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Self-Reported Difficulty in Climbing Up or Down Stairs in Nondisabled Elderly

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Abstract

Objective—To examine clinical and functional correlates of self-reported difficulty in climbing up or climbing down stairs in older adults.

Design—Cross-sectional survey.

Setting—Community sample.

Participants—Older adults (N=310; mean age, 79.7y; 62% women), without disability or dementia.

Interventions—Not applicable.

Main Outcome Measures—Clinical and functional status as well as activity limitations (able to perform activities of daily living [ADLs] with some difficulty).

Results—Of the 310 subjects, 140 reported difficulties in climbing up and 83 in climbing down stairs (59 both). Self-reported difficulty in climbing up stairs was associated with hypertension, arthritis, and depressive symptoms. Difficulty in climbing up stairs was also associated with poor balance and grip strength as well as neurologic gait abnormalities. Subjects with difficulty climbing down stairs had more falls. Both activities were associated with leg claudication, fear of falling, non-neurologic gait abnormalities, and slow gait. Examined individually, self-reported difficulty climbing down stairs captured a wider spectrum of ADL limitations than climbing up stairs. However, combined difficulty in both phases of stair climbing had a stronger association with activity limitations (vs no difficulty; odds ratio, 6.58; 95% confidence interval, 3.35–12.91) than difficulty in any one phase alone.

Conclusions—Self-reported difficulty in climbing up and down stairs revealed commonalities as well as differences in related clinical correlates. Difficulty in both climbing up and down stairs should be separately assessed to better capture clinical and functional status in older adults.

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Keywords

Activities of daily living; Aged; Rehabilitation; Walking

Disability In Basic Activities of daily living (ADLs) is common among older adults,¹ and is assessed in clinical settings by asking older adults about inability or requiring assistance from another person to perform activities such as bathing, climbing stairs, or walking.² Among nondisabled subjects, activity limitations (able to perform ADLs with some difficulty) are considered a marker of the early stages of the disablement process.³⁻⁵ However, the reliability and validity of many individual activities, such as stair climbing, that are used to assess ADLs and function are not well established.⁶⁻⁹

Stair negotiation (climbing up and down stairs) was among the top 5 tasks that community-residing older adults rated as being most difficult due to "old age."^{6,7} Self-reported ability to climb stairs is considered a key marker of functional independence in older adults.⁷⁻⁹ In hospital settings, stair-climbing ability is often assessed to help make decisions about whether a patient should be sent home or to a nursing facility.^{10,11}

Most functional assessment instruments inquire about difficulty only in climbing up stairs or combined difficulty in climbing up and down stairs.⁸ However, the neurologic, cardiovascular, and musculoskeletal demands differ between climbing up and climbing down stairs.^{7,12} Accidents occur about 3 times more frequently while climbing down stairs than up stairs.^{7,13} Hence, asking older adults about difficulty only in climbing up stairs or stair negotiation difficulty overall may not be optimal in assessing functional status and in identifying clinical correlates of limitations in these 2 activities that may be amenable to intervention. Poor characterization of stair negotiation has been identified as a major limitation in functional assessment in previous reviews.^{7,8}

We examined the clinical and functional correlates of self-reported difficulty in climbing up and climbing down stairs separately in a community-residing sample of nondisabled and nondemented older adults. The aims of this study were 3-fold: (1) to examine commonalities and differences in clinical conditions associated with self-reported difficulties in climbing up and down stairs; (2) to establish the reliability for self-reported difficulties in climbing up and down stairs; and (3) to examine whether there was a risk gradient for activity limitations associated with stair negotiation difficulty.

Methods

Study Population

Participants were community-residing adults age 70 and over participating in a gait and mobility substudy of the Einstein Aging Study.^{14,15} Subjects were recruited from Medicare lists of older adults in Bronx County as previously described.^{14,15} Exclusion criteria for the Einstein Aging Study included severe audiovisual loss, being bed-bound, or institutionalization. Potential subjects were contacted by letter explaining the purpose and nature of the study and then contacted by telephone. The telephone interview included verbal consent, medical history, and cognitive screening tests.¹⁴ At the end of the interview, an age-stratified sample of subjects was chosen by a computerized randomization procedure from those who gave verbal consent, and invited for further evaluation at our research center.

