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BATH AIDS AND THE SUBSEQUENT DEVELOPMENT OF BATHING DISABILITY AMONG COMMUNITY-LIVING OLDER PERSONS

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Abstract

Objective—To determine whether the availability of bath aids may forestall the subsequent development of bathing disability.

Design, Setting and Participants—Prospective cohort study of 501 community-living residents of greater New Haven, Connecticut, who were 73 years or older and nondisabled, i.e., required no personal assistance, in bathing.

Measurements—The availability of five bath aids (grab bars, bath seat, nonskid mat or abrasive strips, handheld shower spray, and long handle brush or sponge) was ascertained during a comprehensive home-based assessment. Subsequently, participants were followed with monthly telephone interviews to determine the onset of persistent (i.e., present for at least two consecutive months) disability in bathing and were evaluated for disability in three bathing subtasks (bathing transfers, washing whole body, and drying whole body) during the next home-based assessment, which was completed 18 months after the initial assessment.

Results—The presence of a bath seat was associated with an increased likelihood of developing persistent disability in bathing and disability in each of the three bathing subtasks, although these associations were not statistically significant after adjustment for potential confounders. Nonsignificant elevations in risk were also observed for grab bars, handheld shower spray, and long handle brush or sponge. In the adjusted analysis, the presence of nonskid mats or abrasive strips was associated with a nonsignificant, 23% reduction in the risk of persistent bathing disability and a reduced likelihood of developing disability in washing and drying one's whole body, with corresponding odds ratios of 0.28 (P = 0.003) and 0.38 (P = 0.030), respectively.

Conclusions—In this longitudinal study, the presence of bath aids, with the exception of nonskid mats or abrasive strips, did not forestall the subsequent development of bathing disability. Because

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Study concept and design: Gill.
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it may not be possible to fully account for the effects of self selection, clinical trials may be necessary to demonstrate the potential value of bath aids among community-living older persons.

Keywords

bathing disability; environmental assessment; epidemiology; risk factors; cohort study

INTRODUCTION

Among community-living older persons, the inability to bathe without personal assistance is common and highly morbid. Over the course of six years, more than half of nondisabled older persons 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 (1). Disability in bathing is a primary indication for home aide services (2), often serves as a gateway to disability in other activities of daily living (1), and is strongly associated with the risk of a long-term nursing home admission, independent of potential confounders, including disability in other essential activities of daily living (3).

Bathing typically involves multiple subtasks, with the most common being getting into and out of bathing position and washing and drying one's whole body (4). As a complex task, bathing is inexorably linked to the home environment. Bathing may take place in a shower or tub or at a sink or bedside, and may be facilitated through the use of numerous aids or assistive devices, including (among others) grab bars, shower seats, tub stools or bath chairs, hand-held shower sprays, long-handle brushes or sponges, and nonskid mats or abrasive strips. Nevertheless, several studies have reported that bath aids in general and grab bars in particular are underutilized among community-living older persons, including those with the greatest apparent need (5–12).

Whether bath aids are beneficial, however, is not known. Cross-sectional studies have suggested that bath aids may lead to reductions in self-reported difficulty in bathing (13) and the hours of required personal assistance for bathing (14). Evidence is lacking, however, from longitudinal studies. Hence, we set out to determine whether the availability of bath aids may forestall the subsequent development of bathing disability. We used data from a unique longitudinal study that includes monthly assessments of bathing disability on a large cohort of community-living older persons, along with detailed information about bathing subtasks and the availability of bath aids.

METHODS

Source population

Participants were members of the Precipitating Events Project (PEP), a 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—bathing, dressing, walking, and rising from a chair (15). Exclusion criteria included significant cognitive impairment with no available proxy (16), 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 (15,17). 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. Less than 5% (126 of 2753) of the health plan members who were alive and could be contacted refused to complete the screening telephone interview, and 75.2% (754 of 1002) of the eligible members agreed to

participate in the project. 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 assessments at 18-month intervals and have been interviewed monthly over the phone for the ascertainment of disability, with a completion rate of nearly 100% (18). The study protocol was approved by the Human Investigation Committee, and all participants provided verbal informed consent.

