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Bathing Disability and the Risk of Long-Term Admission to a Nursing Home

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Background. The prevalence of disability in bathing and the likelihood of a long-term nursing home admission increase substantially with age. We performed a prospective study to determine whether the occurrence of persistent disability in bathing is associated with the risk of a long-term nursing home admission, independent of potential confounders, including persistent disability in other essential activities of daily living.

Methods. We studied 754 community-living persons, 70 years old or older, who were nondisabled in four essential activities of daily living. Participants were followed with monthly telephone interviews for a median of 75 months to determine the occurrence of persistent (i.e., present for at least 2 consecutive months) disability in bathing and the time to the first long-term nursing home admission, defined as longer than 3 months.

Results. One hundred thirteen (15.0%) participants had a long-term nursing home admission. At least one episode of persistent bathing disability occurred among 59 (52.2%) participants with a long-term nursing home admission and 210 (32.8%) without a long-term admission ($p < .001$). In a proportional hazards model that was fully adjusted for potential confounders, the occurrence of persistent bathing disabilty increased the risk of a long-term nursing home admission by 77% (hazard ratio 1.77, 95% confidence interval 1.05 to 2.98), but had no effect on the risk of a short-term nursing home admission (hazard ratio 0.87, 95% confidence interval 0.51 to 1.49).

Conclusions. Among community-living older persons, the occurrence of persistent disability in bathing is independently associated with the risk of a long-term nursing home admission, but has no effect on short-term admissions. Interventions directed at the prevention and remediation of bathing disability have the potential to reduce the burden and expense of long-term care services.

BATHING is considered an essential activity in most modern societies (1). In an earlier cross-sectional study (2), we demonstrated that disability in bathing among older persons is common, involves multiple subtasks, and is attributable to an array of physical and psychological problems. Relatively little is known, however, about the adverse consequences of bathing disability. Prior studies have not attempted to distinquish the deleterious effects of bathing disability from those of disability in other activities of daily living (3,4) or have not adequately accounted for other factors that could confound the relationship between bathing disability and subsequent adverse outcomes (5,6). Successfully isolating the harmful consequences of bathing disability would strengthen the justification for interventions to promote safe and independent bathing among older persons. In the current study, we set out to determine whether the occurrence of persistent disability in bathing is associated with the risk of a long-term nursing home admission, independent of potential confounders, including persistent disability in other essential activities of daily living.

Methods

Study Population

Participants were members of the Precipitating Events Project, a longitudinal study of 754 community-living persons, 70 years old or older, who were nondisabled (i.e., required no personal assistance) at baseline in four essential activities of daily living—bathing, dressing, walking inside the house, and transferring from a chair (7). Exclusion criteria included significant cognitive impairment with no available proxy (8), inability to speak English, diagnosis of a terminal illness with a life expectancy less than 12 months, and a plan to move out of the area during the next 12 months.

The assembly of the cohort, which took place between March 1998 and October 1999, has been described in detail elsewhere (7). In brief, potential participants were identified from a computerized list of 3157 age-eligible members of a large health plan in greater New Haven, Connecticut. Eligibility was determined during a screening telephone interview and was confirmed during an in-home assessment. Persons who were physically frail, as denoted by a timed score of greater than 10 seconds on the rapid gait test (i.e., walk back and forth over a 10 ft [3 m] course as quickly as possible), were oversampled to ensure a sufficient number of participants at increased risk for disability (9). Only 4.6% of the 2753 health plan members who were alive and could be contacted refused to complete the screening telephone interview, and 75.2% of the eligible members agreed to participate in the project. Persons who refused to participate did not differ significantly in terms of age or sex from those who were enrolled. The study protocol was approved by the Yale Human Investigation Committee, and all participants provided verbal informed consent.

Data Collection

Comprehensive home-based assessments were completed by trained nurse researchers at baseline, 18, 36, and 54

months, whereas telephone assessments were completed monthly for a median of 75 months by a separate team of interviewers. All research staff were kept unaware of the study aims and hypotheses. Deaths were ascertained by review of the local obituaries and/or from an informant during a subsequent telephone interview; 232 (30.8%) participants died after a median follow-up of 44.5 months, and 32 (4.2%) dropped out of the study after a median follow-up of 23.0 months. Data were otherwise available for 98.6% of the 48,711 monthly telephone interviews.

