ARTICLES

Utility of the Late Life Function and Disability Instrument as an Outcome Measure in Patients Participating in Outpatient Cardiac Rehabilitation: A Preliminary Study

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ABSTRACT

Purpose: The purpose of this study was to examine the concurrent validity of the Late Life Function and Disability Instrument (LLFDI) in patients with coronary heart disease (CHD) and to evaluate the accuracy of information obtained through self-report questionnaire versus interview formats. ***Methods:*** The study included 29 patients older than 60 years attending an outpatient cardiac rehabilitation program. Participants completed the LLFDI, three additional self-report criterion measures, and six performance-based tests; they completed the LLFDI a second time via interview. We used descriptive statistics, correlations, and *t*-tests to analyze the data. ***Results:*** All LLFDI components were correlated (rs $= 0.36–0.83$) with the self-report criterion measures. The Function Component of the LLFDI was moderately correlated with the 6-Minute Walk Test ($r = 0.62$), timed up-and-go ($r = -0.58$), walking speed ($r = -0.57$), and timed sit-to-stand ($r = -0.56$) scores. The LLFDI demonstrated a ceiling effect (10%) only in the Disability Limitation component. All LLFDI component scores obtained via self-report questionnaire were correlated with scores obtained via interview; except in a single subcategory, there was no difference between LLFDI scores obtained through self-report questionnaire and those obtained through interview. ***Conclusions:*** Results indicate that the LLFDI has appropriate validity for older patients (>60 years) with CHD and can be completed independently by patients rather than administered by clinicians.

Key Words: activities of daily living; rehabilitation; mobility limitation; outcome assessment; coronary disease.

RÉSUMÉ

Objectif : L'objectif de cette étude était d'examiner la validité concurrente de l'instrument de fonction et d'incapacité en dernière tranche de vie (Late Life Function and Disability Instrument, ou LLFDI) chez les patients souffrant de coronaropathie et d'évaluer la précision de l'information obtenue à l'aide d'un questionnaire d'autoévaluation, comparativement à une formule d'entrevues traditionnelles. ***Méthode :*** L'étude regroupait 29 patients de plus de 60 ans participant à un programme ambulatoire de réadaptation cardiaque. Les participants ont complété le LLFDI, trois critères d'autoévaluation supplémentaires et six tests fondés sur la performance; ils ont complété un deuxième LLFDI dans le cadre d'une entrevue. Nous avons utilisé des statistiques descriptives, des corrélations et des tests « t » pour l'analyse des données. ***Résultats :*** Toutes les composantes du LLFDI ont été corrélées ($r = 0,36–0,83$) aux mesures des critères d'autoévaluation. La composante « fonction » du LLFDI a été corrélée avec modération à l'aide des résultats de tests de marche de 6 minutes ($r = 0,62$), de tests « up-and-go » chronométrés ($r = -0,58$), de la mesure de la vitesse de marche ($r = -0,57$) et de transferts assis-debout chronométrés ($r = -0,56$). Le LLFDI a démontré un plafonnement (10 %) à la composante « limitation de l'incapacité » uniquement. Tous les résultats des composantes du LLFDI obtenus avec le questionnaire d'autoévaluation ont été corrélés avec ceux obtenus lors des entrevues; à l'exception d'une seule sous-catégorie, on n'a observé aucune différence entre les résultats du LLFDI obtenus à l'aide du questionnaire d'autoévaluation et ceux obtenus lors des entrevues. ***Conclusions :*** Les résultats indiquent que le LLFDI offre une validité adéquate chez les patients plus âgés (>60 ans) souffrant de coronaropathie et peuvent être réalisés de manière autonome par les patients au lieu d'être administrés par les cliniciens.

