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Predictive validity of the Brazilian version of the Tilburg Frailty Indicator for adverse health outcomes in older adults

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ABSTRACT

Purpose: This study aimed to determine the predictive value of the Brazilian Tilburg Frailty Indicator (TFI) for adverse health outcomes (falls, hospitalization, disability and death), in a follow-up period of twelve months.
Methods: This longitudinal study was carried out with a sample of people using primary health care services in Rio de Janeiro, Brazil. At baseline the sample consisted of 963 people aged 60 years and older. A subset of all respondents participated again one year later (n = 640, 66.6% response rate). We used the TFI, the Katz's scale for assessing ADL disability and the Lawton Scale for assessing IADL disability. Falls, hospitalization and death were also assessed using a questionnaire.
Results: The prevalence of frailty was 44.2% and the mean score of the TFI was 4.4 (SD = 3.0). There was a higher risk of loss in functional capacity in ADL (OR = 3.03, CI95% 1.45–6.29) and in IADL (OR = 1.51, CI95% 1.05–2.17), falls (OR = 2.08, CI95% 1.21–3.58), hospitalization (OR = 1.83, CI95% 1.10–3.06), and death (HR = 2.73, CI95% 1.04–7.19) for frail when compared to non-frail elderly, in the bivariate analyses. Controlling for the sociodemographic variables, the frailty domains together improved the prediction of hospitalization, falls and loss in functional capacity in ADL, but not loss in functional capacity in IADL.
Conclusion: The TFI is a good predictor of adverse health outcomes among elderly users of primary care services in Brazil and appears an adequate and easy to administer tool for monitoring their health conditions.

1. Introduction

The model of health care for the elderly that predominates in Brazil still prioritizes both treatment of chronic problems already installed and treatment effects, which generates great use of services and is inefficient and expensive (Marin et al., 2008). It is pointed out that there is a need for changes in the methodologies for providing health care to elderly populations, which consider the importance of maintaining functional independence, quality of life and social insertion of individuals (Lima-Costa & Veras, 2003). In this context, it is important to evaluate frailty among Brazilian older adults, especially in users of primary health care.

Frailty is recognized as a geriatric syndrome and considered as "a state that affects individuals experiencing losses in one or more domains of human functioning, caused by the influence of a number of variables and increasing the risk of adverse health outcomes" (Gobbens, Luijkx, Wijnen-Sponselee, & Schols, 2010). Frailty predicts disability and death, as well as other undesirable outcomes such as falls, fractures, hospitalization and greater use of health services (Fried et al., 2001; Gobbens & van Assen, 2012; Samper-Ternent, Karmarkar, Graham, Reistetter, & Ottenbacher, 2012). In a systematic review aimed at comparing the prevalence of frailty among community-dwelling elderly

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according to sex, age and definition of frailty, a variation of 4.0–59.1% was identified among the 21 selected studies (mean prevalence = 10.7%; 95% CI 10.5–10.9), with the highest frequencies observed in studies using multidimensional frailty assessment instruments (Collard, Boter, Schoevers, & Voshaar, 2012). In addition to the high prevalence in elderly populations and the increased risk for adverse outcomes, frailty is considered a condition with great potential for reversibility, which makes it an important condition for monitoring elderly health in clinical practice (Rodriguez-Mañas & Fried, 2015).

In the last 20 years, different instruments have been proposed for the evaluation of frailty in the elderly. Mostly, they were based on two different approaches: unidimensional, which evaluates only issues related to physical health (Ensrud et al., 2008; Fried et al., 2001; Hyde et al., 2010; Peterson et al., 2009), and a multidimensional that also evaluates other areas of health such as psychological and social health (Cacciatore et al., 2005; Frieswijk, Buunk, Steverink, & Slaets, 2004; Gobbens, Luijkx et al., 2010; Puts, Lips, & Deeg, 2005; Rockwood et al., 1999; Strawbridge, Shema, Balfour, Higby, & Kaplan, 1998). Believing that the multidimensional approach is most adequate to the current setting of frailty in Brazil, the Tilburg Frailty Indicator (TFI) was identified as an appropriate instrument to identify this condition, since, in addition to aggregation of other areas besides physical health, it does not include variables considered as outcomes of frailty, such as disability, falls and hospitalization (Santiago, Luz, Mattos, & Gobbens, 2012). Moreover, a recent systematic review concluded the TFI has the most robust evidence of reliability and validity among 38 multicomponent frailty assessment instruments (Sutton et al., 2016).

