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At the Tipping Point:

Predicting Severe Mobility Difficulty in Vulnerable Older Women

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Abstract

OBJECTIVES—To identify clinical measures that aid detection of impending severe mobility difficulty in older women.

DESIGN—Cross-sectional and longitudinal cohort study.

SETTING—Urban community in Baltimore, Maryland.

PARTICIPANTS—One thousand two community-dwelling, moderate to severely disabled women aged 65 and older in the Women's Health and Aging Study I.

MEASUREMENTS—Self-report and performance measures representing six domains necessary for mobility: central and peripheral nervous systems, muscles, bones and joints, perception, and energy. Severe mobility difficulty was defined as usual gait of 0.5 m/s or less, any reported difficulty walking across a small room, or dependence on a walking aid during a 4-m walking test.

RESULTS—Four hundred sixty-seven out of 984 (47%) had severe mobility difficulty at baseline, and 104/474 (22%) developed it within 12 months. Baseline mobility difficulty was correlated with poor vision, knee pain, feelings of helplessness, inability to stand with feet side by side for 10 seconds, difficulty keeping balance while dressing or walking, inability to rise from a chair five times, and cognitive impairment. Of these, knee pain (odds ratio (OR) = 1.74, 95% confidence interval (CI) = 1.05–2.89), helplessness (OR = 1.87, 95% CI = 1.10–3.24), poor vision (OR = 2.03, 95% CI = 1.06–3.89), inability to rise from a chair five times (OR = 2.50, 95% CI = 1.15–5.41), and cognitive impairment (OR = 4.75, 95% CI = 1.67–13.48) predicted incident severe mobility difficulty within 12 months, independent of age.

CONCLUSION—Five simple measures may aid identification of disabled older women at high risk of severe mobility difficulty. Further studies should determine generalizability to men and higher-functioning individuals.

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Keywords

aging; mobility difficulty; clinical assessment

More than 46% of Medicare beneficiaries in 2004 reported difficulty walking one-quarter of a mile,[1] placing them at risk of progression to mobility disability, dependency, and greater health services requirements.[2] Several screening tests and prognostic indices have been constructed that predict incident mobility limitations or mild mobility disability in relatively high-functioning older persons. These tests and indices primarily use performance measures that reflect impairments and functional limitations[3–5] or self-report indicators of preclinical disability.[6]

Much less is known about how to identify persons on the verge of developing severe mobility difficulty from among the many older adults with functional limitations or mild mobility difficulty. Severe mobility difficulty—great difficulty walking or inability to ambulate without assistance over a short distance, such as a small room—threatens the ability to live independently and negatively affects quality of life. In functionally limited older persons, an initially broad clinical assessment may be particularly appropriate in light of the diverse and complex health issues that may underlie their functional difficulties. Clinical practice and emerging evidence suggest that factors difficult to categorize as impairments or limitations, such as fatigue or pain, can have critical effects on the development of difficulty.[7–10] Although severe mobility difficulty may be evident when a patient can no longer walk unaided from the waiting to the examination room, features that distinguish the state immediately preceding severe difficulty, or that predict its development, are less obvious.

The objective of this study was to identify easily ascertainable clinical measures that distinguish persons at risk of developing severe mobility difficulty over the short term. To accomplish this, an observational cohort study with in-depth clinical information on factors hypothesized to influence mobility difficulty was utilized. As a first step, measures readily obtainable in a clinical setting and highly correlated with severe mobility difficulty were identified. Initial selection of measures was based on a conceptual model that delineates physiological domains necessary for walking.[11] The degree to which measures identified in the first step predicted incident severe mobility difficulty within the next 12 months was then determined.

