

Research Corner

Outcome Measures in Cardiopulmonary Physical Therapy: Focus on the Late Life Function and Disability Instrument (LLFDI)

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INTRODUCTION

Measurement of functional limitations and disability is important in rehabilitation clinical practice and research. Functional limitations reflect “an individual’s reduced capacity to carry out an array of activities that are relevant to effective community living such as walking, climbing, reaching, lifting, and handling everyday objects.” Disability is concerned with an individual’s “limitations in performance of socially defined roles and tasks within a sociocultural and physical environment” and “therefore, focuses on behavioral repertoires rather than the performance of discrete tasks.”¹

Traditionally, functional limitations and disability have been measured with self-report and performance-based instruments. Many of the self-report questionnaires that have been used to measure functional limitations and disability in the past are not sensitive to small changes and have a ceiling effect in higher functioning populations.² Performance-based assessments of function include physical tests such as timed walk tests, sit-to-stand tests, walking speed, and stair climbing ability.³ Although these assessments are objective and eliminate the bias that is inherent in self-report instruments, they include only discrete tasks in a controlled environment that most accurately reflect functional limitations but not disability. In addition, self-report assessments are often more feasible to administer in clinical and research applications than performance-based assessments. To address the limitations of existing outcome measures, the Late Life Function and Disability Instrument (LLFDI) was recently developed to measure impairment in functional and participation in community dwelling older adults.^{4,5}

INSTRUMENT DESCRIPTION

The LLFDI is composed of 2 primary components, the function component and the disability component. The function component of the LLFDI has 32 items that rate task difficulty, as listed in Table 1. This component is broken down into Upper Extremity Function (7 items), Basic Lower Extremity Function (14 items), and Advanced Lower Extremity Function

Table 1. Items Included in the LLFDI Function Component. *These items are answered a second time for patients who use an assistive (without and with) device.

1. Unscrewing the lid off a previously unopened jar without using any devices
2. Going up & down a flight of stairs inside, using a handrail
3. Putting on and taking off long pants (including managing fasteners)
4. Running ½ mile or more
5. Using common utensils for preparing meals (e.g., can opener, potato peeler, or sharp knife)
6. Holding a full glass of water in one hand
7. Walking a mile, taking rests as necessary*
8. Going up & down a flight of stairs outside, without using a handrail*
9. Running a short distance, such as to catch a bus
10. Reaching overhead while standing, as if to pull a light cord
11. Sitting down in and standing up from a low, soft couch
12. Putting on and taking off a coat or jacket
13. Reaching behind your back as if to put a belt through a belt loop
14. Stepping up and down from a curb*
15. Opening a heavy, outside door*
16. Rip open a package of snack food (e.g. cellophane wrapping on crackers) using only your hands
17. Pouring from a large pitcher
18. Getting into and out of a car/taxi (sedan)
19. Hiking a couple of miles on uneven surfaces, including hills
20. Going up and down 3 flights of stairs inside, using a handrail
21. Picking up a kitchen chair and moving it, in order to clean
22. Using a step stool to reach into a high cabinet
23. Making a bed, including spreading and tucking in bed sheets
24. Carrying something in both arms while climbing a flight of stairs (e.g. laundry basket)
25. Bending over from a standing position to pick up a piece of clothing from the floor
26. Walking around one floor of your home, taking into consideration thresholds, doors, furniture, and a variety of floor coverings*
27. Getting up from the floor (as if you were laying on the ground)
28. Washing dishes, pots, and utensils by hand while standing at sink
29. Walking several blocks*
30. Taking a 1 mile, brisk walk without stopping to rest*
31. Stepping on and off a bus
32. Walking on a slippery surface, outdoors*

(11 items). The Disability component of the LLFDI has 16 items that rate task difficulty and frequency, as listed in Table 2. The frequency part of this component is broken down into social (9 items) and personal (7 items) participation items. The limitation part of this component is divided into Instrumental (12 items) and Management (4 items).

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Table 2. Items Included in the LLFDI Disability Components