A new module on bathing was added to the third comprehensive assessment, which was completed in participants' homes three years (or 36 months) after enrollment, from March 2001 to August 2002. The bathing module included an environmental evaluation of the relevant bathroom and a self-reported evaluation of bathing. Complete details of the bathing module, including tests of reliability, have been previously reported (4,12).

Analytic sample—To be eligible for the current study, participants (at the 36-month assessment) had to be living in the community, complete the third comprehensive home-based assessment, and not require personal assistance in bathing. Among the 656 nondecedents of the original cohort, 30 (4.6%) had dropped out of the study, 6 (1%) declined to complete the third comprehensive assessment, 25 (3.8%) completed the assessment over the telephone, 92 (14.0%) required personal assistance in bathing, and 2 (0.3%) were nondisabled in bathing but living in a nursing home. The remaining 501 participants constituted the analytical sample for the current study. Compared with these participants, the 155 nondecedents not included in the analytic sample were, at the time of enrollment, significantly older (mean±SD: 79.2±5.2 years vs. 77.7±5.0 years; P=0.002) and less likely to be male (23.2% vs. 36.3%; P=0.003), but otherwise did not differ in terms of living situation, race or education.

Data collection

The current study used data from two home-based assessments that were completed at 36 and 54 months, respectively, and from monthly telephone interviews that were completed between the 36- and 54-month home-based assessments. A team of trained research nurses completed the home-based assessments using standard procedures and a coding manual (4,12). The monthly telephone interviews were completed by a separate team of research staff who were kept blinded to the results of the home-based assessments.

Home-based assessments—The home-based assessment at 36 months included several covariates and an evaluation of the primary bathing environment. A self-reported evaluation of bathing disability was included in both the 36- and 54-month home-based assessments.

Covariates: In addition to demographic characteristics, data were collected at 36 months on several potential covariates (or confounders). We included only those that were associated with the development of bathing disability in an earlier study (19). Participants were 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; and whether they had lost 10 or more pounds in the past year. Bathing self-efficacy was assessed by a single question from the Tinetti functional self-efficacy scale (20)—how confident/sure are you (completely, very, fairly, a little, not at all) that you can take a bath or shower? Physical activity was assessed by the Physical Activity Scale for the Elderly (PASE) (21). Cognitive status was assessed by the Folstein Mini-Mental State Examination (22), while hearing was assessed with a handheld audioscope (23). Physical capacity and strength were evaluated by three objective tests: the ability to rise from a standard chair in a single attempt with arms folded (24), gross motor coordination, as assessed by having the participant alternatively tap his/her index finger between two circles on a paper and his/her nose ten times (25), and grip strength, as assessed by the average of three readings using a

Jamar Hydraulic handheld dynamometer (26). For all covariates, the amount of missing data was less than 5%.

Bathing environment: Based on direct observation, the study nurse at 36 months determined the presence (or absence) of five types of bathroom modifications or assistive devices (referred to hereafter as bath aids), including: shower seat, tub stool, or bath chair (referred to hereafter as bath seat); grab bar(s); handheld shower spray; long handle brush or sponge; and nonskid mat or abrasive strips.

Bathing disability: At 36 and 54 months, 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 personal assistance were subsequently asked, "At the present time, how much difficulty do you have with bathing (washing and drying your whole body? (no difficulty vs. other). Participants reporting dependence (i.e., need help) or difficulty with bathing, respectively, were asked similar questions about the need (yes/no) for personal assistance or having difficulty (yes/no) with four bathing subtasks, including washing whole body, drying whole body, getting into the bathing position, and leaving the bathing position (4). For the current study, the latter two subtasks were considered as a single subtask, referred to hereafter as bathing transfers.

Monthly interviews—During the monthly interviews, participants were asked, "At the present time, do you need help from another person to bathe (wash and dry your whole body)?" Participants who needed help were considered to be disabled. 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 assessment for bathing disability was substantial (27), with Kappa = 0.73. To address the small amount of missing data (0.4% of observations), we used multiple imputation with fifty random draws per missing observation according to the method described by Allison (28). Participants were not asked about difficulty with bathing during the monthly interviews.

