Guest Editorial

What Links Gait Speed and MCI With Dementia? A Fresh Look at the Association Between Motor and Cognitive Function

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Received December 21, 2012; Accepted January 2, 2013

Decision Editor: Stephen Kritchevsky, PhD

COGNITIVE impairment and dementia are common consequences of aging that have a huge impact on function and quality of life. It is not surprising, therefore, that early detection of individuals at high risk for dementia and the development of effective interventions are major public health priorities. Understanding the biological pathways linking risk factors to cognitive decline and dementia promises to lead to effective therapies. Over the past two decades, the research community has identified numerous genetic, medical, experiential, and psychosocial factors that are associated with cognitive decline and dementia (1–3).

A lower level of motor function, for example, slow gait, is also a risk factor for the development of mild cognitive impairment (MCI), dementia, and a more rapid rate of cognitive decline (4–9). Conversely, a lower level of cognitive function, particularly executive function, is a risk factor for the development of motor impairment, especially falls and a more rapid rate of motor decline (10–14).

One explanation of these two parallel lines of findings is that gait depends on cognitive function (15–17). This interpretation is supported by the many studies that have demonstrated the negative effects of dual tasking on gait (16,17). Although it is possible that cognitive deficits could impair the initiation, planning, or control of movement, it is unlikely that motor impairments alone would cause cognitive dysfunction. Another, more parsimonious explanation for these two lines of research is that cognitive and motor function are not causally related and are not true risk factors for one another, but rather that both are affected by a

common underlying pathophysiology. Thus, individuals who manifest both cognitive and motor deficits might have a greater burden of a shared underlying pathology. Modeling both cognitive and motor function together might, therefore, be more strongly predictive of the development of dementia.

Building on these two parallel lines of findings, Verghese and colleagues (18) introduced a new idea that they refer to as motor cognitive risk (MCR) syndrome. Operationally, MCR was defined as having MCI and slow gait (1.0 *SD* or more below age and sex-based norms). Simply put, the authors attempted to extend the current definition of MCI and asked whether cognitive function and gait taken together are a better predictor of the development of dementia than either of these symptoms alone. Analyses of longitudinal data collected as part of the Einstein Aging Study suggested that participants with the MCR syndrome were more likely to develop dementia, especially vascular dementia. Among the 997 community-living older adults who were followed, the incidence rate of dementia was more than twice as large among participants who had MCR (66 per 1,000 person-years in MCR compared with 24 per 1,000 person-years in non-MCR participants). Moreover, the presence of MCR syndrome apparently provided added value for predicting dementia, with respect to both gait speed alone and MCI alone. For example, the magnitude of the association between slow gait and future dementia was lower than that between MCR and dementia.

From a practical, diagnostic perspective, the results of this study suggest that the prediction of dementia can be

improved by adding the assessment of gait speed. This can be done simply with minimal cost and time. Should tests for dementia risk now include gait speed? These interesting and thought-provoking findings need to be replicated and confirmed on a larger scale. Nonetheless, because the added value appears to be significant and the disadvantages are minimal, it would appear that the potential advantages should be carefully considered.

To better understand the clinical utility and meaning of MCR and to assess whether there is something unique about gait, it may also be helpful to contrast the prediction of dementia based on gait speed to other aspects of motor function. Gait speed is easy to test and provides an excellent general measure of overall function. However, other quantitative motor and gait measures, such as gait variability, may show differential associations with distinct cognitive abilities, and thereby further enhance diagnostic capabilities (13,15,19,20). The trade-offs of simplicity versus diagnostic power will need to be evaluated. Finally, although the models employed in this study only considered the level of gait speed at a single point in time, loss of cognition and motor function often occur simultaneously. Few studies have examined the degree to which the rates of cognitive and motor decline are associated and whether decline in one domain consistently precedes the other (5,7).

The conceptualization of chronic age-related neurological diseases like Alzheimer's disease and stroke is changing and there is increasing recognition that their phenotypic expression may be more complex and varied than originally thought (21,22). For example, based on brain imaging and postmortem studies, it is now recognized that Alzheimer's disease pathology and cerebrovascular disease pathology are common and show widespread accumulation in cognitive and noncognitive brain regions in older persons without clinically diagnosed dementia or stroke. Furthermore, these subclinical pathologies are not "incidental" but are associated with a wide range of clinical deficits including gait and other motor impairments as well as cognitive impairment (23,24). Thus, the progressive accumulation of brain pathology in varied central nervous system locations may account for the wide range of cognitive and noncognitive deficits that manifest in older adults before cognitive impairment is severe enough to warrant a clinical diagnosis of dementia. As demonstrated by Verghese and colleagues, considering gait speed, a noncognitive function affected by brain pathology and cognitive complaints together, may enhance efforts to identify older adults at risk for developing dementia.

The current study is also important because it suggests that by considering gait speed and cognitive impairment, investigators may be able to identify a subgroup of older individuals who may be at high risk for dementia from specific brain pathology. Further studies will need to determine if MCR identifies individuals with postmortem evidence of cerebrovascular rather than Alzheimer's disease pathology. Nonetheless, new studies that seek to explicate

the pathological basis for dementia will likely build on the approach used by Verghese and colleagues. A wider range of clinical data and genetic, laboratory, and biomarkers may help to delineate characteristic clinical profiles for the diverse brain pathologies that contribute to dementia in old age.

MCR is a provocative concept. It further underscores the link between walking and thinking, raises important questions regarding the neurobiological substrate of late-life cognitive and motor impairment, and may provide a means to improve the detection of older individuals who have a high risk of developing dementia. Extending the present findings, one can speculate that MCR may also enhance the prediction of motor decline and falls among older adults. Time will tell if the whole is greater than the sum of its parts with respect to gait, MCI, and MCR.

FUNDING

J.M.H. receives research support from the National Institutes of Health (R01NS078009, P20 MD0068860, R21AG03422), the European Commission, and the Israel Ministry of Health. A.S.B. receives research support from the National Institutes of Health (P30AG10161, R01AG17917, R01NS078009, R01AG040039).

ACKNOWLEDGMENTS

The authors report no disclosures for this manuscript.

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