REVISTA DA ESCOLA DE ENFERMAGEM DA USP
JOURNAL OF SCHOOL OF NURSING · UNIVERSITY OF SÃO PAULO

REVIEW

DOI: http://dx.doi.org/10.1590/S1980-220X2017028703392

Physical frailty and gait speed in community elderly: a systematic review

Fragilidade física e velocidade da marcha em idosos da comunidade: uma revisão sistemática

Fragilidad física y velocidad de la marcha en personas mayores de la comunidad: una revisión sistemática

Maria Angélica Binotto[1,2], Maria Helena Lenardt[1], María del Carmen Rodríguez-Martínez[3]

How to cite this article:
Binotto MA, Lenardt MH, Rodríguez-Martínez MC. Physical frailty and gait speed in community elderly: a systematic review. Rev Esc Enferm USP. 2018;52:e03392. DOI: http://dx.doi.org/10.1590/S1980-220X2017028703392

[1] Universidade Federal do Parana, Programa de Pos-Graduacao em Enfermagem, Curitiba, PR, Brazil.

[2] Universidade Estadual do Centro-Oeste, Departamento de Educação Física, Guarapuava, PR, Brazil.

[3] Universidade de Málaga, Málaga, Spain.

ABSTRACT

Objective: To identify the outcomes of studies on gait speed and its use as a marker of physical frailty in community elderly. **Method:** Systematic review of the literature performed in the following databases: LILACS, SciELO, MEDLINE/PubMed, ScienceDirect, Scopus and ProQuest. The studies were evaluated by STROBE statement, and the PRISMA recommendations were adopted. **Results:** There were 6,303 studies, and 49 of them met the inclusion criteria. Of the total number of studies, 91.8% described the way of measuring gait speed. Of these, 28.6% used the distance of 4.6 meters, and 34.7% adopted values below 20% as cutoff points for reduced gait speed, procedures in accordance with the frailty phenotype. Regarding the outcomes, in 30.6% of studies, there was an association between gait speed and variables of disability, frailty, sedentary lifestyle, falls, muscular weakness, diseases, body fat, cognitive impairment, mortality, stress, lower life satisfaction, lower quality of life, napping duration, and poor performance in quantitative parameters of gait in community elderly. **Conclusion:** The results reinforce the association between gait speed, physical frailty and health indicator variables in community elderly.

DESCRIPTORS

Gait; Aging; Aged; Frail Elderly; Review.

Corresponding author:
Maria Angélica Binotto
Av. Pref. Lothario Meissner, 632, 3º andar
CEP 80210170 – Curitiba, PR, Brazil
manbinotto@yahoo.com.br

Received: 07/20/2017
Approved: 06/04/2018

INTRODUCTION

Physiological changes in aging, sometimes aggravated by the presence of chronic diseases, result in geriatric conditions arising in advanced ages and are amenable to prevention and treatment. Frailty is an example of a severe adverse outcome in the elderly. It increases substantially after the age of 75-80 years, and identifies a subgroup with low resistance and high risk of dependence, falls and mortality[1]. This condition has been recognized as a geriatric syndrome because of its complex symptoms, high prevalence in the elderly, and for being a result of several diseases and multiple risk factors[2-3]. Therefore, it represents a priority for public health[4].

Conceptually, physical frailty is defined as "a medical syndrome with multiple causes characterized by decrease of strength, endurance, and reduction of physiological functions that increase the individual's vulnerability for development, and greater dependence and/or death"[5]. It is associated with outcomes such as falls, dependence, hospitalization, institutionalization, death[3,5-6], risk of compromised recovery after illness, surgery and worse response to treatment[1].

The prevalence of physical frailty is described in international studies conducted with elderly people from communities in different countries, such as South Korea/Asia (9.3% frail and 42% pre-frail)[7], Japan (6.3% frail and 49.5% pre-frail)[8], France (7% frail)[9], residents in the province of Toledo, Spain (8.4% frail and 41.8% pre-frail)[10] and elderly from Taiwan/China (8.3% frail and 45.9% pre-frail)[3]. In Latin America and the Caribbean, researchers analyzed 29 studies and 43,083 elderly subjects through a systematic review and meta-analysis, and results showed percentages of 19.6%, ranging from 7.7% to 42.6%[11].

The functional aspects affected by the condition of frailty are those dependent on energy and speed of performance, and affect tasks that require mobility[6]. From this perspective, one of the frailty phenotype markers is gait speed (GS). Reduced GS is the main indicator of physical frailty in the elderly[12-13]. Besides being one of the pillars of the frailty phenotype, GS is strongly related to sarcopenia[14].

GS can be influenced by individuals' health status, neuromuscular control, cardiorespiratory condition, physical activity level, sensorial and perceptual functions, as well as by characteristics of the environment where they walk[15]. Over time, these combined processes lead to scarcity of available energy, including that for the body's homeostatic balance. Thus, the elderly may develop adaptive behaviors, such as reduced GS[16]. The gait is a sequence of repeated movements of the lower limbs in order to move the body forward, while simultaneously holding the posture steady. For the harmonious performance of these movements, there must be a perfect balance between external forces acting on the body and the response of internal forces from muscles, tendons, bones, ligaments and joint capsules[17].

GS measurement is an indicator of the elderly's health status and wellbeing[18]. It is easily measurable, clinically interpretable and a potentially modifiable risk factor[15]. GS has been recognized as a vital sign, and a valid, reliable and sensitive measure for assessing and monitoring the elderly's functional status and health conditions[19-21]. In addition, GS is a parameter of impairment of physical and cognitive functions, and a strong clinical indicator of the presence of frailty[22]. In a cross-sectional study, was investigated the prevalence of frailty and gait speed, and the relationship between these two indicators was analyzed in a sample of 1,327 individuals aged 65 years or older residing in Northern Madrid, Spain. The results showed that 32.1% of the elderly aged 75 years or older presented reduced GS (<0.8 m/s) and high risk of frailty[23].

Gait speed is an important indicator of health conditions and physical frailty in the elderly, and like other physical changes, it suffers a decline with aging[24]. In a study, were analyzed data from seven studies conducted in the United States and Italy with the objective of estimating the incidence of disability and risk of mortality in 27,220 elderly people (≥65 years old) living in the community and monitored for three years. The results showed GS as a predictor of disability and mortality in the elderly[21]. A study was developed with the objective of investigating the pre-frail condition and its associated factors, and were considered the GS measurements of 195 elderly (≥60 years) users of a Basic Health Unit of Curitiba/PR/Brazil. The condition of pre-frailty for GS was 27.3% and associated with the following: age group between 60 and 69 years old, low schooling, not feeling lonely, use of antihypertensive medication, presence of cardiovascular disease and overweight[25].

This systematic review of the literature is justified by the academic-scientific contribution of a set of knowledge on an emerging topic in geriatrics and gerontology, and more specifically on GS, which has appeared as an important measure in gerontological evaluation.

In view of the above, the objective of the systematic review was to identify the outcomes of studies on gait speed and its use as a marker of physical frailty in community elderly.

METHOD

For the selection of studies and writing of the systematic review, were used the items proposed by the Checklist Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)[26]. The STROBE statement (Strengthening the reporting of observational studies in epidemiology)[27] was used for evaluation of the availability of information and methodological procedures adopted in the selected articles. The 22 checklist items refer to cohort, case-control, and sectional studies[28]. For each of the STROBE items, was assigned a score (integral – 1.0 point, partial – 0.5 points or nonexistent – 0 point) according to availability of information and/or adoption of the inquired procedure in the item, and the maximum value of 22 points. Higher scores represent greater availability of information and methodological procedures adopted by the studies. The checklist was applied individually for each study.

The research question[29] was: what are the results presented in studies regarding gait speed and its use as a marker of physical frailty in community elderly?

The search for studies was performed in September and October 2016. The following databases were consulted: LILACS, SciELO, MEDLINE, PubMed, ScienceDirect, Scopus, ProQuest (Health And Medical Collection). The following descriptors in Health Science (DeCS) were used: "envelhecimento", "aging", "idoso", "aged", "elderly", "idoso fragilizado", "frail elderly", "marcha", "gait". For the search, were used different combinations of descriptors with the Boolean operators "OR" and "AND", and additional words such as "fragilidade", "frailty"; "velocidade da marcha", "gait speed". The combination used for each database is described in Chart 1.

Chart 1 – Search strategies used for each database of this systematic review.