METHODS

Study Population

Data were from the Women's Health and Aging Study I (WHAS I), a cohort study of the causes and natural history of physical disability in older women who were moderately to severely disabled at baseline. An age-stratified random sample was obtained from Medicare enrollment files for community-dwelling women aged 65 and older residing in 12 contiguous ZIP codes in Baltimore, Maryland. Recruitment and baseline data collection occurred from 1992 to 1995. Eligibility criteria consisted of a Mini-Mental State Examination (MMSE)[12] score greater than 17 and self-report of difficulty in one or more tasks from at least two of four functional domains: mobility, upper extremity, higher-functioning, and self-care tasks required for independent living. Difficulty in two or more of these functional realms has been found to represent the one-third most-disabled persons residing in the community.[13] A more-detailed description of subject selection has been published elsewhere.[14] Once women were selected, a comprehensive assessment of health and functional status was obtained using a standardized home-based interview and nurse-administered physical examination.[15]

Outcome Measure: Severe Mobility Difficulty

The outcome, severe mobility difficulty, was conceptualized as great difficulty walking or inability to walk a short distance. It was defined as usual walking speed of 0.5 m/s or slower, any reported difficulty walking or inability to walk across a small room, or dependence on a walking aid during walking trials. Usual walking speed was assessed by timing the participant over a 4-m course in her home; use of a walking aid was allowed. The faster of two trials was used for this analysis. A usual walking speed of 0.5 m/s represented the 35th percentile in this moderately to severely disabled sample. Previous studies have found that a similarly low usual gait speed of less than 0.6 m/s predicted hospitalization and functional decline[16] and that less than 0.42 m/s predicted functional dependence.[17] Information about difficulty walking across a small room was obtained by asking the participant, "By yourself, that is without help from another person or special equipment, do you have any difficulty walking across a small room?" A composite outcome was selected based on clinical judgment about the content validity of mobility difficulty, consideration of mobility difficulty as a latent construct, and the advantages of avoiding reliance on responses to a single item. Exploratory data analyses also demonstrated the tendency for the components to co-occur (Table 1). Additionally, kappa coefficients comparing degree of agreement between each component measure and the combined outcome were 0.62 for usual gait speed of 0.5 m/s or less, 0.65 for reported difficulty walking or inability to walk across a small room, and 0.74 for dependence on a walking aid during walking trials, indicating strong comparability.

Candidate Clinical Measures

A previous study[11] proposed a conceptual model that delineates six physiological domains necessary for mobility: central and peripheral nervous systems, muscles, bones and joints, perceptual system, and energy production. Using this framework and judgment regarding ease of use in a clinical setting, self-report and performance measures representing each of these domains were selected a priori from the baseline comprehensive home interview and nurse-administered home examination. In addition, selection of candidate measures focused on those representing functional impairments; specific diseases or medication history were not examined. The "central nervous system domain" as assessed in the previous study[11] included psychological symptoms as well as neurological signs. Apart from standing balance, discussed below, complete data on neurological signs were not available in WHAS I. For this analysis, depressive symptoms were assessed according to the Geriatric Depression Scale (GDS) and anxiety symptoms according to the anxiety subscale of the Hopkins Symptom Checklist:[18] avoidance of frightening things and feeling nervous or shaky inside, tense, or fearful during the previous week. Based upon earlier work,[19] low personal mastery was assessed as disagreement with the statement "I can do just about anything I set my mind to" or agreement with "I often feel helpless in dealing with the problems of life." Cognitive impairment was defined as an MMSE score between 17 and 24. For participants with less than 12 years of education, scores between 17 and 21 were considered to indicate impairment.[20] Measures of the "peripheral nervous system domain" included self-reported abnormal leg or foot sensation and whether foot numbness was present most of the time. The "muscles domain" was assessed according to grip strength. Poor maximal grip strength was defined as less than 11 kg using a handheld dynamometer.[21,22] The "bone and joints domain" contained several measures that ascertained the presence of reported pain or stiffness in the knees or hips over the previous month, reported knee swelling most days lasting at least 6 weeks, reported foot or back pain lasting at least 1 month during the previous year, and knee or hip tenderness with palpation or pain with passive motion on nurse examination. Additionally, a summary measure was created from reported moderate to severe pain in knees or hips while sitting or lying down, standing upright, or walking on a flat surface. The "perceptual system domain" was assessed according to measures of vision. Vision was considered poor if the participant reported an inability to see well enough in any of three tasks: watching television, recognizing someone across a room, or