Statistical analysis

To determine whether the availability of bath aids may forestall the subsequent development of bathing disability, we performed two distinct sets of analyses. For each, the 36-month assessment served as zero-time, the time at which prognostic estimations are made (29). The outcome for the first set of analyses was persistent bathing disability, as ascertained during the monthly interviews, while the outcome for the second set of analyses was disability in bathing subtasks, as ascertained during the next home-based assessment at 54 months. Because the universal installation of environmental adaptations has become a design feature of many age-restricted housing developments, we reran each set of analyses after excluding participants who lived in age-restricted housing or assisted living facilities. All statistical tests were 2-tailed, and $P < 0.05$ was considered to indicate statistical significance. P-values were not corrected for multiple comparisons. All analyses were performed using SAS version 9.1 (SAS Institute, Cary, NC).

Persistent bathing disability—In the first set of analyses, we evaluated the relationship between the presence of each of the five bath aids, assessed at 36 months, and the onset of persistent bathing disability, as ascertained during the monthly interviews, using the Cox proportional hazards method (30). We chose to evaluate episodes of persistent (i.e., present for at least 2 consecutive months) bathing disability because they are more likely than transient episodes (i.e., present for only a single month) to represent clinically meaningful changes in functional status (16). Data on participants without persistent bathing disability were censored at the time of death or the last completed monthly interview prior to the next home-based

assessment at 54 months. Fourteen (2.8%) participants died without having developed persistent bathing disability after a median follow-up of 6 months, and 4 (0.8%) dropped out of the study without having developed persistent bathing disability after a median follow-up of 13.5 months. Data were otherwise available for 99.6% of the 9,010 monthly interviews. The covariates for the adjusted analyses included age, sex, race, number of chronic conditions, weight loss, low bathing self-efficacy, low physical activity, cognitive impairment, hearing impairment, inability to rise from a chair, timed gross motor coordination, and poor grip strength. The operational details for these covariates were provided in an earlier report (19). As described by Grimes and Schulz (31), the objective of selecting covariates is to account for susceptibility bias, which arises if the compared groups have unequal *baseline* prognostic susceptibilities to the outcome event.

Disability in bathing subtasks—In the second set of analyses, we evaluated the relationship between the presence of bath aids, assessed at 36 months, and subsequent disability (operationalized as needing personal assistance) in a "matched" set of bathing subtasks, as ascertained during the next home-based assessment at 54 months, using the logistic regression method (32). The specific combinations of bath aids and subtasks were selected based on clinical judgment and the results of prior research (12). For example, the presence of grab bars might be expected to facilitate bathing transfers, but not necessarily washing or drying one's whole body. The other combinations of bathing aids and subtasks included bath seat and nonskid mat/strips, respectively, with bathing transfers, washing whole body and drying whole body; and handheld shower spray and long handle brush/sponge, respectively, with washing whole body.

Of the 501 participants in the analytic sample, 6 (1.2%) refused to complete the 54-month assessment and 41 (8.2%) had died, leaving 454 participants available for these analyses. The covariates for the adjusted analyses were the same as those for the first set of analyses. To determine the robustness of our findings, we performed a supplementary set of analyses that operationalized disability as having difficulty, but not needing personal assistance. The sample included a subset of 369 participants who did not need personal assistance and had no difficulty with bathing at 36 months.

RESULTS

The characteristics of participants in our analytic sample are shown in Table 1. The majority of participants were female, white, and did not live alone, while less than one out of five resided in age-restricted housing or an assisted living facility. There was a wide range of ages, education, and scores on the Mini-Mental State Exam, although the majority of participants completed high school and were cognitively intact. The median number of chronic conditions was 2, with the most common being hypertension and arthritis.

