Validation of the Late-Life Function and Disability Instrument

Stephen P. Sayers, PhD, Alan M. Jette, PT, MPH, PhD,† Stephen M. Haley, PT, PhD,† Tim C. Heeren, PhD,‡ Jack M. Guralnik, MD, PhD,§ and Roger A. Fielding, PhD**

OBJECTIVES: To assess the concurrent and predictive validity of the Late-Life Function and Disability Instrument (LLFDI).

DESIGN: Cross-sectional.

SETTING: University-based human physiology laboratory.

PARTICIPANTS: One hundred one men and women aged 80.8 ± 0.4.

MEASUREMENTS: A short physical performance battery (SPPB) and a self-paced 400-m walk (400-m W) were used as performance tests of lower extremity function. The LLFDI was used to assess self-reported function and physical disability. Partial correlations adjusted for age and body mass index were used to determine the concurrent and predictive validity of the LLFDI. Statistical significance was accepted at $P < .004$ using a testwise correction.

RESULTS: LLFDI Overall Function scores were moderately associated with the SPPB ($r = 0.65$, $P < .001$), 400-m W gait speed ($r = 0.69$, $P < .001$), and measures of lower extremity function. Correlations of the two lower extremity subscores of the LLFDI (correlation coefficient (r) = 0.63–0.73, $P < .001$) were greater than for the LLFDI upper extremity subscores ($r = 0.19$–0.26, $P > .004$). Performance measures of function predicted disability limitations in the range of $r = 0.37$–0.44 ($P < .001$) and disability frequency in the range of $r = 0.16$–0.20 ($P > .004$).

CONCLUSION: These findings support the concurrent and predictive validity of the LLFDI. Results support the use of the LLFDI scales as a substitute for physical performance tests when self-report is a preferred data-collection format. **J Am Geriatr Soc 52:1554–1559, 2004.**

Key Words: aging; mobility; functional ability; physical disability

Functional ability may be quantified using performance-based measures or self-report. Short physical performance batteries have gained popularity in the previous few years because of their high reliability and ability to predict disability, institutionalization, and mortality.[1,2] Nevertheless, self-report measures remain the most commonly used instruments in many studies involving older adults because of their low cost and practicality. Self-report instruments examining physical functioning have been limited primarily by their lack of sensitivity to change, concerns over reproducibility, and inability to capture a wide range of functioning.[3,4] Moreover, several studies have shown moderate to poor associations between performance-based measures and self-reported functional status,.[5–7] raising questions about the validity of self-reported measures of physical function.

Self-report instruments are also widely used to assess disability in the performance of daily life activities. These instruments have demonstrated adequate levels of reliability and are very feasible for use in a wide range of studies. Nonetheless, questions remain about their validity and lack of sensitivity to detect changes in disability and frequent ceiling and floor effects.[8] There is currently a need for conceptually sound, responsive instruments to assess self-reported function and disability.

To address some of the limitations of existing instruments, the Late-Life Function and Disability Instrument (LLFDI) was developed as a self-report instrument that evaluates physical functioning and disability.[9,10] The disability component of the LLFDI has shown concurrent validity in correlation with the physical functioning (PF-10) subscale of the Medical Outcomes Study 36-item Short-Form Health Survey (SF-36)[9] and the London Handicap Scale.[11] However, the instrument has not been validated against any performance measure or test battery. The purpose of the investigation was to evaluate concurrent and predictive validity of the functional and disability components of the LLFDI against performance measures of function.

From the *Human Physiology Laboratory, Department of Health Sciences, †Roybal Center for the Enhancement of Late Life Function, Sargent College of Health and Rehabilitation Sciences, ‡School of Public Health, Department of Epidemiology/Biostatistics, Boston University, Boston, Massachusetts; and §Epidemiology, Demography, and Biometry Program, National Institute on Aging, National Institutes of Health, Bethesda, Maryland.

This study was supported by National Institute on Aging Contracts 263-MA-202876 and R01-AG-18844, Roybal Center for the Enhancement of Late-Life Function Grant P50-A11669, and a National Institute on Disability, Rehabilitation Research Post-Doctoral Fellowship in Health Services Research (H133P99004) to Dr. Sayers.