Between 2005 and 2006, 335 consecutive subjects were asked about self-reported difficulty in climbing up and climbing down stairs at their clinic visit. We excluded 20 subjects who were disabled (see below) and 5 subjects who met criteria for dementia.¹⁶ After exclusions, 310

subjects were eligible for this analysis. Informed consents were obtained at clinic visits according to study protocols approved by the local institutional review board.

Clinical Evaluations

Clinical assistants used structured questionnaires to elicit history of medical illnesses and medication use at study visits. Subjects were asked about previous falls and whether they had fear of falling (yes or no). ADL assessments were based on a disability scale developed by Gill and Kurland² for use in community based cohorts. The following ADLs were assessed: bathing, dressing, grooming, feeding, toileting, walking around home, and getting up from a chair. For each task, participants were asked by the research assistant: "At the present time, are you unable or do you need help from another person to complete the task?" None of the subjects reported difficulty feeding themselves. Hence, feeding was not included as an ADL task in this report. Disability was defined as reporting inability or requiring assistance from another person to do any one of the remaining 6 ADL tasks. Subjects who were able to ambulate with a walking aid were not classified as disabled. Participants who did not need help with ADL tasks were subsequently asked: "At the present time, do you have difficulty with the task?" Self-reported difficulty in performing any one of the ADL tasks was defined as activity limitation. Information obtained from subjects was corroborated with family members or significant others, when available. We also consulted medical records and contacted primary care physicians to obtain further details.

Neurologic examinations done at each visit included testing of vibration sensation (abnormal if sensation absent or perceived less than 10s at ankle using 128Hz tuning fork), and deep tendon reflexes (abnormal if absent or depressed at knee or ankle).¹⁵ Study clinicians determined whether gaits were normal or abnormal by visual inspection of gait. Abnormal gaits were further subtyped as either non-neurologic (due to causes such as arthritis, cardiac disease, chronic lung disease, and peripheral vascular disease) or neurologic (unsteady, ataxic, frontal, parkinsonian, neuropathic, hemiparetic, and spastic). See Verghese et al¹⁵ for weblinks to videos of abnormal neurologic gait subtypes. Vision was tested using a Snellen chart (abnormal if visual acuity 20/80 or less in either eye). An extensive neuropsychologic evaluation was done as described before.^{14,17} For this study, we report general cognitive status assessed by the Blessed-Information-Memory concentration test¹⁸ and depressive symptoms by the Geriatric Depression Scale.¹⁹

Stair Negotiation

At study visits, research assistants asked subjects about difficulty in climbing up ("Do you have any difficulty climbing up stairs? 'Yes' or 'No'") and down stairs ("Do you have any difficulty climbing down stairs? 'Yes' or 'No'"). Subjects who reported difficulties climbing stairs were then asked if they attributed their difficulty to visual impairment.

Performance Measures

Quantitative gait, unipedal stance, and grip strength were studied.²⁰⁻²² Research assistants conducted quantitative gait evaluations, independent of the clinician's evaluation, using a computerized mat (457.2×90.2×0.64cm [180.0×35.5×0.25in]) with embedded pressure sensors (GAITRite^a). Subjects were asked to walk on the mat at their "normal walking speed" in a quiet and well-lit hallway.^{17,20,21} Start and stop points were marked by white lines on the floor, and included 1m (3ft) each for initial acceleration and terminal deceleration. Monitoring devices were not attached to the participants during the test. The software computes quantitative parameters based on footfalls recorded. Each trial was 1 walkway in length, and

^aCIR Systems, 60 Garlor Dr, Havertown, PA 19083.

values analyzed were the mean of 2 trials computed automatically by the software. Grip strength (in kilograms) in the dominant hand was measured using a Jamar handgrip dynamometer^b with the subject seated in a comfortable position and with the elbow flexed. The subject was not able to read the machine display. No formal rest periods were used. Measurements were taken by a single trained researcher and the best of 3 measurements was taken.²² Unipedal stance time was recorded as the time subjects balanced on their dominant foot without external support (maximum, 30s).²³