Database	Search strategies
LILACS	"aging OR aged OR elderly AND frail elderly OR frailty AND gait OR gait speed"; "frail elderly AND gait"; "envelhecimento OR idoso AND idoso fragilizado OR fragilidade AND marcha OR velocidade da marcha" "Idoso fragilizado AND marcha"
SciELO	"aging OR aged OR elderly AND frail elderly OR frailty AND gait OR gait speed";"frail elderly AND gait";"envelhecimento OR idoso AND idoso fragilizado OR fragilidade AND marcha OR velocidade da marcha""Idoso fragilizado AND marcha"
MEDLINE	"aging OR aged OR elderly AND frail elderly OR frailty AND gait OR gait speed"; "frail elderly AND gait"
PubMed	"aging OR aged OR elderly AND frail elderly OR frailty AND gait OR gait speed"; "frail elderly AND gait"
ScienceDirect	"aging OR aged OR elderly AND frail elderly OR frailty AND gait OR gait speed"; "frail elderly AND gait"
Scopus	"aging OR aged OR elderly AND frail elderly OR frailty AND gait OR gait speed"; "frail elderly AND gait"
ProQuest	"frail elderly OR frailty AND gait OR gait speed"; "frail elderly AND gait"

Studies considered as eligible for this systematic review were those that met the following inclusion criteria: a) published as an original article in scientific journals; b) publication period between January 2010 and October 2016; c) available in full in Portuguese, English or Spanish; d) indexed in the selected databases; e) indicating the evaluation of frailty by means of the frailty phenotype[6]; f) involving community elderly aged ≥60 years. The exclusion criteria adopted were: a) repeated in the databases; b) included as editorials, reviews, reports of experience, abstracts published in events, monographs, dissertations or theses, review studies and meta-analysis; c) conducted in hospital institutions or with long-term institution residents; d) involving elderly people with a specific disease (hypertension, diabetes, arthritis/arthrosis, cardiovascular diseases, Alzheimer's, Parkinson's).

The selection of studies and gathering of information were performed by two reviewers independently with the aid of a standardized instrument. Firstly, the following information was collected from the selected studies: location (country) where the study was conducted, year and journal of publication, study design, number and characteristic of the sample involved. Secondly, were extracted the objective, prevalence of categorization of physical frailty (frail, pre-frail and non-frail), form of GS measurement, prevalence of reduced GS as a marker of physical frailty and outcomes of the GS.

The procedures for selection of eligible studies involved reading the titles, abstracts and the studies in full. Studies that did not meet the inclusion criteria or did not address the research question were excluded. When applying the search strategies, were found 6,303 studies in the seven databases consulted. After screening, 49 studies were eligible for the systematic review. Figure 1 illustrates these steps, according to PRISMA methodological recommendations[26].

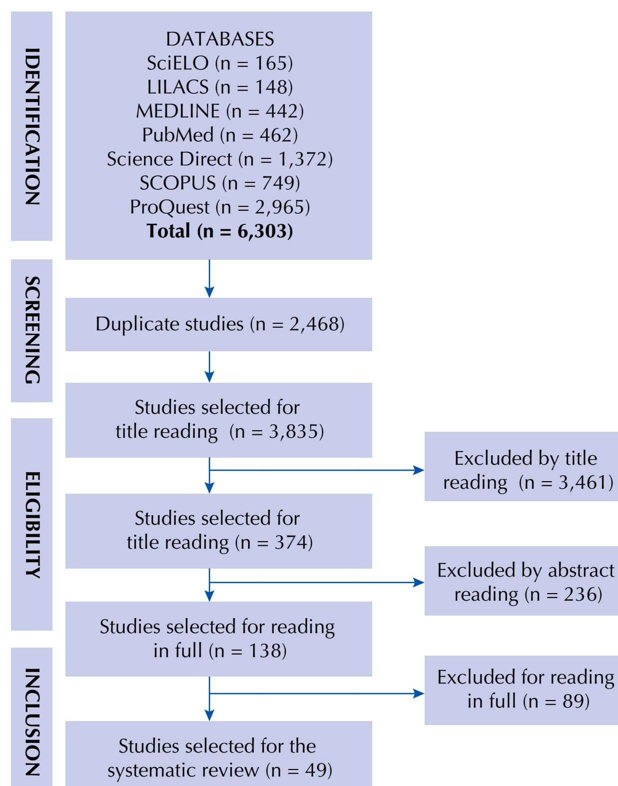

Figure 1 – PRISMA flowchart with information on phases of the selection process of studies for this systematic review.

RESULTS

The characteristics of the selected studies indicated there were more articles published in the years of 2015 (n=14; 28.6%), 2014 (n=12; 24.5%) and 2013 (n=12; 24.5%). Studies conducted in developed countries were predominant (n=25; 51%). Among developing countries, Brazil presented a significant number of studies on the subject (n=15; 30.6%). The majority of studies (n=38; 77.5%) were published in 34 different international journals. Regarding sample size, there were variations in quantity, ranging from 51 elderly subjects in a cross-sectional study to 13,924 participants in a cohort study. There was a predominance of cross-sectional or sectional studies (n=37; 75.5%), and participants' mean age ranged from 68.7±6.9 to 86.0±4.9 years (Table 1).

Table 1 shows the study designs, characteristics of the sample, study objectives, prevalence of frail, pre-frail and non-frail elderly, form of gait speed measurement, distribution of reduced gait speed, outcomes of gait speed in community elderly, and the STROBE score.

The GS measurement protocol was described in 45 (91.8%) studies, which demonstrates different ways of measuring this variable. The distance of GS was described in 34 (69.5%) studies and ranged from 2.4 to 20 meters. In 14 (28.6%) studies, was adopted a distance of 4.6 meters. Regarding the cutoff points for reduced GS, seven (14.3%) studies did not describe the values and adjustment variables, and of those where this information was reported, nine (18.4%) mentioned only adjustment variables (gender, height, body mass index - BMI). Out of the total number of studies, 30 (61.3%) reported cutoff points for reduced GS, of which 13 (26.5%) considered the values below 20% (quintile). In studies where the percentage of reduced GS (n=28; 57.2%) was described, there was a variation between 2.7% and 83.9%. The prevalence of reduced GS as a marker of physical frailty was not described in large part of the studies (n=21; 42.8%). In studies that described the prevalence of reduced GS (n=5; 10.2%) in frail and pre-frail groups, there was variation of 4.7% – 89% and 9.9% – 86.5%, respectively.

Fifteen (30.6%) studies emphasized as outcomes of GS, its association with the variables of disability, frailty, sedentary lifestyle, falls, muscular weakness, diseases, body fat, cognitive impairment, mortality, stress, lower life satisfaction, lower quality of life, napping duration and low performance in quantitative parameters of gait in community elderly. In 14 (28.6%) studies, the results referred to GS by sex. The classification of studies according to the STROBE statement resulted in a score ranging from 15 to 19.5 points with a prevalence of 18 points (n=10; 22.7%).

Table 1 – Description of the design, sample, objective (s), prevalence of physical frailty, GS measurement, prevalence of reduced GS, outcomes of GS and STROBE score in the studies selected for this systematic review.

Author and year	Study design	Sample characteristics	Objective(s)	Frailty classification	GS measurement*	Reduced GS*	GS main outcomes**	STROBE***
Srinivas-Shankar, Roberts, Connolly et al., 2010[30]	Randomized controlled	M ≥ 65 years	To determine the effects of 6 months of testosterone treatment on the muscle mass and strength, physical function and quality of life in pre-frail and frail elderly men.	Placebo: pre-frail 85% frail 15% Intervention: pre- frail 86% frail 14%	GS measured by Tinetti test.	Placebo: 8% Intervention 7%	There was improvement of GS throughout the 6 months of intervention, but without significant differences.	NA
Kim, Yabushita, Kim et al., 2010[31]	Cross-sectional	W Mean age 74.6±5.3 years	To compare and identify the risk of frailty in community-dwelling elderly women.	Frail 0% Pre-frail 68.2% Non-frail 31.8%	GS was assessed by walking speed and adjusted for sex and height.	2.70%	GS is strongly associated with the occurrence of disabilities, and the GS test is strongly associated with a high risk of frailty.	18/22
Pinedo, Saavedra, Jimeno et al., 2010[32]	Cross-sectional	147 W 99 M Mean age 69.9±7.6 years	To determine the gait speed cutoff point by indicating the presence of frailty in community elderly in Lima, Peru.	Frail 7.7% Pre-frail 64.4% Non-frail 27.9%	Slow GS was determined by a 4.5 m walk adjusted for body mass and height. The cutoff point for frail was 0.7 m/s and for pre-frail 1.1 m/s.	Missing information	The slowest GS was found in frail elderly, advanced age, and women.	16.5/22
Montero-Odasso, Muir, Hall et al., 2011[33]	Cross-sectional	78 W 22 M Mean age 82±5.4 years	To evaluate gait in community-dwelling elderly adults and to evaluate if gait variability is associated with frailty.	Frail 20% Pre-frail 55% Non-frail 25%	Slow GS was considered if the participant walked below 1 m/s at a normal and comfortable pace.	50%	Frailty is associated with poor performance in several quantitative parameters of gait.	19.5/22