reading a newspaper. The "energy" domain was operationalized as perceived energy and assessed according to self-report of weakness, fatigue, or lack of energy. Lastly, measures that probably represent multiple domains, such as standing balance and inability to rise from a chair five times without use of arms, were also considered. Balance measures included self-report of balance problems walking on a level surface, standing with eyes closed, dressing while standing, or dizziness after standing; self-report of overall poor balance; and observed inability to stand with feet side by side for 10 seconds. A combined variable was subsequently created from responses to the questions: "How often do you have a problem keeping balance walking on a level surface or dressing while standing?" This variable was coded as never if the response to both questions was never; as often/very often/always/doesn't do if the response to either question was often, very often, always, or doesn't do; and otherwise as sometimes. For the repeated chair stands, participants were asked to rise from a sitting position as quickly as possible five times with arms folded across the chest. A participant was considered unable if she did not succeed in standing without using her arms, responded that it would be unsafe to attempt the task, did less than five stands, or did not attempt the task for a physical reason.

Statistical Analysis

Univariate analyses of candidate measures and severe mobility difficulty in thebaselinesamplewereperformed using t-tests, chi-square tests, and logistic regression. Clinical measures significantly associated with severe mobility difficulty at baseline were then entered into a logistic regression model andeliminatedwithbackward selection (Po.05). Because the objective was to identify meaningful measures irrespective of age and race, these demographic factors were not included in model-building procedures. The final model was analyzed according to age and race strata to determine potential age—race interactions; no such interactions were found.

Progression to severe mobility difficulty 1 year after baseline was modeled in initially outcome-free women using the measures identified in the final cross-sectional model, and age, as predictors. The longitudinal model was also analyzed subsequently with baseline walking speed included as a covariate. All analyses were performed using SAS version 9.1 (SAS Institute, Inc., Cary, NC).

RESULTS

Of the 1,002 women enrolled in WHAS I, 18 were missing data on explanatory variables, leaving a baseline sample of 984. At baseline, 467 (47%) women had severe mobility difficulty. This group was older and had a higher proportion of blacks, a lower mean MMSE score, a higher proportion of lifelong nonsmokers, and a higher proportion with difficulty in all four functional domains than women without severe mobility difficulty at baseline (Table 2).

In the cross-sectional analysis, most measures were significantly associated with severe mobility difficulty at baseline. Inability to perform five chair stands and inability to stand with feet side by side for 10 seconds had exceptionally strong univariate associations (Table 3). Accordingly, 89% of participants unable to stand with feet side by side for 10 seconds and 85% of those unable to rise from a chair five times had severe mobility difficulty, in contrast to 37% and 31%, respectively, without those deficits. Table 3 also shows that some relatively rare conditions, such as abnormal sensation in legs or feet and poor grip strength, were associated with significantly greater odds of severe mobility difficulty.

After entering all significant measures listed in Table 3 into a logistic regression model, seven remained independently significant after backward stepwise selection (Table 4), representing all domains except peripheral nervous system and energy perception. Inability to rise from a chair five times and frequent balance problems while walking on a level surface or dressing

while standing were most strongly associated with severe mobility difficulty at baseline, followed by inability to stand with feet side by side, feelings of helplessness, cognitive impairment, poor reported vision, and presence of knee pain on examination. A stratified analysis demonstrated that the association of these measures did not vary according to age or race.

