Do Elderly People at More Severe Activity of Daily Living Limitation Stages Fall More?

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Abstract

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Objective—The aim of this study was to explore how activity of daily living (ADL) stages and the perception of unmet needs for home accessibility features associate with a history of falling.

Design—Participants were from a nationally representative sample from the Second Longitudinal Survey of Aging conducted in 1994. The sample included 9250 community-dwelling persons 70 yrs or older. The associations of ADL stage and perception of unmet needs for home accessibility features with a history of falling within the past year (none, once, or multiple times) were explored after accounting for sociodemographic characteristics and comorbidities using a multinomial logistic regression model.

Results—The adjusted relative risk of falling more than once peaked at 4.30 (95% confidence interval, 3.29–5.61) for persons with severe limitation (ADL-III) compared those with no limitation (ADL-0) then declined for those at complete limitation (ADL-IV). The adjusted relative risks of falling once and multiple times were 1.42 (95% confidence interval, 1.07–1.87) and 1.85 (95% confidence interval, 1.44–2.36), respectively, for those lacking home accessibility features.

Conclusions—Risk of falling appeared greatest for those whose homes lacked accessibility features and peaked at intermediate ADL limitation stages, presumably at a point when people have significant disabilities but sufficient function to remain partially active.

Keywords

Accidental Falls; Aged; Risk Assessment; Activities of Daily Living

During the next 18–20 yrs, the growth of the older population will increase at an unprecedented rate in the United States. According to current data provided by the U.S.

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Census Bureau, this translates into the population of 65 yrs or older increasing from 40 million in 2010 to 72.1 million by 2030, roughly 20% of the U.S. population.[1] This growth may be caused, in part, by improved medical care and prevention methods. Thus, medicine's challenges will shift from prolonging life to enhancing the quality of survival over the 21st century.

Falls are common in older persons, with 30% of those 65 yrs or older having reported a fall in the previous year.[2,3] Falls can have serious consequences. With more than 2.1 million reported in 2007, falls were the leading cause of nonfatal injuries among persons 65 yrs or older treated in hospital emergency departments in 2008 and the leading cause of death due to unintentional injury in 2007.[4] Even those who are not injured after a fall develop a fear of falling. This fear may cause them to limit their activities, leading to reduced mobility and physical fitness and thus further increasing actual falls.[5] Those falls that lead to injuries can make it hard to get around and limit independent living. Falls can also increase the risk of early death.[6,7] Moreover, the rates of fall-related deaths among older adults rose significantly over the past decade.[8] In 2000, direct medical cost totaled $0.2 billion ($179 million) for fatal falls and $19 billion for nonfatal fall injuries.[8]

The literature suggests that the risks associated with falling are multifactorial. The prevalence of falls is known to increase sharply with age,[9] and falls are more common in women than in men.[10-12] Previous stroke, arthritis of the lower limbs, neuromuscular deficits, and depression are known risk factors.[12-15] Multiple falls are more likely at older ages and are associated with parkinsonism, greater limitations in activities of daily living (ADLs), and dementia or Alzheimer disease.[16] The annual incidence of falls in patients with dementia is 40%–60%, twice the rate of the equivalent cognitively normal elderly population.[17-19] One fall representing an occasional event can result from a particular circumstance such as an environmental hazard, whereas repeated falls tend to be the result of intrinsic factors, such as chronic disease and disability.[20] People who recall falls in the previous year, particularly repeated falls, are more likely to fall in the future.[11] Home hazards are important predictors of falls among older persons,[21] but one study showed that elderly people living alone were not necessarily at greater risk of falling than were those living with family.[22] Among elderly persons, falling seems to result from the accumulated effect of multiple specific disabilities.[23] Restrictions in ADL predict falls during 1 yr[24] and as well as after hospital discharge.[25] Elderly people who have no ADL limitations had fewer fall-related fractures than did those with ADL limitations.[10]

We developed a series of disability-related staging systems to better understand the long-term mechanisms and consequences of disability among groups and populations of people.[26-31] Stages express disability in a manner that recognizes that knowledge about the types of activities limited is just as important to understanding the severity of those limitations in people's abilities to participate in life. A set of ADL stages was designed specifically to image the status of older adults as they live and function in the community.[31] Stages of ADL characterize activity limitations in self-care as expressed by the International Classification of Functioning, Disability and Health terminology.[32] People at higher ADL limitation stages tend to be older, to have a higher prevalence of chronic disabling conditions such as stroke, and to have higher likelihood of both short-term (1-yr) and long-term (10-yr) all-cause mortality.[33,34]