Address correspondence to Stephen P. Sayers, University of Missouri-Columbia, School of Health Professions, Department of Physical Therapy, 114 Lewis Hall, Columbia, MO 65211. E-mail: sayerss@missouri.edu

© 2004 by the American Geriatrics Society
0002-8614/04/$15.00

METHODS

Study Population

Participants were recruited from the greater Boston area. Volunteers were recruited through advertisements in local senior citizens publications and visits to senior residences and through the Harvard Research Cooperative Program on Aging volunteer database.

Eligible participants for the study had to be between the ages of 75 and 90, ambulatory with or without an assistive device (cane or three-posted walker only), and community dwelling, and were required to provide informed consent before participation. Volunteers were excluded from participation if they had severe visual impairment or hearing loss; progressive neurological disease (e.g., Parkinson's disease); myocardial infarction, hip fracture, or hip or knee replacement within the previous 6 months; hospitalization within the previous 3 months; or other significant comorbid disease that might impair ability to participate (e.g., unstable angina pectoris) or were too physically active (e.g., participated in weight training or walking programs) or lived in a nursing home.

Three hundred thirty-nine individuals were contacted to participate in the study; 238 were not interested or did not meet study criteria, leaving 101 eligible participants. All 101 eligible participants completed the study requirements. All subjects gave written informed consent, and the Boston University institutional review board approved the study.

Study Design

The study employed a cross-sectional design to validate self-reported functional ability and disability with functional performance tests. It was hypothesized that the function component of the LLFDI would demonstrate substantial concurrent validity through strong associations with functional performance tests, the strongest of which would be with lower extremity function domains. In addition, it was hypothesized that performance test scores would predict scores on the disability component of the LLFDI because functional ability is known to be predictive of physical disability[1,2] but that these associations would be weaker than those observed for the function component of the LLFDI.

Upon arrival at the laboratory, the body mass of the fully clothed participant was recorded on a standard platform scale to the nearest 0.1 kg. Height was measured to the nearest 0.5 cm with a scale stadiometer. Self-reported functional ability and disability were assessed using the function and disability components of the LLFDI. After completing these questionnaires, participants performed a short physical performance battery (SPPB) and the 400-m self-paced walk (400-m W) test.

Self-Reported Function and Disability

The Late-Life Function and Disability Instrument

The LLFDI was developed as a comprehensive assessment of function and disability for use in community-dwelling older adults.[9,10] Consistent with Nagi's disablement framework, the LLFDI contains items that represent functional limitations (inability to perform discreet physical tasks encountered in daily routines) and disability (inability to take part in major life tasks and social roles).[9,10] The LLFDI assesses function and disability constructs. The function component evaluates self-reported difficulty in performing 32 physical activities consisting of three dimensions: upper extremity, basic lower extremity, and advanced lower extremity.[10] Questions are phrased, "How much difficulty do you have doing a particular activity without the help of someone else and without the use of assistive devices?" with response options of "none," "a little," "some," "quite a lot," and "cannot do" (Appendix 1). Overall functioning and upper and lower extremity subscales are each scored on a 0 to 100 scale, with higher scores indicating higher levels of functioning.

The disability component evaluates self-reported limitations (capability) and frequency (performance) of taking part in 16 major life tasks. Limitation questions are phrased "To what extent do you feel limited in doing a particular task?" with response options of "not at all," "a little," "somewhat," "a lot," and "completely." Frequency questions are phrased, "How often do you do a particular activity?" with response options of "very often," "often," "once in a while," "almost never," and "never" (Appendix 1). The frequency and limitation dimensions of the disability component are each scored on a 0 to 100 scale, with higher scores indicating higher levels of functioning.

Performance Tests of Function

400-Meter Self-Paced Walk

The 400-m W was intended to be a measure of functional ability; assistive devices (e.g., canes, walkers) were not used during the walk. Participants were instructed to walk at a pace they could maintain without overexerting themselves until they completed the 400-m W or could no longer continue. Participants were allowed to rest while standing for 60-second intervals, if necessary. There was no limit to the number of rest stops allowed, but if they could not continue after 60 seconds rest, or if they needed to sit down, the test was stopped. If the participant could not complete the 400-m W in 15 minutes, the test was considered unsuccessful. If the participant's heart rate exceeded 135 beats per minute or fell below 40 beats per minute at any time during the walk, or if the participant reported chest pain; tightness or pressure in the chest; shortness of breath; feeling faint, lightheaded, or dizzy; or reported leg pain, the test was stopped.