The TFI is an instrument for assessing frailty in the elderly that was developed in the Netherlands, and evaluates the physical, psychological and social domains of health. It can be applied by any health professional and requires little financial resources and little time for application (Gobbens, van Assen, Luijkx, Wijnen-Sponselee, & Schols, 2010a). The process of cross-cultural adaptation of the TFI to the Brazilian elderly population has already been carried out, as well as the stages of evaluation of the conceptual, item, semantic and operational equivalences and the pre-test of the instrument version, and the evaluation of its statistical properties (Santiago et al., 2012, Santiago, Luz, Mattos, Gobbens, & van Assen, 2013). Based on the results of previous studies, it is believed that the Brazilian version of the instrument is a useful and valid tool for the evaluation of frailty in the country.

The ability to predict adverse health outcomes, especially disability, is highlighted as one of the main virtues of the evaluation of frailty in the clinical practice of geriatrics and gerontology. Its inclusion in the routine of primary health care has also been valued, with a view to early intervention, reversibility of the condition, prevention of potential damages to the quality of life of elderly, and reduction of costs for the health system (De Lepeleire, Iliffe, Mann, & Degryse, 2009; Lacas & Rockwood, 2012).

Some studies have been conducted aimed at determining the predictive value of the TFI in a longitudinal study. According to Gobbens et al. (2012, 2014) the TFI is a valid instrument to predict disability, health care utilization and quality of life in Dutch community-dwelling elderly. It was concluded that assessment by the TFI is sufficient for predicting health care utilization, but for predicting disability the use of both the TFI and the Timed Up & Go test was recommended.

In addition, Coelho, Paúl, Gobbens, and Fernandes (2015) concluded that the TFI is a predictor of disability and quality of life in Portuguese elderly and Mulasso, Roppolo, Gobbens, and Rabaglietti (2016) showed that the TFI was predictive for falls at 12 months in an Italian aged population. Finally, van Campen (2011) demonstrated that frailty assessed with the TFI is a predictor for death, after adjusting for age, gender and educational level.

All aforementioned TFI-studies have been conducted in European countries. This study aims to evaluate frailty assessed by the Brazilian TFI as a predictor of falls, hospitalizations, functional incapacity and death in elderly, during a one-year follow-up period, in a Latin American country.

2. Material and methods

2.1. Study population and data collection

Individuals aged 60 years or more, users of primary health care services of three health units of Rio de Janeiro, located in areas of social vulnerability, were eligible for the study. Elderly unable to answer the questions of the data collection instrument, whether due to cognitive, sensory or motor problems, were excluded. We used the MMSE, a 30-item test measuring cognitive deficits, to select participants for inclusion; non-literate individuals with a score lower than 18 and literate with a score lower than 24 were excluded from participation (Lourenço & Veras, 2006).

Eight research assistants were duly trained by two members of the research group (LMS and DBF) in order to standardize the procedures of data collection. They carried out 963 interviews in the house of elderly people registered in the lists provided by the health units. Considering the logistical difficulties (such as outdated addresses, locations that are unsafe to visit) to access the elderly, a convenience sample was made.

After a 12-month period follow-up, the same research assistants conducted new interviews with the recruited elderly in their houses, and information was obtained for 640 (66.6%) of them. Due to a federal government relocation of a series of community dwellings during the follow-up period, there were operational difficulties for locating many participants (323; 33.4%) resulting in losses to follow-up in the study.

The study was approved by the Research Ethics Committee of the National School of Public Health/Oswaldo Cruz Foundation in 2013, protocol number CAAE: 15352013.0.0000.5240.