Our objective was to use ADL stages to explore the degree to which the severity and nature of ADL deficit are associated with a history of falling after controlling for other factors. We expect that people at higher ADL limitation stages will be more likely to report a history of falling in the past 12 mos. Applying the bio-psycho-ecologic framework, we hypothesize that peoples' "intrinsic" difficulties performing ADLs and the quality of their "extrinsic"

home environments will be important in explaining falling risks.[35] To gain an appreciation of environmental effects, we explore whether people who perceive that their homes are lacking accessibility features are more likely to have fallen in the past year one or more times, controlling for known risk factors. Consistent with the literature,[12-19] we anticipate that people with a history of falling will be more likely than those without a history to have certain sociodemographic characteristics and a wide variety of mental and physical health conditions. We expect that the perception of an unmet need for home accessibility features as well as ADL stage will be associated with history of falls even after controlling for these sociodemographic factors and health conditions.

METHODS

This study was approved by the institutional review board at the University of Pennsylvania.

Description of Data

Data were obtained from the Second Longitudinal Study of Aging (LSOA II).[36] The LSOA II is a prospective study of a complex multistage cohort of community-dwelling persons 70 yrs or older, which is nationally representative. Respondents to the LSOA II were drawn from sample persons (SPs) interviewed during the 1994 National Health Interview Survey (NHIS) core.[37] These data were linked to the disability supplement follow-back survey (NHIS-D), which added a rich set of questions relevant to people with disability essential to our study. Thus, all people in the LSOA II sample had NHIS-D data because the LSOA II was a subsample of those who were elderly.[38] The disability screen for the follow-back survey in the NHIS was age specific and broad. It included those with limitations in age-appropriate activities; certain diagnoses such as polio, Down syndrome, or schizophrenia; reported psychologic problems such as phobias; receipt of relevant services such as physical therapy for a condition expected to last more than 12 mos; and use of assisted technology or equipment such as a scooter. The detailed screening definitions can be seen in Appendix A of the Disability User guide.[38]

We selected the LSOA II specifically because of its linkage to the NHIS-D, which collected detailed information about the perceptions of unmet needs for home accessibility features and other issues of importance to people with disabilities. The LSOA II also provides information on the causes and correlations of changes in health and functioning after it is linked to the NHIS-D. Proxy respondents provided information when the SP could not be interviewed.

Study Population

Of the 9447 community-dwelling persons in the LSOA II baseline, 130 (1.4%) were excluded for missing one or more ADL and 67 (0.7%) were also excluded for reporting not knowing whether they had fallen during the previous year, leaving 9250, or 97.9%, of the original sample available for analysis. Most (81.5%, $n = 7540$) reported for themselves, whereas 18.5% ($n = 1710$) required a proxy to report. Among those requiring a proxy, 24.4% ($n = 423$) were because of illness, 26.4% ($n = 464$) were because of sensory limitations, 28.1% ($n = 491$) had Alzheimer or other dementia, 11.0% ($n = 183$) had communication disorders, and 38.9% ($n = 657$) were for other reasons. One person could report more than one reason for requiring a proxy.

Exposures

Stages of ADL represented the primary exposure of interest. Stages of ADL were assigned based on the answers to a series of questions about the SP's experienced difficulty in eating, using the toilet (including getting to the toilet), dressing, transferring in and out of a bed or

chair, bathing, and walking (Table 1). Sample persons or proxies were asked whether they had no difficulty (rated as 0), some difficulty (rated as 1), a lot of difficulty (rated as 2), or were unable (rated as 3) to do each activity. Factor analyses of a set of 20 activities validated these particular six activities as discrete ADLs separate from the Instrumental Activities of Daily Living.[39] The ADL stages were developed by examining patterns of item response in the LSOA II baseline data using methods described previously.[40] There are five ADL stages that are assigned from 0 to IV, with higher numbers indicating greater limitations. Each ADL stage specifies the maximum difficulty that a person can have for each activity and still be assigned to the stage. The five ADL stages are labeled in accordance with International Classification of Functioning, Disability and Health performance qualifiers and include no difficulty (ADL-0), mild difficulty (ADL-I), moderate difficulty (ADL-II), severe difficulty (ADL-III), and complete difficulty (ADL-IV) performing ADLs.[32]

The perception of unmet needs for home accessibility features was a secondary exposure of interest. The SP or proxy was asked about the perception of unmet needs for one or more accessibility features in the home, including ramps, kitchen modifications, widened doorways, elevators or stair glides, easy-open doors, railings, alerting devices, accessible parking or drop-off sites, or other special features. This variable was dichotomized as answering yes or no to needing but not having any of the above features.