The walk took place along an indoor corridor running the entire perimeter of the building using a premeasured distance of 400 m. One lap was approximately 100 m, thus the 400-m W consisted of four laps around the corridor of the building. The investigators recorded heart rate, whether the 400-m W was completed (yes or no), and time to completion. For those not completing the test, the time at which the test was stopped, the reason for stopping the test, and the distance completed were recorded.

Short Physical Performance Battery

The SPPB is a performance test assessing lower extremity function[1] using measures of gait speed, standing balance, and lower extremity strength. To assess gait speed, participants

were timed from a standing start and asked to walk at their normal pace over a 4-m distance. The faster of two trials was used. Standing balanced was assessed using a side-by-side stance, a semitandem stance, and a full-tandem stance. To assess lower extremity strength, volunteers were asked to cross their arms in front of their chest and rise from a chair as quickly as they could five times. Each test was scored on a 0- to 4-point scale. If the participant was unable to perform any of the tests, they received a score of 0. Scores of 1 to 4 were based on the time (in quartiles) necessary to complete the walk and chair rise tests and categories of performance in the balance tests.[1] A summary performance score of 0 to 12 was then obtained by summing the scores of the three tests. Scores obtained using the SPPB have been shown to be predictive of subsequent disability, institutionalization, and mortality.[1,2]

Statistical Analyses

To compare 400-m W performance between groups, gait speed was obtained for all 101 participants by dividing the number of meters walked by time to completion (nonmobility-limited group) or time at which the test was stopped (mobility-limited group). Associations between all variables were assessed using Pearson correlations (r). Because 400-m W gait speed and SPPB summary score were significantly correlated with body mass index (BMI) ($r = -0.26$ and $r = -0.29$, respectively), age ($r = -0.36$ and $r = -0.20$, respectively) at the $P < .05$ level, partial correlations were run on all variables controlling for age and BMI. Statistical significance was accepted at $P < .004$ (0.05/12) using a testwise correction. All data were analyzed using SPSS software (SPSS Inc., Chicago, IL).

RESULTS

Subject Characteristics

One hundred one volunteers participated in the study. Table 1 describes the physical characteristics of the participants and differences in function and disability.

Concurrent Validity

Significant correlations were found between 400-m W gait speed and overall function ($r = 0.69$, $P < .001$), basic lower extremity function ($r = 0.66$, $P < .001$), and advanced lower extremity function ($r = 0.73$, $P < .001$) subscores of the LLFDI and between SPPB summary score and overall function ($r = 0.65$, $P < .001$), basic lower extremity function ($r = 0.63$, $P < .001$), and advanced lower extremity function ($r = 0.67$, $P < .001$) subscores of the LLFDI (Table 2). The 400-m W gait speed and SPPB summary scores were not significantly associated with upper extremity function subscores of the LLFDI ($r = 0.26$ and $r = 0.19$, respectively, $P > .004$). The strongest associations between the functional performance measures and functional items of the LLFDI were with the advanced lower extremity function scores.

Predictive Validity

Moderate to weak correlations were found between 400-m W gait speed and limitation ($r = 0.44$, $P < .001$) subscores of the LLFDI and between SPPB summary score and limitation ($r = 0.37$, $P < .001$) subscores of the LLFDI (Table 2). No significant correlations were found between 400-m W gait speed or SPPB summary score and frequency subscores of the LLFDI ($r = 0.20$ and $r = 0.16$, respectively; $P > .004$) (Table 2).