continue…

Table 1…continuation

Author and year	Study design	Sample characteristics	Objective(s)	Frailty classification	GS measurement*	Reduced GS*	GS main outcomes**	STROBE***
Costa, Neri, 2011[34]	Cross-sectional	470 W 219 M Mean age 72.28±5.40 years	To investigate the relationships between frailty and measurements of physical activity.	Missing information	GS was indicated by the average time to walk a distance of 4.6 m. Participants with the 20% highest values of time distribution were considered frail. Averages were adjusted for median of height for men and women.	15.87%	Slow gait was associated with sedentary lifestyle. The median of women's gait time was higher than that of men.	18.5/22
Chang, Chen, Lin et al., 2012[35]	Cross-sectional	197 W 177 M Mean age 74.6±6.3 years	To identify the incidence of frailty and investigate the relationship between frailty and health with quality of life in the elderly.	Frail 5.9% Pre-frail 62.8% Non-frail 31.3%	Slow GS was determined by the completion time of the Get up and Go test. The cutoff point was defined by the slowest 20%.	17.20%	Slow GS contributed to poorer health and quality of life.	18.5/22
Subra, Gillette-Guyonnet, Cesari et al., 2012[36]	Missing information	99 W 61 M Mean age 82.7±6.1 years	To present the main characteristics of the platform for evaluation of frailty and prevention of disabilities.	Frail 52.9% Pre-frail 41.4% Non-frail 5.7%	Slow GS was measured during a 4 m walk. Elderly who took more than 4s to complete the task were considered slow.	83.90%	Slow GS was identified in 83.9% participants, 53.8% had sedentary lifestyle, and 57.7% had low muscle strength.	NA
Cameron, Fairhall, Langron et al., 2013[37]	Randomized controlled	147 W 69 M Mean age 83.3 years	To check the effects of intervention on frailty and on reduced mobility.	Control group n=120 frail, Intervention group n=121 frail	Missing information.	Missing information.	Mean GS: Control group=0.48 m/s and Intervention group=0.50 m/s.	NA
Amaral, Guerra, Nascimento et al., 2013[38]	Cross-sectional	202 W 98 M Mean age 74.3 years	To analyze the association between social support and the frailty syndrome in community-residing elderly.	Frail 18.3% Pre-frail 54.3% Non-frail 25.7%	The GS was calculated by gait time to cover a distance of 4.6 m. The results were adjusted for the median of height, and the lowest quintiles were used as the cutoff point.	19.0%	By considering the frailty screening criteria, the frequency of slow GS corroborates data from previous studies.	18/22
Pegorari, Ruas, Patrizzi, 2013[39]	Cross-sectional	22 W 29 M Mean age 73±6 years	To assess the impact of frailty on respiratory function in community-dwelling elderly.	Frail 9.8% Pre-frail 47.1% Non-frail 43.1%	The slow GS was evaluated by the time spent to walk a 4.6 m distance, and values were adjusted for sex and height.	23.50%	GS values showed no correlation with maximal inspiratory pressure and maximal expiratory pressure.	16/22
Pinto, Neri, 2013[40]	Cross-sectional	1.625 W 847 M Mean age 72.2±5.5 years	To identify factors associated with low life satisfaction in community elderly and to describe them according to sex and age group.	Missing information	GS was calculated by gait time to walk a 4.6 m distance. Reduced GS was defined by the lowest quintile, and adjusted for sex and height.	16.90%	GS was significantly lower in females (0.87 m/s) and in elderly aged ≥ 80 years (0.81 m/s). Reduced GS was significantly associated with lower life satisfaction.	16/22

continue…

Table 1…continuation

Author and year	Study design	Sample characteristics	Objective(s)	Frailty classification	GS measurement*	Reduced GS*	GS main outcomes**	STROBE***
Castell, Sánchez, Julián et al., 2013[23]	Cross-sectional	708 W 619 M Mean age 75.4±7.4 years	To estimate the prevalence of frailty and GS, and to analyze the relationship between these two indicators from the perspective of beginning of frailty diagnosis in the primary care context.	Frail 11.2% Non-frail 88.8%	GS was calculated after walking 3 m. Values were adjusted for sex and height.	42.60%	99.3% of frail elderly and 35.5% of non-frail had reduced GS. Measurement of GS is a simple, quick and easy to perform test, and is a good indicator of health and survival in the elderly.	18/22
Ruggero, Bilton, Teixeira et al., 2013[41]	Cross-sectional	248 W 137 M Mean age 71.4±5.7 years	To identify gait speed in a community elderly population and the association with sociodemographic, mental, and physical health characteristics.	Missing information	GS was calculated by gait time to walk a distance of 4.6 m. The average value of three runs was used for data analysis.	Missing information	The mean GS was 1.11 m/s, and 28.1% presented reduced GS. Elderly people ≥ 75 years old with low level of physical activity, diseases and fear of falls are more likely to present slow GS.	19/22
Vieira, Guerra, Giacomin et al., 2013[42]	Cross-sectional	398 W 203 M Mean age 76.7±5.8 years	To identify the prevalence and factors associated with frailty in community elderly in Belo Horizonte, Minas Gerais, Brazil.	Frail 8.7% Pre-frail 46.3% Non-frail 45%	The gait time was calculated by the time to walk a 4.6 m distance. Cutoff points were determined by the 80th percentile of the time adjusted for sex and height.	Pre-frail: 26.6% Frail: 86.5%	Reduced GS was one of the most frequent components among frail and pre-frail elderly.	18/22
Bollwein, Volkert, Diekmann et al., 2013[43]	Cross-sectional	134 W 72 M Mean age 83 years	To investigate the association between The Mini Nutritional Assessment and frailty in community elderly.	Frail 15.5% Pre-frail 39.8% Non-frail 44.7%	Low gait speed (adjusted for sex and height).	21.90%	Missing information	18.5/22
Neri, Yassuda, Araújo et al., 2013[44]	Cross-sectional	2,355 W 1,123 M	To identify conditions of frailty in relation to sociodemographic, health, cognition, functional and psychosocial variables in community elderly.	Frail 9.1% Pre-frail 51.8% Non-frail 39.1%	The slow gate was defined by the time to walk 4.6 m. The percentile above 80 was considered as reduced GS (values adjusted for sex and height).	19.90%	The percentages of elderly who scored for slow gait were statistically comparable between the percentages of frail, pre-frail and non-frail.	18/22
Perez, Lourenço, 2013[45]	Cross-sectional	537 W 227 M Mean age 76.8±6.8 years	To determine the risk profile and factors associated with frailty in the elderly.	Missing information	The GS was obtained by averaging three assessments of the time taken to walk 4.6 m in a straight line.	Missing information	GS was not significantly associated with the risk of hospitalization.	17.5/22
Sheehan, O'Connell, Cunningham et al,, 2013[46]	Cohort	417 W 189 M Mean age 72.8±7.2 years	To evaluate the relationships between Body Mass Index, frailty and falls.	Frail 8.1% Pre-frail 43.2% Robust 47.5%	Reduced GS was defined by the lowest percentile (20) of GS stratified by sex, as measured by the GAITRite™ walkway system.	10.20%	Obese elderly were significantly more likely to have reduced GS. Falls were significantly associated with reduced GS (p=0.02).	16/22