2.2. Measures

Variables include frailty, adverse health outcomes related to frailty (disability, falls, hospitalization, and death) and sociodemographic variables (age, sex, education, marital status, household situation and family income),

2.2.1. Frailty

Frailty was assessed with the Brazilian version of the Tilburg Frailty Indicator (TFI) (Santiago et al., 2012, 2013). The TFI consists of 15 items, referring to the physical (eight items), psychological (four items), and the social domains (three items). The physical domain (range 0–8) includes: physical health, unexplained weight loss, difficulty in walking, poor balance, vision problems, hearing problems, lack of strength in hands, and physical tiredness. The psychological domain of frailty contains the items problems with memory, feeling down, feeling nervous or anxious, and unable to cope with problems. The social domain includes living alone, lack of social relations, and lack of social support. The scores range from 0 to 15, 0 to 8, 0 to 4, and 0–3, for total, and the physical, psychological, and social domains of frailty, respectively. Higher scores mean a higher level of frailty; scores ≥ 5 points indicate the presence of the condition (Gobbens, Luijkx et al., 2010).

2.2.2. Adverse health outcomes

Disability was evaluated with two instruments; the Katz scale (Katz, Downs, Cash, & Grotz, 1970), to evaluate Basic Activities of Daily Living (ADL) and the Lawton scale (Lawton, Moss, Fulcomer, & Kleban, 1982) to evaluate Instrumental Activities of Daily Living (IADL), both validated for the Brazilian population (Lino, Pereira, Camacho, Ribeiro Filho, & Buksman, 2008; Santos & Virtuoso, 2008).

The Katz's scale (Katz et al., 1970) allowed us to evaluate six ADL items (bathing, dressing, toileting, transferring to and from a bed or chair, feeding, and control sphincters). A score of 0 or 1 is assigned to each item, depending on how independent the individual is when performing the activity. The sum score ranges from 0 to 6 points and

the lower the score, the less dependent the individual is. In this study, at the recruitment, individuals who were unable to perform one or more activities without help were considered ADL dependent (Mattos, Carmo, Santiago, & Luz, 2014; Reyes-Ortiz, Ostir, Pelaez, & Ottenbacher, 2006).

The Lawton scale (Lawton et al., 1982) was used to assess individual performance in eight IADL activities (using the telephone, using transportation, shopping, taking medications on time, handling finances, prepare their food, and clean their house). A score of 0 or 1 is assigned to each item, depending on how independent the individual is when performing the activity. The sum score ranges from 0 to 8 points and the lower the score, the less dependent the individual is. In this study, at the recruitment, we considered individuals who were unable to perform one or more activities without help as IADL dependent (Mattos et al., 2014; Reyes-Ortiz et al., 2006).

The categorical variables of the outcome disability were: "loss of functional capacity in ADL" and "loss of functional capacity in IADL". We considered loss (1 = yes) when there was a reduction in the sum scores and no loss (0 = no) when there was no reduction in the sum scores of variables of disability (ADL and IADL) in the follow-up, when compared to the sum scores at recruitment.

Concerning falls we asked "Did you suffer any fall in the last year?", and "How many times?" if the answer to the first question was "yes". Concerning hospitalization, we asked "Have you been hospitalized in the last year for at least 24 h?" and "How many times?" in case the answer to the first question was "yes". We coded the outcomes falls and hospitalization as present (1) if the answer to the first question was "yes", and absent (0) otherwise.

When the family member reported the death of the older person, the reason and date were asked.

2.3. Data analysis

Initially, we performed descriptive analyses. Subsequently, we chose to categorize some variables for analysis. This was the case of marital status, grouped into four categories (married or living with partner; divorced; widowed; single), and education, grouped into three categories (more than 5 years of education; between 1 and 5 years of education; did not attend school). Family income was analyzed as a multitude of minimum Brazilian wages. During the study period, the Brazilian minimum wage was approximately US$ 227.

Initially, the TFI results were analyzed as a categorical variable (not frail < 5 points or frail ≥ 5 points) (Gobbens, van Assen, Luijkx, Wijnen-Sponselee, & Schols, 2010b). Descriptive analysis of the variables by frailty condition included the computation of means and standard deviations for continuous variables, and frequency distributions for categorical variables. The Pearson's chi-square test was performed to evaluate the presence of differences between the frail and not frail groups. Mortality was predicted using Cox regression analysis, with mortality defined as death occurring during the 12 months of follow-up period.