Statistical Analysis

Initial comparisons were done using descriptive statistics between subjects with and without self-reported difficulty on the 2 tasks (climbing up stairs, climbing down stairs) separately.²⁴ Continuous measures were compared using the 2-tailed independent samples *t* test. Categorical values were compared using the chi-square test. Nonparametric tests were used as appropriate after visually examining distributions of individual variables. All tests were 2-tailed. To account for the multiple comparisons, the level of significance was set at .01.

To examine reliability we compared responses to the stair questions in 110 consecutive subjects who were readministered the questionnaire at the 3-month interval. We also timed 45 subjects climbing 3 steps (height, 20.3cm [8in]; width, 25.4cm [10in]) up and down in random order on a well-lit, uncarpeted flight of stairs. In our preliminary studies, climbing 3 steps was more preferable to our subjects than a full flight of stairs. Of the 45 subjects, 2 used railing support while climbing up and 3 used railing support while climbing down the 3 steps. There was no overlap of subjects between the 2 subgroups. Subjects in these 2 subgroups were consecutively recruited (not randomly) for these analyses. There were no significant differences between the 110 subjects and the remaining 200 subjects in terms of age, sex, and clinical gait abnormalities. The 45 subjects in the stair climbing study were younger (mean age, 75.7y) than the remaining sample (mean age, 79.9y; $P=.07$).

Presence of disability was an exclusion criterion in this study.² ADL limitation (able to perform ADLs with some difficulty) in nondisabled older adults has been identified as a feature of preclinical disability.^{4,5} We examined the association of difficulty climbing up and down stairs as independent variables with ADL limitation (no limitation vs any limitation) as the dependent variable using separate logistic regression models. Next, to assess the utility of asking both questions, we compared 4 categories of stair negotiation performance entered together as predictors including difficulty climbing up but not down stairs, difficulty climbing down but not up stairs, difficulty in climbing both up and down stairs, and no difficulty on stair negotiation (reference group). All models were adjusted for age, sex, and medical illnesses.

Results

Table 1 shows that the majority of subjects were women (62.3%) and the mean age was 79.7 years. Of the 310 subjects, 140 reported difficulties climbing up stairs and 83 down stairs (59 both). Table 1 also shows that subjects who reported difficulty in climbing up stairs had lower education ($P=.002$); though mean education levels were above high school level. Subjects with difficulty climbing up stairs had a higher prevalence of hypertension ($P<.001$) and osteoarthritis ($P<.001$). Leg claudication was associated with difficulty in both phases. There were no group differences in the frequency of neurologic diseases. Difficulty in both activities was associated with a higher prevalence of fear of falling ($P=.001$). Previous falls was common with difficulty in both phases of stair negotiation, but the difference was significant only in those reporting difficulty in climbing down stairs ($P=.01$).

^bAsimow Engineering, 1414 S Beverly Glen Blvd, Los Angeles, CA 90024.

Clinical

Table 2 shows that there were no differences in prevalence of visual impairment in subjects reporting difficulties with stairs climbing compared to those without difficulty climbing up stairs. Two percent of subjects in each group attributed difficulty in stair negotiation to visual problems. Although non-neurologic gaits were more common in subjects reporting difficulty in either climbing up or down stairs, neurologic gaits were more frequent only in subjects reporting difficulty climbing up stairs. There were no significant group differences in prevalence of other neurologic signs.

Performance Assessment

Table 2 shows that difficulty in both climbing up and down stairs was associated with slower gait velocity, cadence, and step length. Only difficulty climbing down stairs was associated with increased step length variability. Subjects with difficulty climbing up stairs had lower unipedal stance time (5.5 ± 7.1 s vs 9.6 ± 9.7 s, $P < .001$) and grip strength (20.8 ± 5.3 kg/cm vs 24.2 ± 7.8 kg/cm, $P < .001$). Unipedal stance time and grip strength was not significantly different between subjects with difficulty climbing down stairs and those without.

