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PSYCHOMETRIC PROPERTIES OF A SCALE TO ASSESS THE SEVERITY OF BATHING DISABILITY

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Abstract

Objective—To develop and evaluate the psychometric properties of a new bathing disability scale.

Design—Reliability and validity study.

Setting—General community.

Participants—Two subsets of community-living older persons, selected from an ongoing longitudinal study, who had some degree of bathing disability or were at increased risk for bathing disability, as determined during a comprehensive assessment at 36 (N=199) and 54 (N=213) months, respectively.

Interventions—Not applicable.

Main Outcome Measures—The bathing disability scale was administered at 36, 54, and 72 months and changes in scores were assessed between 36 and 54 months and 54 and 72 months, respectively, for the two subsets of participants. Convergent construct validity was evaluated by comparisons with changes in ADL (activities of daily living) disability, mobility disability, and the Short Physical Performance Battery (SPPB). Discriminative construct validity was determined by comparisons according to age and physical frailty. Responsiveness was evaluated by comparisons between participants who had and had not been hospitalized and, subsequently, by plotting correlations according to the timing of these hospitalizations.

Results—The test-retest reliability was high, with an intraclass correlation coefficient=0.76 (95% confidence interval, 0.59–0.94). The internal consistency reliability was excellent with Cronbach's alpha=0.91–0.97. Changes in scores on the bathing disability scale were positively correlated with changes in scores in ADL and mobility disability and inversely correlated with changes in scores on the SPPB. A greater decline in scores was observed among the oldest old and those who were physically frail, but these differences did not consistently achieve statistical significance. The scale was responsive to the occurrence and/or timing of intervening hospitalizations.

Conclusions—The bathing disability scale is reliable, valid, and responsive and may be suitable for use in clinical trials to evaluate the effectiveness of interventions to enhance independent bathing.

Keywords

Frail elderly; Disability evaluation; Reliability and validity

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Bathing—washing and drying one's whole body—is considered an essential activity in most modern societies (1). Nonetheless, the ability to bathe independently is often challenged as persons age (2–4), with incidence rates of bathing disability per 1000 person-months as high as 23.0 for persons aged 70 to 79 years and 43.6 for those aged 80 years or older (4). Over the course of six years, more than half of community-living persons aged 70 years or older will have at least one episode of bathing disability and about a third will have multiple episodes, with the duration of each episode averaging about six months (4).

The occurrence of bathing disability is strongly associated with the risk of a long-term nursing home admission, independent of potential confounders, including the occurrence of disability in other essential activities of daily living, such as dressing and walking (5). Strong associations have also been shown between bathing disability and the receipt of home care services (6) and the subsequent development of disability in other activities of daily living (4). Finally, satisfaction with bathing among older persons is often diminished, as shown by a study of home care patients aged 70 years or older, which found that a large proportion of participants were not bathing as often as they would have liked (7). Taken together, these findings provide strong evidence that bathing-related problems often seriously threaten the quality of life of community-living older persons.

Despite the high incidence of bathing disability and associated morbidity, the evidence-base to help guide the prevention and remediation of bathing disability is relatively scant. One impediment to the design of rigorous intervention trials is the absence of any bathing-specific outcome measures. We have previously shown that disability in bathing usually involves multiple bathing-related subtasks and differs considerably in severity, ranging from difficulty adjusting water controls to complete dependence with transferring to and from the bathing position (8). Informed by this prior work, we set out in the current study to develop and evaluate the psychometric properties of a new bathing disability scale. Such a scale would facilitate the assessment of targeted and clinically sensible intervention strategies to enhance safe and independent bathing among community-living older persons.