We also tested the associations of frailty and its three domains with adverse health outcomes to assess the predictive validity of the TFI, using Pearson's correlations for continuous outcomes and Spearman's correlations for categorical ones. We expected positive associations between the frailty domains and the adverse outcomes assessed in a one-year follow-up. We performed logistic regression analyses to control for the effect of other variables in the associations of frailty and its three domains with adverse health outcomes. Logistic regression models were applied to hospitalization, falls, and loss in functional capacity (ADL and IADL), with two modeling blocks. In the first block, we investigated the effect of the sociodemographic characteristics, and in the second the frailty domains (physical, psychological, social) were added to the model. To evaluate the contribution of the variables in the various modeling blocks, we used the likelihood ratio test.

The SPSS (Statistical Package for Social Science for Windows) version 20 (SPSS Inc. Chicago, IL) was used to carry out the statistical analyses, using a two-tailed significance level of 0.05 in all analyses.

Table 1
Distribution of sociodemographic and health variables by frailty at baseline in elderly enrolled in the Family Health Strategy, Rio de Janeiro, Brazil, 2013 (N = 640).

Variables		FRAILTY		
	N total (%)	Frail (%)	Not frail (%)	*p*-value X^2
Sex				
Male	226 (35.3)	77 (27.1)	149 (41.9)	< 0.001
Female	414 (64.7)	207 (72.9)	207 (58.1)	
Age group				
60–69 years	347 (54.2)	153 (54.1)	194 (54.3)	0.005
70–79 years	198 (30.8)	75 (26.5)	123 (34.5)	
80 years or more	95 (14.8)	55 (19.4)	40 (11.2)	
Education				
More than 5 years	238 (37.9)	90 (32.5)	148 (42.2)	0.004
Up to 5 years	297 (47.3)	133 (48.0)	164 (46.7)	
Did not to attend school	93 (14.8)	54 (19.5)	39 (11.1)	
Marital status				
Married/cohabiting	277 (43.5)	103 (36.5)	174 (49.0)	0.009
Divorced	48 (7.5)	18 (6.4)	30 (8.5)	
Widowed	201 (31.6)	105 (37.2)	96 (27.0)	
Single	111 (17.4)	56 (19.9)	55 (15.5)	
ADL disability				
No	577 (90.3)	233 (82.0)	344 (96.9)	< 0.001
Yes	62 (9.7)	51 (18.0)	11 (3.1)	
IADL disability				
No	334 (52.4)	101 (35.7)	233 (65.6)	< 0.001
Yes	304 (47.6)	182 (64.3)	122 (34.4)	

*The differences in absolute values are due to missing values.

3. Results

3.1. Descriptive analyses

Table 1 presents the description of the sociodemographic and health characteristics of the followed sample (n = 640) at baseline. The mean age of the study participants was 70.5 (SD = 8.2) years, with a median of 69.0 years (SD = 8.2 years). The average family income was 2.1 (SD = 2.6) minimum wages, with a median of 1.4 minimum wages. The majority of the individuals were female (64.7%), in the age group of 60–69 years (54.2%) and with low level of education (37.9% more than 5 years). Regarding disability, at baseline 90.3% of the elderly were independent in the Basic Activities of Daily Living (ADL), while 52.4% were independent on the Instrumental Activities of Daily Living (IADL) (see Table 1).

At baseline, frailty prevalence was 44.2% and the mean score of the TFI was 4.40 (SD = 3.0), with a median of 4.0. The distribution of the elderly by frailty is also presented in Table 1. Frail and non-frail individuals differed with respect to gender, age, education, marital status, and disability in ADL and IADL ($p < .001$) (see last column of Table 1). After the follow-up period, there were 19 (3.0%) deaths, 35 (5.7%) cases of loss of functional capacity in ADL, 157 (25.6%) cases of loss of functional capacity in IADL, 60 (9.6%) falls and 67 (10.8%) hospitalizations.