Over a median follow-up of 8 months, 99 (19.8%) participants developed disability in bathing that persisted for at least two months. The median duration of these episodes was 3 months (interquartile range, 2 to 6). Table 2 provides the prevalence of the bath aids at 36 months along with the corresponding hazard ratios for the development of persistent bathing disability. The prevalence of the bath aids ranged from 25.8% for bath seat to 76.9% for nonskid mats or abrasive strips. The presence of a bath seat was associated with an increased risk of persistent bathing disability, although this elevation in risk was not statistically significant in the adjusted analysis. Nonsignificant elevations in risk were also observed for grab bar(s), handheld shower spray, and long handle brush or sponge. In the unadjusted and adjusted analyses, the presence of nonskid mats or abrasive strips was associated with nonsignificant reductions of 30% and 23%, respectively, in the risk of persistent bathing disability. The results did not change appreciably after the 93 participants who resided in age-restricted housing or assisted living

facilities were excluded, although most of the elevated hazard ratios were attenuated. For example, the unadjusted and adjusted hazard ratios (95% CI) were 1.06 (0.65, 1.72) and 1.10 (0.67, 1.82) for grab bar(s) and 1.57 (0.93, 2.66) and 0.94 (0.53, 1.65) for bath seat.

Table 3 provides results of the logistic regression models evaluating the association between the presence of bath aids at 36 months and subsequent disability, operationalized as needing personal assistance, in the matched set of bathing subtasks at 54 months. The presence of a bath seat was associated with an increased likelihood of developing disability in each of the three bathing subtasks, although the odds ratios were attenuated and no longer statistically significant after adjustment for the potential confounders. A similar phenomenon was observed for grab bar(s) and subsequent disability in bathing transfers, although the unadjusted odds ratio was only marginally significant (P = 0.055). In the unadjusted and adjusted analyses, the presence of nonskid mats or abrasive strips was associated with statistically significant reductions in the likelihood of developing disability in both washing and drying one's whole body, with adjusted odds ratios of 0.28 (P = 0.003) and 0.38 (P = 0.030), respectively. There was no significant association between the presence of a handheld shower spray or a long handle brush or sponge and subsequent disability in washing one's whole body, although the odds ratios were elevated for long handle brush or sponge in both the unadjusted and adjusted analyses.

After the 81 participants who resided in age-restricted housing or assisted living facilities were excluded, all but two of the elevated odds ratios were diminished (results available upon request). For example, the unadjusted and adjusted odds ratios (95% CI) were 1.13 (0.44, 2.95) and 1.18 (0.38, 3.64), respectively, for grab bar(s) and bathing transfers and 1.64 (0.62, 4.36) and 1.07 (0.33, 3.50), respectively, for bath seat and washing whole body. Finally, when disability was operationalized as having difficulty but not needing personal assistance, the overall results did not differ appreciably (available upon request), although several of the deleterious associations were accentuated. For example, the unadjusted and adjusted odds ratios (95% CI) were 2.95 (1.50, 5.80) and 2.52 (1.24, 5.13), respectively, for grab bar(s) and bathing transfers and 4.34 (1.77, 10.6) and 4.09 (1.57, 10.7), respectively, for bath seat and washing whole body.

DISCUSSION

In this prospective cohort study of community-living older persons, we found that the availability of bath aids, with the exception of nonskid mats or abrasive strips, did not forestall the subsequent development of bathing disability. In fact, the presence of a bath seat was associated with an increased likelihood of developing persistent disability in bathing and disability in three distinct bathing subtasks. These associations were attenuated, however, and were no longer statistically significant after adjustment for potential confounders, raising the possibility that unmeasured factors could have biased the true, i.e., protective, relationship between the availability of bath aids and subsequent bathing disability.

The capacity-demand hypothesis of disability, which was derived from the original competence-environmental press theory proposed by Lawton (33), suggests that disability occurs when there is a gap or mismatch between personal capabilities and environmental demands (34). Although this conceptual framework is strong, and epidemiological studies have documented high rates of environmental hazards and impediments to independent function, the evidence linking deficits in the home environment to adverse functional outcomes is surprisingly weak, being limited largely to cross-sectional studies (14,35), which are insufficient to establish temporal precedence between a potential risk factor and outcome.