Assessment of disability.—Complete details regarding the assessment of disability, including formal tests of reliability and accuracy, are provided elsewhere (8). During the monthly telephone interviews, participants were assessed for disability using standard questions that were identical to those used during the screening telephone interview (8). For each of the four essential activities of daily living, we asked, ''At the present time, do you need help from another person to (complete the task)?'' Participants who needed help were considered to be disabled in the relevant task. Among a subgroup of 91 participants who were interviewed twice within a 2-day period by different interviewers, we found that the reliability of our disability assessment was substantial (10), with Kappa = 0.73 for disability in bathing and 0.71 for disability in one or more of the other three activities of daily living, hereafter referred to simply as nonbathing disability. To address the small amount of missing data on disability, we used multiple imputation with 50 random draws per missing observation according to the method described by Allison (11).

Assessment of covariates.—During the comprehensive assessments, data were collected on a large array of covariates, which were subsequently grouped into four categories. The demographic factors included age, sex, race, education, and living situation (i.e., alone vs with others). The health-related factors included nine self-reported, physician-diagnosed chronic conditions; number of prescription medications; body mass index (BMI) based on self-reported height and weight; corrected near vision, assessed with a Jaeger card and calculated as the percentage of visual impairment (12); and hearing, as assessed with a handheld audioscope (13). The cognitive–psychosocial factors included cognitive status, as assessed by the Folstein Mini-Mental State Examination (MMSE) (14); depressive symptoms, as assessed by the Center for Epidemiologic Studies Depression (CES-D) Scale (15); functional self-efficacy, as assessed by the Tinetti Scale (16); and social support, as assessed by a modified version of the Medical Outcomes Study (MOS) Social Support Survey (17,18). Finally, the physical-functional factors included grip strength, as assessed by the average of three readings using a Jamar Hydraulic handheld dynamometer (Sammons Preston Rolyan, Bolingbrook, IL); and physical frailty, as previously defined. For all covariates, the amount of missing data was less than 1% in the baseline assessment and less than 5% in all subsequent assessments.

Assessment of outcome.—Information on nursing home admissions was obtained during the monthly telephone interviews. Among a sample of 56 hospitalized participants, the reliability of this information, as compared with review of medical records, was almost perfect, with Kappa = 0.96. The primary outcome was time to the first long-term nursing home admission. Participants who were residents of a nursing home for four consecutive monthly interviews, corresponding to a minimal length of stay of 91 days, were classified as having a long-term admission. This choice corresponds to the criteria used previously by Tinetti and Williams (19). Admissions for short-term restorative or rehabilitative care after surgery or medical illnesses were excluded based on our underlying premise that persistent disability in bathing will lead to increased use of long-term care rather than subacute care. To explicitly test this premise, we evaluated short-term nursing home admissions (i.e., 3 months or less) as an outcome in a secondary set of analyses.

Statistical Analysis

The primary statistical method was proportional hazards analysis using time-dependent covariates (20). Data on participants without a long-term nursing home admission were censored at the time of death or the last completed interview prior to May 31, 2005.

The primary exposure was the occurrence of persistent (i.e., present for at least 2 consecutive months) disability in bathing, as assessed during the monthly telephone interviews. We chose to include episodes of persistent bathing disability as the primary exposure because they are more likely than are transient episodes (i.e., present for only a single month) to represent clinically meaningful changes in functional status (8).

To create a parsimonious model, we selected covariates according to a hierarchical screening process (21). First, we evaluated the bivariate association between each covariate at baseline and long-term nursing home admission (as a dichotomous outcome) using the chi-square test for categorical variables and t test for continuous variables. With the exception of age, sex, and race, which were retained for the final models, only covariates with a p value less than or equal to .30 were considered further. Next, we sequentially evaluated the correlations among the remaining covariates, first within each of the four previously described categories and then overall. When the Spearman's correlation coefficient was greater than 0.3, denoting potential collinearity, we chose a single covariate based on clinical judgment and the strength of association with the primary outcome. We then sequentially evaluated the impact of each of the remaining nine covariates on the overall model fit through a series of Cox proportional hazards models, which included persistent bathing disability, age, sex, and race. These covariates were updated, as indicated, using data from the subsequent comprehensive assessments. To assess each covariate's contribution to the model fit, we used a chi-square distribution with degrees of freedom equaling the number of parameters for the added covariate, based on the difference in the −2 Log Likelihood statistic (−2LL) between the models with and without the covariate. After fitting a separate model for each covariate, we added the covariate with the highest −2LL to the overall model. We continued this process iteratively until no covariate significantly increased the model fit based on the −2LL criterion. For the final model, we evaluated potential nonlinear effects of the