We compared the characteristics of the persons in our sample to the characteristics of the 223 (33.4%) dropouts at baseline. The dropouts had a mean age of 70.0 years (median = 68.0 and SD = 8.6) and their average family wage was 2.3 (median = 1.6 and SD = 2.0). For this group, we also observed that the majority was female (64.4%), in the age group of 60 to 69 years (54.6%) and married or living with a partner (40.0%). However, in this population 46.5% of the individuals had more than 5 years of education. Regarding disability, 91.3% was independent in ADL, while 61.3% were independent in IADL. Frailty prevalence was 45.2%. The only differences between the two groups (dropped out or not) are related to schooling (p = 0.007) and

Table 2
Survival Analysis for mortality according to frailty status.

	Hazard Ratio (crude) (95% CI)	p-value	Hazard Ratio (adjusted)[a] (95% CI)	p-value
Death				
Frailty (frail)	2.73 (1.04–7.19)	0.042	2.72 (1.01–7.31)	0.047
Age (continuous)			1.06 (1.01–1.11)	0.009
Gender (male)			3.11 (1.24–7.76)	0.015

[a] Adjusted for all variables in the model.

functional dependence in IADL (p = 0.009).

3.2. Predictive validity

Frail elderly had a higher risk of death than non-frail elderly during a 12-month follow-up period (see Table 2). The effect of frailty was unaffected by controlling for sex and age. The hazard rate of death among the frail individuals was 2.7 higher than among non-frail individuals. Each additional year of life increased the hazard rate by 6%, and men's hazard rate was three times higher than that of women.

The results of the effects of frailty on adverse health outcomes falls, hospitalization, and loss of functional capacity one year later are summarized in Table 3. For all of the outcomes evaluated, frailty was associated with the adverse outcomes. In these analyses, the odds ranged from 0.5 (loss of functional capacity in ADL) to 3 times higher (loss in functional capacity in IADL), while in the multiple analyses this variation was from 0.6 to approximately 2.5 for the same outcomes. Age also predicted the frailty-related outcomes, with one more year of life associated to an increase in the odds ranging from 4% (hospitalization) to 12% (loss of functional capacity in ADL). Income had a negative effect on loss of functional capacity in IADL, with one year being associated to a decrease of 20% in the odds.

Table 4 presents the results of the logistic regression models controlling for the effects of the sociodemographic variables (age, marital status, education and family income). After controlling for the sociodemographic variables, the frailty domains together improved the prediction of hospitalization, falls, loss in functional capacity in ADL, but not loss in functional capacity in IADL (last block of Table 4). Concerning the individual domains, only the physical domain had a statistically significant effect on hospitalization and loss in functional capacity in ADL.

Table 3
Logistic Regression Analysis of adverse health outcomes.

	Bivariate analysis Odds Ratio (95% CI)	*p*-value	Multiple analysis Odds Ratio[a] (95% CI)	*p*-value
Loss in functional capacity ADL[b]				
Frailty (frail)	3.03 (1.45–6.29)	0.003	2.46 (1.14–5.30)	0.022
Age (continuous)			1.12 (1.08–1.17)	< 0.001
Loss in functional capacity IADL[c]				
Frailty (frail)	1.51 (1.05–2.17)	0.027	1.64 (1.09–2.46)	0.016
Age (continuous)			1.06 (1.03–1.09)	< 0.001
Family Income (continuous)			0.80 (0.69–0.92)	0.002
Falls				
Frailty (frail)	2.08 (1.21–3.58)	0.008	1.94 (1.12–3.39)	0.019
Age (continuous)			1.05 (1.02–1.08)	0.001
Hospitalization				
Frailty (frail)	1.83 (1.10–3.06)	0.020	1.78 (1.05–3.00)	0.031
Age (continuous)			1.04 (1.01 – 1.07)	0.011

[a] Adjusted for gender and the other variables in the models.

