.20                      | 2.83   | 0.49           | 33.77          | 1 | <0.001  | 16.90 | 6.51 | 43.87 |

Alternative models were generated with the items with higher individual value and lower individual value of odds ratio (OR) for the indicators in the testing in 2009. The model that contained weight loss and fatigue explained 59% of the onset of frailty, and self-reported fatigue was the item that, when positive, determined the highest chance of older adults becoming frail (OR=31.41; 95%CI11.66-84.65, p<0.001). In the model with three indicators, slowness of gait speed stood out (OR=54.93; 95%CI 11.38-265.11, p<0.001) (Table 5).

Table 5. Ordinal multinomial logistic regression analysis of frailty in 2009.

| Grouping                                 | Pseudo $R^2$ - Nagelkerke | $\beta$ | Standard Error | Test statistics | OR          | 95%CI EXP (\(\beta\)) |
|------------------------------------------|---------------------------|--------|----------------|----------------|------------|----------------------|
|                                          |                           |        |                | Wald's chi-square | DF | P-value | L.L | U.L   |
| Weight loss (Yes)                        |                           |        |                |                 |            |                      |
| Fatigue (Yes)                            |                           |        |                |                 |            |                      |
| Grip strength (Yes)                      |                           |        |                |                 |            |                      |
| Physical activity level (Yes)            |                           |        |                |                 |            |                      |
| Slow gait speed (Yes)                    |                           |        |                |                 |            |                      |
| Weight loss (Yes)                        | 0.59                      | 3.36   | 0.58           | 33.36          | 1 | <0.001  | 28.74 | 9.20 | 89.84 |
| Fatigue (Yes)                            | 0.59                      | 3.36   | 0.58           | 33.36          | 1 | <0.001  | 28.74 | 9.20 | 89.84 |
| Muscle strength (Yes)                    | 0.49                      | 3.22   | 0.96           | 11.13          | 1 | 0.001   | 24.92 | 3.77 | 164.89|
| Physical activity level (Yes)            | 0.49                      | 2.14   | 0.55           | 15.28          | 1 | <0.001  | 8.54  | 2.91 | 25.01 |
| Gait speed (Yes)                         | 0.49                      | 4.01   | 0.80           | 24.88          | 1 | <0.001  | 54.93 | 11.38 | 265.11|
We perceived an inversion of the items that best explained frailty in 2015 when compared to the 2009 analyses. Low level of physical activity (R² = 0.26), loss of muscle strength (R² = 0.24), and reduced gait speed (R² = 0.23) were the items that, isolated, had the greatest explanatory power for frailty within individual models. Older adults with increased loss of muscle strength (OR = 20.14 95% CI 6.51-62.29, p < 0.001) were more likely to become frail (Table 6).

Table 6. Ordinal multinomial logistic regression analysis of frailty in 2015.

| Bivariate analysis            | Pseudo R² - Nagelkerke | β   | Standard Error | Test statistics | 95%CI EXP (β) |
|-------------------------------|-------------------------|-----|----------------|-----------------|---------------|
|                               |                         |     |                | Wald's chi-square | DF | P-value | OR   | L.L  | U.L  |
| Weight loss (Yes)             | 0.13                    | 1.98| 0.49           | 16.23           | 1  | <0.001  | 7.27 | 2.77 | 19.09|
| Fatigue (Yes)                 | 0.22                    | 2.19| 0.44           | 24.34           | 1  | <0.001  | 8.98 | 3.75 | 21.47|
| Grip strength (Yes)           | 0.24                    | 3.00| 0.58           | 27.18           | 1  | <0.001  | 20.14| 6.51 | 62.29|
| Physical activity level (Yes) | 0.26                    | 3.00| 0.59           | 25.98           | 1  | <0.001  | 20.07| 6.33 | 63.59|
| Gait speed (Yes)              | 0.23                    | 2.74| 0.55           | 24.96           | 1  | <0.001  | 15.55| 5.30 | 45.63|

The model that contained the low level of physical activity, muscle strength, and slowness of gait speed explained 59% of the onset of frailty, whereas the model that contained weight loss and fatigue explained 35% of the onset of frailty in the 2015 assessment. Reduced muscle strength was the item that, when positive, determined the highest chance of the older adults becoming frail (OR = 103.43, 95%CI 10.78-992.49, p < 0.001) (Table 7).
Table 7: Ordinal multinomial logistic regression analysis of frailty in 2015