continue…

Table 1…continuation

Author and year	Study design	Sample characteristics	Objective(s)	Frailty classification	GS measurement*	Reduced GS*	GS main outcomes**	STROBE***
Moreno- Aguilar, Garcia-Lara, Aguolar- Navarro et al., 2013[47]	Cross-sectional	245 W 251 M Mean age 78.0±6.2 years	To determine the association between frailty, health and quality of life of the elderly.	Frail 12.7% Pre-frail 38.9% Non-frail 48.4%	Slow GS was evaluated by the response to two questions for estimating the slowness.	Missing information.	The gait speed (p<0.001) was independently and inversely associated with the physical dimension as a component of quality of life.	17/22
Romero-Ortuno, Soraghan, 2014[48]	Longitudinal	4,001 W 3,057 M Age ≥ 75 years	To create and validate an instrument for the evaluation of frailty in the elderly.	Frail 12.2% Pre-frail 40.9% Non-frail 46.9%	The following were observed by the interviewer: walking without the help of another person or using support.	Missing information.	Missing information.	18/22
Capistrant, Glymour, Berkman, 2014[49]	Cross-sectional	7,330 W 4,886 M Mean age 72.4 years	To evaluate the self-reported and measured indicators of functional mobility limitation among the elderly in six low- and middle-income countries.	Missing information	GS was assessed by timing the time to walk 4 m. The decrease in GS was estimated by the lowest quintile.	Missing information	Those with slow GS have a high likelihood of self-reporting difficult walking.	16,5/22
Santos, Ceolim, Pavarini el al., 2014[50]	Cross-sectional	1,155 W 658 M Age ≥ 65 years	To analyze the association between napping duration and the variables of sex, age, schooling, family income and the elderly's levels of frailty.	Pre-frail 51.9%	The low GS was indicated by the average time spent to walk the 4.6 m distance with adjustments according to sex and height.	18%	There was an association between napping duration and the decrease in GS (p=0.1770).	19.5/22
Han, Lee, Kim, 2014[7]	Cross-sectional	6,094 W 4,294 M	To examine the association between cognitive function and frailty in community-dwelling elderly.	Frail 9.3% Pre-frail 42.3% Robust 48.4%	For the slow gait speed, was considered the lowest quintile for the 2.5 m gait speed with adjustment for the mean height by sex.	Missing information.	Missing information.	17.5/22
Johar, Emeny, Bidlingmaier et al., 2014[51]	Cross-sectional	Age 65-90 years, Mean age 75.1 years	To examine the association of daytime cortisol secretion with frailty in the elderly.	Frail 3.36% Pre-frail 35.17% Robust 61.48%	Low gait speed defined for the longest time in the Timed Up and Go test (highest quintile stratified by sex and height).	Missing information	Slow GS was associated with increased cortisol levels at night.	18/22
Landi, Onder, Russo et al., 2014[52]	Cross-sectional	170 W 187 M Mean age 86.0±4.9 years	To evaluate the relationship between calf circumference and physical performance, muscle strength, functional status and frailty in long-lived elderly.	Missing information	Slow GS was identified by the cutoff point of <0.8 m/s to walk a 4 m distance.	Missing information	There was no association between calf circumference and gait speed.	18/22
Tavassoli, Guyonnet, Abellan Van Kan et al., 2014[53]	Missing information	686 W 422 M Mean age 82.9±6.1 years	To describe the Geriatric Frailty Clinic structure, the organization, details of overall assessment and preventive interventions against disabilities.	Frail 54.5% Pre-frail 39.1% Non-frail 6.4%	Reduced GS was defined by time > 4 s to walk 4 m.	51.40%	The mean gait speed was 0.78 ± 0.27 m/s.	NA

continue…

Table 1…continuation

Author and year	Study design	Sample characteristics	Objective(s)	Frailty classification	GS measurement*	Reduced GS*	GS main outcomes**	STROBE***
Curcio, Henao, Gomez, 2014[54]	Cross-sectional	981 W 897 M Mean age 70.9±7.4 years	To estimate the prevalence and factors associated with frailty in the elderly population in a rural area, and to analyze their relationship with comorbidity and functional disability.	Frail 12.2% Pre-frail 53% Non-frail 34.8%	Slow GS was defined as the lowest quintile in the 6 m gait speed test adjusted for sex and height.	24,40%	23.2% of frail elderly patients showed reduced GS. There was a statistically significant difference between men and women and slow GS (p <0.001).	19/22
Schoon, Bongers, Van Kempen et al., 2014[55]	Cross-sectional	333 W 260 M Mean age 76.8±4.8 years	To investigate whether a frailty assessment can be replaced by mobility testing as a prerequisite for self-monitoring of frailty.	Frail 10% Pre-frail 43% Non-frail 47%	Slow GS was defined as <0.76 m/s. The subjects walked twice at their preferred speed, and the GS was evaluated at a 4 m distance.	Missing information	GS has a strong correlation with frailty.	17.5/22
Darvin, Randolph, Ovalles et al., 2014[56]	Cohort	39 W 26 M Mean age 80.6±6.4 years	To confirm if plasma levels of glycoproteins and interleukin-6 are increased with frailty in the elderly.	Frail 18.5% Pre-frail 48% Non-frail 33.5%	Missing information.	Missing information.	Mean GS values for the elderly: Non-frail=2.8±0.5; pre-frail=2.8±0.7 and frail=3.9±1.4.	15/22
Alexandre, Corona, Nunes et al., 2014[57]	Cross-sectional	873 W 540 M ≥ 60 years	To analyze the similarities between associated factors and components of frailty in the elderly.	Missing information	The GS was determined by the Short Physical Performance Battery Assessing Lower Extremity Functional test. The 20% slower individuals were classified with reduced GS adjusted for height.	34.40%	The mean gait time for men was 4.03 ± 0.1, and for women, 4.5 ± 0.1. Joint disease, sedentary lifestyle, cognitive decline and muscle weakness were associated with slow GS.	16.5/22
Bez, Neri, 2014[58]	Cross-sectional	470 W 210 M Mean age 72.285±4 years	To describe conditions of grip strength, GS and health self-assessment, and to investigate relationships among them by considering the variables of sex, age and family income, in community-dwelling elderly members of a population study on frailty.	Missing information	GS was indicated by the mean time in seconds taken by each elderly person to walk a 4.6 m distance. The averages were adjusted for the median height for men and women.	Missing information	Elderly ≥ 80 years and women had lower GS; slow gait and low income were risk factors for worse health evaluation. The elderly with the highest risk of worse perceived health are those with the greatest limitation in gait speed (risk 1.9 times).	16.5/22
Silveira, Pegorari, Castro, et al., 2015[59]	Cross-sectional	32 W 22 M Mean age 72,9 ± 6 years	To check the association of palmar grip strength, GS, fear of falls and falls with frailty levels.	Frail 11.1% Pre-frail 46.2% Non-frail 42.5%	The reduced GS was measured by the time to walk a distance of 4.6 m. Cutoff points were based on the 20th percentile of the sample and adjusted for sex and height.	Frail 66.6% and pre-frail 36%	There was a significant difference between non-frail and pre-frail (p=0.0001), and non-frail and frail (p=0.0023) in relation to GS. Frailty is associated with decrease of GS.	17/22

continue…

Table 1…continuation

Author and year	Study design	Sample characteristics	Objective(s)	Frailty classification	GS measurement*	Reduced GS*	GS main outcomes**	STROBE***
Falsarella, Gasparotto, Barcelos et al., 2015[60]	Cross-sectional	142 W 93 M Mean age 71.76±5.06 years	To investigate the association between body composition and frailty and to identify profiles of body composition in non-frail, pre-frail and frail elderly.	Frail 12.7% Pre-frail 48% Non-frail 39.1%	The GS was indicated by the mean time in seconds taken by each elderly to walk a 4.6 m distance.	Missing information	GS was associated with fat mass and percentage of body fat. The mean was 0.94 m/s with a significant difference between women and men.	17.5/22
Nishiguchi, Yamada, Fukutani et al., 2015[61]	Cross-sectional	W Mean age 73.0±5.4 years	To determine if frailty and pre-frailty are associated with cognitive decline and sarcopenia in community elderly.	Frail 10.6% Pre-frail 56.8% Non-frail 32.6%	In order to measure slow GS, was calculated the speed to walk 10 m, and slow GS was defined as <1.0 m/s.	Missing information	There was a significant difference between GS and the frailty groups (frail, pre-frail and non-frail).	16.5/22
Çakmur, 2015[62]	Cross-sectional	90 W 78 M Mean age 72.70±7.73 years	To identify frailty and wellbeing problems in elderly people living in Turkey (characterized by low socioeconomic status).	Frail 7.1% Pre-frail 47.3% Non-frail 45.6%	Slow GS was measured by the 6 m gait speed test adjusted for sex and height according to the Short Physical Performance Battery (<0.8 m/s) standards.	83.20%	41.2% of men and 42% of women presented reduced GS.	18.5/22
Aguilar-Navarro, Amieva, Gutiérrez-Robledo et al., 2015[63]	Longitudinal	3,026 W 2,618 M Mean age 68.7±6.9 years	To describe the characteristics and prognosis of individuals classified as frail in a sample of community-resident Mexican elderly.	Frail 37.2% Pre-frail 51.3% Non-frail 11.5%	The low gait speed was evaluated by two self-reported questions. Participants who answered affirmatively to any of these questions were considered frail.	50.40%	41.4% of men and 58.2% of women presented reduced GS.	17.5/22
AT, Bryce, Prina et al., 2015[64]	Cohort	Missing information	To test the physical and multidimensional predictive validity of the frailty phenotype in Latin American countries, India and China.	Prevalence of frailty was 17.5%	The slow gait speed was evaluated by the time to walk 5 m. Those who took 16 s or more to complete the task were considered as slow speed.	Missing information	Association between slow GS and cognitive impairment with incident of dependence. Reduced GS was associated with both mortality and dependence.	19/22
Martínez-Ramírez, Martinikorena, Gómez et al., 2015[65]	Longitudinal	399 W 319 M Mean age 75.4±6.1 years	To investigate if parameters extracted from the signs of trunk acceleration can provide additional information about the frailty syndrome.	Frail 9.1% Pre-frail 45.5% Non-frail 45.4%	For slow GS, the elderly were asked to walk at their usual pace according to a standardized protocol. The slower quintile was considered slow.	Missing information	The results indicate there is a close relationship between frailty and gait patterns. Slow gait can provide relevant information for frailty assessment.	17/22