4. Discussion

In this research, the prevalence of frailty was 44.2% at the baseline. This figure is comparable with other TFI investigations. Gobbens et al. (2010b) found a prevalence of 47.1% among Dutch older people aged ≥75 years, and among Polish community-dwelling elderly aged ≥60 years the prevalence of frailty was 44.1% (Uchmanowicz et al., 2016). In the present study, the incidence of death, loss of functional capacity in ADL and IADL were 3.0%, 5.7% and 25.6%, respectively, after one year. In addition, falls and hospitalization were present in 9.6% and 10.8% of the participants. Our study showed that the TFI predicted all adverse outcomes; however, after controlling for socio-demographic variables the TFI did not predict loss of functional capacity in IADL. Of the three frailty domains (physical, psychological, social), only the physical domain predicted the following adverse outcomes one year later: loss in functional capacity in ADL and hospitalization. This finding is supported by previous studies using the TFI for assessing frailty. For example, a study among Dutch elderly aged 75 years and older also found that only the physical of frailty was associated with ADL disability and hospitalization one year later (Gobbens, van Assen, Luijkx, & Schols, 2012). However, a multidimensional assessment, including not only the physical domain of frailty, but also the psychological and social domains of frailty, is very important. After all, these two domains are associated with other adverse outcomes of frailty in elderly such as lower quality of life, contacts with health care professionals, and receiving nursing (Gobbens et al., 2012; Gobbens, van Assen, & Schalk, 2014).

Of all the adverse outcomes related to frailty in elderly there is no doubt that death has been the most investigated. According to Shamliyan, Talley, Ramakrishnan, and Kane (2013) survival estimates vary depending on the definition of frailty. In the present study we showed that death can be predicted by the TFI. More studies in other countries and populations are needed to establish the predictive value of the TFI for death.

We observed a higher frequency of loss of functional capacity in IADL compared to loss in ADL, at the end of the follow-up (25.6% versus 5.7%). The higher frequency of IADL is explained by ADL being a more severe and later form of disability than IADL disability (Wong et al., 2009). Both their different frequency and the fact that the Brazilian TFI only predicted loss of functional capacity in ADL are reasons to distinguish the two types of functional capacity when examining adverse health outcomes of frailty. In previous longitudinal studies, conducted in Portugal, Italy and the Netherlands, the TFI also predicted loss in functional capacity in ADL and IADL (Coelho et al., 2015; Gobbens et al., 2012; Roppolo, Mulasso, Gobbens, Mosso, & Rabaglietti, 2015). However, it should be noted that in these studies also only the physical domain of the TFI was responsible for the effects on functional capacity. Gobbens et al. (2014) concluded that five physical TFI items together (unintentional weight loss, difficulty in walking, lack of strength in hands, physical tiredness, low physical activity), referring to the phenotype of frailty by Fried et al. (2001), predicted loss in functional capacity in both ADL and IADL; the other three physical TFI components (poor balance, hearing problems, vision problems) together did not predict loss of functional capacity (Gobbens et al., 2014). We suggest further research regarding the predictive value of individual frailty components of the Brazilian TFI on loss of functional capacity, as these findings may offer health care professionals more specific information on which frailty components they can address their interventions aiming to prevent or delay loss of functional capacity.

As well as loss in functional capacity, falls has been considered an important health issue for elderly, since they raise mortality rates and greatly contribute to mobility disability and institutionalization (Rubenstein, 2006). The instrument used to evaluate frailty in the present study (TFI) included many of the factors (like gait, balance, hearing, vision, weakness and fatigue) associated with falls, which explains its ability to predict this outcome.

Table 4
Sequential logistic regression analyses of adverse health outcomes.

