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Slower gait speed increases risk of falling in older adults with depression and cognitive complaints

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ABSTRACT

Slowed gait is one of the strongest predictors of fall risk in older adults. The present study investigated whether gait speed mediated the relationship between depression and fall history in 147 older adults presenting to a memory clinic for cognitive complaints. Depression, cognitive status, gait speed, and number of falls within the last year were the primary measures. Results revealed fallers, relative to non-fallers, had slower gait speed and higher depression scores. As hypothesized, analyses using the PROCESS macro found that gait mediated the relationship between depression and fall history. Additionally, the combination of depression and mild cognitive impairments (MCI) associated with a significantly greater likelihood of falling. Our findings indicate that combined depression and MCI have additive effects on fall risk, likely through the destabilizing effect of slowed gait on balance. Better understanding the underlying pathophysiology involved in MCI and depression-related gait disturbances may lead to improved intervention targets for fall risk prevention.

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Cognitive decline; executive function; fall risk; pathophysiology; dementia; personalized medicine

Introduction

Falls are the leading cause of mortality and non-fatal injuries within older adults (Centers for Disease Control and Prevention, 2014a). Mild cognitive impairments (MCI) and depression have both been identified as risk factors for falls in older adults (Ambrose et al., 2013; Beauchet et al., 2008; Briggs et al., 2018; Doi et al., 2015; Kvelde et al., 2015; Lowe et al., 2020; MacAulay et al., 2014, 2014, 2017; Montero-Odasso et al., 2012; Verghese et al., 2009). However, little is known about the combined effect of depression and MCI on fall risk. It is possible that the combination of depression and MCI might have even more deleterious additive effects on fall risk through slowed gait.

Growing evidence suggests that depression and MCI may share common pathophysiology that may potentiate fall risk. Common factors in MCI and later life depression include slowed gait and decreases in cognitive efficiency (Hughes et al., 2020; Koenig et al., 2014; Kvelde et al., 2015; Naidu et al., 2019). The present study aimed to determine whether: 1) slowed gait speed is a mechanism by which depression increases

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fall risk through mediational analyses, and 2) the likelihood of falling was higher in patients with MCI as compared to subjective cognitive concerns (SCC) with- and without depression. Based on these research questions, we hypothesized that: a) depression would associate with slower gait speed and fall risk, b) gait speed would mediate the relationship between depression and fall risk, and c) older adults with combined depression and MCI would be at greater risk of falling than those without objective cognitive impairments. Should our hypotheses be supported, these findings have significant clinical implications for the assessment, intervention, and clinical documentation of fall risk.

Methods

Study population

All patients presented for neuropsychological assessment for cognitive complaints at an outpatient memory clinic within the Department of Neurology at the Medical University of South Carolina (MUSC). Inclusion criteria for this study included being age 45 or older, able to walk independently, and age-related cognitive concerns. Exclusion criteria included a diagnosis of dementia, severe cognitive impairments (Mini-Mental State Exam: ≤18; Folstein et al., 1975), Parkinson's disease, a major stroke, intellectual disorder, severe obesity, normal pressure hydrocephalus, psychotic disorder, and/or moderate-to-severe traumatic brain injuries. This study was approved by the MUSC Institutional Review Board.

Measures

Clinical assessments

Individuals selected for this study underwent comprehensive neuropsychological assessments due to age-related cognitive/memory complaints. Patients were diagnosed with MCI by a licensed clinical neuropsychologist. Those with subjective cognitive concerns not supported by objective examination on neuropsychological testing were deemed as SCC. Current depressive symptoms were assessed using the Geriatric Depression Scale (GDS 30-item; Yesavage et al., 1986) or the Beck Depression Inventory-II (BDI; Beck et al., 1996). Usual walking speed was collected for two trials (4.57 meters). Average gait speed scores were formed from the trials. More detailed information about the study procedures is available (MacAulay et al., 2017).

Statistical analyses

Descriptive statistics were generated for the patient characteristics. To allow for comparison, a depression symptom scale was formed from converting BDI-II and GDS scores into z-scores. Relevant group differences were investigated via ANOVAs, chi-square, or Fisher's exact tests. Chi-square tests examined the frequency of falls and depression relative to cognitive status. The PROCESS macro tested whether gait speed mediated the relationship between depression symptoms and fall history (Hayes, 2012).

Table 1. Patient characteristics.

	Total (N = 147)	SCC (n = 85)	MCI (n = 62)	*p-value*
Age	65.97 (9.17)	63.13 (8.61)	69.85 (8.27)	**<.001**
% Female	61.20	68.20	51.60	**.028**
Education	14.85 (2.74)	15.34 (2.46)	14.18 (2.98)	**.016**
Race (%)				.141
White	84.40	88.20	78.00	-
Black	13.60	9.40	20.30	-
Other	1.40	2.40	1.60	-
Mini Mental State Exam	27.22 (1.98)	28.67 (1.29)	25.76 (2.66)	**<.001**
Major Cardiovascular Event	14.30	9.40	21.00	**.019**
Hyperlipidemia	53.10	41.20	69.40	**<.001**
Hypertension	55.10	45.90	67.70	**<.001**
Diabetes	17.00	16.50	17.70	.925
Major Cerebrovascular Event	21.10	12.90	32.30	**.008**
Depression History (%)	50.00	54.20	44.44	.242
Geriatric Depression Scale, *n* = 64	8.02 (5.09)	8.73 (1.53)	8.10 (5.42)	.553
Beck Depression Inventory, *n* = 77	11.84 (7.65)	12.33 (7.58)	9.62 (6.71)	.105
Gait Speed (seconds)	7.28 (0.22)	6.86 (1.53)	7.70 (2.22)	**.017**
Fall within last year (%)	27.21	25.90	30.50	.542

Note. Subjective Cognitive Complaints (SCC); Mild Cognitive Impairment (MCI). Different *n*'s reflect difference in battery and/or missing data. Values presented in Means and Standard Deviations: *M* (*SD*) unless otherwise noted.