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Measurement of functional limitations and disability is important in rehabilitation clinical practice and research. Functional limitations have been defined as "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."[1(p.901)] Disability relates to an individual's "limitations in performance of socially defined roles and tasks within a sociocultural and physical environment" and "therefore, focuses on behavioural repertoires rather than the performance of discrete tasks."[1(p.901)]

Coronary heart disease (CHD) affects a diverse patient population; therefore, the resulting limitations in function and disability are extremely variable. Such diversity makes objective measurement of function and disability in this patient population difficult. The ability to measure functional limitations and disability is important in rehabilitation because these factors usually influence a patient's treatment and prognosis. Traditionally, functional limitations and disability have been measured with both self-report and performance-based instruments. Many established self-report outcome measures are used to assess function and disability in rehabilitation; however, many self-report tools that measure function and disability are not sensitive to small changes or have a ceiling effect in populations with diverse activity competencies, such as patients with CHD.[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]

The Late Life Function and Disability Instrument (LLFDI) was developed to measure deficits in function and participation in a population of community-dwelling older adults and was intended to address the limitations of existing outcome measures.[4,5] The LLFDI was designed to be administered by interview; whether it can be used in a self-report questionnaire format is unknown. Self-report outcome measures that can be administered in questionnaire rather than interview format are more feasible to use in many clinical and research situations. The LLFDI's validity has been examined in several populations but not, to date, specifically in older patients with CHD.[6–9] The psychometric attributes of an instrument are relative, not absolute, and depend on the population in which they are assessed; therefore, to use the LLFDI with patients with CHD, we must first establish its validity and measurement properties. Previously used outcome measures have limited utility with patients with CHD because they are subject to a ceiling effect, produce skewed scores, or both.[10] The primary purpose of this study, therefore, was to examine the concurrent validity of the LLFDI in older patients with CHD. A second purpose was to evaluate the accuracy of LLFDI information obtained through self-report questionnaire versus interview formats.

METHODS

Participants

This study included 30 people with CHD participating in an urban hospital-based outpatient cardiac rehabilitation (CR) program with a referral catchment area of approximately 60 km. Criteria for study participation were ability to follow multistep directions, emotional stability, and current participation in an outpatient CR program. At the time of the study, patients qualified for outpatient CR services in the United States included those with a diagnosis of coronary artery bypass surgery, acute myocardial infarction, or chronic angina. Individuals were excluded from the study if they were unable to understand written or spoken English, had cognitive deficits (below Level 6 on the Ranchos Los Amigos scale), or were younger than 60 years old.

Procedures

Study participants reviewed and signed an informed consent form approved by the facility's Institutional Review Board and were then given a packet of self-report questionnaires to take home, complete, and return at their next CR session. Participants were instructed to answer the questions in order, to not go back and review previous answers, and to finish the self-report questionnaires in a single session; no time limit was specified. Participants first completed a self-report questionnaire for background and medical information; next, they completed the following self-report outcome measures in random order: LLFDI, Physical Activity Scale for the Elderly (PASE), Physical Function subscale of the RAND 36-Item Health Survey (RAND-36), and the London Handicap Scale (LHS). Participants returned 1–5 days later for performance-based tests and an interview administration of the LLFDI, performed by a single study investigator.

The performance-based measures of physical function used in this study were the 6-Minute Walk Test (6MWT), timed up-and-go (TUG), timed sit-to-stand (TSS), and walking speed (WS). Testing order was randomly determined, and total testing time was approximately 1 hour, with rest as needed between tests. Patients were allowed to use assistive devices for ambulation, as well as supplemental oxygen, if needed.[11]

Instruments

The LLFDI has two primary components: Function and Disability. The Function component of the LLFDI consists of 32 items that rate task difficulty (see Box 1) and is divided into Upper Extremity Function (7 items), Basic Lower Extremity Function (14 items), and Advanced Lower Extremity Function (11 items). The Disability component of the LLFDI consists of 16 items rating both task difficulty and frequency of participation (see Box 2). The Limitation part of this component is divided into Instru-

Box 1 Items Included in the Late Life Function and Disability Instrument Function Component

Standardized 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).[5]

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

*These items are answered a second time for patients who use an assistive device.
Basic LE = Basic Lower Extremity subcategory item; Advanced LE = Advanced Lower Extremity subcategory item; UE = Upper Extremity subcategory item.

mental (12 items) and Management (4 items). The Frequency part of this component is divided into Social (9 items) and Personal (7 items) participation items. Box 3 lists the item anchors of the LLFDI Function and Disability components.[4,5]

