

Association among measures of mobility-related disability and self-perceived fatigue among older people: a population-based study

Wuber J. S. Soares¹, Camila A. Lima¹, Tereza L. Bilton²,
Eduardo Ferrioli³, Rosângela C. Dias⁴, Monica R. Perracini¹

ABSTRACT | Objective: To investigate the relationship between self-perceived fatigue with different physical functioning tests and functional performance scales used for evaluating mobility-related disability among community-dwelling older persons. **Method:** This is a cross-sectional, population-based study. The sample was composed of older persons with 65 years of age or more living in Cuiabá, MT, and Barueri, SP, Brazil. The data for this study is from the FIBRA Network Study. The presence of self-perceived fatigue was assessed using self-reports based on the *Center for Epidemiologic Studies-Depression Scale*. The Lawton instrumental activities of daily living scale (IADL) and the advanced activities of daily living scale (AADL) were used to assess performance and participation restriction. The following physical functioning tests were used: five-step test (FST), the Short Physical Performance Battery (SPPB), and usual gait speed (UGS). Three models of logistic regression analysis were conducted, and a significance level of $\alpha < 0.05$ was adopted. **Results:** The sample was composed of 776 older adults with a mean age (SD) of 71.9 (5.9) years, of whom the majority were women (74%). The prevalence of self-perceived fatigue within the participants was 20%. After adjusting for covariates, SPPB, UGS, IADL, and AADL remained associated with self-perceived fatigue in the final multivariate regression model. **Conclusion:** Our results suggest that there is an association between self-perceived fatigue and lower extremity function, usual gait speed and activity limitation and participation restriction in older adults. Further cohort studies are needed to investigate which physical performance measure may be able to predict the negative impact of fatigue in older adults.

Keywords: physical therapy; aging; functional capacity; fatigue.

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● Introduction

Reports of fatigue are common in the older adult population^{1,2} and affect about 15-75% of community-dwelling older persons³⁻⁸, depending on the studied population. Fatigue is about twice as common in women and increases with age^{3,4}, possibly reaching 70% among older persons 85 years of age and older⁹. Self-perceived fatigue is characterized as a subjective, conscious, and unpleasant symptom that involves the whole body and may be influenced by intrinsic and extrinsic factors. Under this perspective, a conscious report of tiredness is the most relevant information for fatigue evaluation².

Self-perceived fatigue has a complex and multidimensional nature⁶. Different types of fatigue may coexist in the same person, thus hampering the

identification of etiological factors. The most frequent types are mental fatigue, which may be subdivided into emotional and cognitive, and physical fatigue, which may be subdivided into sleepiness, low strength, and energy loss¹⁰. Studies highlight that there is a negative impact of self-perceived fatigue over mental and physical health and over functionality in older persons¹¹⁻¹³.

Some studies have pointed out a substantial relationship between self-perceived fatigue, functional disability, and performance restriction in activities of daily living^{11,13}. Older persons that reported fatigue presented less handgrip strength, slower walking speed, and poorer physical functionality of the lower limbs, even after comorbidity adjustment¹¹.

¹Programa de Mestrado e Doutorado em Fisioterapia, Universidade Cidade de São Paulo (UNICID), São Paulo, SP, Brazil

²Faculdade de Ciências Humanas e da Saúde, Pontifícia Universidade Católica de São Paulo (PUC-SP), São Paulo, SP, Brazil

³Departamento de Clínica Médica, Faculdade de Medicina de Ribeirão Preto (FMRP), Universidade de São Paulo (USP), Ribeirão Preto, SP, Brazil

⁴Departamento de Fisioterapia, Programa de Ciências da Reabilitação, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, MG, Brazil

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Ultimately, fatigue can be considered a complex health condition and it is associated with many domains of functionality among older adults, such as those related to body structure and function, activity limitation, and participation restriction, which encompass the International Classification of Functioning, Disability and Health framework (ICF)¹⁴.

Despite observed association between fatigue and physical function, the majority of studies have been carried out with older adults that have specific health states or diseases, such as older persons in pulmonary rehabilitation¹⁵ or suffering from cancer¹⁶ or cardiac issues¹⁷. Besides, very few investigations addressed the magnitude of this association between fatigue in a comprehensive approach using physical functioning capacity and performance instruments among older persons living in the community. Therefore, a cross-sectional study was performed to investigate the relationship between self-perceived fatigue and different physical functioning tests and functional performance scales commonly used for evaluating mobility-related disability among community-dwelling older persons.

