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Examining the relationship between falls and mild cognitive impairment on mobility and executive functions in community-dwelling older adults

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Keywords

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Cognitive impairment and falls are geriatric “giants” that significantly increase morbidity and mortality in older adults. Even mild cognitive impairment (MCI) is a significant risk factor for falls.¹ Clinical gait abnormalities including slow gait and falls are early

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TLA: Study concept and design, acquisition of data, analysis and interpretation of data, preparation of manuscript, and critical review of manuscript. JCD and JB: analysis and interpretation of data, writing of manuscript, and critical review of manuscript. CLH, ED: Acquisition of data and critical review of manuscript. LN: Writing and critical review of manuscript. All authors had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

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biomarkers of cognitive impairment,² suggesting that impaired cognitive function and mobility share common underlying pathophysiology.

Despite the vast interest in the interplay between impaired cognitive function and mobility, few studies to date have investigated whether their co-manifestation results in a broader and greater degree of deficits, potentially due to greater burden of pathology, than singular domain (i.e., cognitive or mobility) impairment. Understanding the specific and extent of deficits may facilitate the development of effective screening and prevention strategies. Therefore, we examined the independent and synergistic effects of: 1) MCI status as defined by a Montreal Cognitive Assessment (MoCA) score < 26/30³ and; 2) fall status (i.e., 2 falls is a faller, 1 fall is a non-faller) on measures of cognitive function and mobility over a 12-month period. For cognitive function, we focused on executive functions as they are highly associated with impaired mobility, including falls.

METHODS

We conducted a 12-month prospective study (baseline and 12 months) with 149 women and men, aged 70 to 80 years; 2) with 24/30 Mini-Mental State Examination (MMSE) scores;⁴ and 3) living independently in their own homes. We obtained ethics approval from the Vancouver Coastal Research Health Institute and University of British Columbia's Clinical Research Ethics Board. All participants provided informed written consent.

Dependent Variables

Executive functions—Selective attention and conflict resolution was assessed by the Stroop Test⁵, set shifting was assessed by Trail Making Tests (TMT) (Part A & B)⁶, the Verbal Digits Tests (Forward & Backward) were used to assess working memory⁷

Balance and mobility—Mobility and balance were assessed using the Short Physical Performance Battery (SPPB)⁸ and the Timed-Up-and-Go Test (TUG).⁹ Physiological falls risk was assessed using the short form of the Physiological Profile Assessment (PPA), a valid and reliable measure of falls risk.¹⁰

Grouping—Participants were divided into the following four groups: 1) No MCI (i.e., MoCA score ≥ 26; reference group) and non-faller (1 displacement falls (with or without syncope) in the previous 12 months), 2) MCI (i.e., MoCA score < 26) and non-faller, 3) No MCI and faller (experienced ≥ 2 minimal displacement non-syncopal falls in the previous 12 months) and 4) MCI and faller.

Data Analysis

Using SPSS 22.0, the primary analyses consisted of linear mixed models, where time (baseline vs. follow-up) was a within-subjects repeated measure and group membership was a between-subjects fixed effect. An unstructured covariance matrix provided the best model fit (based on the Bayesian Information Criterion), and denominator degrees of freedom were calculated from the Satterthwaite approximation. Separate models were fitted for the following dependent variables: Stroop, Trail Making Test, Verbal Digit Span, SPPB, TUG

and PPA. Models were adjusted for (main effect and interaction with time): age, sex, IADLs, and ABC.

RESULTS

Of the 149 participants aged $75 \pm (3)$ years, 81 were non fallers, 68 were fallers, 58 had no MCI and 91 had MCI. Figure 1 details results from six adjusted linear mixed models.

Model 1: Response Inhibition (Stroop Test)

There was a trend toward group 2 showing poorer change over time relative to group 1 ($p = .062$, Cohen's $D = .51$). Including covariates nullified this trend.

Model 2: Set Shifting (Trail Making Test)

Group 2 showed significant improvements from baseline to follow-up. No group differed in the amount of change over time. This pattern of results held in the partially and fully adjusted models.

Model 3: Working Memory (Digits Backward – Digits Forward)

No group showed significant increases or decreases in performance over time in the partially and fully adjusted models.

Model 4: Mobility (SPPB)

Group 3 also showed greater improvements in SPPB scores over time compared to the reference group (Cohen's $D = .66$). All results were non-significant in the fully-adjusted model.

Model 5: Mobility (TUG)

The reference group made greater improvements than the highest risk group in the adjusted model (Cohen's $D = .50$). There was a trend toward greater improvements in the reference group compared to fallers without MCI ($p = .06$, Cohen's $D = .48$).

Model 6: Falls Risk (PPA)

There was no longitudinal within- or between-group difference in change in falls risk in the unadjusted, partially, or fully adjusted models.

DISCUSSION

Our study highlights that the combination of positive MCI and fall status may be a significant risk profile for future deterioration in mobility. MCI alone is a more important predictor of concurrent executive deficits than fall status. Future research should further explore the unique and synergistic effects of falls and MCI as “early” indicators of future decline in mobility and executive function in order to accurately tailor future intervention and prevention strategies for men and women.

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Figure 1. Longitudinal results from adjusted linear mixed models

Note: For all variables except SPPB, negative change represents improvement in performance. Error bars represent the standard error of the mean. Covariates (not shown) include: age, sex, IADLs, and ABC. * $p = .05$. $^{\ddagger} p = .06$.