Table 1. Subject Characteristics

Characteristic	All Participants N = 101	Mobility Limited n = 34	Non-Mobility Limited n = 67	*P*-value
Age, mean ± SEM	80.8 ± 0.4	81.9 ± 0.8	80.2 ± 0.5	.061
Height, cm, mean ± SEM	161.6 ± 0.9	160.5 ± 1.4	162.2 ± 1.2	.371
Weight, kg, mean ± SEM	72.5 ± 1.8	75.8 ± 3.2	70.9 ± 2.1	.188
Men, n (%)	37 (37)	11 (32)	26 (39)	
Women, n (%)	64 (63)	23 (68)	41 (61)	
Performance Tests, mean ± SEM*				
400-m W gait speed	0.87 ± 0.0	0.59 ± 0.0	1.0 ± 0.0	<.001
Short physical performance battery	7.9 ± 0.3	5.5 ± 0.4	9.1 ± 0.3	<.001
Late-Life Function and Disability				
Instrument, mean ± SEM†				
Functional component				
Overall function	55.9 ± 1.1	48.2 ± 1.1	59.8 ± 1.3	<.001
Upper extremity	74.1 ± 1.4	68.3 ± 2.1	77.0 ± 1.6	.002
Basic lower	66.7 ± 1.4	57.2 ± 1.3	71.6 ± 1.7	<.001
Advanced lower	43.1 ± 1.8	29.3 ± 2.3	50.0 ± 1.9	<.001
Disability component				
Limitation	64.8 ± 1.0	58.6 ± 1.6	67.7 ± 1.20	<.001
Frequency	51.4 ± 0.7	48.9 ± 0.9	52.7 ± 0.9	.008

SEM = standard error of the mean.
* Scores range from 0 to 12, with higher scores indicating higher levels of functioning.
† Scores range from 0 to 100, with higher scores indicating higher levels of functioning.

Table 2. Partial Correlations Between Self-Report and Functional Performance Measures, Controlling for Age and Body Mass Index (N = 101)

Self-Reported Function and Disability	400-Meter Walk Test Gait Speed	Short Physical Performance Battery
Functional component		
Overall function	0.69*	0.65*
Upper extremity function	0.26	0.19
Basic lower extremity function	0.66*	0.63*
Advanced lower extremity function	0.73*	0.67*
Disability component		
Limitation	0.44*	0.37*
Frequency	0.20	0.16

* $P < .001$.

DISCUSSION

In this study, the LLFDI demonstrated concurrent and predictive validity with functional performance using the 400-m W test and the SPPB. Consistent with the first hypothesis, the function component of the LLFDI demonstrated substantial associations with functional performance measures, which were strongest for the overall and lower extremity function dimensions. With respect to predictive validity, it was found that performance measures of physical function predicted limitations in daily activities in the disability component of the LLFDI (limitation), and as expected, the association was weaker than that for the function component of the LLFDI. Physical performance tests did not predict the frequency with which older adults performed their daily life activities. Although the LLFDI has been validated previously against self-report instruments of function and disability,[9,10] these data are the first to show that the function and disability components of the LLFDI both demonstrate significant associations with performance-based measures of function.

The strength of the associations between the LLFDI and performance-based measures of function demonstrated in the present study suggests that this instrument may be more representative of physical performance than previously used instruments. For example, one study[5] showed significant, but only modest, associations between gait speed from an 8-foot walk and self-reported mobility in older men ($r = 0.17$–0.32). Significant but weak associations between 400-m W performance and self-reported difficulty in various mobility tasks (e.g., walking a mile, walking up 20 steps, lifting/carrying 20 lbs) ($r = -0.27$ to -0.37) and SPPB summary score with self-reported mobility tasks ($r = 0.21$–0.29) were also reported in nondisabled older men and women in the Health, Aging and Body Composition cohort.[6] In a study of a smaller population of functionally limited older women,[7] there were significant, but only modest, associations between stair climb performance and PF-10 score ($r = 0.48$) and nonsignificant associations between maximal gait speed and PF-10 score ($r = 0.28$), but in the same study, repeated chair rise performance was shown to be significantly associated with PF-10 score ($r = 0.58$).

