EDITORIAL

Predicting Dementia from Decline in Gait Speed: Are We There Yet?

A common health-related concern of adults aged 50 and older is the future risk of cognitive decline and dementia. This concern, and risk, is magnified with older age. Geriatricians are commonly asked to address these concerns and provide specific answers, but we lack appropriate tools. Current methods to predict dementia are expensive and invasive (e.g., amyloid imaging) or require referral to specialists for a comprehensive battery of cognitive tests and may have limited value in cross-section.

An article in this month's issue of the *Journal of the American Geriatrics Society*[1] points us toward a relatively unexpected approach. Montero-Odasso and colleagues[1] propose that examining changes in performance in the motor domain could predict clinical decline in the cognitive domain. Many motor tasks require high levels of concentration; athletes routinely review and discuss their motor performance to devise strategies to improve it. It is a common experience that our attention is heightened when performing a novel motor task or one that we have not performed in a long time, such as dancing or biking. The link between cognitive and motor performance is not surprising in itself, but Montero-Odasso and colleagues focused on a simple, overlearned motor task: walking over a short, level surface in a well-lit room without physical obstacles or other visual or auditory distractions. From a biomechanical perspective, even such an automated task as walking is the result of an exquisitely coordinated sequence of smaller movements. Walking requires timely integration of internal and external stimuli to produce automated sequences of muscular contractions, including axial muscles along the spine and neck, arms, legs, and feet. Although complex biomechanical measurements can be derived from walking tests, Montero-Odasso and colleagues chose to measure a simple marker: the time it takes to walk a fixed distance. What is notable about their findings is the simplicity and ease of measuring walking speed. Assessing such a simple marker repeatedly over time may offer an advantage over more complex measurements of cognition in predicting dementia onset.

A recent National Institute on Aging–sponsored conference series highlighted the link between the central nervous system and mobility in older adults without neurological disorders and urged clinicians to include walking measures as part of routine clinical assessment.[2] Although diagnosed and often managed separately from each other, slow walking and poor cognition commonly co-occur and often decline in parallel. There is strong evidence that older adults who walk slowly are also at greater risk of developing dementia, in addition to mobility disability. Effect sizes appear remarkably similar across studies; the consistency of the results across different study designs, populations, and methods to measure walking characteristics makes a compelling case for the use of gait measures to predict dementia in the medium to long term.

The link between walking and cognition has biological plausibility. It is becoming increasingly clear that the co-occurrence of slower walking and lower cognition is at least in part due to shared neural substrates.[3] We and others have recently shown that it is likely the hippocampus is a shared resource for walking and cognition because of its role regulating spatial orientation and memory.[2,3] There is also substantial overlap between the areas and connecting tracts that regulate attention and motor coordination, as well as the neurotransmitters regulating these complex behaviors. Lastly, an indirect causal link between gait slowing and dementia has been proposed; individuals with worse physical performance are less physically active, potentially leading to less social and intellectual engagement, which are strong risk factors for dementia, and thus perpetuating a vicious cycle for older adults.[2]

More complex measures, such as walking while performing other tasks (dual-task conditions), have also been linked to incident dementia,[4,5] but these tasks are more challenging to implement in a doctor's office, and it is not clear that they offer a real advantage over simple time to walk. Time to walk is appealing as a potential test to determine risk of future dementia because it easy to measure, reliable, not invasive, and affordable.

Several challenges need to be addressed before walking speed (or other gait measures) becomes a biomarker of dementia and enters clinical practice as a tool to predict cognitive impairment.

The most urgent of these challenges is the need to better understand what age-related slower walking is, because the underlying causes and mechanisms are not well understood. Montero-Odasso and colleagues focused on a population without neurological disease, so it is reasonable to assume that walking slowly was not due to clinically overt neuropathological processes. Generally speaking, "age-related" slow walking is primarily defined as the *absence* of neurological diseases, rather than the *presence* of specific causes. The causes of age-related slow walking

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are multifactorial, resulting from a combination of many subclinical impairments in a multitude of central and peripheral systems. Although each system's impairment contributes to some extent to slow walking, it is not clear that one is more important than the other. The large majority of studies examining the relationship between walking characteristics and cognition have not accounted for peripheral contributors to gait slowing or have focused on selected ones.

Although it is unlikely that one measure would sufficiently accurately predict a construct as complex as dementia, combining simple measures of walking and walking-related predictors with cognitive testing could improve the prediction of dementia, as the findings of Montero-Odasso and colleagues support. Walking, cognition, and even the main contributors to slow walking could be easily measured in a doctor's office, for example a quick vision screening, chair stand, weight, height, pain questionnaire, and ankle arm index. Computerized tablets are already offered in waiting rooms to collect self-reported measures of cognitive and physical function and pain. Doctors' offices could also be equipped with kiosks that include computerized walkways and platforms to automatically record footsteps and muscle functional characteristics to collect these measures objectively and rapidly and combine them into one algorithm.

If this plan seems tantalizing simple, it is also premature. Steps to help us reach clinical application could include the following. A risk score algorithm could be developed based on a comprehensive review of existing studies of older adults without neurological disease that have measures of walking characteristics, walking-related contributors, and dementia outcomes. Then this algorithm could be applied to compute population attributable risks of conversion from normal cognition to mild cognitive impairment and from mild cognitive impairment to dementia. Cost-effectiveness analyses should identify the number of cases of dementia that could eventually be identified. Benefits of better risk prediction for dementia will be realized when disease-modifying therapies become available, but in the meantime, risk management strategies can include lifestyle modification (e.g., diet, exercise, cardiovascular risk management), for which beneficial evidence is growing. The way toward better prediction of dementia risk, and thereby spurring greater support, services, and interventions along the way, requires taking one persistent step at a time.

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