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ORIGINAL RESEARCH

Use of the Houghton Scale to Classify Community and Household Walking Ability in People With Lower-Limb Amputation: Criterion-Related Validity

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Abstract

Objective: To examine the criterion-related validity of using the self-reported Houghton Scale to classify community-dwelling people with lower-limb amputation according to the suggested score ranges for independent community (Houghton Scale score ≥9), household and limited community (Houghton Scale scores 6–8), and limited household (Houghton Scale score ≤5) walking ability categories as referenced to performance-based balance ability and walking speed criteria.

Design: Cross-sectional cohort study.

Setting: Community-based wellness walking programs in 8 states in the Mid-Atlantic, Midwest, and Southeast regions of the U.S.

Participants: Volunteers (N = 180; 66.5% men, n = 118; mean age, 55.5±16y) 7.1±13.1 years since amputation, with transtibial-level amputation in 47% (n = 79) and amputation caused by vascular disease in 49.4% (n = 89).

Interventions: None.

Main Outcome Measures: Self-reported data: Houghton Scale, Prosthetic Evaluation Questionnaire mobility subscale, and Activities-specific Balance Confidence (ABC) Scale. Clinical performance-based measures: balance ability assessed with 3 Berg Balance Scale (BBS) items and walking ability assessed with the timed Up and Go (TUG) test and 2-minute walk test (2MWT). The primary reference criteria were performance-based balance ability measured with the 3 BBS items and gait speed calculated from the 2MWT.

Results: On the Houghton Scale, 45.9% (78/170) of the participants scored ≥9, 30.6% (52/170) of the participants scored between 6 and 8, and 23.5% (40/170) of the participants scored ≤5. The Houghton Scale correlated with the Prosthetic Evaluation Questionnaire mobility subscale (r = .73), ABC Scale (r = .76), balance ability (r = .67), TUG test (r = −.67), and 2MWT (r = .73). The 3 Houghton Scale ability categories differed significantly from each other (P < .05) for all outcome measures: Prosthetic Evaluation Questionnaire mobility subscale, ABC Scale, balance ability, TUG test, and 2MWT.

Conclusions: The Houghton Scale demonstrated criterion-related validity by differentiating community-dwelling people with lower-limb amputation into community, limited community/household, and household ability categories that corresponded to performance-based balance and walking criteria. Average prosthetic walking speeds for each category compared with similar walking ability categories defined in other patient populations.

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After lower-limb amputation, limited prosthetic walking ability remains a common yet persistent impairment.[1] Compared with people without amputation,[2] walking speed is generally slower regardless of the amputation etiology or level.[3,4] Determining the level of prosthetic use and walking ability in the household and community affects prosthetic prescription and functional walking prognosis.[5]

Two types of walking ability assessments for people with lower-limb amputation have been performance-based timed assessments and self-report measures.[6] A systematic review of measures used to assess outcomes after-lower limb amputation found timed measures of general walking ability were among the highest rated for reliability and validity.[7] Among the most valid

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and reliable self-reported functional measures for people with amputations were the Prosthetic Evaluation Questionnaire and Houghton Scale.[7]

Past studies have documented moderate correlations among the Houghton Scale, Prosthetic Evaluation Questionnaire mobility subscale, and performance-based walking speed, with concurrent validity with convergence between the 2 self-report measures.[8] Ordinal-level data from self-reported prosthetic function measures demonstrate associations with ratio-level timed walking speed data; however, subjective perception of ability and objective performance are not equivalent entities.[8]

The 12-point Houghton Scale was originally suggested for classifying people after initial prosthetic rehabilitation according to walking ability category: scores $\geq$9 corresponded to independent community walking ability, scores from 6 to 8 corresponded to household and limited community walking ability, and scores $\leq$5 suggested limited-household walking ability.[9] Household and community walking ability categories have been criteria referenced for other populations (eg, community-dwelling older adults,[10] people with stroke[11]). Although the Houghton Scale scores in people with lower-limb amputation demonstrate reliability and concurrent validity,[8,12] the validity of the self-reported Houghton Scale community and household walking ability categories referenced to performance-based balance and walking criteria remains unknown.