● Method

This is a cross-sectional, population-based study conducted in two Brazilian cities with similar human development indexes in the FIBRA Network Study (Frailty in Brazilian Older Adults). Households were enrolled according to population density and to the number of community-dwelling older adults living in the census areas. Participants were evaluated from March 2009 to April 2010.

People were excluded if they: presented cognitive impairment assessed by the Mini-Mental State Examination and adjusted by schooling¹⁸; had a permanent or temporary walking disability (canes and walkers were permitted, but not wheelchairs); presented a severe stroke or Parkinson's disease or terminal illness; or had a severe hearing and vision impairment hindering communication.

Study participants were evaluated in two phases. The first one consisted of face-to-face semi-structured interviews using a multidimensional questionnaire in a single session held by a trained health care professional, lasting 40 to 120 minutes. The second one consisted of a physical and functional data collection, lasting 20 to 30 minutes and using a battery of ten physical tests and anthropometric data, performed by physical

therapists at public schools, community centers, and healthcare centers next to the older adults' residences.

All subjects signed an Informed Consent Form approved by the Research Ethics Committee of Pontifícia Universidade Católica de São Paulo (PUC-SP), São Paulo, SP, Brazil under research protocol number 269/2007 for the FIBRA study in Barueri and by the Research Ethics Committee of Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto (HC/FMRP), Universidade de São Paulo (USP), Ribeirão Preto, SP, Brazil under protocol number 5018/2007 for the FIBRA study in Cuiabá, MT, Brazil.

The presence of self-perceived fatigue was evaluated using self-reports based on two questions from the *Center for Epidemiologic Studies-Depression Scale* (CES-D)¹⁹. Participants answered questions regarding their fatigue experience in the two previous weeks: "Did you feel that you had to make an effort to cope with your activities of daily living?" and "Did you leave many of your interests and activities behind?" Possible answers were "never/rarely, a few times, mostly, always." Those who reported "mostly" and "always" in one of the questions were considered to have self-perceived fatigue¹¹.

To characterize the sample, sociodemographic variables and physical/mental health conditions were investigated. Regarding physical and mental health variables, the following characteristics were evaluated: number of diseases diagnosed by a doctor within the last year and reported by the participants from a list (heart disease, lung disease, high blood pressure, stroke, diabetes, depression, malignant tumor), number of medications of continuous use taken within the last 3 months, falls within the last year, presence of health problems within the last year (urinary incontinence, falls, memory issues, trouble sleeping). The presence of depression was evaluated by the Geriatric Depression Scale (GDS-15)²⁰ and participants who presented five or more depressive symptoms were considered to have a positive screening for depression. Excessive sleepiness was evaluated using the Epworth Sleepiness Scale (cutoff >11 points)²¹. Self-rated health was evaluated by asking the older adults how they perceived their own health in general (very good, good, regular, poor or very poor); the ones who answered "poor" or "very poor" were considered to have a poor health perception. Physical activity level was evaluated using the Minnesota Leisure Times Activities Questionnaire (MLTPA-Q)^{22,23}. Older persons whose energy expenditure was inferior to 450 mets/week were considered to be sedentary²⁴.

In order to investigate the association between fatigue and functional performance, we used the Lawton Instrumental Activities of Daily Living scale²⁵. Social participation was measured using the advanced activities of daily living scale²⁶. The physical-functioning tests conducted were: the Five-Step test²⁷, the Short Physical Performance Battery (SPPB)²⁸, and usual gait speed²⁹.

The Five-Step Test measures the time (in seconds) it takes for the participant to go up and down a 10.1 cm wooden platform five times in a row. A cut-off point of 21 seconds was used²⁷. Usual gait speed was measured from the time taken to walk a 4.6 meters long path, having 2 meters for acceleration and another 2 for deceleration. The test was carried out three times and the average was used. A cut-off point of 1.0 m/s was used.

The Short Physical Performance Battery (SPPB)²⁸ assesses the overall functionality of the lower limbs and consists of three parts: body stability balance test, usual gait speed, and the sit-to-stand test. Scores range from zero (worst performance) to 12 points (best performance). A cut-off point of 7 points or less was used³⁰.