	Hospitalization	Falls	Loss in functional capacity in ADL	Loss in functional capacity in IADL
Sex (women)	−0.21 (0.32)	0.02 (0.34)	0.01 (0.51)	−0.67 (0.23)**
Age (continuous)	0.03 (0.02)	0.06 (0.02)*	0.10 (0.24)***	0.06 (0.01)***
Marital Status				
Married/cohabiting	0.03 (0.32)	0.31 (0.34)	−0.40 (0.52)	0.22 (0.23)
Education				
> 5 years	0.10 (0.30)	0.44 (0.33)	−0.39 (0.46)	0.09 (0.24)
Family Income (Minimum wages)	0.002 (0.001)	0.004 (0.001)*	−0.02 (0.11)	−0.23 (0.08)**
X^2 (5)	6.49	21.80*	29.20***	43.13***
Physical Frailty	0.15 (0.07)*	0.12 (0.07)	0.34 (0.10)***	0.08 (0.05)
Psychological Frailty	0.07 (0.15)	0.12 (0.15)	−0.08 (0.21)	0.11 (0.11)
Social Frailty	−0.30 (0.20)	−0.27 (0.21)	−0.42 (0.29)	−0.15 (0.14)
X^2 (3)	8.19*	6.47*	15.63***	5.50
X^2 (8)	14.68	28.27*	44.82***	48.64***

The standard errors are presented between brackets.

The use of health services and, more specifically, hospitalization have been pointed out as an outcome of frailty among elderly (Fried et al., 2001; Gobbens et al., 2012; Landi et al., 2007). In the present study we also have shown that frailty predicted hospitalization, after adjusting for gender. The finding that a multidimensional measure of frailty can predict hospitalization is supported by Gobbens et al. (2012) and Landi et al. (2007), using the TFI and the Minimum Data Set for Home Care (MDS-HC), respectively. Landi et al. (2007) emphasizes the role of social factors in predicting hospitalizations; both persons living alone as persons with economic hardship were more at risk for hospitalization. In the study by Gobbens et al. (2012) hospitalization was only predicted by the physical frailty domain of the TFI.

Our study has some limitations. First, the short follow-up period (one year) may be considered as a limitation; maybe this period was too short to detect major changes in some adverse outcomes (e.g. ADL). In addition, the number of people that passed away was small (N = 19), which is related to both the short follow-up period and the relatively young population (mean age of 70.5 years). Second, the dropout was considerable (one third); it is not inconceivable that the "frailest" elderly dropped out leading to an underestimation of the predictive value of the TFI. Third, although the prevalence of frailty was similar to previous studies, possibly this figure would have been higher if people with cognitive, sensory or motor problems were not excluded. Fourth, as a substantial number of people had to be excluded from the study because of illiteracy, the practical use of the TFI as a self-report measure may be limited in areas with high illiteracy. For these areas, we recommend assistance in completing the TFI for those who cannot read well.

Early identification of frail elderly is an important first step aiming to diminish frailty and to prevent its adverse outcomes (De Lepeleire et al., 2009; Lacas & Rockwood, 2012). Our findings suggest that primary health care professionals in Brazil can use the TFI for the identification of frailty. The TFI is an attractive instrument to use in practice because completing the TFI takes less than 15 min (Gobbens et al., 2012). In addition, the scores on the frailty domains and in particular the items of the TFI provide a direction to the interventions that should be carried out by health care professionals (e.g. general practitioner, nurse, physiotherapist). Characteristics of promising interventions among frail elderly with the aim to prevent functional loss in ADL are: multidisciplinary and multifactorial in nature preceded by a tailor-made assessment, involving case management and long-term follow up (Daniels, Metzelthin, van Rossum, Witte de, & van den Heuvel, 2010). A systematic review and meta-analysis also found that elderly might benefit from an assessment and complex interventions, defined as interventions related to different aspects of care (e.g. based on medical and social needs), and with regard to living safety and independently (Beswick et al., 2008). Puts et al. (2017) found that physical activity interventions and rehabilitation reduced the level of frailty. However, more studies seem necessary to establish which interventions are both effective and efficient to prevent frailty and adverse outcomes in elderly, so quality of life is maintained.

5. Conclusions

In conclusion, our study showed that the TFI is a valid instrument to predict falls, loss of functional capacity in basic activities of daily living and instrumental activities of daily living, hospitalization and death among community-dwelling elderly in Brazil. This evaluation of the predictive validity of the Brazilian version of the Tilburg Frailty Indicator completes the process of cross-cultural adaptation and validation of the original instrument. We offer primary health care professionals in Brazil the TFI, a user-friendly instrument, which they can use for the identification of frail elderly.

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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