selected continuous covariates, first by adding a quadratic term and then by categorizing these covariates using clinical cut points, and we assessed potential interactions between bathing disability and age, sex, and race, respectively. Finally, to account for other potential confounders, we reran our final model twice after sequentially adding two time-varying covariates—persistent nonbathing disability and acute hospitalization in the month prior to the nursing home admission (22), as ascertained from the monthly telephone interviews. The accuracy of these latter reports, based on an independent review of hospital records among a subgroup of 94 participants, was high, with Kappa = 0.94.

All statistical tests were two-tailed, and $p < .05$ was considered to indicate statistical significance. All analyses were performed using SAS (version 9.1; SAS Institute, Cary, NC).

Results

Of the 754 study participants, 319 (42.4%) had at least one nursing home admission after a median follow-up of 32 months. For 206 participants, the duration of the admission was 3 months or less. Hence, 113 (15.0%) participants had a nursing home admission that met our criterion for long-term care. The median duration of these admissions was 11 months (range, 4–63 months). Of the participants with a long-term admission, 32 (28.3%) were subsequently discharged to the community, while 48 (42.5%) died in the nursing home, hospice, or hospital.

As shown in Table 1, several characteristics were significantly associated ($p < .05$) with a long-term nursing home admission in bivariate analyses. Hearing impairment did not meet the bivariate p value criterion ($\leq .30$) and was not considered further. Number of prescription medications, functional self-efficacy, and grip strength were highly correlated ($p \geq .30$) with one or more of the other covariates and, hence, were also excluded from the multivariable analyses. At least one episode of persistent bathing disability occurred among 59 (52.2%) participants with a long-term nursing home admission and among 210 (32.8%) participants without a long-term admission ($p < .001$). The corresponding results for persistent nonbathing disability were 46 (40.7%) and 190 (29.6%), respectively ($p = .019$). Additional information on exposure to persistent bathing and nonbathing disability is provided in Table 2.

Table 3 provides the results of the series of proportional hazards models. In the unadjusted models, the occurrence of persistent bathing disability was significantly associated with an elevated risk for both long-term and short-term nursing home admissions, with hazard ratios of 5.23 and 1.92, respectively. For long-term admissions, sequential adjustment for the covariates lowered the hazard ratios associated with persistent bathing disability, but the associations remained statistically significant. In the fully adjusted model, the occurrence of persistent bathing disability increased the risk of a long-term nursing home admission by 77% (hazard ratio 1.77, 95% confidence interval 1.05 to 2.98). These results did not change when hearing impairment, the only factor that did not meet the bivariate p value criterion, was added to the fully adjusted model. There was no association between persistent bathing disability and short-term nursing home admissions in the adjusted models.

Table 1. Baseline Characteristics of 754 Participants With and Without a Long-Term Nursing Home Admission

Characteristic	Long-Term Nursing Home Admission: Yes ($N = 113$)	Long-Term Nursing Home Admission: No ($N = 641$)	p Value*
Demographic			
Age (y), mean ± *SD*	80.8 ± 5.2	78.0 ± 5.1	<.001
Female, %	75.2	62.7	.01
Non-Hispanic white, %	93.8	89.9	.19
Lives alone, %	41.6	63.8	<.001
Education (y), mean ± *SD*	11.4 ± 2.8	12.1 ± 2.9	.04
Health-related			
Chronic conditions, mean ± *SD*†	1.9 ± 1.4	1.6 ± 1.1	.03
Prescription medications, mean ± *SD*	4.3 ± 2.7	3.9 ± 2.3	.19
Body-mass index (kg/m^2), mean ± *SD*‡	26.1 ± 5.0	27.0 ± 5.2	.09
Visual impairment, %			
None or mild (<6%)	58.4	69.7	.06
Moderate (6%–25%)	19.5	13.4	
Severe (>25%)	22.1	16.9	
Hearing impairment, %§			
None or mild	38.1	42.9	.38
Moderate	35.4	36.2	
Severe	26.6	20.9	
Cognitive–Psychosocial			
Score on Folstein MMSE < 24, %‖	21.2	9.7	<.001
Score on CES-D ≥ 16, %¶	36.3	19.3	.03
Functional self-efficacy, mean ± *SD*#	26.4 ± 8.1	30.9 ± 7.4	<.001
Social support, mean ± *SD***	20.5 ± 6.4	22.7 ± 5.2	<.001
Physical–Functional			
Grip strength (kg), mean ± *SD*	19.0 ± 7.1	22.8 ± 8.7	<.001
Physical frailty, %††	59.3	39.8	<.001