To address this limitation, we used a longitudinal design, taking advantage of high quality data on the bathing environment, which were based on direct observation by a research nurse, monthly assessments of bathing disability, and detailed information about bathing subtasks. We postulated that the presence of bath aids, by enhancing the ability to perform specific subtasks (e.g. grab bars to facilitate transfers to/from the bathing position) or alleviating environmental risks (e.g. bath seat to prevent falls), would be associated with a reduction in subsequent bathing disability. Contrary to our expectation, however, we found that the presence of bath aids, other than nonskid mats or abrasive strips, did not reduce the likelihood of developing bathing disability and actually appeared detrimental, leading to small to moderate elevations in risk, prior to adjustment for potential confounders.

While it is possible that many bath aids are not beneficial, it is unlikely that they are detrimental. We believe that our unexpected findings may be attributable, at least in part, to self-selection, i.e., the availability of bath aids identifies high-risk individuals. Indeed, in almost all cases, regardless of whether disability was operationalized as needing personal assistance or as having difficulty, the elevations in risk were attenuated after adjustment for factors, including inability to rise from a chair, low bathing self-efficacy, and low physical activity, that are strongly associated with subsequent bathing disability (19). A similar phenomenon was observed when participants who resided in age-restricted housing or assisted living facilities were excluded from the analyses, suggesting that they had greater vulnerability (or susceptibility) for developing bathing disability than the other participants, even after accounting for the known risk factors of bathing disability.

In the current study, we evaluated the presence, rather than the use, of bath aids. Because nondisabled persons who use a bath aid likely have greater inherent vulnerability than those who have a bath aid but do not use it, the effect of self-selection may have been even more pronounced had we evaluated the use, rather than the presence, of bath aids. Although we have previously demonstrated that intervening illnesses or injuries leading to hospitalization or restricted activity are strongly associated with the onset of persistent bathing disability (19), these events were not included in our multivariate models because they were ascertained subsequent to zero-time (i.e., during the monthly telephone interviews) and, hence, do not reflect baseline prognostic susceptibilities (31).

Of the five bath aids, nonskid mats/abrasive strips may be the least susceptible to self-selection, as reflected by their much higher prevalence rate and the absence of any meaningful difference between the unadjusted and adjusted results, which demonstrated reductions in the likelihood of bathing disability. The consistency of these results across several different outcomes, including persistent disability in bathing and disability in the three bathing subtasks, suggests that nonskid mats/abrasive strips may be protective.

Our inability to detect a protective effect for the presence of bath aids other than nonskid mat/abrasive strips could be attributable to factors other than self selection. For example, it is possible that the bath aids identified in some homes were intended for someone other than the study participant. In addition, while the home environment likely changes over time (36), our ascertainment of bath aids was based on only a single assessment. Given these and other inherent limitations of epidemiologic studies, a controlled trial of bath aid use may be required to determine the true effectiveness of bath aids in promoting independent bathing among community-living older persons.

It is also possible that bath aids may be effective in managing rather than preventing disability in bathing. For example, in the setting of disability, the presence of bath aids may make it easier for a caregiver to provide assistance with bathing, leading to reductions in caregiver burden and enhancing quality of life, without necessarily reversing the underlying disability.

Our study is unique in that data on bathing disability were available at monthly intervals, with relatively little attrition or missing data. This allowed us to identify episodes of bathing disability that persisted for at least two months, thereby reducing the possibility of measurement error. In addition, our analyses focused on the most commonly used bath aids (37), which were matched to the most relevant bathing subtasks (4). Finally, for these latter analyses, disability was operationalized separately as needing personal assistance and as having difficulty, two complementary forms of disability that differ by severity (38).

Whether our findings can be generalized widely may be reasonably questioned. As previously noted (39), the demographic characteristics of our source population closely mirror those of persons aged 70 years 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 (40), and at least partially offset the absence of a population-based sample.