continue…

Table 1…continuation

Author and year	Study design	Sample characteristics	Objective(s)	Frailty classification	GS measurement*	Reduced GS*	GS main outcomes**	STROBE***
Parentoni, Mendonça, Dos Santos et al., 2015[66]	Cross-sectional	W Mean age 73.96±6.91 years	To evaluate the impact of gait speed on maximal inspiratory pressure, maximum expiratory pressure, hand grip strength and frailty in community-residents elderly.	Frail 30.2% Pre-frail 39.6% Non-frail 30.2%	Missing information.	Missing information	GS is a predictor of some health outcomes, including respiratory muscle function and frailty. The mean GS was 0.72 m/s. Non-frail= 0.95 m/s and pre-frail + frail=0.62 m/s.	16.5/22
Camicioli, Mizrahi, Spagnoli et al., 2015[67]	Cross-sectional	51 W 21 M	To determine the handwriting aspects associated with the frailty phenotype and to determine if handwriting was associated with aspects of frailty or cognitive impairment.	Missing information	Slow GS was defined by a walking time greater than 20 m based on height and sex cutoff points (Cardiovascular Health Study).	Missing information	For both sexes, the low overall writing speed was found in individuals characterized by reduced GS.	18.5/22
Shimada, Makizako, Doi et al., 2015[8]	Cohort	2,105 W 1,975 M Mean age 71.7±5.3 years	To identify the differences in disability incidence among frail elderly with and without reduced gait.	Frail 6.5% Pre-frail 49.3% Non-frail 44.2%	The GS was measured by the time to walk a 2.4 m distance. The slowness was defined according to the cutoff point < 1.0 m/s.	Frail 4.7% Pre-frail 9.9 %	The probability of disability incidence was significantly higher in pre-frail elderly without reduced GS, pre-frail with reduced GS, frail without reduced GS and frail with reduced GS compared to non-frail elderly (p <0.001).	18/22
Sergi, Veronese, Fontana, et al., 2015[68]	Cohort	956 W 611 M Mean age 73.6±6.7 years	To check if the pre-frailty condition prevents the onset of cardiovascular diseases in a cohort of community elderly without cardiac problems.	Pre-frail 44.7% Non-frail 55.3%	Reduced GS was defined using the timed walk in a 4-m route at normal pace stratified by sex and BMI cutoff points.	Missing information	Reduced GS is a strong predictor of incidence of cardiovascular diseases. Among the physical domains of pre-frailty, low GS is the best predictor of future cardiovascular diseases.	17/22
Chen, Honda, Chen et al., 2015[69]	Cross-sectional	934 W 593 M Mean age 73.3±6.0 years	To define the domain of low physical activity of the frailty phenotype by using the measure based on accelerometer in community elderly.	Frail 9.3% Pre-frail 43.9% Non-frail 46.8%	The GS was defined by the time to perform a 5 m course. The 20% slower subjects stratified by sex and height were considered frail for GS.	17.10%	16.9% of men and 17.2% of women presented reduced GS.	19/22
Hörder, Skoog, Johansson et al., 2015[70]	Cohort	710 W 518 M ≥ 75 years	To compare trends of frailty by using data from two birth cohorts examined in 1987 and 2005.	Missing information	The GS was evaluated by the time spent to walk 20 m. Reduced gait speed was defined as < 1 m/s.	1987 cohort: 19% and 2005 cohort: 16%	Among women with better educational level, a smaller proportion presented reduced GS.	18.5/22

continue…

Table 1…continuation

Author and year	Study design	Sample characteristics	Objective(s)	Frailty classification	GS measurement*	Reduced GS*	GS main outcomes**	STROBE***
Schwenk, Mohler, Wendel et al., 2015[71]	Cross-sectional	100 M 25 H Age ≥ 65 years	To analyze the ability of evaluation of gait, balance and physical activity based on sensors in order to determine the levels of frailty (non-frail, pre-frail, frail).	Frail 16.8% Pre-frail 48% Non-frail 35.2%	Slow GS was quantified by the time to walk a 4.57 m distance stratified by sex and height.	Missing information	The stride length and the double support significantly discriminated the frailty state. Elderly patients who used assistive devices had slower GS, and these differences increased with increasing frailty.	18/22
Liu, Lyass, Larson el al., 2016[72]	Cross-sectional	Age ≥ 60 years	To investigate if inflammatory and oxidative stress biomarkers linked to cardiovascular disease were associated with frailty and the related outcome of GS.	Frail 7.4% Pre-frail 45.1% Non-frail 47.5%	For assessment of slow GS, participants walked 4 m. They were classified as slow according to criteria of Fried et al.	Frail 89% Pre-frail 41%	Increased levels of isoprostanes and Lp-PLA2 mass were associated with a greater probability of frailty. Higher mean concentrations of these biomarkers and osteoprotegerin were associated with reduced GS. There is a relationship between oxidative stress and GS.	17.5/22
Jones, Neubauer, O'Connor et al., 2016[73]	Missing information	W and M Mean age 77±8 years	To determine if muscle activity recorded during the specific task or groups of tasks could be used to correctly classify the frailty phenotype in the elderly.	Frail 9.2% Pre-frail 26.3% Non-frail 64.5%	GS was calculated by the time to walk a 4.6 m distance. Those with gait speed of less than 1 m/s were identified as frail. The cutoff points of 1.5 to 1.0 m/s and greater than 1.5 m/s defined the pre-frail and non-frail, respectively.	Frail 9.2% Pre-frail 23.7%	Pre-frail participants had faster gait speed than frail participants (p=0.001).	NA
Santos-Orlandi, Ceolim, Pavarini et al., 2016[74]	Cross-sectional	2,073 W 1,002 M	To analyze the association between napping duration and variables of gender, age, schooling, family income and levels of frailty of community elderly.	Frail 5.5% Pre-frail 51.5% Non-frail 38.9%	Low GS was indicated by the time spent to walk the 4.6 m distance with adjustments according to sex and height.	20.90%	Missing information	17.5/22
García-Peña, Ávila-Funes, Dent et al., 2016[75]	Cross-sectional	606 W 502 M Mean age 69.8±7.6 years	To determine the prevalence of frailty and associated factors by using the Fried phenotype and the frailty index.	Frail 24.9% Non-frail 75.1%	Slow GS was defined by the time to walk 4 m. The 20% subjects with lower values adjusted for sex and height were considered frail.	25.20%	22.3% of men and 28.3% of women presented reduced GS.	18/22

GS= gait speed; W= women; M= men; NA= not applicable.

Note: *GS outcomes as a marker of physical frailty (Fried et al.[6]).

**Result of GS as a measure of outcome in studies.

***STROBE= statement for evaluation of studies (score obtained/total score).

Note: (n=49 studies).

DISCUSSION

The results of the studies showed an association between GS and variables of disability[31], frailty[31-32,54-55,59,65-66], cognitive impairment, dependence, mortality[23,64], sedentary lifestyle[34,41], muscle weakness[57], worse health and quality of life[35,47,58], stress[51,72], napping duration[50], obesity[46], mass and percentage of body fat[60] and low performance in quantitative parameters of gait[33]. There was a significant association between reduced GS and lower life satisfaction[40], and the episode of fall at follow-up was significantly associated with reduced GS[46]. Low energy expenditure, exhaustion, and reduced gait speed are strong predictors of incidence of cardiovascular disease[68]. Elderly people aged 75 years and over, with low level of physical activity, stroke, diabetes, urinary incontinence and high concern with falls have a higher chance of having reduced GS[41].

The reduction of gait speed showed an association with mortality[18,76], cognitive impairment, functional disability[14,76], advanced age, physical inactivity and diseases[77-78].

As observed in the different studies, even though there is no established consensus for GS measurement, there was a predominance of distance of 4.6 meters[23,34,38,39-40,42,44-45,50,58-60,73-74], and cutoff points for reduced GS were defined by the lowest quintile value [7,34,40,42,44,49,54,57,59,65,69,72,75]. These studies follow the procedure/protocol of the study[6]. Given the importance of GS in clinical practice, there must be a consensus, a standardization of the measurement of this marker of physical frailty. The use of GS in clinical practice is recommended as a key tool in geriatric assessment given its simplicity, speed, objective parameter and sensitivity to changes caused by the aging process[17]. It is noteworthy that the studies included in this systematic review evaluated gait speed in different ways and presented diverse interventions and designs.

