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BRIEF REPORT

MAXIMUM WALKING SPEED CAN IMPROVE THE DIAGNOSTIC VALUE OF FRAILTY AMONG COMMUNITY-DWELLING OLDER ADULTS A CROSS-SECTIONAL STUDY

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Abstract: This study investigates the diagnostic accuracy of the combination of usual walking speed (UWS) and maximum walking speed (MWS) to identify frailty in community-dwelling older adults. A population-based study with 758 participants aged 65 and older was conducted. Frailty syndrome was determined using the Fried phenotype. UWS and MWS were evaluated in a 4.6-meter path. Both measures were categorized using the 1.0 m/s cut points, and participants were categorized into three groups: those with "very good", "good" and "insufficient" walking reserve capacity (WRC). Of all participants, 9% were identified as frail and 47% as prefrail. The "insufficient" WRC presented a low sensitivity of 0.55, high specificity of 0.91 and moderately useful likelihood ratios (LR+ 6.57, LR- 0.48) to identify frailty. Based on Fagan's nomogram, an elder's corresponding post-test probability of being frail with an "insufficient" WRC would be around 40%, which substantially increased the diagnostic accuracy of frailty.

Key words: Usual gait speed, fast gait speed, sensitivity, specificity, likelihood ratios.

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Introduction

Frailty in late life is expressed by the physiological inability to respond appropriately in dynamic situations, ultimately increasing the risk of adverse outcomes (1). Despite the recommendation that frailty should be evaluated routinely (2), there is a lack of consensus on the best tool to identify and evaluate frailty, particularly in primary health care (3). Walking speed (WS) is associated with frailty and may serve as a marker of the physiological systems' functional reserve. Indeed, it is considered a practical, reliable, sensitive and low-cost clinical tool used to evaluate and monitor functional status and health in this population (4-6). Comfortable speed is preferably used to walk short distances, indoors or on the street (7) and is commonly labeled usual walking speed (UWS). Slow UWS is predictive of functional decline (5, 8, 9), falls (7, 9, 10), cognitive impairment (11), hospitalization (8) and higher mortality rates (8, 9).

The maximum walking speed (MWS) is that the individual is able to achieve when asked to walk as quickly as possible without running and is considered a more demanding task than UWS. A low MWS reflects low physiological reserve (7). It is plausible to consider that the inability to increase the UWS may help at identifying frail older people. This study aims at exploring the diagnostic accuracy of the combination of the UWS and MWS using a 1.0 m/s cut point denominated walking reserve capacity to identify frailty syndrome in community-dwelling older adults and compare it with the single UWS.

Method

This study is part of the FIBRA Network (Frailty among Brazilian Older Adults), a multicenter cross-sectional, population-based study. Older people aged 65 and over of both sexes who were permanent residents in households located in the selected census tracts were included. The exclusion criteria were severe cognitive impairment according to the Mini-Mental State Examination, adjusted for education level; 2) inability to walk; 3) localized loss of strength and aphasia due to severe stroke; 4) Parkinson's disease (either severe or unstable); 5) severe hearing or visual impairment; and 6) terminal illness. The study population included 758 participants aged 65 to 93 from the FIBRA study. Households were enrolled between March 2009 and April 2010 after the cluster randomization of census regions based on population density.

Frailty was operationalized using the Fried phenotype (1): weight loss (≥4.5kg in the last year), weakness (grip strength in the lowest quintile adjusted for gender and BMI), exhaustion (using two questions from the Center for Epidemiologic Studies Depression scale - CES-D), low physical activity level (lowest quintile for each gender) and slow WS (lowest quintile adjusted for gender and height). Those participants with three or more of these components were considered frail, with 1 or 2prefrail and none as nonfrail.

WS in meters per second was obtained in a 4.6-meter pathway, with 2m for acceleration and an additional 2m for deceleration, dividing the distance traveled by the time taken

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Table 1
Main characteristics of the sample according to frailty classification (n=758)

Characteristics	Nonfrail N (%)	Pre-Frail N (%)	Frail N (%)	P-value
Gender				
Male	116 (36.0)	131 (36.0)	25 (34.7)	0.977
Female	206 (64.0)	233 (64.0)	47 (65.3)	
Age				
65-74 years	266 (82.6)	265 (72.8)	38 (52.8)	<0.001
75-79 years	35 (10.9)	52 (14.3)	11 (15.3)	
80 years	21 (6.5)	47 (12.9)	23 (31.9)	
Self-perceived health				<0.001
Very good and good	187 (58.1)	162 (44.5)	23 (31.9)	
Regular	122 (37.9)	171 (47.0)	38 (52.8)	
Poor and very poor	13 (4.0)	31 (8.5)	11 (15.3)	
4 or more comorbidities	30 (9.3)	90 (24.8)	31 (43.1)	<0.001
4 or more medications	75 (23.3)	116 (31.9)	25 (34.7)	0.103

to cover that distance using a stopwatch (Cronobio® model SW2018). Participants were instructed to walk at their usual pace (UWS) and as quickly as possible (MWS). The mean value of three trials for each speed was used for data analysis. Participants were assessed at a local community facility service in a well-lit room by trained evaluators, and they wore their regular shoes and used assistive devices if needed. The cut point used for UWS was: <1.0m/s e ≥1.0m/s (6, 7).