The disability component of the LLFDI contains two dimensions: the limitation dimension, or the capability of performing life's tasks, and the frequency dimension, or the regularity in participating in life's tasks.[9] The limitation dimension is an assessment of capability, whereas the frequency dimension is a measure of performance. Responses to self-report questions differ depending upon whether older persons respond to what they actually do (performance) versus what they feel they are capable of doing (capability).[12,13] Frequency of performance may be an important dimension of disability, because although individuals may not perceive a limitation in certain tasks, they may perform these tasks less often. Significant associations were found between limitation subscores of the LLFDI and functional performance tests, but there were no significant associations between frequency subscores and functional performance tasks. In the development of the disability component of the LLFDI, one study[10] found that the grouping of questionnaire items in the frequency dimension seemed to be independent of mobility and physical skills (focusing more on personal and social roles), whereas the limitation dimension reflected the importance of physical skills.[10] Because the performance measures were discrete physical tasks (without environmental or behavioral influence), this may partially explain why the frequency dimension was not significantly associated with these tasks, whereas the limitation dimension was. The significant associations between SPPB scores (a functional task) and limitation subscores (disability) are also intriguing because the SPPB has previously been shown to be highly predictive of future disability.[2] In addition, there was a significant relationship between 400-m W and limitation subscores, which may support the face validity of this functional task as a measure of mobility-related disability. These findings highlight the complexity of physical disability as a hypothesized consequence of limitations in functional ability. Although one aspect of the disability component (limitation) identified simple limitations in physical performance, the behavioral aspect of disability (regularity in participating in life's tasks) is not revealed through the performance of a physical task. Instruments that have operationalized disability inconsistently[8] and which have failed to consider the substantial behavioral component associated with physical disability have limited the measurement of self-reported disability. The finding that the frequency component of the LLFDI was not significantly associated with physical performance emphasizes that physical disability is not simply the inability to perform physical tasks, but is influenced by environmental and behavioral factors. These findings also imply that, at each level of functional ability, there may be a wide range of frequency of performance.

The results of this study also indicate that the LLFDI avoids the difficulty of floor and ceiling effects observed using other self-report measures.[14] Only one individual reached a maximum score, three received the lowest possible score on the advanced lower extremity function scale, and only one reached the maximum score on the overall function scale. These findings are consistent with a previous report of an approximately 2% incidence of ceiling and floor effects using the functional scales of the LLFDI.[15] No ceiling and floor effects were observed on the disability component of the LLFDI.

In conclusion, the LLFDI demonstrated significant concurrent and predictive validity based on moderate, statistically significant associations with functional performance measures. The advanced lower extremity function dimension of the LLFDI demonstrated the strongest associations with functional performance measures. The disability component of the LLFDI also demonstrated significant associations with functional performance tasks, although these associations were only significant for the limitation dimension of the LLFDI. These data warrant the recommendation of the LLFDI overall and lower extremity function scales as a substitute for physical performance tests when self-report is a preferred data-collection format. Further research will be needed to determine whether the LLFDI is more sensitive than existing instruments and whether it is responsive to change from exercise interventions or to change over time.

REFERENCES

1. Guralnik JM, Simonsick EM, Ferruci L et al. A short physical performance battery assessing lower extremity function: Association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol 1994;49:M85–M94.
2. Guralnik JM, Ferrucci L, Pieper CF et al. Lower extremity function and subsequent disability: Consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. J Gerontol A Biol Sci Med Sci 2000;55A:M221–M231.
3. Linn BS, Linn MW. Objective and self-assessed health in the old and very old. Soc Sci Med 1980;14A:311–315.
4. Reuben DB. What's wrong with ADLs? J Am Geriatr Soc 1995;43:936–937.
5. Hoeymans N, Feskens EJM, van den Bos GAM et al. Measuring functional status: Cross-sectional and longitudinal associations between performance and self-report (Zutphen Elderly Study 1990–93). J Clin Epidemiol 1996; 49:1103–1110.
6. Simonsick EM, Newman AB, Nevitt MC et al. Measuring higher level physical function in well-functioning older adults: Expanding familiar approaches in the Health ABC Study. J Gerontol A Biol Sci Med Sci 2001;56A:M644–M649.
7. Suzuki T, Bean JF, Fielding RA. Muscle power of the ankle flexors predicts functional performance in community-dwelling older women. J Am Geriatr Soc 2001;49:1161–1167.
8. Verbrugge LM, Jette AM. The disablement process. Soc Sci Med 1994;38: 1–14.
9. Jette AM, Haley SM, Coster WJ et al. Late life function and disability instrument. II. Development and evaluation of the disability component. J Gerontol A Biol Sci Med Sci 2002;57A:M209–M216.
10. Haley SM, Jette AM, Coster WJ. Late life function and disability instrument. I. Development and evaluation of the function component. J Gerontol A Biol Sci Med Sci 2002;57A:M217–M222.
11. Dubuc N, Haley SM, Ni P, Kooyoomjian J, Jette AM. Function and disability in late life: comparison of the Later Life Function and Disability Instrument to the Short-Form-36 and the London Handicap Scale. Disable Rehabil 2004;26:362–370.
12. Young NL, Williams JI, Yoshida KK et al. The context of measuring disability: Does it matter whether capability or performance is measured? J Clin Epidemiol 1996;49:1097–1101.
13. Gloth FM III, Walston J, Meyer J et al. Reliability and validity of the frail elderly Functional Assessment Questionnaire. Arch Phys Med Rehabil 1995;74:45–53.
14. Sherman S, Reuben D. Measures of functional status in community-dwelling elders. J Gen Intern Med 1998;13:817–823.
15. Haley SM, Ludlow LH, Kooyoomjian JT. Extending the range of functional assessment in older adults. Development of the Late-Life Function and Disability Instruments (Late Life FDI). J Aging Phys Activity 2002;10:453–465.

