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Original Article

# What Are the Main Factors Associated with Gait Speed in Older Women with Non-Specific Acute Low Back Pain?

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SUMMARY

*Background:* The gait speed test has been widely used for evaluating low back pain. However, limited information is available on the factors that possibly influence the test results. This study aimed to investigate the influence of sociodemographic, clinical, psychosocial, and physical factors on the gait speed of older women with acute low back pain.

*Methods:* Sociodemographic, clinical, psychosocial, and physical factors on the gait speed were evaluated in a convenience sample of older women. Statistical analysis was performed using multiple regression analysis.

*Results:* Four hundred and fifty-five older women (age: 68 ± 9) were included. Variables such as age, education, low back pain intensity, body mass index, comorbidities, depressive symptoms, fear of falling, anterior trunk mobility, and hand grip strength explained 18.8% of the gait speed test ($R^2 = 0.188$; $p < .001$).

*Conclusion:* Age, education, low back pain intensity, body mass index, comorbidities, depressive symptoms, fear of falling, anterior trunk mobility, and handgrip strength were found to be associated with gait speed in older women with acute low back pain. These variables can act independently or synergistically.



## 1. Introduction

Gait speed is considered the sixth functional vital sign.[1] In a recent systematic review involving 49 studies with community adults aged ≥ 60 years and without a specific disease, the outcome of gait speed was associated with sedentary lifestyle, falls, muscle weakness, diseases, body fat, cognitive impairment, mortality, stress, lower life satisfaction, lower quality of life, napping duration, disabilities, and frailty.[2]

Studies have demonstrated that low back pain is independently associated with functional decline, particularly walking performance. Older adults with low back pain walked slower than their pain-free peers during self-selected and fast walking.[3] However the results are contradictory, Tagliaferri et al. recruited 1182 females aged greater than 60 years. Gait speed was not associated with low back pain intensity.[4] Although gait speed have been widely used to study older adults with low back pain, studies evaluating the factors that influence the test considered only isolated factors.[5] Identifying predictive factors for disability can promote classification into subgroups and contribute to the selection of the best therapeutic strategies.

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Historically, low back pain studies have focused on the general population, which is economically active.[6] It should be noted that the anatomical and physiological bases and functional repercussions of low back pain in older adults are not comparable to those of the adult population.[7]

Disability predictors can act independently or synergistically. Thus, the present study aimed to investigate the contribution of sociodemographic, clinical, psychosocial, and physical factors to the gait speed of older women with acute low back pain.

## 2. Methods

### 2.1. Study design

This was an observational, cross-sectional, ancillary study of the Back Complaints in the Elders study (BACE), an international consortium of epidemiological studies includes researchers from Australia, Brazil, and the Netherlands,[8] approved by the Research Ethics Committee of the Federal University of Minas Gerais. All individuals included in the study signed an informed consent form.

### 2.2. Participants

The sample selection was performed conveniently. The recruitment period was from 2011 to 2013, and participants were recruited from the private and public sectors. To avoid the influence of sex on the walking performance and improve the internal validity, the sample was composed only of women. The study sample was a subsample of community-dwelling older women from Brazil. The inclusion criteria were older adults (aged ≥ 60 years) who presented with an acute episode of low back pain (with current symptoms that had been occurring for < 6 weeks). Low back pain was defined as any self-reported pain between the lowest ribs and inferior gluteal folds. Participants with severe diseases, cognitive impairment, or severe visual, motor, or hearing loss were excluded.

### 2.3. Instruments and procedures

#### 2.3.1. Sociodemographic and clinical factors

To assess sociodemographic and clinical factors, information was collected on age and education. Low back pain intensity was assessed in the last 24 hours using the Numerical Visual Analog Scale (0–10).[9] The body mass index was recorded and classified according to the cutoff point of Lipschitz et al.,[10] and the number of chronic comorbidities were recorded.

#### 2.3.2. Psychosocial factors

The Center for Epidemiological Studies Depression (CES-D) Scale was used to investigate depressive symptoms. A score ≥ 15 points is considered indicative of a depressive condition.[11]

Kinesiophobia is the term used to define the excessive fear of movement that results in feelings of vulnerability to pain or fear of injury recurrence. In the present study, FABQ-Phys was used for analysis. Scores ≥ 16 are indicative of kinesiophobic individuals.[12]

To measure catastrophization, defined as a negative and exaggerated orientation for the perception of painful stimuli, a catastrophization scale containing 13 items was used. The scores for each item vary from 0 to 4 on a Likert scale, on which 0 = none, 1 = mild, 2 = moderate, 3 = severe, and 4 = always is defined. To obtain the final score, we summed the scores of all items, which ranged from 0 to 52, with a score greater than 30 representing a clinically relevant level of catastrophism.[13]