<ol style="list-style-type: none"> 1. Keep (Keeping) in touch with others through letters, phone, or email. 2. Visit (Visiting) friends and family in their homes. 3. Provide (Providing) care or assistance to others. This may include providing personal care, transportation, and running errands for family members or friends. 4. Take (Taking) care of the inside of your home. This includes managing and taking responsibility for homemaking, laundry, housecleaning and minor household repairs. 5. Work (Working) at a volunteer job outside your home. 6. Take (Taking) part in active recreation. This may include bowling, golf, tennis, hiking, jogging, or swimming. 7. Take (Taking) care of household business and finances. This may include managing and taking responsibility for your money, paying bills, dealing with a landlord or tenants, dealing with utility companies or governmental agencies. 8. Take (Taking) care of your own health. This may include managing daily medications, following a special diet, scheduling doctor's appointments. 9. Travel (Traveling) out of town for at least an overnight stay. 10. Take (Taking) part in a regular fitness program. This may include walking for exercise, stationary biking, weight lifting, or exercise classes. 11. Invite (Inviting) people into your home for a meal or entertainment. 12. Go (Going) out with others to public places such as restaurants or movies. 13. Take (Taking) care for your own personal needs. This includes bathing, dressing, and toileting. 14. Take (Taking) part in organized social activities. This may include clubs, card playing, senior center events, community or religious groups. 15. Take (Taking) care of local errands. This may include managing and taking responsibility for shopping for food and personal items, and going to the bank, library, or dry cleaner. 16. Prepare (Preparing) meals for yourself. This includes planning, cooking, serving, and cleaning up.

Table 3. Response Items Anchoring the LLFDI Scores.

Function Component – Difficulty
<ol style="list-style-type: none"> 5 None: You have no difficulty doing the activity 4 A little: You can do it alone with a bit of difficulty 3 Some: You can do it, but you have a moderate amount of difficulty doing it alone 2 Quite a lot: You can manage without help, but you have quite a lot of difficulty doing it 1 Cannot do: It is so difficult that you cannot do it unless you have help
Factors that may influence your level of difficulty: pain, fatigue, fear, soreness, ailments, disabilities.
Disability – Frequency
<ol style="list-style-type: none"> 5 Very often: frequently, a lot of the time, a major part of your life. 4 Often: regularly, a regular part of your life. 3 Once in a while: infrequently, from time to time, occasionally 2 Almost never: very infrequently, rarely. 1 Never
Disability – Limitation
<ol style="list-style-type: none"> 5 Not at all: no limitations 4 A little: Slight limitation 3 Somewhat: moderate limitation 2 A lot: heavy limitation 1 Completely
Examples of limiting factors that may restrict you: mental or physical energy, too much effort, social and economic circumstances, transportation problems, accessibility issues, health.

All items on the LLFDI are scored on a 5-point ordinal scale. Table 3 outlines the item anchors on the LLFDI. This instrument was designed to be an interviewer administered self-report outcome measure.

Instructions for the Function component questions are as follows: *“In this following section, I will ask you about your ability to do specific activities as part of your daily routines. I am interested in your sense of your ability to do it on a typical day. It is not important that you actually do the activity on a daily basis. In fact I may mention some activities that you don’t do at all. You can still answer these questions by assessing how difficult you think they would be for you to do on an average day. Factors that influence the level of difficulty you may have may include: pain, fatigue, fear, weakness, soreness, ailments, health conditions, or disabilities. I want to know how difficult the activity would be for you to do without the help of someone else, and without the use of a cane walker or any other assistive walking device (or wheelchair or scooter). How much difficulty do you have...? (remember this is without the help of someone else and without the use of any assistive walking device).”*

Instructions for the Disability component questions are as follows: *“In this set of questions, I will ask you about everyday things you do at this time in your life. There are two parts to each question. First, I will ask you how often you do a certain activity. Next, I will ask you to what extent do you feel limited in doing this activity. For each question, please select the one answer that comes closest to the way you have been feeling.”*

The LLFDI can be used with permission via a one time purchase of the instrument and manual from the Boston University Roybal Center for the Enhancement of Late-Life Function. There is also scoring software that will transform raw scores into scaled scores for each component subsection. The LLFDI scoring forms and ordering information are available at <http://www.bu.edu/hdr/products/llfdi/index.html>.

RELIABILITY

Test-retest reliability of the LLFDI has been evaluated over a 1 to 3 week period in 150 ethnically and racially diverse adults over the age of 60 years. The test-retest reliability of the function component of the LLFDI summary scores was extremely high with ICC = 0.91-0.98.⁵ The test-retest reliability of the Disability Component of the LLFDI summary scores was moderate to high with ICC = 0.68-0.82.⁴ The validity of the LLFDI has also been previously established in community-dwelling older adults. Differences in known-functional limitation groups were found for both the Function and Disability components of the LLFDI supporting its discriminative validity.^{4,5}

Recently, a study was performed to determine if the LLFDI could be administered via self-report instead of by interview in patients with cardiovascular disease (CVD).⁶ Subjects (n=29) were patients over 60 years old with CVD participating in an outpatient cardiac rehabilitation program. Study participants completed the LLFDI in a self-report format and again using an interview format 1 to 5 days later. All LLFDI component scores obtained via self-report were significantly correlated ($r = 0.77-0.95$) with scores obtained via interview. There was no significant difference between LLFDI scores obtained through

patient self-report and those obtained through interview. These findings suggest that this instrument can be independently completed by patients with CVD rather than administered by clinicians. Self-report administration of the LLFDI makes it more feasible to use in cardiac rehabilitation settings.