Our study purpose was to determine for community-dwelling people with lower-limb amputation the criterion-related validity of using Houghton Scale scores to classify individuals into community and household walking ability categories with respect to self-reported prosthetic function and performance-based balance and walking speed criteria.

Methods

This cross-sectional cohort study was conducted in cooperation with a wellness walking program[13] for people with lower-limb loss according to the study protocol approved by the institutional review board of the participating university medical center.

Participants

A volunteer convenience sample was recruited from the wellness walking program which was conducted by the same leaders at 10 outpatient facilities in 8 states within the Mid-Atlantic, Midwest, and Southeast regions of the United States during 2014 and 2015. Study participation was voluntary and not a condition of participation in wellness walking program activities.[13] After providing informed consent, participants were included if they met the following criteria: community-dwelling individuals of any age, sex, and race; with amputations of any number, level, and etiology; and that used lower-limb prostheses to any extent and period of time. Individuals not living in a community setting, not able to participate in the wellness program, and without prostheses were excluded, as were individuals not capable of understanding the study purpose or procedures for any reason including English-language or cognitive deficits.

List of abbreviations:

ABC	**Activities-specific Balance Confidence**
ANOVA	**analysis of variance**
BBS	**Berg Balance Scale**
TUG	**timed Up and Go**
2MWT	**2-minute walk test**

Procedures

Participants completed the research questionnaire that included basic demographic and medical history information, self-reported assessments of prosthetic use (Houghton Scale and Prosthetic Evaluation Questionnaire mobility subscale), and the Activities-specific Balance Confidence (ABC) Scale.

Program participants and physical therapy and prosthetic professionals and paraprofessionals attending the sessions were given detailed verbal and visual instruction by the wellness walking program leaders for each performance-based balance and walking ability measure, including 3 selected Berg Balance Scale (BBS) tasks, the 10-foot timed Up and Go (TUG) test, and the 2-minute walk test (2MWT). The professionals/paraprofessionals recorded each participant's results on standardized data collection sheets.

Outcome measures

The 4-question self-reported Houghton Scale quantifies daily prosthetic use and function in various walking conditions.[9] Total scores range from 0 to 12 without ceiling or floor effects,[12] with higher scores indicating better function.[9] The 12-point Houghton Scale has good to excellent test-retest reliability and moderate concurrent validity and internal consistency with self-reported functional ability scales and performance assessments like the 2MWT.[8,12] Reliability and validity coefficients were interpreted as moderate ($0.5 \leq r < .75$), good ($.75 \leq r < 0.9$), and excellent ($0.9 \leq r$).[14] The Houghton Scale score ranges (Houghton Scale scores $\geq$9, 6–8, and $\leq$5) were suggested to classify walking ability categories.[9]

The 12-question self-reported Prosthetic Evaluation Questionnaire mobility subscale has demonstrated good psychometric characteristics for measuring mobility[15] and excellent reliability.[16] Originally designed with visual analog scales, a 5-level response format used in this study was validated with similar psychometric properties.[15]

The self-reported ABC Scale assesses subjective balance confidence when performing 16 activities that challenge balance during common activities (eg, reaching to a shelf, walking to a curb, negotiating icy sidewalks).[17] The ABC Scale has excellent test-retest reliability and internal consistency and moderate concurrent validity with functional gait measures in people with lower-limb amputation.[18]

Performance-based balance ability was assessed using tasks from the BBS, which has excellent validity[19] and reliability in people with lower-limb amputation.[20] Because the wellness walking program allowed insufficient time to complete the entire BBS, 3 specific tasks ranging from easy to difficult[19] that could identify people who reach the community ambulation level[21] were selected as balance ability measures: stand with eyes closed, look behind over shoulders, and turn 360°.[19]

Performance-based timed walking ability measures included the TUG test and 2MWT. Distances were premeasured with a standard tape measure and timed by professional/paraprofessional wellness walking program attendees. Participants used walking aids in their typical manner. Timed walking assessments have been found easy to administer without complicated equipment or professional expertise.[22]