METHODS

Study Population

Participants were members of the Precipitating Events Project (PEP), an ongoing longitudinal study of 754 community-living persons, aged 70 years or older, who were initially nondisabled (i.e., required no personal assistance) in four essential activities of daily living (ADL)—bathing, dressing, walking, and rising from a chair (9). Exclusion criteria included significant cognitive impairment with no available proxy (10), inability to speak English, diagnosis of a terminal illness, and a plan to move out of the area during the next 12 months. The assembly of the cohort has been described in detail elsewhere (9,11). The participation rate was 75.2%. Persons who refused to participate did not differ significantly from those who were enrolled in terms of age or sex. PEP participants have completed comprehensive, home-based assessments at 18-month intervals and have been interviewed monthly over the phone with a completion rate of nearly 100% (12). The attrition rate for reasons other than death has been less than 5%. The study protocol was approved by the Human Investigation Committee, and all participants provided verbal informed consent.

A new module on bathing, including a self-reported evaluation of bathing (described below), was added to the comprehensive assessment at 36 months and was also included at 54 and 72 months.

Analytic samples—To be eligible for the first analytic sample, participants had to be living in the community at 36 months and complete the comprehensive assessment at 36 and 54

months. Because our ultimate objective is to test interventions to enhance independent bathing, we also required that participants (at 36 months) either have some degree of bathing disability or be at increased risk for bathing disability. As in prior studies (8,13), participants were considered to have disability in bathing if they required personal assistance to bathe (wash and dry their whole body) or if they had difficulty with bathing. Based on the results of an earlier study (14), participants were considered to be at increased risk for bathing disability if they were unable to rise from a standard chair in a single attempt with their arms folded (15), scored less than 24 on the Folstein Mini-Mental State Examination (MMSE) (16), or had low bathing-self efficacy, as assessed by a single question from the Tinetti functional self-efficacy scale (17)—how confident/sure are you that you can take a bath or shower?

Of the 597 community-living participants who completed the comprehensive assessment at 36 months, 249 had or were at increased risk for bathing disability. Of these, 50 did not complete the comprehensive assessment at 54 months, primarily because of deaths. The remaining 199 participants constituted the first analytical sample. At 36 months, 45 (22.6%) of these participants required personal assistance with bathing, 82 (41.2%) had difficulty with bathing, and 72 (36.2%) were at increased risk for bathing disability.

To evaluate the consistency of our results, we created a second analytic sample using data from the 54- and 72-month assessments. Of the 509 community-living participants who completed the comprehensive assessment at 54 months, 246 had or were at increased risk for bathing disability. Of these, 3 did not complete the comprehensive assessment at 72 months and 30 had died. The remaining 213 participants constituted the second analytical sample. At 54 months, 51 (23.9%) of these participants required personal assistance with bathing, 72 (33.8%) had difficulty with bathing, and 90 (42.3%) were at increased risk for bathing disability. One hundred thirty-four participants were included in both analytic samples.

Data collection

The current study used data from three comprehensive assessments that were completed at 36, 54 and 72 months, respectively, and from monthly telephone interviews that were completed between the 36- and 72-month comprehensive assessments. A team of trained research nurses completed the comprehensive assessments using standard procedures and a coding manual (8,18). The monthly telephone interviews were completed by a separate team of research staff who were kept blinded to the results of the comprehensive assessments.

Comprehensive assessments—In addition to the self-reported evaluation of bathing, data were collected on several measures that were used to evaluate the validity of the new bathing disability scale. For descriptive purposes, participants were also asked about the presence of nine self-reported, physician-diagnosed chronic conditions: hypertension, myocardial infarction, congestive heart failure, stroke, diabetes mellitus, arthritis, hip fracture, chronic lung disease, and cancer.

Development of bathing disability scale: Participants were asked, “At the present time, do you need help from another person to bathe (wash and dry your whole body)?” Those who did not require help were subsequently asked, “At the present time, how much difficulty do you have with bathing (washing and drying your whole body)?” Participants who indicated that they needed help (or had difficulty) with the bathing “task” were asked whether they needed help from another person to complete (or had difficulty completing) eight specific bathing subtasks: obtaining and using supplies, getting undressed, turning on the water and adjusting the temperature, getting into bathing position, washing the whole body, leaving the bathing position, drying the whole body, and getting redressed. These subtasks were adapted from an occupational therapy component of an earlier home-based, rehabilitation protocol that recorded

detailed observations of persons performing the bathing task (19). No additional subtasks were identified through the use of an “other” subtask question, which was added to the bathing assessment at 54 months, thereby supporting the content validity of the scale (20). Participants who needed help with the bathing task but not with a specific subtask were subsequently asked about the degree of difficulty they had completing the subtask.