The distance for calculation of GS used in the different studies varied greatly. A recent systematic review revealed that gait speed distance ranged from four to six meters in 83% of the studies analyzed, and four meters was the most used distance[79]. In another study[14], was observed that most researchers used distances between four and six meters and the distance of the course should allow the test application in the clinical setting as a routine examination.

Reduced GS as a marker of physical frailty was higher in women compared to men[32,34,40,57-58,60,62-63,69,76]. This is confirmed by the results of nine studies, which totaled a sample of 26,625 elderly (≥ 65 years) living in the community. Researchers found a significantly lower percentage of GS (≤ 0.8 m/s) in women (31%), while it was 10% in men[80]. In contrast, in a study with the objective of investigating sex differences in gait patterns in elderly participants of the Baltimore Longitudinal Study of Aging, no difference between sexes for GS (p=0,185) was found after adjusting for age, height, and body mass[81].

The prevalence of reduced GS varied greatly in the studies, and values ranged from 2.7%[31] to 83.9%[36]. However, in most of them, the percentages of reduced GS as a marker of physical frailty were not described. In some studies[8,42,59,72-73], the prevalence of reduced GS was reported in frail and prefrail groups. This demonstrates that GS and other markers of physical frailty (fatigue/exhaustion, weight loss, physical activity, muscle strength) were poorly explored in the studies analyzed.

National surveys describe percentage values of reduced GS in the elderly close to those found in the present review. The study "Frailty in Brazilian Elderly (FIBRA)" with a sample of 5,532 community elderly (> 65 years) found that 20.9% of elderly people had slow gait. The markers with greatest odds for development of frailty were slow gait and muscle weakness[82]. In a study conducted with elderly (≥ 60 years) and the aim to associate physical frailty with the quality of life of elderly users of basic health care in Curitiba/PR/Brazil, 25.6% of the 203 elderly individuals participating showed reduced GS[83].

Studies[31,33,35,55,59,65-66] showed that frailty is associated with reduced GS, and these findings are in agreement with another study. Data from the English Longitudinal Study of Aging (ELSA) showed that 90% of elderly classified as fragile had reduced GS[84].

The limitations of this systematic review study are related to information deficits found in some studies, which can impair the analyzes. As for the method, the definition of the search period, languages and databases consulted may have delimited the search and, consequently, relevant studies on the subject may have not been selected.

CONCLUSION

The studies evaluating physical frailty in community elderly indicated the association of the outcome of GS with disabilities, frailty, sedentary lifestyle, falls, muscle weakness, diseases, body fat, cognitive impairment, mortality, stress, lower life satisfaction, lower quality of life, napping duration, and poor performance in quantitative parameters of gait in community elderly.

The GS measurement protocol varied among the studies. The distance and cutoff points for reduced GS defined by the frailty phenotype were adopted in some studies. Efforts are needed in order to standardize the way of measuring this variable, mainly because of its importance in clinical practice.

The findings of this systematic review reinforce the association between GS and physical frailty and health indicator variables in community elderly. The studies demonstrate the importance of GS measurement in gerontological evaluations. Randomized studies are recommended in order to validate and establish a consensus regarding the way of measuring GS as a tool for gerontological evaluation.

RESUMO

Objetivo: Identificar os desfechos dos estudos sobre velocidade da marcha e seu emprego como marcador de fragilidade física em idosos da comunidade. **Método:** Revisão sistemática da literatura realizada nas bases de dados LILACS, SciELO, MEDLINE/PubMed, ScienceDirect, Scopus e ProQuest. Os estudos foram avaliados pelo STROBE e adotaram-se as recomendações do PRISMA. **Resultados:** Obtiveram-se 6.303 estudos, e 49 deles atenderam aos critérios de inclusão. Do total de estudos, 91,8% descreveram a forma de mensuração da velocidade da marcha. Desses, 28,6% utilizaram a distância de 4,6 metros, e 34,7% adotaram valores abaixo de 20% como pontos de corte para velocidade da marcha reduzida, procedimentos que seguem o fenótipo de fragilidade. Quanto aos desfechos, em 30,6% dos estudos houve associação entre a velocidade da marcha e as variáveis incapacidades, fragilidade, sedentarismo, quedas, fraqueza muscular, doenças, gordura corporal, comprometimento cognitivo, mortalidade, estresse, menor satisfação com a vida, menor qualidade de vida, duração dos cochilos e baixo desempenho em parâmetros quantitativos da marcha em idosos da comunidade. **Conclusão:** Os resultados reforçam a associação da velocidade da marcha, fragilidade física e variáveis indicadoras de saúde em idosos da comunidade.

DESCRITORES

Marcha; Envelhecimento; Idoso; Idoso Fragilizado; Revisão.

RESUMEN

Objetivo: Identificar los resultados de los estudios acerca de la velocidad de la marcha y su empleo como marcador de fragilidad física en personas mayores de la comunidad. **Método:** Revisión sistemática de la literatura realizada en las bases de datos LILACS, SciELO, MEDLINE/PubMed, ScienceDirect, Scopus y ProQuest. Los estudios fueron evaluados por el STROBE y se adoptaron las recomendaciones del PRISMA. **Resultados:** Se lograron 6.303 estudios, y 49 de ellos atendieron a los criterios de inclusión. Del total de estudios, el 91,8% describieron la forma de medición de la velocidad de la marcha. De esos, el 28,6% utilizaron la distancia de 4,6 metros, y el 34,7% adoptaron valores por debajo del 20% como puntos de corte para velocidad de la marcha reducida, procedimientos que siguen el fenotipo de fragilidad. En cuanto a los resultados, en el 30,6% de los estudios hubo asociación entre la velocidad de la marcha y la variables incapacidades, fragilidad, sedentarismo, caídas, debilidad muscular, enfermedades, grasa corporal, compromiso cognitivo, mortalidad, estrés, menor satisfacción con la vida, menor calidad de vida, duración de las siestas y bajo desempeño en parámetros cuantitativos de la marcha en personas mayores de la comunidad. **Conclusión:** Los resultados refuerzan la asociación entre la velocidad de la marcha, la debilidad física y las variables indicadoras de salud en personas mayores de la comunidad.

DESCRIPTORES

Marcha; Envejecimiento; Anciano; Anciano Frágil; Revisión.

REFERENCES

1. Fried LP. Investing in health to create a third demographic dividend. Gerontologist. 2016;56: Suppl 2:S167-77.
2. Fried LP, Ferrucci L, Darer J, Williamson JD, Anderson G. Untangling the concepts of disability, frailty and comorbidity: implications for improved targeting and care. J Gerontol A Biol Sci Med Sci. 2004;59(3):255-63.
3. Chen X, Mao G, Leng SX. Frailty syndrome: an overview. Clin Interv Aging. 2014;9:433-44.
4. Cesari M, Prince M, Thiyagarajan JA, De Carvalho IA, Bernabei R, Chan P, et al. Frailty: An Emerging Public Health Priority. J Am Med Dir Assoc. 2016;17(3):188-92.
5. Morley JE, Vellas B, Van Kan GA, Anker SD, Bauer JM, Bernabei R, et al. Frailty consensus: a call to action. J Am Med Dir Assoc. 2013;14(6): 392-7.
6. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: Evidence for a phenotype. J Gerontol A Biol Sci Med Sci. 2001;563(3):M146-56.
7. Han ES, Lee Y, Kim J. Association of cognitive impairment with frailty in community-dwelling older adults. Int Psychogeriatr. 2014;26(1):155-63.
8. Shimada H, Makizako H, Doi T, Tsutsumimoto K, Suzuki T. Incidence of disability in frail older persons with or without slow walking speed. J Am Med Dir Assoc. 2015;16(8):690-6.
9. Avila-Funes JA, Helmer C, Amieva H, Barberger-Gateau P, Le Goff M, Ritchie K, et al. Frailty among community-dwelling elderly people in France: The three-city study. J Gerontol A Biol Sci Med Sci. 2008;63(10):1089-96.
10. Garcia-Garcia FJ, Gutierrez Avila G, Alfaro-Acha A, Amor Andres MS, De Los Angeles De La Torre Lanza M, Escribano Aparicio MV, et al. The prevalence of frailty syndrome in an older population from Spain. The Toledo Study for Healthy Aging. J Nutr Health Aging. 2011;15(10): 852-6.
11. Da Mata FAF, Pereira PPS, Andrade KRC, Figueiredo ACMG, Silva MT, Pereira MG, et al. Prevalence of frailty in Latin America and the Caribbean: a systematic review and meta-analysis. PLoS One. 2016;11(8):e0160019.
12. Hoogendijk EO, Abellan van Kan G, Guyonnet S, Vellas B, Cesari M. Components of the frailty phenotype in relation to the frailty index: results from the Toulouse Frailty Platform. J Am Med Dir Assoc. 2015;16(10):855-9.
13. Sutorius FL, Hoogendijk EO, Prins BA, Van Hout HP. Comparison of 10 single and stepped methods to identify frail older persons in primary care: diagnostic and prognostic accuracy. BMC Fam Pract. 2016;17:102.
14. Inzitari M, Calle A, Esteve A, Casas A, Torrents N, Martíne N. ¿Mides la velocidad de la marcha en tu práctica diaria? Una revisión. Rev Esp Geriatr Gerontol. 2017;52(1):35-43.
15. Fritz S, Lusardi M. White paper: walking speed: the sixth vital sign. J Geriatr Phys Ther. 2009; 32(2):2-5.
16. Vermeulen J, Spreeuwenberg MD, Daniëls R, Neyens JC, Van Rossum E, De Witte LP. Does a falling level of activity predict disability development in community-dwelling elderly people? Clin Rehabil. 2013;27(6):546-54.
17. Kirkwood RN, Araújo PA, DIAS CS. Gait biomechanics in elderly fallers and non fallers: a literature review. Rev Bras Ci Mov. 2006;14(4):103-10.