| Grouping                        | Pseudo R² - Nagelkerke | β     | Standard Error | Wald’s chi-square | DF | P-value | OR     | 95%CI EXP (β) |
|---------------------------------|-------------------------|-------|----------------|-------------------|----|---------|--------|--------------|
| Weight loss (Yes)               | 0.35                    | 2.38  | 0.54           | 19.22             | 1  | <0.001  | 10.84  | 3.73, 31.45  |
| Fatigue (Yes)                   | 2.39                    | 0.46  | 27.28          | 1                 | <0.001 | 10.94  | 4.46, 26.84 |
| Grip strength (Yes)             | 4.37                    | 1.13  | 14.85          | 1                 | <0.001 | 79.39  | 8.58, 734.24 |
| Physical activity level (Yes)   | 0.59                    | 3.16  | 0.76           | 17.55             | 1  | <0.001  | 23.64  | 5.38, 103.83 |
| Gait speed (Yes)                | 4.64                    | 1.15  | 16.17          | 1                 | <0.001 | 103.43 | 10.78, 992.49 |

DF = Degrees of Freedom; CI = Confidence Interval; L.L = Lower Limit; U. L = Upper limit; OR: Odds Ratio

DISCUSSION

The study found an evolution of frailty indicators with an increase in the number of items scored positively for characterization of the frailty phenotype, according to the model proposed by Fried et al. The data are indicative of progressive evolution of the syndrome according to patients’ greater longevity and corroborate with prevalence studies or that have adopted a longitudinal design to monitor the syndrome in community-dwelling older adults.

More than 70% of the studied sample of the second assessment period was identified as frail or pre-frail. The prevalence found for frail (9.8%) and pre-frail (65%) older adults is similar to data from national studies and international ones. A study carried out with older adults in Indonesia found an overall prevalence of 8.1% of frail older adults and 61.6% of pre-frail ones. It also corroborates with the study developed by Sousa et al. with a sample of 391 community-dwelling older adults in the Northeast Region that showed a prevalence of 17.1% of frailty and 60.1% of pre-frailty.

Some studies demonstrate that the group of frail older adults has presented conditions of vulnerability or even greater propensity to develop adverse health conditions, such as death,
disability and hospitalization\textsuperscript{4,9,18,19,21,22}. Such facts highlight the need for obtaining information to understand what is behind the frailty syndrome, compromising the quality of life of older adults who are in the pre-frail and frail levels\textsuperscript{17,19,26}.

Because of the increase in the frailty phenotype, there was a transition from the older adults who were, during the first assessment, in the non-frail stage and went into the pre-frail stage; there was also a slight increase to the number of frail older adults’ group. In light of these results, it is necessary to discuss the consequences of the greater installed vulnerability arising from declining conditions, caused by the frailty syndrome. According to Fhon et al.\textsuperscript{17}, the frailty syndrome causes a cumulative decline to the physiological system, derived from dynamic complexes of the multiple physiological systems. Frail elderly people are more likely to develop functional disability, so the syndrome has been discussed as a potential precursor to functional disability in old age\textsuperscript{2-4,6}.

The transition between the levels of frailty draws attention to, on the one hand, the possibility of worsening conditions that limit older adults and compromise their functionality and quality of life, possibly even leading to death; and on the other hand, it signals the possibilities of reversibility of the syndrome, since some older adults can become robust and reverse the conditions installed by the syndrome\textsuperscript{19,27}. The longitudinal study \textit{The Progetto Veneto Anziani}, carried out with 2,925 individuals in Italy, found that among frail older adults, about 40\% of them died and 26.5\% returned to pre-frailty condition. Among the non-frail, 50\% remained robust, 26.7\% became pre-frail, 6.3\% frail and 17.0\% died. Among the pre-frail, 12.3\% became robust, 20.7\% frail and 36.4\% pre-frail\textsuperscript{24}. A longitudinal study conducted with the database of the Study of Health, Well-Being, and Aging (SABE) in 2006 and 2010, found a 9.8\% increase in the prevalence of frailty. The evolution of frailty was 3.3\% among the non-frail and 14.7\% among the pre-frail. A regression of 27.8\% of the pre-frail older adults in 2006 to the non-fragile condition in 2010 was also reported\textsuperscript{19}. 
These data reinforce the discussions that assert the possibility of the frailty syndrome being reversible, in this sense, the development of care actions directed to the older adult’s public\(^4\). Therefore, studies point out the need to identify the frailty and to intervene on it even before people reach 65 years old, when the studies that evaluate the syndrome are more frequent. Such actions have a preventive nature and can also help in the rehabilitation of functions that suffer declines throughout aging, with possibilities of mitigating the risks and damage already installed\(^{19,28}\).

Regarding the prevalence of frailty indicators in both assessment periods, self-reported weight loss was the only one that suffered a slight reduction. According to cross-sectional studies carried out in order to estimate the prevalence of frailty in older adults, self-reported weight loss has been one of the indicators that contributes the least to determining the syndrome\(^{7,8,22}\). Moreover, it is assured that self-reporting poses as a challenge in terms of precision and reliability of the results; it is, therefore, an evaluation that deserves attention, so its investigation may be possible through reports from family members and/or caregivers who accompany the older adults\(^{29}\).