Confounding Variables

We identified confounding variables based on published risk factors associated with falling one or multiple times.[12-19]

Sociodemographic variables included sex, race (white, black, and other), and age (70–74, 75–79, 80–84, and 85 yrs). Education was classified as whether the SP graduated from high school. Living situation was dichotomized as living alone or not.

Heath status was indicated by the presence of 13 chronic conditions grouped into seven categories. The SP or proxy was asked whether a physician had ever told the SP whether he or she had one or more of the following conditions: stroke, cardiopulmonary disorder (heart attack, myocardial infarction, angina, other heart disease, bronchitis, emphysema, or asthma), diabetes, cancer, dementia, osteoporosis, hypertension, or arthritis. The SP was considered as having cognitive impairment if the survey information was reported by a proxy because of poor memory or Alzheimer disease. History of a major psychiatric disorder was indicated if, during the past 12 mos, the SP had schizophrenia, paranoid disorder, bipolar disorder, or major depression lasting two or more weeks. Each chronic health condition was a separate variable.

Outcome Measure

The outcome of this study was history of falling in the previous year. Sample persons or proxies were asked if, during the past 12 mos, they had fallen. If the answer was yes, then they were then asked whether they had fallen more than once.

Statistical Analysis

The LSOA II uses a multistage sample design. To obtain the correct variance estimates, we took into account clustering, sample weights, and stratification in the analyses. All statistical analyses were performed with Stata/MP version 11.0 (StataCorp, College Station, TX) using the proper statements to account for the complex sampling design.

First, the prevalence of sociodemographics, health status, and stage were calculated as weighted proportions from the LSOA II data to reflect expected prevalence in the population for each exposure and confounding variable.

Second, we looked at the unadjusted associations between sociodemographics, health status, ADL stage, and perception of unmet needs of home accessibility features with history of falling in the previous year. We reported unweighted sample sizes and weighted proportions.

Because history of falling in the previous year has multiple ordered levels (no falls, one fall, or multiple falls), we first attempted an ordinal logistic regression. Because the proportional odds assumption required for ordinal logistic regression was violated, we fit a multinomial logistic regression model on the outcome. Modeling was purposeful. Variables were placed in fixed models to test hypothesized associations between ADL stage, unmet needs for home accessibility features, and the risk of falling once or more than once. These exposure variables were entered into fixed models already containing the confounding variables. The following confounding variables were controlled for: sociodemographics, education, living situation, health status, cognitive impairment, and major psychiatric disorder.

Because the outcome of history of falls in the previous year has multiple levels, relative risk ratios and their 95% confidence interval (CIs) were reported. As an example, a relative risk ratio of 1.42 (95% CI, 1.07–1.87) for falling once comparing those who perceived lack of home accessibility features with those who did not can be interpreted as follows: the relative risk of falling once, that is, the risk of falling once divided by the risk of no falls (no falls is the reference level for the multinomial logistic regression) for those who perceived lack of home accessibility features is 1.42 times (95% CI, 1.07–1.87) the same relative risk for those who did not perceive lack of home accessibility features. All P values presented are two tailed, where $P < 0.05$ was considered statistically significant.

RESULTS

Among the 9250 community-dwelling persons included in this study, more than half were women and the majority were white (Table 2). The average age was 76.4 yrs (SD, 5.8 yrs). A small proportion of SPs stated that their homes lacked home accessibility features. Most of the community-dwelling SPs in this analysis were staged at ADL-0, followed by ADL-I. Very few people were completely disabled (stage ADL-IV). Table 2 provides a description of the confounding variables by number of falls in the past 12 mos.