Notes: *The t test was used to evaluate differences in means, whereas the chi-square or Fisher Exact test was used to evaluate differences in percentages.

†From among nine: hypertension, myocardial infarction, congestive heart failure, stroke, diabetes mellitus, arthritis, hip fracture, chronic lung disease, and cancer.

‡Body mass index was initially evaluated as a continuous variable, but was found to have a nonlinear effect on the primary outcome in multivariable analysis. Hence, it was subsequently categorized into three groups based on published cut points (23) and its relationship with the primary outcome, as underweight or normal (< 25 kg/m^2), overweight (25–29.9 kg/m^2), or obese (≥ 30 kg/m^2).

§Based on 1000 and 2000 Hz measurements for the left and right ears, a 0–4 additive score was created, with 0–1, 2–3, and 4 tones missed (of 4) denoting none or mild, moderate, and severe impairment, respectively.

‖Possible scores on the Folstein MMSE range from 0 to 30, with scores < 24 denoting cognitive impairment (14).

¶Possible scores on the CES-D Scale range from 0 to 60, with scores ≥ 16 denoting depressive symptoms (15).

#Possible scores range from 0 to 40, with higher scores denoting greater self-efficacy (16).

**Possible scores range from 0 to 28, with higher scores denoting greater social support (17,18).

††Physical frailty was defined in the basis of slow gait speed, as denoted by timed score > 10 seconds on the rapid gait test, i.e., walk back and forth over a 10-ft (3-m) course as quickly as possible (9,22).

SD = standard deviation; MMSE = Mini-Mental State Examination; CES-D = Center for Epidemiologic Studies Depression.

Table 2. Number of Person-Months with Persistent Bathing Disability and Persistent Nonbathing Disability Per 1000 Person-Months Among Participants With and Without a Long-Term Nursing Home Admission

	Long-Term Nursing Home Admission						
	Yes ($N = 113$)			No ($N = 641$)			
	Mean	Median	Intraquartile Range	Mean	Median	Intraquartile Range	p Value
Persistent bathing disability	167	44	0–254	79	0	0–60	<.001
Persistent nonbathing disability	108	0	0–151	62	0	0–53	<.005

Note: The exposure period includes the time to long-term nursing home admission or to a censoring event for participants without a long-term nursing home admission. Values of p were calculated using the Wilcoxon rank test.

Discussion

In this prospective cohort study of community-living older persons, we found that the occurrence of persistent bathing disability is strongly associated with the risk of a long-term nursing home admission. This relationship persisted despite adjustment for several potential confounders, including the occurrence of persistent disability in other essential activities of daily living, and was not observed for short-term nursing home admissions.

From this observational study, we cannot establish a direct cause-and-effect relationship between persistent bathing disability and long-term nursing home admissions. Our methods and analyses were designed, however, to assess the evidence of an association in an unbiased manner. First, both bathing disability and nursing home admissions were ascertained prospectively by research staff who were unaware of the study aims and hypotheses. Second, the frequency of our assessments ensured that the occurrence of bathing disability preceded admission to the nursing home. Third, in our multivariable analysis we adjusted for a large number of demographic, health-related, cognitive, psychosocial, physical, and functional factors, including physical frailty, persistent disability in other activities of daily living, and acute hospitalization in the month prior to nursing home admission. Nonetheless, it is possible that additional unmeasured factors may have confounded the relationship between persistent bathing disability and long-term nursing home admissions. This possibility is diminished by our finding that persistent bathing disability was not independently associated with the risk of a short-term nursing home admission.