Responses to each subtask were scored as: 0 (no difficulty at all), 1 (a little difficulty), 2 (some difficulty), 3 (a lot of difficulty), and 4 (help). A bathing disability scale was created by summing the scores of the eight subtasks, yielding a range of possible scores from 0 to 32. Participants who required no help and had no difficulty with the bathing task received a score of 0.

To determine the reliability of the bathing disability scale, a subset of 25 participants who required help with the bathing task were reassessed over the phone within 72 hours by a different interviewer, who was blinded to the results of the initial assessment.

Measures for validity testing: Data were collected on three self-reported and performance-based measures of physical function. The ADL scale included five traditional self-care tasks: dressing, transferring, toileting, eating, and grooming. Bathing was not included since our objective was to validate a new bathing disability scale. Based on prior research (21), each task was scored as “0” for did not need help and did not have difficulty, “1” for difficulty but no help, and “2” for help regardless of difficulty; and a summary ADL disability score was created with a range of 0 (no disability) to 10 (total disability) (22). As described previously (23), the mobility scale included three tasks—walking inside the home, walking ¼ mile, and walking up a flight of stairs—that were scored as “0”, “1”, or “2”, based on the need for help or difficulty, and a fourth item that was also scored as “0”, “1”, or “2”, based on the average amount of time (in hours) walked per day (>0.75, 0.25–0.75, or <0.25); and a summary mobility disability score was created with a range of 0 (no disability) to 8 (total disability).

Physical performance (or capability) was assessed with a modified version of the Short Physical Performance Battery (SPPB) (24) that included the standard balance maneuvers but substituted three timed chair stands (instead of five) and timed rapid gait (back and forth over a 10 foot course) instead of timed usual gait (over a 4-meter course without a turn). Quartile cut-points for these latter two tasks were determined from the first 356 (of 754) enrolled participants, who had been selected randomly from our source population (9). As per convention (24), scores for the balance, chair stands and gait tasks ranged from 0 to 4, with 0 indicating the inability to complete the task and 4 the highest level of performance; and a composite SPPB score (range 0–12) was calculated by adding the three scores. Because slow gait speed is the single best indicator of physical frailty (15,25,26), we also dichotomized the timed gait task using the standard cut-point of greater than 10 seconds (9), allowing us to distinguish participants who were physically frail from those who were not.

Monthly interviews—Data from the monthly interviews were used to evaluate the responsiveness of the bathing disability scale. Each month, participants were asked whether they had stayed at least overnight in a hospital since the last interview. The accuracy of these reports, based on an independent review of hospital records, was high with Kappa = 0.94 (95% confidence interval, 0.87–1.0) (27). We have previously demonstrated that illnesses or injuries leading to hospitalization are potent precipitants of disability in essential activities of daily living (27), including bathing (14).

Statistical Analysis

We calculated the descriptive characteristics of participants in the first and second analytic samples, respectively. We evaluated the distribution of scores on the bathing disability scale

at 36 and 54 months, respectively, and calculated changes in scores between 36 and 54 months (i.e. the first time interval) using data from the first analytic sample. We repeated these analyses for the bathing disability scale at 54 and 72 months (i.e. the second time interval) using data from the second analytic sample. To facilitate clinical interpretation, changes in scores were categorized (and subsequently analyzed) as none (0) versus small (1–2), moderate (3–5) or large (6 or more) decline or improvement, respectively, yielding a 7-point ordinal variable, a strategy that is particularly effective at assessing change (28–30).