While fatigue and weight loss are widely discussed in the current literature as self-report measures, they were the indicators with the highest predictive power in the 2009 assessment. These two indicators together constituted the model with the greatest predictive power for classified frailty. The model with the five indicators of frailty explained 89% of frailty in the sample in 2009.

Although there are difficulties in assessing weight loss, this measurement holds important contributions in the evaluation of frailty. Mello et al.\(^3\) discuss the importance of nutritional and lifestyle aspects in identifying frailty, related to the weight of older adults. An association of low weight with the occurrence of frailty has been found\(^{12,30}\). Another aspect raised in the discussions about this variable concerns the fact that the measurement can be
overestimated by the older adults, since thinness and weight loss can be considered as something healthy, beautiful and an indicator of youth\textsuperscript{31}.

The Brazilian Association of Palliative Care\textsuperscript{32} defines self-perceived fatigue as a generalized tiredness noticed by the older adults after performing their daily activities, manifesting itself physically and psychologically as mental fatigue and indisposition. We believe that more attention must be given to the assessment of fatigue in the older adults, since this condition has not been a concern for most healthcare professionals who care for the older adult’s population, and for this reason, the production of studies on the subject is still unsatisfactory\textsuperscript{20}. The prevalence of fatigue found in this study was high when compared to the results of other studies with older adults in other Brazilian locations\textsuperscript{7,8}. Marchiori and Tavares\textsuperscript{20} followed up the frailty conditions of older adults one year after hospital discharge, finding that fatigue was associated with a higher number of comorbidities and advocated therapeutic interventions to improve energy efficiency by means of compensatory activities.

When it comes to the analyses that estimated how each item that makes up the frailty phenotype influenced the determination of the syndrome in the second assessment period, the items physical activity, grip strength, and slowness of gait speed stood out. Together, these three indicators composed the model with greater predictive power for frailty in the second assessment in 2015. Furthermore, it was not possible to generate an explanatory model with the five indicators as proposed by Fried et al.\textsuperscript{4} for the older adults who participated in the second assessment.

The model composed of the three indicators was also described in a multicenter research with a sample of 5,532 Brazilian older adults that sought to evaluate the contribution of each indicator in determining frailty in Brazilian older adults. It was noticed that in the isolated level of physical activity ($R^2 = 0.37$), slowness of gait speed ($R^2 = 0.32$) and muscle strength ($R^2 =$
0.28) had greater predictive power, while in the development of models that grouped the items, the set of three indicators stood out with 69.6% of explanation for the onset of frailty. The contribution of reduced levels of physical activity in determining frailty was discussed in a prospective longitudinal cohort study with 12-month follow-up of a rural-community-dwelling older adults in Malaysia. Regression analyses pointed to an almost three times higher risk of obtaining a worsening transition to higher frailty states among the older adults with low physical activity, plus the results showed that there was less likelihood of transitioning to lower frailty states in older adults with low physical activity. 

Studies have pointed out the physical activity item among the most contributing factors in determining the syndrome in community-dwelling older adults. It is worth mentioning that the measurement of physical activity has been questioned, considering that the instrument proposed by Fried et al. to estimate the low level of physical activity contains some items that do not suit the socioeconomic reality of some locations, in terms of access. As a result, some studies have made adaptations to the instrument, aiming at minimizing such noted difficulties in some questions of the instrument.

The loss of grip strength is indicative of a reduction in muscle strength, which, in turn, is debated as one of the main causes that lead to sarcopenia. A study carried out with 1,457 Portuguese older adults identified a high level of grip strength reduction (76.7%), indicating this as the main indicator of frailty in the sample studied. As observed in this study, the gradual evolution of this loss has been observed in processes in which the evolution of the syndrome worsens. Faria et al. noted that after two assessments, the second one happening 24 months after the first, grip strength was the item with the highest occurrence in determining frailty. Due to these findings, the authors discuss the need to promote interventions in order to enhance overall muscle strength and encourage the mobility of older adults as a way to avoid aggravating the frailty condition.
Gait speed is an important indicator of frailty in the older adults. In this study, considering the two assessments, the slowness of gait increased by 1.85 the chances of the elderly developing frailty. It is worth pointing out that the second assessment included more longevous older adults. The results corroborate data from international studies that identified an increased risk for worsening frailty status in the older adults over short periods of time\textsuperscript{25,36}. Study conducted with older adults in Indonesia\textsuperscript{25}, a longitudinal assessment was performed after 12 months had elapsed from the first one and an increased gait slowness was identified in a short period of time, such impact was discussed as functional mobility impairment and its effects were discussed as a possibility of deficit accumulation in aging, as well as robustness of this indicator for characterization of frailty.