Comorbidities were self-reported regarding the presence of chronic diseases and health conditions diagnosed by a physician in the last twelve months. The number of regular medications used regularly in the last three months was ascertained. Self-rated health was classified as poor, very poor, regular, good or very good.

Data analysis

Statistical Analyses

Walking reserve capacity (WRC) is the combination of the UWS and MWS and was used to classify participants into three groups, as follows: those with "UWS ≥ 1 m/s and MWS ≥ 1 m/s" were classified as having a "very good WRC", those with "UWS<1 m/s and MWS ≥ 1m/s" were classified as having a "good WRC"; and those with "UWS < 1 m/s and MWS<1 m/s" were considered to have "insufficient WRC".

The number of participants with a UWS < 1 m/s or ≥ 1 m/s and those in the "very good", "good" and "insufficient" groups were used to populate 2 × 2 contingency tables and calculate sensitivity, specificity, accuracy, positive and negative predictive value and positive and negative likelihood ratios to identify frail older adults.

Table 2
Diagnostic accuracy measures to identify frail older people according to UWS and WRC using 1 m/s cut-point, according to a recommended interpretation of positive and negative likelihood ratios (LR) (13)

Accuracy measures	UWS	Insufficient WRC
	1.0m/s	1.0m/s
Sensitivity	0.9 (0.81 to 0.95)	0.55 (0.44 to 0.66)
Specificity	0.6 (0.57 to 0.64)	0.91 (0.89 to 0.93)
Accuracy	0.63	0.88
Positive predictive value	0.19	0.4
Negative predictive value	0.98	0.95
Positive likelihood ratios (95% CI)	2.3 (2.04 to 2.59)	6.57 (4.76 to 9.06)
Negative likelihood ratios (95% CI)	0.16 (0.07 to 0.32)	0.48 (0.37 to 0.62)

UWS= usual walking speed, WRC= walking reserve capacity (UWS < 1.0 m/s and MWS<1.0 m/s). Herbert R. Confidence Interval Calculator (2013).https://www.pedro.org.au/portuguese/downloads/confidence-interval-calculator/. Access date: [05/16/17]. Positive LR results: Not useful- less than 2.00; Mildly useful – 2.050 and 5.00; Moderately useful- between 5.00 and 10.00; Very useful- greater than 10.00. Negative LR results: Not useful- more than 0.50; Mildly useful – between 0.20 and 0.50; Moderately useful- between 0.10 and 0.20; Very useful- less than 0.10.

Results

Of all participants, 72 (9.5%) were identified as frail, with a mean age of 71.9±5.8 years. Table 1 presents the sample characteristics according to frailty classification. The mean UWS and MWS were 1.04 m/s (±0.29) and 1.38 m/s (±0.37), respectively. Among those participants with a UWS <1.0 m/s, 19.5% were considered frail. Among those in the "insufficient WRC" group, 40.8% were considered frail.

Diagnostic accuracy measures to identify frail older people are presented in table 2, according to a recommended interpretation of positive and negative likelihood ratios (LR) (15). Overall, the "insufficient WRC presented a low sensitivity of 0.55 and a high specificity of 0.91. It may be considered moderately useful (LR+ between 5.00 and 10.00)(12) for ruling in (LR+ = 6.57; 95% CI 4.76 to 9.06) to ruling out (LR- = 0.48; 95% CI 0.37 to 0.62) frailty.

Discussion

This study showed that the identification of frailty is considerably improved when the combination of UWS and MWS is applied using the cut-point of 1.0 m/s. Using the interpretation based on the Fagan's nomogram, an elder's corresponding post-test probability of being frail in "insufficient WRC" would be around 40% (12).

This approach was based on the functional reserve capacity approach. Previous studies indicated that the use of the UWS as a single measure is suitable for screening and monitoring frailty (3,7,9). Our study is the first one to suggest that the combination of UWS and MWS, which reflects the walking reserve capacity, allows for improvement in the identification of frailty among older people living in the community.

The use of a combination of UWS and MWS may offer substantial improvement as a single measure and low-cost clinical tool to identify and monitor frail older people living in the community, particularly in primary health care, because it requires little space and time, making it a suitable routine measure.

Fast walking is a more demanding task, as it requests greater energy expenditure, greater neuromuscular control to deal with the inertial forces for propulsion of the body and more regular strides, possibly allowing for the identification of older people with less physiological reserve (7). Greater requirements imposed on the balance control system during MWS demand additional physiological effort and may decrease walking velocity among frail older people.

This study's strengths include a large sample of older people based on a population-based design. Moreover, likelihood ratios are independent of the disease prevalence (13, 14, 15) and quantify any individual patient's probability of having a condition (14, 15). However, the cross-sectional design limits the establishment of predictive capacity. In addition, the Fried phenotype includes UWS as a criterion for the phenotype, and it may have inflated the diagnostic measures. Further studies should be performed to determine whether the combination of UWS and MWS predicts frailty over time and is helpful in the identification of frailty transitions.

Conflict of interest: None declared by Authors.

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