Overall, 1963 (21.2%) SPs fell at least once in the previous year. There were 1060 SPs (11.5%) who reported only one fall, whereas 903 (9.8%) reported having multiple falls in the previous year. Only 5.2% of people at ADL-0 can be expected to fall more than once, compared with 17.2%, 26.7%, 27.9%, and 14.7% of those at ADL-I, -II, -III, and -IV, respectively. Figure 1 shows the weighted population prevalence of falls over the past year stratified by ADL stage. The pattern of any falls, one fall, and multiple falls is shown in the graph. The total height of the bars shows the weighted percentage who claimed one or more falls. People at ADL-III are the most likely to have a history of falling one or more times over the past year (17.6% and 27.9%, respectively). In contrast, just more than 15% of those at ADL-0 and just fewer than 15% of those at ADL-IV can be expected to fall. The gray bar indicates the weighted percentage of those who recalled falling only once, whereas the black portion of the bar delineates who recalled falling more than once. The proportion of total fallers who fell multiple times compared with one time increased with ADL limitation stage. People at ADL-IV were the least likely group to experience falling. All those who did fall fell multiple times in the previous year.

Table 3 shows the associations between each exposure and history of falling after controlling for all the confounding sociodemographic and health status variables listed in Table 2. Among those who stated that they lacked home accessibility features, the relative risk of falling once was 1.42 (95% CI, 1.07–1.87) and the relative risk of falling more than once was 1.85 (95% CI, 1.44–2.36) compared with the relative risk of SPs who did not state that they lacked home accessibility features. The relative risk of falling once in the previous year was 1.38 (95% CI, 1.16–1.63), 1.53 (95% CI, 1.14–2.05), and 1.85 (95% CI, 1.32–2.60) for SPs with mild limitation (ADL-I), moderate limitation (ADL-II), and severe limitation (ADL-III), respectively, compared with the same relative risk for SPs with no limitation (ADL-0). At complete limitation (ADL-IV), the relative risk ratio was 0, as there were no SPs who fell only once in the previous year. Similar trends were seen for the relative risk of falling more than once in the previous year, but the relative risk ratios for ADL-I, -II, and -III compared with ADL-0 were much higher. In addition, for the last stage, the relative risk was not statistically different from that of stage 0.

DISCUSSION

According to findings from this population-based study, 21.2% of persons 70 yrs or older who are living in the community would be expected to report falling at least once over the last year. Among persons in this age group, 11.5% would be expected to recall falling once, and 9.8%, to report falling multiple times. As anticipated, people who fell were more likely to experience unmet needs for home accessibility features. Although ADL stage was strongly associated with a history of falling, the association was more complex than expected. Also as expected, the likelihood of having at least one fall increased progressively with severity of limitation from ADL-I to ADL-III compared with those at ADL-0. Although those at ADL-III (i.e., with severe limitations) were most likely to have experienced a fall, this likelihood dropped at the highest ADL limitation stage. Those unable to do any self-care tasks (ADL-IV) were least likely to have a history of falling, even less likely than those with no limitations at ADL-0. To our knowledge, this is the first time this kind of association between ADL severity and the history of falling has been documented.

In direct parallel to the patterns of stage and falling, we previously found that people's perceptions of unmet needs for home accessibility features also increased progressively with severity of limitation from ADL-I to ADL-III then declined at ADL-IV.[34] Thus, it seems that both the perception of environmental barriers in the home and falling are most common among those at moderately severe stages of self-care limitation. Interestingly, Northridge and coworkers[21] report that vigorous older people were more susceptible to environmental hazards in the home and that home hazards were not associated with falling in those already considered frail. Moreover, Liu and Lapane[41] found that elderly community-dwelling people with accessibility features in their homes compared with those without those features had modestly reduced risks of functional decline, suggesting that the home environment might be adapted to maintain function. As a cross-sectional study, we were unable to assign a temporal order or causality between the perceived lack of home accessibility features and falling. Logically, people with mild to moderately severe limitations will be more likely to report a history of falls and to perceive the need for home accessibility features than those unable to perform any activities because they are still capable of autonomous activity. This highlights the importance of early programs for falls prevention and environmental adaptations among elderly people living in the community while their ADL limitations are still mild.