For the longitudinal analysis, the 535 women with no severe mobility difficulty at baseline were re-examined at 1 year. At the 1-year follow-up, 24 had died, five refused to remain in the study, and 32 had missing information on one of the variables because of illness or other reasons, leaving 474 women in the longitudinal sample. One hundred four (22%) women free of severe mobility difficulty at baseline developed it within 1 year. Feelings of helplessness, knee pain on examination, inability to perform five chair stands, self-reported poor vision, and cognitive impairment predicted incident severe mobility difficulty within 12 months, after adjustment for age (Table 4). When baseline walking speed was included in this model, the odds ratios did not markedly change, and all remained significant except for inability to rise from a chair five times. This suggests that women with a sense of helplessness, knee pain on examination, poor vision, and cognitive impairment are at greater risk of onset of severe mobility difficulty over 1 year, independent of initial walking speed.

Of the seven measures correlated with severe mobility difficulty cross-sectionally, the two balance-related measures did not predict its onset within 1 year. Closer examination revealed that 89% of participants unable to stand with feet side by side for 10 seconds had concurrent severe mobility difficulty at baseline, leaving only 17 women with this inability and without the outcome to be included in the longitudinal sample. In addition, a notable percentage of self-reported balance problems while walking on a level surface or dressing had resolved or improved by the 1-year re-assessment; 19% of those with problems sometimes at baseline improved to never having problems at 1 year, whereas 62% with problems always, very often, or often improved to sometimes or never having problems.

DISCUSSION

From among a broad range of factors representing six domains considered central to walking ability, seven clinical measures were found to be independently associated with prevalent severe mobility difficulty in community-resident, functionally limited older women. These factors included feelings of helplessness and cognitive impairment, representing the central nervous system domain; knee pain on examination, representing the bone and joints domain; poor reported vision, representing the perceptual domain; and three measures probably representing multiple domains: inability to rise from a chair five times, inability to stand with feet side by side for 10 seconds, and reported balance problems while walking on a level surface or dressing. Twenty-two percent of those without severe mobility difficulty—having great difficulty or needing an aid to walk within one's home or having a measured usual gait speed slower than 0.5 m/s—developed it within 1 year. The longitudinal analysis revealed that feelings of helplessness, inability to rise from a chair five times, knee pain on examination, poor reported vision, and cognitive impairment independently distinguished women at high risk of developing severe mobility difficulty.

Study findings provide evidence that, in functionally limited older women, deficits from multiple domains signal the transition to severe mobility difficulty. A brief clinical examination that encompasses five diverse measures that require little time, equipment, or training to acquire may bolster strategies to detect and prevent mobility dependence in disabled older women. Increased ability of clinicians to evaluate mobility status in older persons is important and significant, given the high personal and societal costs of mobility difficulty[23–26] and evidence of the benefit of physical activity in older populations.[27]

Cognitive impairment was most strongly associated with incident severe mobility difficulty, consistent with previous findings of cognitive function predicting gait speed decline in initially well-functioning older adults.[28] This suggests that cognitive impairment may be an important signal of the transition to severe mobility difficulty regardless of overall functioning and presence of other impairments (e.g., pain and vision). The MMSE requires little training to administer and is frequently used as a screening tool in clinical practice.

Inability to rise from a chair five times without use of arms was strongly associated with severe mobility difficulty at baseline and within 1 year. Although initially considered an indicator of lower extremity strength, particularly of the quadriceps muscles, it is now known that multiple factors, including back muscle composition and balance, pain, and "vitality" influence chair stand ability.[29,30] Chair stand ability may be a robust indicator of severe mobility difficulty because it requires the integrated and coordinated action of factors similar to those needed for walking, including lower limb strength and balance. Together with findings that timed chair stands predict subsequent mobility difficulty in higher-functioning populations,[3] these results suggest that the ability to perform repeated chair stands is an effective predictor across the spectrum of functional capacity.