Comparison of older adults with and without fatigue regarding sociodemographics and clinical variables was carried out using the Chi-Square or Fisher's Exact

tests. To compare both groups in terms of physical functioning capacity and functional performance, the T test or Mann-Whitney test was used, according to the adherence to normal distribution. Three models of logistic regression analysis were conducted in order to investigate the magnitude of association among fatigue and physical functioning capacity, functional performance, and social participation. Model 1 shows the crude logistic regression analysis. Model 2 was adjusted for the following covariates: number of diseases, memory difficulty, urinary incontinence, physical inactivity, and daytime excessive sleepiness. Model 3 was adjusted for covariates included in Model 2 plus arthritis, osteoporosis, hypertension, and depressive symptoms. The odds of presenting fatigue with confidence intervals of 95% (CI 95%) and *p* values were reported for each model. The adopted significance level was $\alpha < 0.05$. Statistical analyses were made using the program SPSS®, version 19.0 or Windows.

● Results

As shown in Figure 1, 776 older persons took part in this study, 391 of whom were from Cuiabá and 385 from Barueri. The mean age (SD) was 71.9 (5.9) years and from all participants 64% were women and

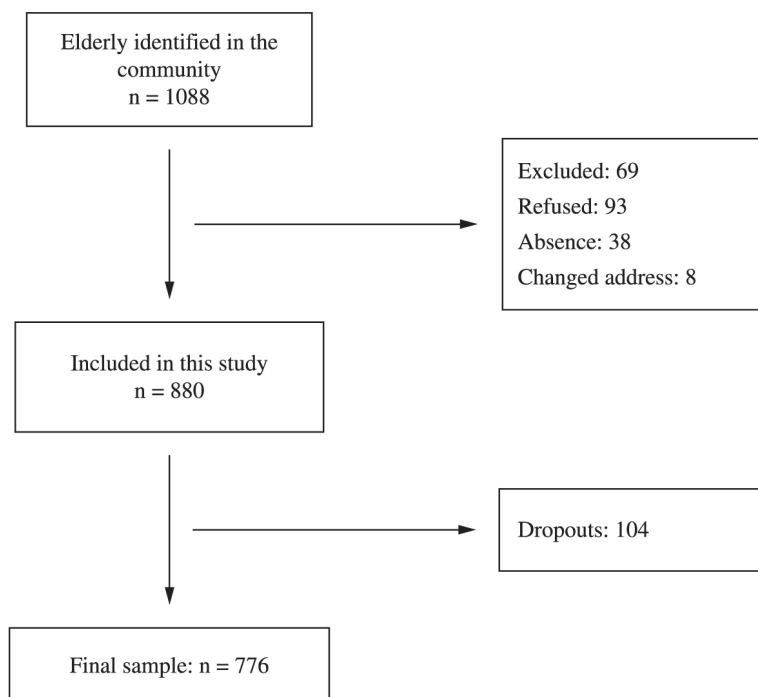


Figure 1. Flow chart of study participants.

50% rated their health as poor. The prevalence of fatigue within the participants was 20.1%. The comparison between fatigued and non-fatigued older persons, according to sociodemographic variables, diseases, health conditions, depression, and sedentarism is shown in Table 1.

Older persons who reported fatigue had a poorer performance in physical-functioning tests and a greater

restriction in advanced and instrumental activities of daily living when compared to non-fatigued older persons (Table 2). After adjusting for covariates, the SPPB, the usual gait speed and the advanced and instrumental activities of daily living remained significantly associated with fatigue in the final model (Table 3).

Table 1. Sociodemographics and clinical characteristics among non-fatigued and fatigued community-dwelling older adults, FIBRA study (n=776).

Characteristics	Total Population n=776	Non fatigued n=621	Fatigued n=155	p-value
Female Sex	497 (64.0)	381 (62.2)	116 (71.2)	0.035
75 years old and over	225 (29.0)	173 (28.2)	52 (31.9)	0.382
Schooling (0-4 years)	577 (74.4)	448 (73.1)	129 (79.1)	0.130
Income (0-1 MW)*	411 (54.7)	316 (53.5)	95 (59.4)	0.210
Diseases (≥4)	153 (19.8)	93 (15.2)	60 (37.0)	<0.001
Medication (≥4)	220 (28.4)	171 (27.9)	49 (30.1)	0.625
Arthritis	239 (30.8)	164 (26.8)	75 (46.0)	<0.001
Osteoporosis	209 (26.9)	155 (25.3)	54 (23.1)	0.047
Hypertension	521 (67.1)	393 (64.1)	128 (78.5)	<0.001
Falls	300 (38.7)	217 (35.4)	83 (50.9)	<0.001
Memory problems	381 (49.2)	289 (47.2)	92 (56.4)	0.042
Sleeping problems	333 (43.0)	260 (42.6)	73 (44.8)	0.656
Excessive sleepiness	162 (20.9)	116 (18.9)	46 (28.2)	0.012
Poor self-rated health	393 (50.6)	289 (47.1)	104 (63.8)	<0.001
Urinary incontinence	157 (20.3)	110 (17.9)	47 (29.0)	0.003
GDS**	194 (25.0)	108 (17.6)	86 (52.8)	<0.001
Sedentary< 450 Mets	199 (25.9)	145 (24.0)	54 (33.1)	0.021