VALIDITY

The *concurrent validity* of the LLFDI was examined by comparing scores with 2 other established self-report instruments, the Short Form-36 physical functioning subscale (PF-10) and the London Handicap Scale (LHS). Function summary scores were highly correlated with PF-10 scores ($r = 0.74-0.86$) and Disability summary scores were moderately correlated with LHS scores ($r = 0.47-0.66$). In addition, the study investigators concluded that “the LLFDI had a wide range of content coverage, less ceiling effects and better relative precision across the spectrum of function and disability than the PF-10 and the LHS.”² The concurrent validity of the LLFDI has also been examined by comparing scores to performance-based measurements (400-M Walk Test, Short Physical Performance Battery, stair climbing, Timed-Up-and-Go Test), habitual physical activity (Physical Activity Scale for the Elderly), and body composition (body mass index) and had yielded moderate to high correlations.^{1,3}

Recently the concurrent validity of the LLFDI in patients with CVD has been reported.⁷ Subjects ($n=32$) were patients over 60 years old with CVD participating in a cardiac rehabilitation program. Study participants completed the following outcome measures: LLFDI, Physical Activity Scale for the Elderly, Physical Function Subscale of the RAND 36-Item Health Survey, London Handicap Scale, 6 Minute Walk Test, Timed-Up-and-Go, Walking Speed, and Timed Sit-to-Stand Test. We used descriptive statistics and correlations to analyze the data ($P < 0.05$). All LLFDI components were significantly correlated ($r = 0.36-0.83$) with the Physical Activity Scale for the Elderly, Physical Function Subscale of the RAND 36-Item Health Survey, and London Handicap Scale. The Function Component of the LLFDI was significantly correlated with 6 Minute Walk Test ($r = 0.62$), Timed-Up-and-Go ($r = -0.58$), Walking Speed ($r = -0.56$), and Timed Sit-to-Stand Test scores ($r = -0.56$). The LLFDI did not demonstrate a floor effect and only the Disability component difficulty scale of the LLFDI had a ceiling effect in 10% of study participants. The results of this study show that scores on the Function component of the LLFDI have a moderate to strong relationship with self-report and performance-based outcome measures in patients with CVD. Also, scores on the Disability component of the LLFDI have a moderate relationship with self-report outcome measures but little relationship with performance-based outcome measures.

SCORE INTERPRETATION

The raw scores taken from the LLFDI are not easily interpreted by themselves. The scaled scores are easier to clinically interpret as they are derived from a transformation of the raw scores (performed by the associated software) into a 0-100 scale where a higher score represents a better score with less limitation. The scaled scores of the LLFDI have been operationally classified into 4 statistically different subgroups

of older adults for clinical interpretation: Severe, Moderate, Slight, and No Limitations. Table 4 describes the mean scores of individuals placed each category.^{4,5} Roughly, the difference in scores between categories is 11 for the Function component, 9 for the Disability component limitation, and 5 for Disability component frequency.

Table 4. Mean Scaled Summary Scores of the 4 Levels of Limitation from the Component Scaled (0-100) Summary Scores of the Late Life Function & Disability Instrument (LLFDI)

	Functioning	Disability Limitation	Disability Frequency
Severe Limitations	41.7	55.4	44.3
Moderate Limitations	53.2	63.5	49.5
Slight Limitations	65.6	73.8	53.6
No Limitations	75.6	82.5	58.1

Patients starting outpatient cardiac rehabilitation exhibit the following LLFDI Function and Disability scores (mean & SD): Function component = 62 ± 11 , Disability component limitations = 71 ± 20 , and Disability component frequency = 51 ± 7 .⁷ These scores are consistent with a classification between the moderate to slight limitation categories. In comparison, Ouellette et al⁸ used the LLFDI while studying a group of mild to moderately involved community dwelling and independent ambulating individuals with stroke (mean age=66). As expected, a group with stroke and hemiparesis scored below the group of individuals in cardiac rehabilitation with a function component score of 48 and disability component limitation and frequency scores of 56 and 47 respectively.

The reliability of a measure can be combined with the standard deviation taken from a patient population to determine the standard error of the measure. The standard error of measurement is used to determine the minimal detectable change of an instrument. The minimal detectable change is the minimal amount of change in a measurement to exceed the levels of measurement error. The intraclass correlation coefficient of the LLFDI components has been described earlier as function = 0.960, disability limitation 0.819 and disability frequency 0.680.⁵ When applying these intraclass coefficient correlations to the standard deviations from the LaPier study above,⁷ the minimally detectable changes using a 95% confidence interval are 4.3 for the function component, 16.7 for the disability component limitation, and 7.8 for the disability component frequency.