All components of the LLFDI are scored on a five-point scale on which higher scores indicate better performance and less limitation than lower scores. Raw LLFDI scores are scaled for easier clinical interpretation by transforming the raw scores into a scale ranging from 0 to 100 on which a higher score represents a better score with less limitation. Test–retest reliability and validity of the LLFDI have previously been evaluated over a 1–3 week period in 150 ethnically and racially diverse adults older than age 60 years. Previous results demonstrated that the test–retest reliability of LLFDI Function summary subscale scores was extremely high (intraclass correlation coefficients [ICCs] = 0.91–0.98)[5]

Box 2 Items Included in the Late Life Function and Disability Instrument Disability Component

Standardized 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."[5]

1. Keep (Keeping) in touch with others through letters, phone, or email. – *Frequency SR & Limitation MR*
2. Visit (Visiting) friends and family in their homes. – *Frequency SR & Limitation IR*
3. Provide (Providing) care or assistance to others. This may include providing personal care, transportation, and running errands for family members or friends. – *Frequency SR & Limitation IR*
4. Take (Taking) care of the inside of your home. This includes managing and taking responsibility for homemaking, laundry, housecleaning, and minor household repairs. – *Frequency PR & Limitation IR*
5. Work (Working) at a volunteer job outside your home. – *Frequency SR & Limitation IR*
6. Take (Taking) part in active recreation. This may include bowling, golf, tennis, hiking, jogging, or swimming. – *Frequency SR & Limitation IR*
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. – *Frequency SR & Limitation MR*
8. Take (Taking) care of your own health. This may includes managing daily medications, following a special diet, scheduling doctor's appointments. – *Frequency PR & Limitation MR*
9. Travel (Travelling) out of town for at least an overnight stay. – *Frequency SR & Limitation IR*
10. Take (Taking) part in a regular fitness program. This may include walking for exercise, stationary biking, weight lifting, or exercise classes. – *Frequency PR & Limitation IR*
11. Invite (Inviting) people into your home for a meal or entertainment. – *Frequency SR & Limitation MR*
12. Go (Going) out with others to public places such as restaurants or movies. – *Frequency SR & Limitation IR*
13. Take (Taking) care for your own personal needs. This includes bathing, dressing, and toileting. – *Frequency PR & Limitation IR*
14. Take (Taking) part in organized social activities. This may include clubs, card playing, senior centre events, community or religious groups. – *Frequency SR & Limitation IR*
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. – *Frequency PR & Limitation IR*
16. Prepare (Preparing) meals for yourself. This includes planning, cooking, serving, and cleaning up. – *Frequency PR & Limitation IR*

Frequency SR = Frequency response, social role subcategory; Frequency PR = Frequency response, personal role subcategory; Limitation MR = Limitation response, management role subcategory; Limitation IR = Limitation response, instrumental role subcategory.

and test–retest reliability of Disability summary subscale scores was moderate to high (ICCs = 0.68–0.82).[4] Differences in known functional limitation groups were found for both the Function and Disability components of the LLFDI; this finding supports the measure's discriminative validity.[4,5] We examined the LLFDI's concurrent validity by comparing scores with those on two other established self-report instruments, the Medical Outcomes Short Form-36 and the LHS.[4,5] Function summary scores were highly correlated with Medical Outcomes Short Form-36 scores (rs = 0.74–0.86), and Disability summary scores were moderately correlated with LHS scores (rs = 0.47–0.66).[4,5] The LLFDI's concurrent validity has also been examined by comparing scores with those on performance-based measurements (400-Metre Walk Test, Short Physical Performance Battery, stair climbing, TUG test), habitual physical activity (PASE), and body composition (body mass index); these comparisons have yielded moderate to high correlations.[1,3]

We chose the PASE to evaluate the LLFDI's concurrent validity because it is a self-report questionnaire designed to assess leisure, household, and occupational activity in people older than 65 years.[12] The 12-item PASE uses variable ordinal scales (e.g., 1 = yes, 2 = no; 0 = never, 4 = often [5–7 days]; 1 = <1 hr, 4 = >4 hrs) to record the frequency of occurrence of each activity within the past 7 days. Each response is correlated with a set weighted value of between 20 and 36; the final score is calculated by summing the product of the task frequency and the set weighted values for all items. The PASE has strong concurrent validity with other indicators of physical activity (leg strength, grip strength, static balance, resting heart rate) and has a test–retest reliability of 0.75.[12]