*MW-Minimum Wage R\$ 465.00 (four hundred and sixty five Reais) a month according to Law 11.944 of 2009³¹. **GDS: Geriatric Depression Scale.

Table 2. Physical functioning limitation and participation restriction among non-fatigued and fatigued community-dwelling older adults. FIBRA study (n=776).

	Total Population n=776	Non-fatigued n=621	Fatigued n=155	p-value
SPPB <7	145 (18.7)	98 (16.0)	47 (28.8)	<0.001
SPPB. median (IQI)	10.0 (3.0)	10.0 (3.0)	9.0 (3.0)	<0.001‡
UGS< 1m/s	341 (44.0)	235 (38.3)	106 (65.4)	<0.001
UGS. mean (SD)	1.04 (0.29)	1.07 (0.29)	0.89 (0.26)	<0.001*
Five-step test >21s	309 (39.9)	222 (36.2)	87 (53.7)	<0.001
Five-step test. mean (SD)	16.2 (6.2)	15.7 (5.9)	18.4 (7.0)	<0.001
AADL >5	393 (50.7)	350 (57.2)	43 (26.4)	<0.001
AADL. median (IQI)	5.0 (5.0)	5.0 (4.0)	8.0 (5.0)	<0.001‡
IADL >0	464 (59.8)	406 (66.2)	58 (35.6)	<0.001
IADL. median (IQI)	0.0 (2.0)	0.0 (1.0)	2.0 (4.0)	<0.001‡

SPPB: Short Physical Performance Battery; GS: Gait Speed; AAVD: Advanced Activity Daily Living; IADL: Instrumental Activity Daily Living.

‡ Mann-Whitney test. *Student's t test.

Table 3. Multivariate models for the association of mobility-related disability measures and self-perceived fatigue among community-dwelling older adults. FIBRA study (n=776).

Variables	OR	Model 1		OR	Model 2		OR	Model 3	
		95%-CI	p value		95%-CI	p value		95%-CI	p value
SPPB <7	2.12	1.42-3.18	<0.001	1.73	1.13-2.65	0.011	1.58	1.02-2.47	0.041
UGS <1 m/s	3.04	2.11-4.37	<0.001	2.62	1.79-3.83	<0.001	2.44	1.65-3.61	<0.001
Step Test >21 s	1.98	1.28-3.09	0.002	1.44	0.89-2.32	0.133	1.44	0.87-2.39	0.150
AADL >5	3.72	2.54-5.47	<0.001	3.52	2.37-5.23	<0.001	2.93	1.95-4.41	<0.001
IADL >0	3.55	2.47-5.09	<0.001	3.06	2.10-4.46	<0.001	2.53	1.71-3.73	<0.001

SPPB: *Short Physical Performance Battery*; GS: *Gait Speed*; AADL: *Advanced Activity Daily Living*; IADL: *Instrumental Activity Daily Living*. Model 1: univariate analysis; Model 2: adjusted for covariates: number of diseases, memory difficulty, urinary incontinence, physical inactivity and daytime excessive sleepiness; Model 3: adjusted for covariates in Model 2 plus arthritis, osteoporosis, hypertension and depressive symptoms.

● Discussion

The present study analyzed the prevalence of self-perceived fatigue and its association with physical-functioning capacity, functional performance, and participation restriction among a representative sample of community-dwelling older persons. We observed an independent relationship between self-perceived fatigue and the functionality of lower limbs, assessed by the SPPB, and usual gait speed. In addition, fatigue was also associated independently with functional performance and activity restriction identified by the older person's ability to perform instrumental and advanced activities of daily living. These associations remained significant even after the regression model was adjusted for covariates such as the number of comorbidities, the presence of diseases, specific health conditions, and depressive symptoms.