Poor reported vision was predictive of severe mobility difficulty at 1 year, consistent with previous findings of its associated risk of functional decline.[31,32] Although visual acuity is commonly assessed in clinical settings, a previous study[33] found that nonstandard vision tests had higher failure rates with older age than standard high-contrast visual acuity and visual fields testing, which showed the lowest failure rates. To characterize vision in these analyses, a simple three-item question was selected for its efficiency and ease of use in screening. Poor self-reported vision may be predictive of severe mobility difficulty, because it captures problems with other aspects of vision important to mobility, such as contrast sensitivity and depth perception, in addition to visual acuity. It also reflects vision under "real world" conditions, such as poor lighting, that may reduce mobility. Additional longitudinal studies are needed to evaluate the ability of this three-item question, versus standard and nonstandard vision tests, to predict mobility difficulty.

In the clinical setting, helplessness is often considered a symptom of depression and, accordingly, is one component of the GDS. Although several longitudinal studies have shown that depressive symptoms predict physical decline,[34,35] to the authors' knowledge, no study has examined the role of sense of helplessness alone in predicting mobility difficulty. In univariate models, agreement with the statement, "I often feel helpless in dealing with the problems of life," and mild depressive symptomatology, represented by a GDS score greater than 9, each predicted incident severe mobility difficulty. However, backward selection eliminated GDS scores from the final cross-sectional model. A possible explanation is that 64% of women with feelings of helplessness also had mild depressive symptom-atology and that helplessness and a GDS score greater than 9 were moderately correlated, with a Spearman correlation coefficient of 0.45. This suggests that the helplessness dimension of depression may play a significant role in the association between difficulty and depression or could be an outcome of this association. Further studies are needed to confirm whether the single statement assessing helplessness is as informative as the 30-item GDS in predicting mobility difficulty.

Related studies[36,37] of the WHAS population examined three groups: one with emotional vitality, a four-item construct defined as high levels of happiness and personal mastery, as well as low levels of depressive symptomatology and anxiety; an intermediate group that failed to meet at least one of the four emotional vitality criteria; and a group with high depressive symptomatology. Personal mastery was partly defined as disagreement with the statement "I often feel helpless in dealing with the problems of life." The authors found that the intermediate group tended toward poorer function and higher mortality than emotionally vital subjects. The

current study suggests that feelings of helplessness may account for the greater risk of the intermediate group.

Knee tenderness on palpation or pain with passive motion detected by a trained examiner was also a significant independent predictor of severe mobility difficulty. This is often a clinical sign of knee osteoarthritis, a well-documented risk factor for decline in walking ability.[38–40] In contrast, self-reported knee pain was not found to reliably predict onset of severe mobility difficulty. It may be that knee pain on examination was a more-robust predictor, because it may be a more-sensitive measure and less dependent on subject behavior and activity participation. Individuals with knee pain often avoid activity that generates pain, including walking, although such pain may underlie the impending development of severe mobility difficulty due to deconditioning and strength loss, among other factors.

A major difference between the cross-sectional and longitudinal models was the nonsignificance of the two balance-related measures in the latter. The inability to stand with feet side by side had a strong correlation with severe mobility difficulty and accordingly was rare in women without severe mobility difficulty at baseline, who constituted the longitudinal sample. Self-reported balance problems while dressing or walking on a level surface may not have been predictive because a substantial number of subjects with these difficulties at baseline reported none or less-frequent balance problems at 1 year. These results suggest that the inability to stand with feet side by side and self report of balance problems dressing or walking reflect balance incapacities whose presence is synonymous with severe mobility difficulty.