Appendix 1

Late-Life Function and Disability Instrument (LLFDI) Questionnaire Items

Disability Questions

How often do you?. . .(very often, often, once in a while, almost never, never)
To what extent do you feel limited in?. . .(not at all, a little, somewhat, a lot, completely)
D1. keep (keeping) in touch with others through letters, telephone, or e-mail
D2. visit (visiting) friends and family in their homes
D3. provide (providing) care or assistance to others
D4. take (taking) care of the inside of your home
D5. work (working) at a volunteer job outside your home
D6. take (taking) part in active recreation
D7. take (taking) care of household business, finances
D8. take (taking) care of your own health
D9. travel (traveling) out of town for at least an overnight stay
D10. take (taking) part in a regular fitness program
D11. invite (inviting) people into your home for a meal or entertainment
D12. go (going) out with others to public places such as restaurants or movies
D13. take (taking) care of your own personal care needs
D14. take (taking) part in organized social activities
D15. take (taking) care of local errands
D16. prepare (preparing) meals for yourself

Function Questions

How much difficulty do you have?. . .(none, a little, some, quite a lot, cannot do)
F1. unscrewing the lid off a previously unopened jar without using any devices
F2. going up and down a flight of stairs inside, using a handrail
F3. putting on and taking off long pants (including managing fasteners)
F4. running half a mile or more
F5. using common utensils for preparing meals (e.g., can opener, potato peeler, or sharp knife)

(Continued)

Appendix 1 (Continued)

F6. holding a full glass of water in one hand
F7. walking a mile, taking rests as necessary
F8. going up and down a flight of stairs outside, without using a handrail
F9. running a short distance, such as to catch a bus
F10. reaching overhead while standing, as if to pull a light cord
F11. sitting down in and standing up from a low, soft couch
F12. putting on and taking off a coat or jacket
F13. reaching behind your back as if to put a belt through a belt loop
F14. stepping up and down from a curb
F15. opening a heavy, outside door
F16. ripping open a package of snack food (e.g., cellophone wrapping on crackers) using your hands
F17. pouring from a large pitcher
F18. getting into and out of a car/taxi (sedan)
F19. hiking a couple of miles on uneven surfaces, including hills
F20. going up and down three flights of stairs inside, using a handrail
F21. picking up a kitchen chair and moving it, to clean
F22. using a step stool to reach into a high cabinet
F23. making a bed, including spreading and tucking in bed sheets
F24. carrying something in both arms while climbing a flight of stairs (e.g., laundry basket)
F25. bending over from a standing position to pick up a piece of clothing from the floor
F26. walking around one floor of your home, taking into consideration thresholds, doors, furniture, and variety of floor coverings
F27. getting up from the floor (as if you were lying on the ground)
F28. washing dishes, pots, and utensils by hand while standing at the sink
F29. walking several blocks
F30. taking a 1-mile, brisk walk without stopping to rest
F31. stepping on and off a bus
F32. walking on a slippery surface outdoors

Please visit the following Website (www.bu.edu/roybal) for information on the LLFDI instrument, users' manual, and scoring software.