We chose the LHS to evaluate LLFDI's concurrent validity because it is a well-established measure of disability.[13–15] The LHS measures disability on six functional dimensions: mobility, independence, occupation, orienta-

Box 3 Response Items Anchoring the Late Life Function and Disability Instrument Scores

Function Component – Difficulty

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 Component – Frequency

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 Component – Limitation

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.

tion, social integration, and economic self-sufficiency.[13] Each section consists of six hierarchically scaled descriptions; participants self-report what activities they do or do not do. A handicap score of 100 indicates no disadvantage, and a score of 0 represents maximum disadvantage. The LHS has been shown to have good reliability and concurrent validity with other measures of disability[13–15] and to be a more sensitive indicator of disability than the Barthel Index.[15]

The RAND-36 is a readily available and inexpensive self-report instrument that measures generic health-related quality of life. The RAND-36 was developed as part of the Medical Outcomes Study, a 4-year observational study with more than 2,500 participants.[16,17] The RAND-36 consists of 36 items and generates eight subscales; the Physical Functioning subscale was used for data analysis in this study. Scores on the RAND-36 are reported on a scale ranging from 0 to 100; higher values indicate a more positive state of health. This outcome measure has well-documented psychometric properties and has been used extensively to study quality of life in patients with cardiopulmonary diagnoses; measurements obtained with this instrument have well-documented reliability, validity, and sensitivity.[18,19]

The TUG test measures how long it takes a patient to stand up, walk 3 m, return to the chair, and sit down, with or without an assistive device.[20] Longer time intervals indicate more impaired balance and functional ability. The TUG has excellent intrarater reliability (ICC = 0.99) and interrater reliability (ICCs = 0.98–99) in patients with Parkinson disease, frail elderly adults, and patients with dementia.[21–23] This test has also been shown to predict fall risk in community-dwelling adults.[24] In addition, age- and gender-based normative data for the TUG have been published.[25]

WS over a short distance (5 m) was measured at a preferred pace and a fast pace. A shorter time when walking at a fast pace and a greater difference between preferred and fast WS both indicate better functional ability.[26] Preferred and fast WS have also been shown to predict onset of functional dependency in older adults.[27] Test–retest reliability of WS tested over a 5–6 m distance was 0.92–0.99 in patients with stroke or dementia.[23,28,29] In addition, Visser and colleagues[30] found a significant relationship between WS and muscle cross-sectional area in adults 70–79 years old. WS has also been shown to discriminate between known groups of elderly individuals categorized by degree of habitual activity, use of ambulatory aids, and type of living environment.[31,32] Finally, Kressig and colleagues[33] found that slow WS was directly related to fear of falling in older adults transitioning to frailty.

We used the TSS to evaluate lower body strength. More repetitions in 30 seconds indicate greater leg strength. Sit-to-stand tests have well-documented and acceptable degrees of reliability and validity in community-dwelling older adults and people with chronic disease.[34–36] Excellent test–retest reliability of the TSS has been found in

patients with stable rheumatoid arthritis, older adults, and patients with dementia (rs > 0.80).[23,34–36] Specifically, Jones and colleagues[36] reported ICCs of 0.84–0.92 with repeated trials of a 30-second chair stand test in older adults. Concurrent validity of TSS with TUG and WS has been documented in older adults.[34] Visser and colleagues[30] also found a significant relationship between repeated chair-stand performance and muscle cross-sectional area in adults 70–79 years old. The criterion-related validity of the TSS has been demonstrated by significant correlations between TSS scores and leg-press performance and isokinetic knee torque in older adults.[36,37] Sit-to-stand performance has been shown to predict future disability in older adults.[38]