**LIMITATIONS OF THE STUDY**

This study comprises some limitations that initially pertain to the excessive number of losses of older adults who were expected to be part of the second assessment. The losses were related to deaths and comorbidities that installed physical and cognitive disabilities in some of them, there were missing addresses (older adults who moved homes, addresses that were not located), and there were also some rejections. The period between the first and the second assessment is considered long since it totaled more than five years (70 months).

Another limitation that should be considered in the present study was the limited number of variables for a longitudinal study of the possible outcomes associated with the syndrome. The older adults who were part of the first assessment who had not scored above the cutoff points in the Mini Mental State Examination (MMSE) (instrument through which the cognitive status of the older adults participants was tracked) did not answer the other questionnaires and research scales, being restricted to gauging the frailty phenotype. To reach a larger number of older adults in the sample of this study, the research surveyed the number of older adults who
were cognitively able and unfit, according to the first assessment of the MMSE, who underwent an assessment of the frailty phenotype.

For future studies, it is suggested that even the older adults who present signs of cognitive impairment can be evaluated regarding their functional capacity through simple scales such as the Katz, Brody and Lawton instrument, that can be answered with the help of a caregiver. In addition, other instruments can also be applied, such as, for example, simplified questionnaires of signs and symptoms, depressive symptoms, risk of falls, and sleep. Considering the results, one can see the need for the older adults to be followed up regarding possible transitions in the frailty profile, in shorter periods of time, between two years or three years on an ongoing basis.

CONCLUSIONS

An increase in frailty indicators was observed in the surveyed older adults’ participants, a fact that contributed to transitions between levels of frailty. The individual evaluation of each of the indicators in the characterization of the frailty syndrome, considering the assessment in both time periods, brought data that drew attention. In the first evaluation the model with two indicators (fatigue and weight loss) was determinant, in the second assessment the model with three indicators (level of physical activity, grip strength, and gait speed) was predominant. In the first assessment the five indicators together were able to explain 89% of the frailty while in the second assessment with the oldest adults it was not possible to create a model containing all five frailty indicators together. The data do not invalidate the five-indicator model as proposed by Fried but raise questions about how older adults can be assessed throughout aging when considering longer periods of time between assessments. The studies available in the literature on the subject develop assessments in shorter periods of time (12 months, predominantly; 18 months, 3 years, for example). This research had access to older adults evaluated in a longer
period and consequently found with more pronounced physical and cognitive impairments. The accuracy of self-report variables on frailty in older adults (when assessed alone without the support of a physical measure that supports the first self-report data) is questioned in this study, while the need for joint assessment of physical and self-reported measures is emphasized.

The study of the variations of each item in determining the syndrome, between the first and the second assessment, highlights the importance of paying greater attention so that interventions based on the prevention of further aggravations that may help to delay and/or reestablish functions that are in decline and that negatively interfere in the well-being of older adults, may be carried out.

Lastly, the results indicate the need for actions aimed at prevention and postponement of the indicators that act in the pathological aging process, characterized by the early appearance of disabilities in older adults. It is also considered that there is a necessity for other assessment measurements to encourage more accurate evaluations regarding other indicators that point to the development of frailty. Another noteworthy need concerns the inclusion of measures for psychological, cognitive and social assessments of the conditions that are responsible for maintaining subjective well-being even in the face of frailty.

### AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

### ABBREVIATIONS

| Abbreviation | Description |
|--------------|-------------|
| REC          | Research Ethics Committee |
| FIBRA        | Frailty in Brazilian Older Adults |
| UNICAMP      | University of Campinas |
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CONTRIBUTORS

ARL, EGSJ, and MCE planned the research and data analyses. ARL, ICCC and CSM wrote the first draft of the manuscript. EGSJ provided statistical support. MCE, RAA, RAO, ICCC, SAU interpreted the results. RAA, RAO, and SAU performed the first critical revision of the manuscript. All authors reviewed the subsequent stages of manuscript production and critically reviewed the final submission version.

ETHICS DECLARATIONS

The project was sent to the Research Ethics Committee (REC) of the State University of Paraíba (Universidade Estadual da Paraíba) for due consideration and was approved under
opinion number 20599513.9.0000.5187. For the beginning of the study the older adults were previously informed about the aims and background of the study, about their voluntary participation and about the confidentiality and anonymity of the information. Then, as a necessary condition for participation in the study, they signed (or fingerprinted) the Informed Consent Form (ICF), in two copies, one for the participant or legal representative and the other for the researcher. The research met the guidelines established by Resolution Number 466 of December 12, 2012 of the National Health Council, which regulates studies involving human beings.

DISCLOSURE

The authors have no potential conflicts of interest to disclose.
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