SUGGESTIONS FOR CLINICAL USE

The LLFDI is a useful self-report outcome measure of function and disability in patients with or at risk of cardiovascular disease. It has a minimal floor or ceiling effect because items reflect a wide range of activities. The reliability and validity of the LLFDI has been established in community dwelling well older adults and those participating in outpatient rehabilitation. Additionally, Denkinger and colleagues⁹ recently reported the validity, responsiveness, and sensitivity to change of the Function component of the LLFDI in a geriatric inpatient rehabilitation unit population

suggesting that it may be a useful instrument in other populations. The disability component of the LLFDI could not be used in this inpatient population because most of the items were not applicable. Also, the LLFDI has been used as an outcome measure in several research studies involving community-dwelling patients who had sustained an ischemic stroke, demonstrating its utility in this patient population.^{8,10}

Probably the greatest barrier to using the LLFDI in clinical settings is the response burden and administration time. Completion time of the LLFDI has been reported to be 20 to 30 minutes.^{1,11} Administration of the instrument via self-report rather than in an interview format reduces the time burden of the clinician but not the patient. Due to this response burden a short form and a computer adaptive test version of the LLFDI have been investigated. McAuley et al¹ developed a 15-item Function component and 8-item Disability component short form version of the LLFDI. High correlations, that ranged from $r = 0.76$ to 0.96 , were reported between the original and abbreviated versions of the LLFDI. Using another strategy to reduce response burden of the LLFDI, the original developers of the instrument have investigated use of item response theory methods and computer adaptive testing. Briefly, this approach does not use a fixed set of questions but adjusts the assessment to the current level of function and disability for the individual older adult so that items that are too easy or too hard are excluded from administration.¹¹ This methodology show great promise for using the LLFDI in research trials but may have limited utility in clinical settings due to limited feasibility.

In summary, the LLFDI could be a useful outcome measure for patients with cardiovascular and pulmonary impairments particularly high functioning patients. This population of high functioning patients can often benefit from physical therapy services but demonstrating function limitation, participation restriction, and improvement with intervention is often challenging.

REFERENCES

1. McAuley E, Konopack JF, Motl RW, Rosengren K, Morris KS. Measuring disability and function in older women: psychometric properties of the Late-Life Function and Disability Instrument. *J Gerontol.* 2005;60A(7):901-909.
2. Dubuc N, Haley SM, Ni P, Kooyoomjian JT, Jette AM. Function and disability in late life: comparison of the Late-Life Function and Disability Instrument to the Short Form-36 and the London Handicap Scale. *Disability Rehabil.* 2004;26(6):362-370.
3. Sayers SP, Jette AM, Haley SM, Heeren TC, Guralnik JM, Fielding RA. Validation of the Late-Life Function and Disability Instrument. *J Am Geriatr Soc.* 2004;52:1554-1559.
4. Jette AM, Haley SM, Coster WJ, et al. Late life function and disability instrument: I. development and evaluation of the disability component. *J Gerontol* 2002;57A:M209-M216.
5. Haley SM, Jette AM, Coster WJ, et al. Late Life Function and Disability Instrument: II. development and evaluation of the function component. *J Gerontol.* 2002;57A:M209-M216.
6. Kinney LaPier TL, Waitt M. Using the Late Life Function and Disability Instrument as a self-report outcome measure in patients with cardiovascular disease. *J Cardiopulm Rehabil Prevent.* 2007;27(5):331.
7. Kinney LaPier TL, Waitt M. Is the late life function and disability instrument an effective outcome measure in patients with cardiovascular disease? *Circulation.* 2007;115(21):e579.
8. Ouellette MM, LeBrasseur NK, Bean JF, et al. High-intensity resistance training improves muscle strength, self-reported function, and disability in long-term stroke survivors. *Stroke.* 2004;35:1404-9.
9. Dekinger MD, Igl W, Coll-Planas L, Bleicher J, Nikolaus T, Jamour M. Evaluation of the short form of the Late-Life Function and Disability Instrument in Geriatric Inpatients – validity, responsiveness, and sensitivity to change. *J Am Geriatr Soc.* 2009;57:309-314.
10. LeBrasseur NK, Sayers SP, Ouellette MM, Fielding RA. Muscle impairments and behavioral factors mediate functional limitations and disability following stroke. *Phys Ther.* 2006;86(10):1342-1350.
11. Jette AM, Haley SM, Ni P, Olarsch S, Moed R. Creating a computer adaptive test version of the Late-Life Function and Disability Instrument. *J Geront.* 2008;63A(11):1246-1256.