Intrarater reliability of the 6MWT has been reported extensively in many patient populations, including patients with heart failure (ICCs = 0.82–0.96),[39–42] peripheral arterial disease (ICC = 0.94)[43], end-stage lung disease (ICC = 0.99),[44] cystic fibrosis (no difference between repeated trials),[45] and pacemakers (no difference between repeated trials).[46] Connely and colleagues[47] reported excellent interrater reliability (ICCs = 0.93–0.95) during walk tests in frail elderly people. The most common criterion outcome compared with walk-test distance is maximal oxygen consumption (V_{O_2}max). Bernstein and colleagues[48] reported a correlation of 0.45 between V_{O_2}max and 2-minute walk test distance in elderly patients with chronic obstructive pulmonary disease. Many studies have examined the relationship between V_{O_2}max and 6MWT distance in patients with chronic obstructive pulmonary disease ($r = 0.64$),[49] end-stage lung disease ($r = 0.73$),[44] heart failure ($r = 0.65$),[41,42] pulmonary hypertension ($r = 0.70$),[50] peripheral arterial disease ($r = 0.37$),[43] and cystic fibrosis ($r = 0.76$)[45].

Data Analyses

We used descriptive statistics, correlations, and t-tests to analyze the data (Microsoft Excel 2007, Microsoft Corp., Redmond, WA). Ceiling and floor frequencies were calculated by documenting how many participants received a score of either 0 (minimum) or 100 (maximum) on the LLFDI. To evaluate concurrent validity, we calculated Pearson correlations between LLFDI scores and other criterion measures. In addition, we performed t-tests to examine differences between questionnaire-administered and interview-administered LLFDI scores. We also calculated CIs and minimum detectable change. The α level was set at 0.05. Statistical power for $n = 30$ was estimated to be greater than 0.80.

RESULTS

The analysis was based on 29 participants because 1 study participant was lost during follow-up. Participants had a mean age of 69 years (SD 9), and 72% were male. Characteristics of the study participants are given in Table 1. Mean scores were as follows: on the Function component, 62 (SD 11), range = 43–85; Disability component (Limitation scale), 71 (SD 20), range = 46–100; and Disability component (Frequency scale), 51 (SD 7), range 40–69. Although the mean scores suggest moderate to slight limitation, the lower ends of the ranges indicate severe limitations.[4,5] The LLFDI did not demonstrate a floor effect, and only the Disability component Limitation scale of the LLFDI showed a ceiling effect in 10% of study participants.

All LLFDI component scores were significantly correlated (rs = 0.36–0.83) with the PASE, RAND-36, and LHS (see Table 2). The Function component scores were also significantly correlated with all the performance-based criterion measures. Disability component Limitation scale scores were correlated with some of the performance-based measures, but Frequency scale scores were not. All LLFDI component scores and subscale scores obtained via self-report were correlated with scores obtained via interview (see Table 3); there was no difference between LLFDI scores obtained via the two methods except on the Social Role subscale in the Disability component Frequency scale.

The standard error of measurement is used to determine the minimum detectable change of an instrument (i.e., the minimal amount of change in a measurement that is not attributable to measurement error).[51] The ICC of the LLFDI components has been described earlier (Function = 0.96, Disability Limitation = 0.82, Disability Frequency = 0.68).[5] When these ICCs are applied to the standard deviations from the present data set using a 95% CI, the minimum detectable change is 4.3 for the Function component, 16.7 for the Disability component Limitation scale, and 7.8 for the Disability component Frequency scale.

DISCUSSION

The results of this study suggest that the LLFDI, administered by interview or self-report format, can be a useful outcome instrument to objectively measure the constructs of function and disability for older patients with CHD. Data from this study indicate that this patient population demonstrates a wide range of functional abilities: LLFDI component scores showed as much as a 69% difference between minimum and maximum scores. We found no floor effect and only a minimal ceiling effect for the LLFDI. In documenting improvements after rehabilitation, it is ideal to use an outcome measure that can be used across the continuum of care (acute care, outpatient, lifelong fitness, etc.) with both low- and high-functioning patients. In this study, we included only patients who were in the outpatient phase of CR and progressing toward the maintenance phase, so although variable in range abilities, study participants were all in the same stage of rehabilitation.