Self-efficacy for falls was assessed using the Falls Efficacy Scale – Brazil scale. A score ≥ 23 points suggests an association with sporadic falls and ≥ 31 points with recurrent falls.[14]

#### 2.3.3. Physical factors

Anterior trunk mobility was assessed using the fingertip-to-floor test. The participant stood erect high with shoes removed and feet together and was asked to bend forward as far as possible, while maintaining the knees, arms, and fingers fully extended. The vertical distance between the tip of middle finger and floor was measured with a supple tape measure and recorded in centimeters. A distance greater than 10 cm is suggestive of trunk hypomobility.[15] A previous study showed high reproducibility for anterior flexion measure with an intraclass correlation coefficient of 0.92.[16]

The calf circumference was measured with an inelastic tape in the portion of the largest muscular belly, with the participant seated and the knee at 90°. A calf circumference < 31 cm is considered a clinical indicator of sarcopenia.[17] The test has excellent test-retest reliability, with intraclass correlation coefficients of 0.97.[18]

To assess handgrip strength, the Jamar® dynamometer was used. The handgrip strength was measured isometrically in the dominant upper limb. The participant was seated in a chair with a backrest without armrests, the shoulder adducted, the elbow flexed at 90°, the forearm in the neutral position, and the wrist between 0° and 30° of extension and 0° to 15° ulnar deviation. The scores were calculated by the average of three attempts with 60 seconds interval between them. Adequate handgrip strength values for older women are ≥ 16 kgf. Excellent test-retest reliability for this instrument has been observed in long-term prospective measurements, demonstrating intraclass correlation coefficients of 0.94 and 0.98 according to tested side.[19]

### 2.4. Gait speed

To evaluate usual gait speed, the distance/time (m/s) ratio was measured across a distance of 8.6 m. Participants were instructed to walk at a self-selected speed. The gait speed test has excellent test-retest reliability, with intraclass correlation coefficients values between 0.96 and 0.98.[20] Gait speed below 0.8 m/s are predictors of adverse health events.[21]

All questionnaires and tests were applied by trained researchers.

### 2.5. Statistical analysis

The sample calculation was developed by considering 10 cases for each independent variable.[22] Thus, at least 120 individuals were required. As this was an auxiliary study of the BACE project, data from a larger sample were analyzed (n = 455). Data distribution was investigated using the Shapiro-Wilk test. Multiple regression analysis and the backward method were used to examine the relationship between independent variables and the dependent variable (gait speed). To determine which independent variables were included in the regression model, univariate analysis between the dependent and independent variables was performed using Pearson or Spearman's correlation coefficient. Correlations with $p < 0.05$ were selected in the regression model. Regarding the assumptions of the model, multicollinearity was considered a problem when the variance inflation factor was > 10. Homoscedasticity was analyzed by observing graph-predicted and observed values. Residue independence was determined using the Durbin-Watson test. For all analyses, a significance level of 0.05 was considered.

## 3. Results

The research team screened 3711 older women who participated in the Brazilian BACE study, resulting in the inclusion of 455 participants (Figure 1).

In a general analysis, the older women had low education level, moderate pain, were overweight, had multiple comorbidities, depressive symptoms, were kinesiophobic, with recurrent risk of falls, did not present a reduction in muscle mass in the calf, had appropri-

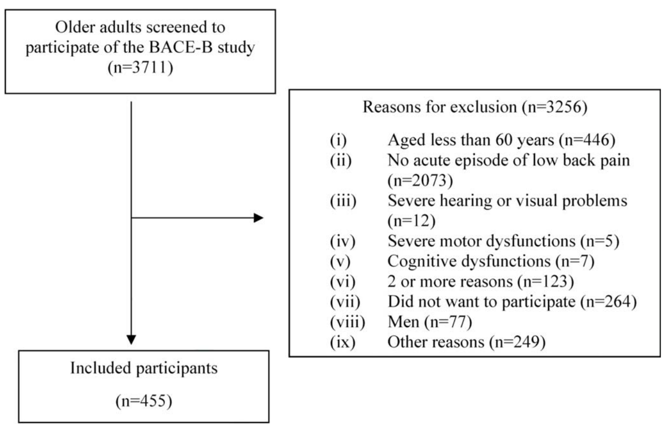


**Figure 1.** Flowchart of patient recruitment.

ate handgrip strength, and good performance of the gait speed test (Table 1). The variance inflation factor was < 10, range from 1.04 to 1.45. In relation to homoscedasticity, residuals were randomly scattered around the center line of zero, with no obvious pattern.