Reliability

The test-retest reliability assessed at the 3-month interval was good for both the climbing up ($\kappa = .81$) and climbing down stair questions ($\kappa = .84$) in 110 subjects from this sample.

Self-reported stair negotiation difficulty was compared with stair climbing times in 45 subjects. There were no significant differences between the 19 men and 26 women in this subgroup in time to climb up (2.6 ± 0.6 s vs 3.1 ± 0.9 s, $P = .121$) or down stairs (3.3 ± 1.4 s vs 3.8 ± 1.8 s, $P = .432$). The 18 subjects who reported difficulty climbing up stairs took longer to climb up (3.5 ± 0.9 s vs 2.5 ± 0.6 s, $P = .001$) and down stairs (4.9 ± 1.9 s vs 2.8 ± 0.7 s, $P = .001$) than the 27 subjects without self-reported difficulty climbing up stairs. The 20 subjects who reported difficulty climbing down stairs took longer to climb down (4.7 ± 1.9 s vs 2.8 ± 0.7 s, $P = .001$) and up stairs (3.4 ± 0.9 s vs 2.5 ± 0.6 s, $P = .002$) than the 25 without self-reported difficulty climbing down stairs.

Activities of Daily Living

Table 1 shows that the most frequently reported ADL limitation overall was getting up from a chair (21.6%), which was associated with difficulty in both climbing up and down stairs. Difficulty climbing down stairs was in addition associated with higher frequency of self-reported limitations in bathing, dressing, and walking inside the house.

To account for subjects in the control group with difficulty in 1 phase of stair negotiation but not the other, we repeated our analysis restricting controls to 149 subjects without any stair negotiation difficulty (either climbing up and down stairs). The results were not materially different, though the strength of the associations changed. Subjects with difficulty climbing up stairs had significantly more ADL limitations in bathing ($P = .005$) and chair rise ($P < .001$) than controls. Climbing down stairs was associated with limitations in bathing ($P = .01$), chair rise ($P < .001$), dressing ($P = .05$), and walking inside the house ($P = .01$).

Self-reported difficulty in individual phases of stair negotiation was examined in separate logistic regression models. Self-reported difficulty in climbing up stairs was associated with an odds ratio (OR) of 2.99 (95% confidence interval [CI], 1.86–4.91) for ADL limitation (able to perform ADL with some difficulty) compared with subjects who reported no difficulty climbing up stairs. Difficulty in climbing down stairs was associated with an OR of 4.40 (95% CI, 2.54–7.59) for ADL limitation compared with subjects who reported no difficulty climbing down stairs. In the combined model (see Methods), self-reported difficulty in climbing both

up and down stairs was associated with an OR of 6.58 (95% CI, 3.35–12.91) for ADL limitation compared with subjects who reported no difficulty on either phase of stair climbing. Difficulty in only climbing up stairs (OR=1.77; 95% CI, 0.92–3.40) or only in climbing down stairs (OR=1.99; 95% CI, 0.69–5.67) was not significant in this combined model.

Discussion

Our findings show that self-reported difficulty in climbing up or down stairs is associated with commonalities as well as differences in clinical and functional correlates in older adults. Difficulty in climbing up stairs was associated with lower education, hypertension, arthritis, and depressive symptoms. Difficulty climbing up stairs was also associated with poor balance, reduced grip strength, and neurologic gait abnormalities. Difficulty climbing down stairs was associated with higher prevalence of falls. Difficulty in both phases was associated with leg claudication, fear of falling, presence of non-neurologic gait abnormalities, and slower gait compared with controls. Hence, self-reported difficulties in both phases of stair negotiation together capture a wider spectrum of medical, clinical, and functional status in older adults than either one alone.