Study results indicate that the LLFDI has good concurrent validity in older patients with CHD, as has

Table 1 Summary of Study Participants' Demographic Characteristics

Characteristic	Percentage of participants
Sex; male	75
Race	
Caucasian	94
Hispanic/Latino	0
Asian/Pacific Islander	3
Native American	3
Employment status	
Retired	66
Part time	13
Full time	19
Homemaker	3
Education level	
High school (12th grade)	41
Technical school	22
Bachelor's degree	19
Graduate degree	16
Unknown	3
Type of residence	
House	91
Apartment	6
Group home	3
Living situation	
Alone	19
Spouse only	72
Other	9
Assistive device	
None	91
Cane	6
Walker	3
Cardiac diagnosis	
Heart attack	25
Bypass surgery	56
Heart valve surgery	13
Stable angina	6
Heart transplant	0
Angioplasty	38
Comorbidities	
Osteoarthritis	53
Cancer	25
Depression	9
Diabetes	34
Hypertension	47
Hyperlipidemia	47
Low back pain	53
Pulmonary disease	16
Neurologic disorder	13

been demonstrated previously with other populations. In community-dwelling older adults, the LLFDI was able to discriminate differences in individuals with known functional limitations, which supports its discriminative validity.[4,5] A previous study found that LLFDI Function component scores were strongly correlated with SF-36 scores ($rs = 0.74–0.86$), and Disability component scores were moderately correlated with LHS scores ($rs = 0.47–0.66$);[13] LLFDI scores have also shown moderate to high correlations with performance-based outcome measures.[1,3] Similarly, this study's results indicate that the LLFDI Functional component has good concurrent validity with established self-report and performance-based outcome measures. This finding is consistent with the more direct influence of impairments (e.g., muscle weakness and poor aerobic capacity) on functional tasks than of disability leading to role limitation.

The greatest barrier to using the LLFDI in clinical settings is likely the response burden and administration time: Time to complete the LLFDI in interview format has been reported as 20–30 minutes.[1,52] The results of this study, however, suggest that the LLFDI can be administered via self-report questionnaire rather than interview. All LLFDI subscale scores obtained via in-person interview were correlated with scores obtained by having patients complete the items in a self-report questionnaire. In only one category (Social role) was the difference between means statistically significant; even here, however, the actual difference between scores was only 2.1, which is less than for the MDC. Self-report administration of the LLFDI makes this instrument more feasible for use in clinical CR settings and in longitudinal research studies.

Administration of the LLFDI via self-report rather than in an interview format reduces the time burden for the clinician, but not for the patient. Because of this response burden, a short form and a computer-adaptive test version of the LLFDI have been investigated. McAuley and colleagues[1] developed a short form version of the LLFDI with a 15-item Function component and an 8-item Disability component. High correlations ($rs = 0.76–0.96$) were reported between the original and abbreviated versions of the LLFDI.[1] Using another strategy to reduce response burden of the LLFDI, the original developers of the instrument have investigated 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.[52] This methodology shows great promise for using the LLFDI in research trials but may not be feasible for use in clinical settings.

Our study examined the psychometric properties of the LLFDI in patients older than 65 years with CHD and found results similar to those previously established in community-dwelling healthy older adults and several

Table 2 Correlations between Late Life Function and Disability Instrument Components and Criterion Outcome Measures

		Disability	
Outcome measure	Function	Limitation	Frequency
Physical Activity Scale for the Elderly	0.56*	0.56*	0.54*
RAND-36 Item Health Survey	0.83*	0.68*	0.38*
London Handicap Scale	0.65*	0.49*	0.36*
Timed up-and-go	−0.58*	−0.26	0.00
Preferred walking speed	−0.57*	−0.33*	0.01
Fast walking speed	−0.55*	−0.24	−0.01
6-Minute Walk Test	0.62*	0.33*	−0.19
Timed sit-to-stand	−0.56*	0.12	−0.26

*$p < 0.05$.