To examine the univariate analysis, Spearman's correlation coefficient was used. Kinesiophobia and calf circumference did not correlate with the performance in the gait speed test and were not included in the regression model (Table 2).

Table 3 summarizes the results of the regression model. From the variables inserted, catastrophization was removed and the adjusted determination coefficient of the final model was .188

## 4. Discussion

Although there are studies that have investigated loss of function in theoretical models, there is a need for models to be adjusted by age group and health conditions. The variables age, education, low back pain intensity, body mass index, number of comorbidities, depressive symptoms, fear of falling, anterior trunk mobility, and hand grip strength influenced 18.8% of the gait speed test.

Previous studies have shown that age is a determinant of functionality.[1,2] Increasing age causes atrophy of type II fibers and decline in motor units and alpha motoneurons. These reflect changes caused by aging in the neuroendocrine and immune systems, with a decrease in the serum levels of sex and growth hormones and an increase in plasma levels of acute-phase proteins and cytokines that cause catabolism of muscle fibers. Additionally, reduced protein intake, edentulism, and gastrointestinal malabsorption contribute to functional decline in older adults.[23] The aforementioned changes justify the influence of age on gait speed performance.

By contrast, education had a positive association. Formal education is an important marker of cognitive reserve and is directly related to less atrophy of the hippocampus, greater brain weight, and synaptic plasticity.[24] It is also suggested that older adults with higher education have higher incomes and are more engaged in social participation, physical activity, leisure activities, and prevention and treatment of diseases, which directly impacts functionality.[25]

Another variable that constituted the final regression model was low back pain intensity. Queiroz et al. compared the functionality of older women divided into three groups, one with low back pain, another with pain complaints in other places, and a third group without pain. The worst functional results were obtained by the participants with low back pain.[26] Previous studies have found that patients with low back pain present changes in kinematics,[27] kinetics, and muscle activation.[28] Patients with low back pain walk more slowly and have reduced step length as a strategy to attenuate the magnitude of the internal and external forces exerted,[29] which corroborates the findings of the present study.

We observed that the higher the body mass index, the worse the gait performance. Body fat releases inflammatory mediators that are catabolic to muscle fibers.[26] According to a cohort study of 2,306 older adults, a 5.7 $cm^2$ increase in thigh intramuscular adipose tissue was associated with a 0.01 reduction in the gait speed.[30]

The number of chronic comorbidities was also associated with the gait speed. Regardless of a specific diagnosis, comorbidities in older adults affect mobility.[31] In a study of 5,501 older adults, lower gait speed was associated with heart disease (odds ratio [OR] = 2.06), respiratory illness (OR = 3.25), rheumatic disease (OR = 2.16), depression (OR = 2.51), and polypharmacy (OR = 2.14).[1] In another survey, the authors included more than 30,000 participants with low back pain. The identified risk factors for disability were female sex, increasing age, low education, greater pain intensity, greater number of comorbidities, and low level of physical activity.[32]

**Table 1**
Descriptive sample characteristics (n = 455).

| Variables | Median (Interquartile range) |
|---|---|
| Age (y) | 68 (9) |
| Education (y) | 6 (5) |
| VAS (0–10) | 5 (4) |
| BMI (Kg/$m^2$) | 28.7 (6.3) |
| Comorbidities (n) | 5 (4) |
| CES-D (0–60) | 19 (12) |
| FABQ-Phys (0–24) | 17 (8) |
| PCS (0–52) | 21 (20) |
| FES-I (16–64) | 31 (14) |
| ATQ (cm) | 16 (13) |
| CC (cm) | 36.5 (5) |
| HGS (Kgf) | 21 (6.3) |
| Gait speed (m/s) | 0.9 (0.3) |

Note. ATQ = Anterior Trunk Mobility; BMI = Body Mass Index; CC = Calf Circumference; CES-D = Center for Epidemiologic Studies Depression; FABQ-Phys = Fear Avoidance Beliefs Questionnaire - Physical Activities; FES-I = Falls Efficacy Scale International; HGS = Handgrip Strength; PCS = Pain Catastrophizing Scale; VAS = Visual Analogue Scale.