The test-retest reliability of the bathing disability scale was assessed using the intraclass correlation coefficient (ICC), with values of 0.81 to 1.0 denoting almost perfect agreement, 0.61 to 0.80 denoting substantial agreement, and 0 to 0.60 denoting slight to moderate agreement (31). Using data from each of the two analytic samples, we evaluated four additional psychometric properties of the bathing disability scale: internal consistency reliability, convergent construct validity, discriminative construct validity, and responsiveness (32). Internal consistency reliability was assessed using Cronbach's Alpha (33), with values greater than 0.80 denoting excellent reliability (34). Factor analysis was conducted to determine whether a single factor solution confirmed the internal consistency results.

As recommended by Guyatt et al. (35), we tested a series of prespecified hypotheses to assess the convergent and discriminative construct validity of the bathing disability scale. For convergent validity, we hypothesized that changes in scores on the bathing disability scale would be positively correlated with changes in scores on the two disability scales (ADL and mobility) and inversely correlated with changes in scores on the measure of physical capability (SPPB). Because the scales did not yield normal distributions and included many tied values, we used Kendall's Tau-b correlation coefficient for ordinal data. For discriminative validity, we hypothesized that participants who were physically frail or aged 85 years or older, respectively, would experience a greater decline in scores on the bathing disability scale than participants who were not physically frail or who were younger than 85 years. To account for the non-normal distribution of the data, these hypotheses were tested using the nonparametric Wilcoxon Rank Sum Test.

To assess responsiveness, we first compared changes in scores on the bathing disability scale between participants who had and had not been hospitalized during the first and second time intervals, respectively. Because the likelihood of recovery following a precipitating event increases as the time after the event increases (11), we also completed a more specific analysis that accounted for the time between the hospitalization and follow-up assessment (at 54 and 72 months, respectively). For each month prior to the follow-up assessment, we calculated the correlation between the change in bathing disability score and the occurrence (yes/no) of an intervening hospitalization, defined as a hospital admission that occurred between the specific month and follow-up assessment. The reference group for these calculations included participants who had not been hospitalized during the relevant 18-month time interval. We hypothesized that the correlations, assessed using Kendall Tau-b, would decrease as the time between the hospitalization and follow-up assessment increased. To test this hypothesis, we plotted the correlation coefficients according to the time prior to the follow-up assessment for each of the two 18-month intervals, fit regression lines to the plotted points, and evaluated whether the slopes of the two lines were different from zero. The results of the responsiveness analyses did not differ substantively when changes in scores on the bathing disability scale were not categorized.

All analyses were performed using SAS version 9.1 (SAS Institute, Cary, NC). All statistical tests were two-tailed, and a P-value < .05 was considered statistically significant.

RESULTS

The characteristics of participants in the two analytic samples are shown in Table 1. As expected, participants in the second sample were a bit older than those in the first. With the exception of living situation, which differed only modestly between the two samples, there were no substantive differences in the other characteristics, including the number of chronic conditions, cognitive status, disability, physical performance, and physical frailty.

Figure 1 provides two sets of box plots showing the distribution of scores on the bathing disability scale at 36 and 54 months for the first analytic sample and at 54 and 72 months for the second analytic sample. Scores were skewed, as reflected by the differences between the median and mean values. Although the scores at follow-up were generally greater than the initial scores, a large minority of participants in each analytic sample scored 0 at both time-points. The test-retest reliability of the bathing disability scale was high, with an ICC of 0.76 (95% confidence interval, 0.59–0.94). The internal consistency reliability was excellent with values for Cronbach's alpha ranging from 0.91 (at 36 months for first analytic sample) to 0.97 (at 72 months for second analytic sample). Factor analysis yielded only a single factor with an eigenvalue greater than one (36).

Changes in scores on the bathing disability scale over 18 months are shown in Figure 2. About a third of participants in each sample had no change in scores. Improvements in scores were observed more commonly in the first sample (31.2%) than the second sample (16.0%), while large declines were observed more commonly in the second sample (32.9%) than the first (15.6%).