To test the statistical robustness of the predictive measures, the longitudinal model was repeated using each component of the composite measure of severe mobility difficulty separately—usual gait speed, self-reported difficulty walking across a small room, and dependence on an aid to walk 4 m. There were some differences in the combinations of significant clinical measures that emerged for each component. This suggests that use of a more-limited or -restrictive operational definition of severe mobility difficulty may miss important subgroups at risk and supports use of a composite assessment. Use of a composite assessment is consistent with clinical practice, in which evidence of pathology is frequently derived from several sources. Furthermore, self-report and performance-based measures are considered to provide complementary information.[41–43]

Several limitations should be considered. The general-izability of these results is limited to disabled community-resident women without severe cognitive impairment; thus, further studies are needed to determine applicability to men and those with severe dementia. In addition, the potential contribution of chronic diseases was not examined, because they were not included in the conceptual model used to select candidate measures, although impairments themselves are likely to reflect disease severity.[5,26] In addition, clinical measures for some domains were limited in precision and scope, which therefore were not well represented in the analysis.

In summary, this study found a parsimonious set of clinical measures, drawn from a range of physiological domains, that identify older individuals at high risk of developing severe mobility difficulty. With a few brief questions and tests that require no special equipment and little training, clinicians and ancillary staff can identify those at risk of losing meaningful walking ability. Better recognition of threatened mobility independence enables clinicians to provide timely recommendations of appropriate interventions and anticipatory guidance on meeting future needs.

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Table 1

Frequencies of All Possible Combinations of the Three Components of Severe Mobility Difficulty

Outcome Component	Number of Women with Each Combination of Outcome Components							
	136	**67**	**31**	**92**	**64**	**26**	**39**	**527**
Usual gait speed ≤0.5 m/s	Y	Y	Y	Y	N	N	N	N
Reported difficulty or inability walking across a small room	Y	N	Y	N	Y	N	Y	N
Dependence on a walking aid*	Y	Y	N	N	Y	Y	N	N

The outcome, severe mobility difficulty, was defined as usual walking speed of 0.5 m/s or slower, any reported difficulty walking or inability to walk across a small room, or dependence on a walking aid during walking trials. Most participants met no or all outcome criteria, suggesting content validity.

Y = yes; N = no.

*Dependence on a walking aid was determined by observing whether a participant used a walking aid over a 4-m course.

Table 2

Characteristics of Older Women in the Women's Health and Aging Study I According to Severe Mobility Difficulty Status at Baseline

Characteristic	Severe Mobility Difficulty		*P*-Value
	No (n = 535, 53.4%)	Yes (n = 467, 46.6%)	
Age, mean	75.8	81.2	<.001
White, %	76.6	66.0	<.001
Mini-Mental State Examination score, mean	27.0	25.6	<.001
Education, years, mean	10.3	9.4	<.001
Lifelong nonsmoker, %	49.2	57.8	<.001
Body mass index, kg/cm2, mean	28.3	28.6	.54
Number of domains disabled in, %*			
2	53.3	18.6	<.001
3	29.2	23.8	.05
4	17.6	57.6	<.001

*Disability is reported difficulty in one or more tasks within a domain. The four domains assessed were: mobility, upper extremity, higher functioning, and self-care.

Table 3

Univariate Association Between Candidate Measures and Severe Mobility Difficulty at Baseline