Both intrinsic and extrinsic (stair architecture and lighting) factors may have an effect on stair negotiation in older adults.⁷ Intrinsic factors include vision, somatosensory function, cardiovascular disease, musculoskeletal factors, joint disease, cognition, and neurologic diseases.⁷ Very few of our subjects attributed stair climbing difficulty to visual impairment. However, self-report and our brief visual examination may not adequately capture difficulty in depth perception, contrast sensitivity, or low-light ambient vision, which are important visual components of stair negotiation in older adults. Furthermore, there are other factors that an individual might perceive as the cause of their stair climbing difficulty, such as arthritis or unsteadiness, which were not specifically assessed in relation to stair climbing in this study. Interestingly, community-residing older adults have not been reported to use stairs less frequently than younger adults. They may, however, be more cautious than younger adults in stair climbing.^{7,25} Impaired stair performance in older adults may also be due to fear of falling,^{7,26} which in our study was linked with difficulty in both phases of stair climbing. A higher prevalence of falls was seen in our subjects. Possible explanations include the older age of our sample (mean age, 80y), systematic fall ascertainment, and high prevalence of ADL limitations (not meeting disability criteria). We assessed any previous falls at baseline, and not just in the previous 12 months, to minimize recall bias in our cognitively normal subjects. The association of difficulty in climbing down stairs with falls merits further study.

The stair negotiation difficulty was based on self-report by the subjects, and was not based on direct observation of stair climbing in all subjects. However, the stair negotiation questions had high test-retest reliability. In our small subgroup analysis, stair-climbing times were equally impaired in those reporting difficulty climbing up or down stairs. However, both of these subgroup analyses are based on small samples, and should be replicated in larger samples. We are continuing to measure stair climbing times in our cohort, which will permit a more detailed examination of this common activity in the future. But the results of this subgroup analysis do support the reliability of subject responses.

ADL limitations are associated with increased risk of future disability in older adults.^{4,5} Difficulty in climbing up stairs was associated with significant limitations only in chair rise. Difficulty in climbing down stairs was in addition associated with limitations in bathing, dressing, and walking inside. These 2 activities together captured more ADL limitations than individually.

Self-reported difficulty in either climbing up and down stairs identified ADL limitations, with stronger associations seen with climbing down stairs. However, self-reported difficulty in both phases of stair negotiation was a stronger predictor of ADL limitation than difficulty in either phase alone. Subjects who had difficulty in both climbing up and down stairs had an over 6-fold greater risk of having ADL limitations than those without stair negotiation difficulties. Although the confidence intervals for this estimate are wide, the lower bound was well above 1. The cross-sectional nature of the study precludes comment on longitudinal associations. Our ongoing studies will help us examine whether self-reported difficulties in stair climbing at baseline predicts future disability and functional decline.

The strengths of our study include our large sample size and systematic assessments using validated instruments.^{14,15,20,21} The clinical assessments were done blinded to results from the stair negotiation questions.

Study Limitations

This study has limitations that need to be considered. Subjects with disability or dementia were excluded.^{2,16} It is likely that we may have seen stronger associations of stair negotiation difficulties with study outcomes by including older adults with disability. However, many of these subjects are likely to have difficulty climbing stairs.⁸⁻¹¹ To improve reliability of responses, we did not include subjects with dementia. Our findings should be verified in other clinical and nursing home samples including subjects with disability and dementia. The number of steps or flights of stairs was not specified in our questionnaire, because our intention was to get our subjects' global impression of task difficulty. Also, these architectural elements may vary in our urban subjects with different housing arrangements. Our focus in this study was the validity of responses to the individual questions, which are widely used in functional assessment and ADL questionnaires,⁸ rather than direct measurements of the activities. Hence, our controls included subjects with difficulty on one but not the other phase of stair negotiation. However, our secondary analysis shows that restricting controls to those without difficulty on both phases of stair climbing did not materially change the results.

Conclusions

Stair negotiation difficulty is widely used to assess and define functional status in older adults. Based on our findings, we suggest that difficulty in both climbing up and down stairs should be included in functional assessments. These 2 activities should be separately assessed in future studies to improve reliability and validity to identify and predict outcomes such as ADL limitations or falls in older adults. Combined difficulty in both phases of stair negotiations identifies older nondisabled adults with ADL limitations, who may be targeted for further investigations and interventions to prevent disability.