Table 2 provides results for convergent construct validity. As hypothesized, changes in scores on the bathing disability scale were positively correlated with changes in scores in ADL disability and mobility disability and inversely correlated with changes in scores on the SPPB for each of the two analytic samples.

As shown in Table 3, evidence for discriminative construct validity was mixed. As hypothesized, participants who were physically frail or aged 85 years or older, respectively, experienced a greater decline in scores on the bathing disability scale than participants who were not physically frail or who were younger than 85 years, but these differences were not statistically significant in the first analytic sample and were only marginally significant for age in the second analytic sample.

Of the participants in the first and second analytic samples, respectively, 41.7% and 49.3% were hospitalized during the relevant 18-month time intervals. While participants who were hospitalized had a greater decline in bathing disability scores than those who were not hospitalized, this difference was statistically significant only for the second sample (Table 3). As shown in Figure 3, the correlation between the change in bathing disability scores and the occurrence of an intervening hospitalization decreased significantly as the time prior to the follow-up assessment increased for each of the two samples, although the decline was more pronounced for the first sample. The correlations for the second sample were all within a relatively narrow range of 0.24 to 0.33, and these values were all higher than those for the first sample.

DISCUSSION

In the current study, we provide evidence to support the reliability, validity, and responsiveness of a new scale to assess the presence and severity of bathing disability. Although additional research is warranted to confirm the validity and establish the clinical utility of the bathing

disability scale, our initial results suggest that it may be suitable for use in clinical trials to evaluate the effectiveness of interventions to enhance independent bathing.

Interventions directed at the prevention and remediation of bathing disability are warranted for at least three reasons. First, disability in bathing is a powerful determinant of morbidity and mortality (5,37–39). Second, bathing disability is the number one reason why older persons require home aide services (6). Third, the financial and nonfinancial costs attributable to bathing disability are substantial (6,40–43). Were interventions developed to enhance independent bathing, they could not be rigorously evaluated in the absence of bathing-specific outcome measures.

Because the bathing disability scale includes all subtasks that were previously identified during detailed observations of persons performing the bathing task (19), it has strong content validity (20). The results of the current study indicate that the test-retest reliability of the scale is high and the internal reliability is excellent, with factor analysis demonstrating the presence of only a single factor.

The confirmation of hypothesized relationships with three distinct functional measures provides strong evidence to support the convergent construct validity of the bathing disability scale (35). Evidence supporting its discriminative construct validity, however, was not as strong. Although a greater decline in scores was observed, as hypothesized, among the oldest old and those who were physically frail, these differences did not consistently achieve statistical significance.

The bathing disability scale was responsive to the occurrence and/or timing of intervening hospitalizations. Based on the results of our prior research (11,27), we had hypothesized that scores on the scale would decline more in the setting of a serious illness or injury, as reflected by an acute hospital admission, than in the absence of such an intervening event, and that this decline would be greater if it was observed more proximately to the event. These hypotheses were confirmed in two different analytic samples, although statistical significance was not achieved for the former hypothesis in the first analytic sample.

Study Limitations

Changes in scores on the bathing disability scale were assessed over 18 months, a time interval that may not be optimal since the effectiveness of interventions to promote independent bathing would likely be assessed over shorter periods of time. Because such interventions will need to be suitably targeted, inclusion in our study was restricted to persons who had some degree of bathing disability or were at increased risk for bathing disability. As a result, a high proportion of our participants were physically frail and had low scores on the SPPB. The psychometric properties of the bathing disability scale would likely be diminished in populations that are more physically robust. Despite the selection of a vulnerable population, the distribution of scores on the bathing disability scale was skewed towards lower values, a phenomenon that has been observed with other disability scales (44–46). Changes in scores, however, were more normally distributed, as shown in Figure 2. Our study was not designed to determine whether these changes are clinically meaningful. Before the bathing disability scale is used as an outcome measure, the minimum clinically important change will need to be established (28, 29). Finally, while the consistency of our results across two analytic samples represents an important strength, these samples were not entirely independent.