Our results are consistent with those of other investigators who have found, respectively, that needing personal assistance with bathing increased the odds of being admitted to a nursing home or receiving paid, long-term home services nearly 5-fold over a 1-year period (5) and that bathing was the most important activity of daily living in predicting paid and unpaid hours of personal assistance (6). While providing evidence to support the deleterious effects of bathing disability, these prior studies accounted for only a limited array of factors that confer high risk for adverse outcomes among older persons. We conducted the current study because it was uncertain whether bathing disability is an independent risk factor for long-term nursing home admissions.

Our study was not designed to establish the mechanisms by which bathing disability leads to long-term nursing home admissions. Two possible bathing-related pathways include: (i) inadequate availability of personal assistance in the home and (ii) safety concerns. As noted earlier, relative to other activities of daily living, bathing requires the highest number of paid and unpaid hours of care (6). From a safety perspective, a disproportionate number of injurious falls occur in the bathroom (24,25). Moreover, in an earlier clinical trial (26), we found that many frail older persons were fearful of falling while bathing. Rates as high as 30% have been reported in other studies of community-living

Table 3. Hazard Ratios for Admission to a Nursing Home Associated with Persistent Bathing Disability

Model No.	Covariates*,†	Long-Term Nursing Home Admission	Short-Term Nursing Home Admission
		Hazard Ratio (95% Confidence Interval)	
1	Persistent bathing disability only	5.23 (3.47–7.88)	1.92 (1.25–2.95)
2	Persistent bathing disability, age, sex, and race	3.76 (2.46–5.75)	1.59 (1.02–2.47)
3	Persistent bathing disability, age, sex, race, physical frailty, cognitive impairment, body mass index, and chronic conditions	1.92 (1.25–2.96)	1.08 (0.69–1.70)
4	Persistent bathing disability, age, sex, race, physical frailty, cognitive impairment, body mass index, chronic conditions, and persistent nonbathing disability	1.90 (1.13–3.18)	0.99 (0.59–1.66)
5	Persistent bathing disability, age, sex, race, physical frailty, cognitive impairment, body mass index, chronic conditions, persistent nonbathing disability, and acute hospitalization in month prior to nursing home admission	1.77 (1.05–2.98)	0.87 (0.51–1.49)

Notes: *The continuous factors include age (in 5-y increments) and the number of chronic conditions. The dichotomous factors include persistent bathing disability; sex; race (Non-Hispanic white, as compared with other); physical frailty, defined as timed score > 10 seconds on the rapid gait test; cognitive impairment, defined as score < 24 on the Folstein Mini-Mental State Examination; persistent nonbathing disability; and acute hospitalization in the month prior to nursing home admission. Body mass index was classified as overweight (25–29.9 kg/m^2) or obese (≥ 30 kg/m^2), respectively, as compared with underweight or normal (< 25 kg/m^2).

†Covariates are listed in the order that they entered the models, as described in the statistical methods. Lives alone, education (y), visual impairment (none or mild, moderate, or severe), depressive symptoms (score ≥ 16 on Center for Epidemiologic Studies Depression [CES-D] Scale), and social support, as assessed by the Medical Outcomes Study (MOS) Social Support Survey, were evaluated in the multivariable analyses but did not meet criteria for inclusion in the final models.

older persons (25). In addition, about one in seven older persons who experience difficulty getting out of their bathtub have been stuck in the tub on at least one occasion (27). These bathing-related problems adversely affect the quality of life of community-living older persons and may inform the decision-making process regarding the need for long-term nursing home admissions.

Whether our findings can be generalized widely may be reasonably questioned. As previously noted (22), the demographic characteristics of our source population closely mirror those of persons 70 years old or older in New Haven County, which, in turn, are comparable to those in the United States as a whole. The high participation rate, completeness of data collection, and low rate of attrition for reasons other than death all enhance the generalizability of our findings (28), and at least partially offset the absence of a population-based sample.

The prevalence of bathing disability increases substantially with age, such that 21% of community-living persons 85 years old or older require personal assistance for bathing (29). The results of the current study, coupled with earlier findings (5,6,30), indicate that disability in bathing likely contributes to costly long-term care services. Interventions directed at the prevention and remediation of bathing disability, therefore, have the potential to reduce the burden and expense of long-term care services. Identifying potentially modifiable risk factors for bathing disability, including the absence or nonuse of adaptive equipment, should be a high research priority.

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