18. Studenski S, Perera S, Patel K, Rosano C, Faulkner K, Inzitari M, et al. Gait speed and survival in older adults. JAMA. 2011;305(1):50-8.

19. Abellan van Kan G, Rolland Y, Andrieu S, Bauer J, Beauchet O, Bonnefoy M, et al. Gait speed at usual pace as a predictor of adverse outcomes in community-dwelling older people an International Academy on Nutrition and Aging (IANA) Task Force. J Nutr Health Aging. 2009;13(10):881-9.

20. Middleton A. Fritz SL, Lusardi M. Walking speed: the functional vital sign. J Aging Phys Act. 2015;23(2):314-22.

21. Perera S, Patel KV, Rosano C, Rubin SM, Satterfield S, Harris T, et al. Gait speed predicts incident disability: a pooled analysis. J Gerontol A Biol Sci Med Sci. 2016;71(1):63-71.

22. Woo J. Walking speed: a summary indicator of frailty? J Am Med Dir Assoc. 2015: 16(8):635-7.

23. Castell MV, Sánchez M, Julián R, Queipo R, Martín S, Otero A. Frailty prevalence and slow walking speed in persons age 65 and older: Implications for primary care. BMC Fam Pract. 2013;14:86.

24. Jerome GJ, Ko SU, Kauffman D, Studenski SA, Ferrucci L, Simonsick EM. Gait characteristics associated with walking speed decline in older adults: results from the Baltimore Longitudinal Study of Aging. Arch Gerontol Geriatr. 2015;60(2):239-43.

25. Lenardt MH, Carneiro NHK, Betiolli SE, Ribeiro DKMN, Wachholz PA. Prevalence of pre-frailty for the component of gait speed in older adults. Rev Latino Am Enfermagem. 2013; 21(3):734-41.

26. Moher D, Liberati A, Tetzlaff J, Altman DG; The PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA Statement. PLoS Med. 2009;6(7):e1000097.

27. Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. Strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ Br Med J. 2007;335(7624):806-8.

28. Malta M, Cardoso LO, Bastos FI, Magnanini MMF, Silva CMP. Iniciativa STROBE: subsídios para a comunicação de estudos observacionais. Rev Saúde Pública. 2010;44(3): 559-65.

29. Galvão TF, Pereira MG. Revisões sistemáticas da literatura: passos para sua elaboração. Epidemiol Serv Saúde. 2014;23(1):183-4.

30. Srinivas-Shankar U, Roberts SA, Connolly MJ, O' Connell MDL, Adams JE, Oldham JA, et al. Effects of testosterone on muscle strength, physical function, body composition, and quality of life in intermediate-frail and frail elderly men: a randomized, double-blind, placebo-controlled study. J Clin Endocrinol Metab. 2010;95(2):639-50.

31. Kim M, Yabushita N, Kim M, Nemoto M, Seino S, Tanaka K. Mobility performance tests for discriminating high risk of frailty in community-dwelling older women. Arch Gerontol Geriatr. 2010;51(2):192-8.

32. Pinedo LV, Saavedra PJO, Jimeno HC. Velocidad de la marcha como indicador de fragilidad en adultos mayores de la comunidad en Lima, Peru. Rev Esp Geriatr Gerontol. 2010;45(1):22-5.

33. Montero-Odasso M, Muir SW, Hall M, Doherty TJ, Kloseck M. Olivier Beauchet, et al. Gait variability is associated with frailty in community-dwelling older adults. J Gerontol A Biol Sci Med Sci. 2011;66(5):56-76.

34. Costa TB, Neri AL. Medidas de atividade física e fragilidade em idosos: dados do FIBRA Campinas, São Paulo, Brasil. Cad Saúde Pública. 2011;27(8):1537-50.

35. Chang YW, Chen WL, Lin FG, Fang WH, Yen MY, Hsieh CC, et al. Frailty and Its impact on health-related quality of life: a cross-sectional study on elder community-dwelling preventive health service users. PLoS One. 2012;7(5):e38079.

36. Subra J, Gillette-Guyonnet S, Cesari M, Oustric S, Vellas B; Platform Team.The Integration of frailty into clinical practice: preliminary results from the gérontôpole. J Nutr Health Aging. 2012;16(8):714-20.

37. Cameron ID, Fairhall N, Langron C, Keri Lockwood K, Monaghan N, Aggar C, et al. A multifactorial interdisciplinary intervention reduces frailty in older people: randomized trial. BMC Med. 2013;11:65.

38. Amaral FLJS, Guerra RO, Nascimento AFF, Maciel, ACC. Social support and the frailty syndrome among elderly residents in the community. Ciênc Saúde Coletiva. 2013; 18(6):1835-46.

39. Pegorari MS, Ruas G, Patrizzi LJ. Relationship between frailty and respiratory function in the community-dwelling elderly. Braz J Phys Ther. 2013;17(1):9-16.

40. Pinto JM, Neri AL. Factors associated with low life life satisfaction in community-dwelling elderly: FIBRA Study. Cad. Saúde Pública. 2013;29(12):2447-58.

41. Ruggero CR, Bilton TR, Teixeira LF, Ramos JLA, Alouche SR, Dias RC, et al. Gait speed correlates in a multiracial population of community-dwelling older adults living in Brazil: a cross-sectional population-based study. BMC Public Health. 2013;13:182.

42. Vieira RA, Guerra RO, Giacomin KC, Vasconcelos KSS; Souza ACA, Pereira LSM, et al. Prevalência de fragilidade e fatores associados em idosos comunitários de Belo Horizonte, Minas Gerais, Brasil: dados do estudo FIBRA. Cad Saúde Pública. 2013;29(8):1631-43.

43. Bollwein J, Volkert D, Diekmann R, Kaiser MJ, Uter W, Vidal K, et al. Nutritional Status assording to the mini nutritional assessment (MNA®) and Frailty in community dwelling older persons: a close relationship. J Nutr Health Aging. 2013;17(4):351-56.

44. Neri AL, Yassuda MS, Araújo LF, Eulálio MC, Cabral BE, Siqueira MEC, et al. Metodologia e perfil sociodemográfico, cognitivo e de fragilidade de idosos comunitários de sete cidades brasileiras: estudo FIBRA. Cad Saúde Pública. 2013;29(4):778-92.

45. Perez M, Lourenço RA. FIBRA-RJ: fragilidade e risco de hospitalização em idosos da cidade do Rio de Janeiro, Brasil. Cad Saúde Pública. 2013;29(7):1381-91.

46. Sheehan KJ, O'Connell MD, Cunningham C, Crosby L, Kenny RA.The relationship between increased body mass index and frailty on falls in community dwelling older adults. BMC Geriatr. 2013;13:132.

47. Moreno-Aguilar M, García-Lara JM, Aguilar-Navarro S, Navarrete-Reyes AP, Amieva H, Ávila-Funes JA. The Phenotype of frailty and health-related quality of life. J Frailty Aging. 2013;2(1):2-7.

48. Romero-Ortuno R, Soraghan CA. Frailty Instrument for primary care for those aged 75 years or more: findings from the survey of health, ageing and retirement in Europe, a longitudinal population-based cohort study (SHARE-FI75+). BMJ Open. 2014;4(12):e006645.

49. Capistrant BD, Glymour MM, Berkman LF. Assessing mobility difficulties for cross-national comparisons: results from the WHO Study on AGEing and Adult Health. J Am Geriatr Soc. 2014;62(2):329-35.