The negative effects of fatigue may contribute to a vicious cycle of low functionality with severe limitations in psychomotor skills, thus raising the risk of progressive physical functioning decline and activity restriction in older people. From this perspective, the assessment of physical-functioning tests may demonstrate more adequately the negative impact of fatigue on older people's health than considering only the presence of specific diseases^{32,33}.

Fatigue in older adults can be classified into physical fatigue and mental fatigue¹⁰. It is common for older persons to experience more than one kind of fatigue and for conditions that relate to physical fatigue (muscle weakness, sleep disorders, and a low level of energy) and mental fatigue (depressed humor and poor focus) to interact concentrically and not in a linear fashion, ultimately demonstrating the multifactorial nature of fatigue within this population^{10,33}.

Clinical evaluation, when performed properly, is a stage that optimizes eldercare. Choosing an

evaluation instrument that accomplishes the main complaint is crucial for treatment planning, especially in a service with excessive patient turnover and absence of state-of-the-art technology. Physical functioning tests are objective measures that reflect functional limitations, whilst self-reported measures of functional performance may bring some bias related to gender and cultural differences, leading some authors to consider that functional capacity tests might predict disability more accurately than self-reported questionnaires. This leads to a wide acceptance of the use of physical-functioning tests to evaluate the functionality level of older people¹⁴. On the other hand, today there is also a relevant discussion towards the concept that disability should be considered an umbrella concept that includes the involvement of people in daily life situations and that the environment should be considered an important contextual factor that may influence how disability is experienced by the individual³².

Our results reveal that despite the adjustment for important covariates, there is a significant relationship between the SPPB, usual gait speed, and self-perceived fatigue. The SPPB has been recommended as an instrument to evaluate functional ability in older persons, essentially physical functionality of the lower limbs, and it is capable of predicting future functional decay^{29,30}. SPPB comprises three dimensions: balance in static position, usual gait speed, and lower limb strength to sit down and rise from a chair. Muscle weakness in the lower limbs is frequently associated with physical fatigue and has an impact on the ability to generate isometric muscle contraction to maintain posture in a static position, which may negatively affect the performance in SPPB balance tests. Besides that, muscle weakness in the lower limbs may directly impair the ability to perform the test of sitting down and rising from a chair. It has been observed that

there is a relationship between self-perceived fatigue and peak torque¹³, which represents the individual's maximum muscle strength, demonstrating the highest muscle performance level in the isokinetic test. A plausible explanation for this relationship may be the increased use of the oxidation pathway during muscle contraction and strength generation to produce adenosine triphosphate (ATP)^{13,34}.

Gait speed is described in the literature as a powerful predictor of survival, disability, hospitalization or institutionalization, dementia, and falls³⁵. A substantial relationship between usual gait speed and self-perceived fatigue has been observed in this study. Although gait speed is a test that is also included in the SPPB, our results showed that the performance in the walking speed test alone presented a more significant relationship with fatigue. A plausible explanation for this would be that fatigued older persons would self-select their walking speed accordingly with their perception of functional reserve³⁵. In addition, a decline in peak torque during muscle contraction was proved to negatively affect the walking speed^{34,35}. The ability to maintain a steady position for only 10 seconds, a task that is also assessed in SPPB, is possibly less affected by the negative perception of being fatigued. However, the sit to stand task demands energy expenditure and the perception of being fatigued might influence this test. An explanation would be that the composite effect of the three tests would less influenced by perceived fatigue than the gait speed test alone.

Our study design restrains the use of gait speed and SPPB as predictors of disability due to fatigue. For physical therapists involved in clinical practice, it is important to observe that older people with fatigue may show a poor performance in these measures. Consequently, a further evaluation of its implications should be conducted among this population.

● Conclusion

Our results suggest that there is an association between self-perceived fatigue and lower extremity function, usual gait speed and activity limitation and participation restriction in older adults. Further cohort studies are needed to investigate which physical performance measure may be able to predict the negative impact of fatigue in older adults.

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Correspondence

Monica R. Perracini

Universidade Cidade de São Paulo
Rua Cesáreo Galeno, 448, Tatuapé
CEP 03071-000, São Paulo, SP, Brasil
e-mail: monica.perracini@unicid.edu.br