**Table 2**
Univariate analysis of predictors of gait speed among elderly women with acute low back pain (n = 455).

| Variables | Gait speed (m/s) | |
|---|---|---|
| | Spearman correlation | |
| | p value | rho |
| Age (y) | < .001* | -.24 |
| Education (y) | < .001* | .16 |
| VAS (0–10) | < .001* | -.18 |
| BMI (Kg/$m^2$) | .028* | -.10 |
| Comorbidities (n) | < .001* | -.15 |
| CES-D (0–60) | < .001* | -.22 |
| FABQ-Phys (0–24) | .513 | -.03 |
| PCS (0–52) | .002* | -.14 |
| FES-I (16–64) | < .001* | -.24 |
| ATQ (cm) | .001* | -.15 |
| CC (cm) | .93 | -.04 |
| HGS (Kgf) | .001* | .20 |

Note. ATQ = Anterior Trunk Mobility; BMI = Body Mass Index; CC = Calf Circumference; CES-D = Center for Epidemiologic Studies Depression; FABQ-Phys = Fear Avoidance Beliefs Questionnaire - Physical Activities; FES-I = Falls Efficacy Scale International; HGS = Handgrip Strength; PCS = Pain Catastrophizing Scale; VAS = Visual Analogue Scale.
* Statistically significant.

**Table 3**
Results of hierarchical linear regression model (n = 455).

| | Dependent variable = Gait Speed | | |
|---|---|---|---|
| | $R^2$ | $R^2$ adjusted | p value |
| Model 1 | .201 | .187 | < .001* |
| Model 2 | .200 | .188 | < .001* |

Model 1: Age, education, VAS, BMI, comorbidities CES-D, PCS, FES-I, ATQ, HGS
Model 2: Model 1 except PCS
Standardized β Model 2: Age = -.17; Education = .08; VAS = -.07; BMI = -.09; Comorbidities = -.07; CES-D = -.10; FES-I = -.10; ATQ = -.13; HGS = .15.

Note. ATQ = Anterior Trunk Mobility; BMI = Body Mass Index; CES-D = Center for Epidemiologic Studies Depression; FES-I = Falls Efficacy Scale International; HGS = Handgrip Strength; PCS = Pain Catastrophizing Scale; VAS = Visual Analogue Scale.
* Statistically significant.

Regarding psychosocial aspects, depressive symptoms and fear of falls constituted the final regression model. Depressive symptoms are common in older adults. Inflammatory, endocrine, and immunological changes compromise the integrity of the striatal fronto, amygdala, and hippocampal pathways, increasing the vulnerability to depression.[33] Older adults with depressive symptoms present lethargy, drowsiness, and lack of concentration, which favors the occurrence of functional deficits. Some medications used to treat these symptoms can also affect the gait speed.[34]

In relation to fear of falls, it is noteworthy that acute low back pain leads to an increase in the threshold of nociceptive afferents in the lumbar region, causing interference in the spinal motor pathway and motor cortex. Patients with low back pain present with deterioration of proprioceptive information.[35] Thus, they present a greater and faster displacement of the center of gravity, increased oscillation in the anteroposterior direction,[35] more active sural triceps, limitation of the hip strategy, and inhibition of muscle activation for protection of injured tissues.[36] In a recent study of 104 older adults, participants in the low back pain group had a higher risk of falls, greater postural sway, and longer reaction time.[37]

Regarding the influence of physical factors, anterior trunk mobility and grip strength were included in the final model. Ekedahl et al., conducted a longitudinal study on patients with low back pain and assessed the relationship between the distance from the third finger to the floor and disability.[38] An increase in trunk mobility improved patients' functionality. It is important to highlight the results of a previous study by our research group. When included as an isolated variable, trunk mobility explained 1.5% of the result of the gait speed test, which reinforces the dynamic interaction between the factors and indicates the need for a more comprehensive understanding of the factors involved in the functionality of older women with low back pain.[39]

Handgrip strength was found to be positively associated with gait speed. The main premise is that handgrip strength predicts global muscle strength, and therefore, low values of grip strength are associated with disability.[40] In a 12-month longitudinal study of older women with low back pain, handgrip strength explained 2.1% of the results of the gait speed, reiterating that in reductionist models it is more difficult to understand predictors of disability.[39]

Finally, we highlighted that the functionality of older women with low back painis a multidimensional construct. We suggest that future studies explore variables such as sleep quality, social support, eating habits, and physical activity level. Among the limitations of the study, we highlight that the sample was composed only of older women and cross-sectional design prevents from drawing any conclusion about the chronology and the causality of the associations found. Besides, LBP is self-reported, but this type of assessment is common due to the subjectivity of LBP and it is well accepted in epidemiological studies.

## 5. Conclusion

Age, education, low back pain intensity, body mass index, comorbidities, depressive symptoms, fear of falling, anterior trunk mobility, and handgrip strength influenced 18.8% of the test results. These variables can act independently or synergistically.

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## Conflict of interest

None.

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