Results

Sample characteristics

Table 1 presents the patient characteristics by cognitive status. One-Way ANOVAs found that fallers demonstrated slower gait speed than non-fallers [F (1, 145) = 11.58, $p = .001$] and patients with MCI demonstrated a slower gait than those with SCC, F (1, 145) = 8.55, $p = .004$.

Mediation analyses

The PROCESS macro tested the hypothesis that gait speed mediated the relationship between depression symptoms and fall history. As Figure 1 shows, greater depression

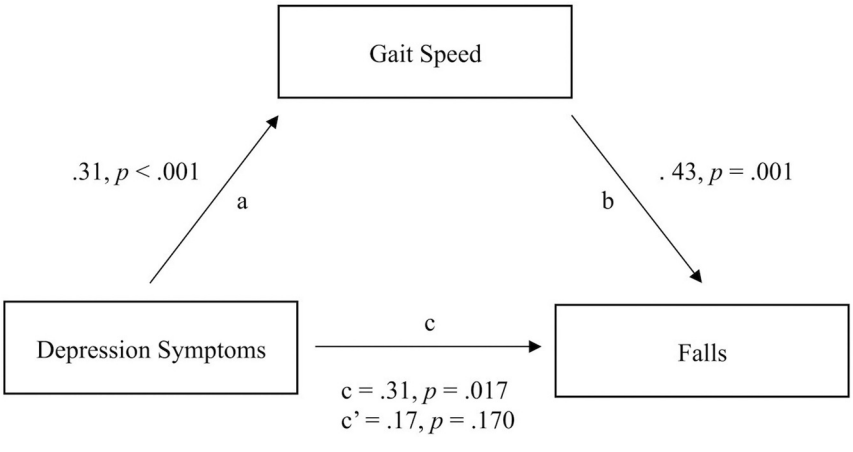

Figure 1. Conceptual model depicts the mediating role of gait speed between depression and fall risk.

symptoms were significantly associated with slower gait (path a) and higher fall risk when slowed gait was not in the model (path c). There was, however, a significant indirect effect (path c') indicating that slowed gait mediated the relationship between depression and fall history, ß = .13, 95% CI [.0094, .3912]. This indirect effect accounted for approximately 9% of the variance in fall risk.

Group differences in the likelihood of falling

As hypothesized, chi-square tests revealed that the likelihood of falling was statistically greater in MCI patients with depression compared to those without depression (X^2 = 4.45, p= .035); whereas, the likelihood of falling did not statistically differ between SCC patients with or without depression (X^2 = 1.57, p= .211).

Discussion

Our findings identified gait speed as an important underlying mechanism in fall risk that may be useful as a treatment target for reducing fall risk in those with MCI and/or depression. To our knowledge, this study provides the first evidence that slowed gait speed mediates the relationship between depression and fall risk in older adults with cognitive concerns. Results also found that the comorbid presence of depression and MCI associated with a greater likelihood of falling than MCI alone.

Physical therapy remains the primary intervention to prevent and/or reduce falls in older adults (Centers for Disease Control and Prevention, 2014b). The CDC's current guidelines for fall risk typically involve recommendations for physical exercises and strength-based training. However, while physical interventions are effective when lower extremity weakness is the primary cause, primarily physical interventions for gait speed may not be as effective for those with depression and cognitive impairments. In this respect, multimodal treatments that target gait, cognitive, and depressive symptoms may increase the effectiveness of mobility and fall risk interventions in older adults with MCI and/or depression (Kvelde et al., 2015; MacAulay et al., 2015; Montero-Odasso et al., 2012)

The present study measured gait speed, which can be easily collected without extensive set-up or instrumentation in clinical settings. A strength of this study's design is that diagnoses were based on comprehensive neuropsychological evaluations performed in a clinically representative Treatment-seeking population. Limitations to this study include its cross-sectional design and that the patients diagnosed with MCI relative to SCC were significantly older, which may contribute to the observed slower gait speed.

In sum, slowed gait is a common risk factor for falling in MCI and depression. This work demonstrates the clinical utility of gait speed assessment for fall risk in a memory clinic setting and emphasizes the importance of routine screening for depression and MCI in those that have fall histories. Routine gait speed assessment may improve our ability to detect and identify treatment targets to prevent falls in older adults. Our findings also suggest that screening for depression and MCI may help identify those at ultra-high risk of falling. Future research is warranted to identify potential underlying pathophysiology involved in MCI and depression-related gait disturbances and how this contributes to fall risk.

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Author Contributions

Rebecca K. MacAulay, PhD, was responsible for the conception and design of the study, writing the article, and contributed to data acquisition, analysis and interpretation.

Angelica Boeve, MA contributed to the data analysis and interpretation.

Lisa D'Errico, MS contributed to the editing of the manuscript.

Amy Halpin, MA contributed to the editing of the manuscript.

Dana Szeles, PhD contributed to data acquisition and editing of the manuscript.

Mark T. Wagner, PhD, was responsible for the conception and design of the study, and contributed to data acquisition, analysis and interpretation.

This work was presented in part at the International Neuropsychological Society 46th Annual Meeting, Washington, DC.

Disclosure of interest

The authors report no conflict of interest.

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