50. Santos AA, Ceolim MF, Pavarini, SCL, Neri AL, Rampazo, MK. Association between sleep disorders and frailty status among elderly. Acta Paul Enferm. 2014;27(2):120-5.

51. Johar H, Emeny RT, Bidlingmaier M, Reincke M, Thorand B, Peters A, et al. Blunted diurnal cortisol pattern is associated with frailty: a cross-sectional study of 745 participants aged 65 to 90 years. J Clin Endocrinol Metab. 2014;99(33):E464-8.

52. Landi F, Onder G, Russo A, Liperoti R, Tosato M, Martone A, et al. Calf circumference, frailty and physical performance among older adults living in the community. Clin Nutr. 2014;3(3):539-44.

53. Tavassoli N, Guyonnet S, Abellan Van Kan G, Sourdet S, Krams T, Soto ME, et al. Description of 1,108 older patients referred by their physician to the “Geriatric Frailty Clinic (G.F.C) for Assessment of Frailty and Prevention of Disability” at the gerontopole. J Nutr Health Aging. 2014;18(5):457-64.

54. Curcio CL, Henao GM, Gomez F. Frailty among rural elderly adults. BMC Geriatr. 2014;14:2.

55. Schoon Y, Bongers K, Van Kempen J, Melis R, Olde RM. Gait speed as a test for monitoring frailty in community-dwelling older people has the highest diagnostic value compared to step length and chair rise time. Eur J Phys Rehabil Med. 2014;50(6):693-701.

56. Darvin K, Randolph A, Ovalles S, Halade D, Breeding L, Richardson A, et al. Plasma protein biomarkers of the geriatric syndrome of frailty. J Gerontol A Biol Sci Med Sci. 2014;69(2)182-6.

57. Alexandre TS, Corona LP, Nunes DP, Santos JLF, Yeda AO, Duarte YAO, et al. Similarities among factors associated with components of frailty in elderly: SABE Study. J Aging Health. 2014;26(3):441-57.

58. Bez JPO, Neri AL. Gait speed, grip strength and self-rated health among the elderly: data from the FIBRA Campinas network, São Paulo, Brazil. Ciênc Saúde Coletiva. 2014;19(8): 3343-53.

59. Silveira T, Pegorari MS, Shamyr SC, Ruas G, Novais-Shimano SG, Patrizzi LJ. Association of falls, fear of falling, handgrip strength and gait speed with frailty levels in the community elderly. Medicina. 2015;48(6):549-556.

60. Falsarella GR, Gasparotto LPR, Barcelos CC, Coimbra IB, Moretto MC, Pascoa MA, et al. Body composition as a frailty marker for the elderly community. Clinical Interventions in Aging. 2015;10:1661–1667.

61. Nishiguchi S, Yamada M, Fukutani N, Adachi D, Tashiro Y, Hotta T, et al. Differential Association of Frailty With Cognitive Decline and Sarcopenia in Community-Dwelling Older Adults. J Am Med Dir Assoc. 2015;16(2):120-4.

62. Çakmur, H. Frailty among elderly adults in a rural area of Turkey. Med Sci Monit. 2015;21:1232-42.

63. Aguilar-Navarro SG, Amieva H, Gutiérrez-Robledo LM, Avila-Funes JA. Frailty among Mexican community-dwelling elderly: a story told 11 years later. Salud Publica Mex. 2015; 57:S62-9.

64. At J, Bryce R, Prina M, Acosta D, Ferri CP, Guerra M, et al. Frailty and the prediction of dependence and mortality in low- and middle-income countries: a 10/66 population-based cohort study. BMC Med. 2015;10:138.

65. Martínez-Ramírez A, Martinikorena I, Gómez M, Lecumberri P, Millor N, Rodríguez-Mañas L. et al. Frailty assessment based on trunk kinematic parameters during walking. J Neur Enginee Rehabil. 2015;12:48.

66. Parentoni AN, Mendonça VA, Dos Santos KD, Sá LF, Ferreira FO, Gomes PDA, et al. Gait speed as a predictor of respiratory muscle function, strength, and frailty syndrome in community-dwelling elderly people. J Frailty Aging. 2015;4(2):64-8.

67. Camicioli R, Mizrahi S, Spagnoli J, Büla C, Demonet JF, Vingerhoets F, et al. Handwriting and pre-frailty in the Lausanne cohort 65+ (Lc65+) study. Arch Gerontol Geriatr. 2015;61(1):8-13.

68. Sergi G, Veronese N, Fontana L, De Rui M, Bolzetta F, Zambon S, et al. Pre-Frailty and risk of cardiovascular disease in elderly men and women: the Pro.V.A. Study. J Am Coll Cardiol. 2015;65(10):976-83.

69. Chen S, Honda T, Chen T, Narazaki K, Haeuchi Y, Supartini A, et al. Screening for frailty phenotype with objectively-measured physical activity in a west Japanese suburban community: evidence from the Sasaguri Genkimon Study. BMC Geriatr. 2015;15:36.

70. Hörder H, Skoog I, Johansson L, Falk H, Frändin K. Secular trends in frailty: a comparative study of 75-year olds born in 1911-12 and 1930. Age Ageing. 2015;44(5):817-22.

71. Schwenk M, Mohler J, Wendel C, D’Huyvetter K, Fain M, Taylor-Piliae R, et al. Wearable sensor-based in-home assessment of gait, balance, and physical activity for discrimination of frailty status: baseline results of the Arizona frailty cohort study. Gerontology. 2015;61(3):258-67.

72. Liu CK, Lyass A, Larson MG, Massaro JM, Wang N, D’Agostino RB Sr, et al. Biomarkers of oxidative stress are associated with frailty: the Framingham Offspring Study. Age (Dordr). 2016;38(1):1.

73. Jones GR, Neubauer NA, O’Connor B, Jakobi JM. EMG Functional tasks recordings determines frailty phenotypes in males and females. Exp Gerontol. 2016;77:12-8

74. Santos-Orlandi AA, Ceolim MF, Pavarini SCI, Oliveira-Rossignolo SC, Pergola-Marconato AM, Neri AL. Factors associated with duration of naps among commmunity-dwelling elderly: data from the multicenter study FIBRA. Texto Contexto Enferm. 2016;25(1):e1200014.

75. García-Peña C, Ávila-Funes JA, Dent E, Gutiérrez-Robledo L, Pérez-Zepeda M. Frailty prevalence and associated factors in the Mexican health and aging study: a comparison of the frailty index and the phenotype. Exp Gerontol. 2016;79:55-60.

76. Liu B, Hu X, Zhang Q, Fan Y, Li J, Zou R, et al. Usual walking speed and all-cause mortality risk in older people: A systematic review and meta-analysis. Gait Posture. 2016;44:172-7.

77. Pérez-Zepeda MU, González-Chavero JG, Salinas-Martinez R, Gutiérrez-Robledo LM. Risk factors for slow gait speed: a nested case-control secondary analysis of the Mexican Health and Aging Study. J Frailty Aging. 2015;4(3):139-43.

78. Busch TA, Duarte YA, Nunes DP, Lebrão ML, Naslavsky MS, Rodrigues AS, Amaro Junior E. Factors associated with lower gait speed among the elderly living in a developing country: a cross-sectional population-based study. BMC Geriatr. 2015;15:1-9.

79. Pamoukdjian F, Paillaud E, Zelek L, Laurent M, Lévy V, Landre T, et al. Measurement of gait speed in older adults to identify complications associated with frailty: a systematic review. J Geriatr Oncol. 2015;6(6):484-96.

80. Studenski SA, Peters KW, Alley DE, Cawthon PM, McLean RR, Harris TB, et al. The FNIH Sarcopenia Project: rationale, study description, conference recommendations, and final estimates. J Gerontol A Biol Sci Med Sci. 2014;69(5):547-58.

81. Ko S, Tolea MI, Hausdorff JM, Ferrucci L. Sex-specific differences in gait patterns of healthy older adults: results from the Baltimore longitudinal study of aging. J Biomech. 2011;44(10):1974-9.

82. Silva SLA, Neri AL, Ferrioli E, Lourenço RA, Dias RC. Fenótipo de fragilidade: influência de cada item na determinação da fragilidade em idosos comunitários – Rede FIBRA. Ciênc Saúde Coletiva. 2016;21(11):3483-92.

83. Lenardt MH, Carneiro NHK, Binotto MA, Willig MH, Lourenço TM, Albino J. Frailty and quality of life in elderly primary health care users. Rev Bras Enferm. 2016;69(3):448-53.

84. Gale CR, Cooper C, Sayer AA. Prevalence of frailty and disability: findings from the English longitudinal study of ageing. Age Ageing. 2015;44(1):162-5.