Table 3 Late Life Function and Disability Instrument Scores Obtained Through Interview and Self-Report

		Mean score (SD)	
Component and subscale	*r**	Interview format	Self-report format
Function total	0.95	62.0 (11.0)	60.8 (10.7)
Upper Extremity	0.86	81.2 (14.1)	80.0 (14.0)
Basic Lower Extremity	0.92	74.6 (14.0)	73.7 (15.8)
Advanced Lower Extremity	0.83	50.2 (19.7)	49.2 (18.2)
Disability—Limitation total	0.90	73.8 (15.2)	71.5 (14.0)
Instrumental role	0.91	72.6 (16.8)	70.9 (16.0)
Management role	0.52	91.1 (13.5)	87.5 (13.2)
Disability—Frequency total	0.77	51.3 (6.8)	52.8 (7.1)
Social role	0.87	46.3 (8.6)	48.4 (9.5)*
Personal role	0.55	62.0 (17.1)	62.9 (15.0)

*$p < 0.05$.

other patient populations. Denkinger and colleagues[7] 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 populations other than community-dwelling healthy older adults. (The Disability component of the LLFDI could not be used in this inpatient population because most of the items were not applicable.) The LLFDI has also 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.[6,8] Ouellette and colleagues[6] used the LLFDI in studying a group of community-dwelling and independently ambulating individuals with mild to moderately involved stroke (mean age 66 years). As expected, the group with stroke and hemiparesis scored lower than individuals in CR (Function component score of 48 and Disability component Limitation and Frequency scale scores of 56 and 47, respectively). Hand and colleagues[9] recently examined construct validity of the LLFDI in a diverse population of adults with chronic conditions. They found that the LLFDI correlated strongly with quality-of-life physical function ($r = 0.84$) and moderately with other outcome measures ($rs = 0.31–0.67$).

In clinical settings, the LLFDI could be used with patients who have CHD in several ways. The LLFDI could be used in addition to other more commonly available outcome measures, such as the 6MWT, TUG, SF-36, and Duke Activity Status Index. Alternatively, to reduce response burden and clinicians' time, the LLFDI could replace a currently used outcome measure in all or some CR participants. For example, perhaps the LLFDI could be administered to higher-functioning patients (e.g., >500 m on the 6MWT or >80% on the SF-36) who are less likely to demonstrate change with other standardized outcome measures because of ceiling effects.[10]

Caution should be used in generalizing this study's

results. The number of study participants was relatively small, and participants were recruited by convenience sampling from a single CR program; whether the LLFDI is a useful outcome measure in patients with CHD in other settings is unknown. The order of LLFDI administration (self-report vs. interview) was not randomized, but it is unlikely that a patient would remember many specific answers from one format to the other, given the high number of items, the duration interval, and the multiple outcome measures used in this study. Last, we did not evaluate the LLFDI's reliability in patients with CHD in this study. Previously reported LLFDI data for older adults have demonstrated high test–retest reliability of the Function component scores (ICCs = 0.91–0.98) and Disability component scores (ICCs = 0.68–0.82).[5]

CONCLUSION

The LLFDI should be considered a viable outcome measure for older patients with CHD because it can be administered via self-report and has good concurrent validity. This population of high-functioning patients can often benefit from physical therapy services, but demonstrating baseline functional limitation and participation restriction, as well as improvement with intervention, is often challenging.

KEY MESSAGES

What Is Already Known on This Topic

The validity of the LLFDI has been examined in community-dwelling healthy older adults but not in disease-specific populations, such as patients with CHD. The LLFDI's test–retest reliability and validity have previously been evaluated in adults older than 60 years. Previous studies have reported that the test–retest reliability of LLFDI Function summary subscale scores was extremely high and test–retest reliability of Disability summary subscale scores was moderate to high. Differences in known functional limitation groups were found for both the Function and Disability components of the LLFDI, supporting the measure's discriminative validity. The concurrent validity of the LLFDI has previously been examined by comparing scores with those of other established self-report instruments and performance-based measurements.

What This Study Adds

We found that the LLFDI has appropriate validity for older patients (>60 y) with CHD and can be completed independently by patients as well as administered by clinicians via interview. All LLFDI components were correlated with the self-report criterion measures. The Function component of the LLFDI was moderately correlated with the 6MWT, TUG, WS, and TSS scores. The LLFDI demonstrated a ceiling effect (10%) only in the Disability component Limitation scale. All LLFDI component scores obtained via self-report questionnaire were correlated with scores obtained via interview; except in a single subcategory, there was no difference between LLFDI scores obtained through self-report questionnaire and those obtained through interview.

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