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Table 1

Demographic and Clinical Profile

Variables	Overall (N=310)	Climbing Up Stairs			Climbing Down Stairs		
		Difficult (n=140)	Not Difficult (n=170)	P	Difficult (n=83)	Not Difficult (n=227)	P
Age (y)	79.7±5.7	80.4±5.7	79.1 ±5.6	.045	80.0±5.9	79.5±5.6	.536
Women (%)	62.3	67.1	58.2	.131	69.9	59.5	.111
Education (y)	14.0±3.6	13.3±3.5	14.6±3.6	.002*	13.8±3.5	14.1 ±3.7	.529
Blessed test ¹⁶	2.0±2.1	2.2±2.2	1.8±2.1	.026	1.9 ±1.9	2.0±2.1	.371
Geriatric Depression Scale ¹⁷	2.1 ±2.1	2.7±2.3	1.8±1.9	<.001*	2.7±2.3	2.0±1.9	.022
Medical illness (%)							
Diabetes	12.9	10.0	16.4	.130	18.1	11.1	.131
Hypertension	49.7	58.6	42.4	.006*	55.4	47.6	.254
Heart failure	2.6	2.9	2.4	.999	3.6	2.2	.451
Leg claudication	36.1	49.3	25.4	<.001*	51.8	30.4	.001*
Stroke	8.4	9.3	7.6	.683	9.6	7.9	.653
Parkinson's disease	0.3	0.0	0.7	.453	1.2	0.0	.277
Osteoarthritis	48.7	57.1	41.8	<.001*	54.2	46.7	.252
Falls	44.2	50.0	39.4	.070	56.6	39.6	.010*
Fear of falls	26.7	37.1	18.2	.001*	44.6	20.3	.001*
ADL limitations (%)							
Bathing	5.8	11.4	4.1	.021	13.3	4.5	.010*
Dressing	7.7	10.0	5.9	.204	14.5	5.3	.010*
Walking inside	4.2	6.4	2.4	.091	9.6	2.2	.008*
Chair rise	21.6	35.7	10.0	<.001*	47.0	12.3	<.001*
Grooming	1.9	2.9	1.2	.420	2.4	1.8	.614
Toileting	3.9	5.0	2.9	.395	7.2	2.6	.091

NOTE. Values are mean ± standard deviation (SD) or as indicated.

* Significant at $P \leq .01$.

Table 2

Neurologic, Functional, and Gait Assessments

Variables	Climbing Up Stairs			Climbing Down Stairs			
	Overall (N=310)	Difficult (n=140)	Not Difficult (n=170)	P	Difficult (n=83)	Not Difficult (n=227)	P
Neurologic							
Visual acuity <20/80	93	44	49	.712	25	68	.890
Abnormal reflex	74	76	72	.371	75	74	.888
Abnormal vibration	16	17	15	.643	19	15	.382
Neurologic gait	16	23	10	.003*	22	14	.110
Non-neurologic gait	19	30	10	<.001*	34	14	<.001*
Functional							
Grip strength (kg)	22.7±6.6	20.7±5.2	24.2±7.8	<.001*	21.9±6.5	22.9±6.7	.270
Unipedal stance (s)	9.0±8.9	6.5±7.5	10.7±9.6	<.001*	6.5±7.4	9.6±9.4	.020
Gait							
Velocity (cm/s)	92.2±24.0	84.5±23.4	104.1 ±20.7	<.001*	80.89±23.4	100.5±22.1	<.001*
Cadence (step/min)	101.5±12.5	98.7±13.9	103.9±10.7	<.001*	96.9±13.2	103.3±11.7	<.001*
Step length (cm)	56.0±10.6	51.2±10.6	59.9±8.8	<.001*	49.8±11.5	58.3±9.3	<.001*
Step length variability (coefficient of variation)	2.8±1.9	3.1 ±2.5	2.6±1.2	.131	3.2±1.7	2.7±1.9	.001*

NOTE. Values are percent or mean ± SD.

* Significant at $P \leq .01$.