Candidate Clinical Measures	Total N = 1,002	SMD		Unadjusted Odds Ratio of SMD (95% Confidence Interval)
		Yes (n = 467, 46.6%)	No (n = 535, 53.4%)	
	Prevalence (%)			
Central nervous system and psychological				
Cognitive impairment*	8.2	12.7	4.3	3.22 (1.96–5.31)
Geriatric Depression Scale score >9 (normal range 0–9)	31.7	40.8	23.7	2.21 (1.69–2.90)
≥2 anxiety symptoms	18.7	24.2	14.4	1.93 (1.39–2.70)
Can do anything I set my mind to (disagree)	27.3	34.8	20.8	2.03 (1.53–2.70)
I often feel helpless (agree)	30.8	41.8	21.4	2.64 (2.00–3.49)
Peripheral nervous system				
Abnormal sensation in legs or feet	6.1	8.6	3.9	2.31 (1.34–3.98)
Presence of foot numbness	5.1	6.4	3.9	1.68 (0.95–2.98)
Foot numbness present often	2.4	3.6	1.3	2.84 (1.17–6.92)
Muscles				
Grip strength ≤11 kg	12.5	17.6	8.0	2.44 (1.65–3.61)
Bones and joints				
Knee pain or stiffness†	54.6	59.5	50.3	1.45 (1.13–1.87)
Hip pain or stiffness†	37.3	37.9	36.8	1.05 (0.81–1.35)
Moderate to severe knee or hip activity pain	51.0	57.2	45.6	1.59 (1.24–2.05)
Knee swelling most days	23.0	28.3	18.4	1.75 (1.30–2.36)
Foot pain‡	32.9	31.5	34.1	0.89 (0.68–1.16)
Back pain‡	40.4	40.5	40.4	1.00 (0.78–1.29)
Knee pain on examination	36.4	47.6	26.6	2.51 (1.93–3.27)
Hip pain on examination	24.2	26.7	21.9	1.30 (0.97–1.74)
Perceptual				
Poor reported vision	16.9	23.1	11.4	2.34 (1.66–3.29)
Energy				
Does not feel full of energy	44.2	42.0	46.2	1.19 (0.92–1.52)
Unusually tired†	38.1	38.6	37.6	1.05 (0.81–1.35)
Unusually weak†	24.3	28.9	20.2	1.61 (1.20–2.15)
Composite measures				
Balance problem walking on level surface or dressing§	31.6	50.4	15.3	10.79 (7.23–16.10)
Balance problem standing eyes closed§	27.3	42.9	14.1	5.42 (3.89–7.57)
Dizzy after standing	38.6	40.0	37.5	1.11 (0.86–1.44)
Poor overall balance	59.0	75.0	45.2	3.62 (2.76–4.75)
Unable to stand feet side by side for 10 seconds	18.6	35.6	3.8	14.22 (8.75–23.10)
Unable to do five chair stands	28.7	52.5	8.1	12.61 (8.79–18.09)

SMD = severe mobility difficulty.

*Cognitive impairment was defined as a Mini-Mental State Examination score between 17 and 24. For participants with less than 12 years of education, scores between 17 and 21 were considered to indicate impairment.

†In previous month.

‡For 1 month during previous year.

§Always, very often, or often versus never.

Table 4

Clinical Measures Associated with Severe Mobility Difficulty at Baseline and 1-Year Follow-Up

Clinical Measure	Cross-Sectional Model* n = 984	Longitudinal Model† n = 474
	Odds Ratio (95% Confidence Interval)	
I often feel helpless (agree)	2.22 (1.56–3.15)	1.87 (1.10–3.24)
Balance problem walking on level surface or dressing		
Sometimes versus never	2.55 (1.66–3.92)	1.37 (0.80–2.35)
Often or always versus never	5.63 (3.49–9.10)	2.00 (0.99–4.01)
Knee pain on examination	1.89 (1.35–2.64)	1.74 (1.05–2.89)
Unable to do five chair stands	6.33 (4.16–9.65)	2.50 (1.15–5.41)
Unable to stand feet side by side for 10 seconds	4.71 (2.69–8.24)	1.37 (0.45–4.16)
Poor reported vision	1.65 (1.05–2.57)	2.03 (1.06–3.89)
Cognitive impairment‡	2.01 (1.06–3.81)	4.75 (1.67–13.48)
Age	-	1.03 (1.00–1.07)
Model area under the receiver operating characteristic curve	0.85	0.73

*All statistically significant clinical measures listed in Table 1 were entered into a logistic regression model and then eliminated with backward selection ($P>.05$), producing the cross-sectional model.

†Clinical measures in the cross-sectional model were then entered into a logistic regression model with severe mobility difficulty at 1 year as the outcome, producing the longitudinal model.

‡Cognitive impairment was defined as a Mini-Mental State Examination score between 17 and 24. For participants with less than 12 years of education, scores between 17 and 21 were considered to indicate impairment.