CONCLUSIONS

The bathing disability scale is reliable, valid, and responsive, and shows promise as a possible outcome measure for use in clinical trials designed to evaluate the effectiveness of interventions

to enhance independent bathing. Additional research is needed to confirm the validity of the scale and to establish the minimum clinically important change in scores.

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Figure 1.

Box plots showing the distribution of scores on the bathing disability scale at 36 and 54 months for the first analytic sample and at 54 and 72 months for the second analytic sample. The lower border, midline, and upper border of each box represent the 25th percentile, median, and 75th percentile scores, respectively. The line from each box extends to the highest score. The "+" denotes the mean score.

Figure 2.

Changes in scores on the bathing disability scale between 36 and 54 months for the first analytic sample and between 54 and 72 months for the second analytic sample. Changes were categorized as none (0 points) versus small (1–2), moderate (3–5) or large (6 or more) decline or improvement, respectively.

Figure 3.

Associations between changes in scores on bathing disability scale and the occurrence of an intervening hospitalization according to the time prior to the follow-up assessment at 54 and 72 months, respectively, for the first and second analytic samples. An intervening hospitalization was defined as a hospital admission that occurred between the specific month and follow-up assessment. Because the 72-month follow-up assessment was delayed for some participants, data points are included at 19 and 20 months for Sample 2.

Table 1

Characteristics of Participants in the two Analytic Samples *

Characteristic [†]	First Analytic Sample (n=199)	Second Analytic Sample (n=213)
Age in years	81.8 ± 5	83.1 ± 5
Female	143 (71.9)	145 (68.1)
Non-Hispanic white	171 (85.9)	185 (86.9)
Lives alone	96 (48.2)	117 (54.9)
Education in years	11.4 ± 3.0	11.5 ± 2.9
Chronic conditions	2.2 ± 1.3	2.2 ± 1.2
Mini-Mental State Exam score	25.7 ± 3.0	24.9 ± 3.7
ADL disability score	1.4 ± 1.7	1.2 ± 1.6
Mobility disability score	3.9 ± 1.9	3.8 ± 1.8
SPPB [‡] score	5.2 ± 2.5	4.7 ± 2.2
Physically frail	105 (53.0)	112 (53.0)

* As described in the Methods, the first analytic sample was assembled at 36 months, while the second analytic sample was assembled at 54 months. 134 participants were included in both analytic samples.

[†] Data are given as mean ± standard deviation or number (percentage) of participants.

[‡] Short Physical Performance Battery.

Table 2

Associations between Changes in Scores on Bathing Disability Scale and Changes in Scores on Other Functional Measures*

Functional Measure	First Analytic Sample		Second Analytic Sample	
	Correlation	P-value	Correlation	P-value
ADL disability	0.17	.002	0.40	<.001
Mobility disability	0.18	.001	0.25	<.001
SPPB [†]	−0.17	.003	−0.22	<.001

* As described in the Methods, changes in scores on the bathing disability scale were analyzed using a 7-point ordinal variable, and correlations were assessed using Kendall's Tau-b.

[†] Short Physical Performance Battery.

Table 3

Changes in Scores on Bathing Disability Scale According to Age, Physical Frailty, and Hospitalization*

	First Analytic Sample		Second Analytic Sample	
	Mean Change	P-value	Mean Change	P-value
Age (years)				
≥ 85	0.48	.20	1.28	.05
< 85	0.10		0.78	
Physical frailty				
Present	0.30	.40	1.22	<.001
Absent	0.06		0.32	
Hospitalization [†]				
Yes	0.39	.25	1.49	<.001
No	0.09		0.47	

* As described in the Methods, changes in scores on the bathing disability scale were analyzed using a 7-point ordinal variable; all changes in scores represent a decline over the relevant follow-up period (or time interval), which was 36 to 54 months for the first analytic sample and 54 to 72 months for the second analytic sample.

[†] Defined as a hospital admission occurring between the 36- and 54-month assessments for the first analytic sample and between the 54- and 72-month assessments for the second analytic sample.