In summary, the presence of bath aids, with the exception of nonskid mats or abrasive strips, did not forestall the subsequent development of bathing disability in this epidemiologic study. Neither use nor self-selection effects were fully accounted for, thus clinical trials may be necessary to demonstrate the potential value of bath aids among community-living older persons.

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Table 1

Characteristics of Participants at 36 Months

Characteristic*	N=501
Age, years	
Median	80
Range	73 – 99
Female	319 (63.7)
Non–Hispanic white	451 (90.0)
Lives alone	215 (42.9)
Resides in age–restricted housing or assisted living facility	93 (18.6)
Education†, years	
Median	12
Range	0 – 17
Chronic conditions‡	
Median	2
Range	0 – 6
Hypertension	296 (59.1)
Arthritis	218 (43.5)
Cancer	103 (20.6)
Diabetes mellitus	96 (19.2)
Chronic lung disease	86 (17.2)
Myocardial infarction	87 (17.4)
Stroke	43 (8.6)
Congestive heart failure	32 (6.4)
Hip fracture	29 (5.8)
Mini–Mental State Exam Score	
Median	27
Range	12 – 30

*Data are presented as No. (%) unless otherwise indicated.

†17 years denotes postgraduate education.

‡Presented in descending order according to prevalence.

Table 2

Prevalence of Bath Aids at 36 Months and Proportional Hazard Ratios with 95% Confidence Intervals for Time to Persistent Bathing Disability*, N=501

Bath Aid	Prevalence (%)	Hazard Ratio (95% confidence interval)	
		Unadjusted	Adjusted†
Grab bar(s)	44.1	1.35 (0.91, 2.00)	1.08 (0.72, 1.62)
Bath seat	25.8	1.75 (1.16, 2.64)	1.14 (0.74, 1.77)
Nonskid mat or abrasive strips	76.9	0.70 (0.45, 1.07)	0.77 (0.49, 1.19)
Handheld shower spray	31.9	1.37 (0.91, 2.05)	1.16 (0.77, 1.75)
Long handle brush or sponge	37.5	1.32 (0.89, 1.96)	1.47 (0.97, 2.21)

* Ascertained during the monthly interviews.

† Adjusted for age, sex, race, number of chronic conditions, weight loss, low bathing self-efficacy, low physical activity, cognitive impairment, hearing impairment, inability to rise from a chair, timed gross motor coordination, and poor grip strength, as described in the Methods.

Table 3

Association Between the Presence of Bath Aids at 36 Months and Subsequent Disability in Specific Bathing Subtasks at 54 Months, N=454*

Bath Aid		Bathing Transfers	Washing Whole Body	Drying Whole Body
		Odds Ratio (95% confidence interval)†		
Grab bar(s)	Unadjusted	2.03 (0.98, 4.19)		
	Adjusted	1.53 (0.68, 3.46)		
Bath seat	Unadjusted	2.08 (1.00, 4.33)	2.15 (1.05, 4.38)	2.74 (1.33, 5.63)
	Adjusted	1.71 (0.73, 3.98)	1.57 (0.68, 3.60)	2.24 (0.97, 5.17)
Nonskid mat or abrasive strips	Unadjusted	0.50 (0.24, 1.05)	0.32 (0.16, 0.65)	0.38 (0.18, 0.78)
	Adjusted	0.53 (0.22, 1.26)	0.28 (0.12, 0.65)	0.38 (0.16, 0.91)
Handheld shower spray	Unadjusted		1.14 (0.55, 2.37)	
	Adjusted		0.82 (0.35, 1.91)	
Long handle brush or sponge	Unadjusted		1.64 (0.82, 3.27)	
	Adjusted		1.65 (0.73, 3.75)	

*The specific combinations of bath aids and subtasks were selected based on clinical judgment and the results of prior research, as described in the Methods. Disability was operationalized as needing personal assistance.

†The adjusted models included age, sex, race, number of chronic conditions, weight loss, low bathing self-efficacy, low physical activity, cognitive impairment, hearing impairment, inability to rise from a chair, timed gross motor coordination, and poor grip strength, as described in the Methods.