The perception of unmet need(s) for home accessibility features was associated with a history of falls even after reducing the effects of known risk factors. Because our analysis was not prospective, the perceived lack of home accessibility features may either be a risk

factor for falls or have occurred as a consequence of a fall (reverse causality). Thus, future prospective studies measuring this perception as an exposure before the fall occurs will be essential in determining whether perceived lack of home accessibility features was a risk factor or a consequence of falling. Nevertheless, whether operating as a risk factor or consequence of the perceived unmet need, the association between need for home accessibility feature(s) with a history of falls seems clinically important. If this perceived need is proven to be a risk factor, it would be potentially modifiable through the provision of home accessibility features. Similarly, if people are made aware of unmet needs for home accessibility features because of their falling experience, this would suggest that the history of a fall should trigger the clinical review of architectural hazards in the home environment. The associations between ADL stage and the perception of unmet needs for home accessibility features remained after extensively controlling for multiple confounding physical and mental conditions associated with a history of falls reported in the literature[12-15] for single and multiple falls.

Stages of ADL are derived by asking people about difficulties performing six self-care tasks as they care for themselves in their homes. Their homes have particular environmental features. Thus, stages reflect the "lived experiences" of people in the contexts of their current living spaces.[32] Presumably, perceptions of difficulty associated with each self-care task could change if home accessibility features were altered. Thus, ADL stage might change, as could the vulnerability to falls if features of the environment changed. This assumption provides opportunities for rehabilitation professionals. It has been shown that elderly people will remove environmental hazards if these are identified and pointed out during home assessment.[42] Stages group people according to the nature and severity of limitations in performing self-care as each individual describes what he or she does. We assume that elderly people's cognitive and physical impairments interact with their environments to cause ADL limitations.[35] Those limitations, combined with their needs and desires to manage their own lives, determine what tasks and other actions they perform that contribute to the falls risk experienced.

Two recent systematic reviews documented in multiple studies that the presence and/or severity of activity limitations is associated with greater likelihood of falling in community-dwelling elderly people.[43,44] Most typically, ADL limitation was presented as disturbance in one or more ADLs without specifying which task(s) were limited.[43] In contrast, the five ADL stages classify people into groups that place a ceiling on the maximum amount of difficulty they can have in each specific task, making it possible to explore vulnerability to falling among groups of people having difficulties with specific ADLs. People at ADL-I can be expected to have a lot of difficulty walking and/or bathing and some difficulty dressing and transferring. As they continue to perform these activities, they will logically be more vulnerable to falling than would those without difficulties. Falling reasonably accelerates further at ADL-II relative to ADL-I because now they may be unable to walk or bathe and may have a lot of difficulty dressing and transferring. People at ADL-III with severe limitations are, by definition, unable to meet the ADL-II thresholds of no difficulty of eating or toileting but are still able to do at least one ADL with or without difficulty. Because they still have some self-care skill, they may continue to attempt to care for themselves even if they are at high risk of falling. At ADL-IV, expectations change dramatically. Most people unable to perform any ADL tasks will not attempt to perform those tasks and thus logically have less opportunity to fall.

Findings from a recent study comparing risk factors between indoor and outdoor falling suggest other opportunities effect, arising from different life contexts.[45] Although people with a great deal of difficulty or an inability to perform ADLs compared with those with no difficulty were more likely to fall indoors, they were less likely than those with no ADL

difficulties to fall outdoors. Most people who have severe ADL limitations will rarely venture outdoors, thus providing little opportunity to fall. Difficulties performing activities, performance of those activities, and the qualities of the environments in which performance occurs seem interconnected. As life engagement and volitional activities decline, people have fewer opportunities to fall. However, fear-related avoidance of ADLs is common and an independent predictor of falling.[14,20] Consequently, people with a history of falling tend to engage in fewer activities.[46] Future work might focus on these dynamics. We believe that fear of falling might increase risk of falling at the lower activity limitation stages until a point of greater severity when that fear becomes so overwhelming that the consequent reduction in activities is so pronounced as to reduce risk of falls. It appears from our data that by ADL-IV, this has happened. However, certainly, we do not advocate restriction of activities as a fall prevention strategy.

This study is limited in that we could not infer causal relationships between ADL stages and the perception of unmet needs for home accessibility features and falls. Moreover, it is known that particularly those with cognitive impairment and those whose falls do not lead to injury tend to underreport falls.[47] Nevertheless, the directions of association in our data were plausible. Moreover, we believe that the inclusion of information from close proxy respondents for elderly people surveyors found unable to report because of cognitive impairment or other reasons likely diminished this bias.

Freedman and coworkers[48] called for efforts to compare the impact of various interventions and management strategies in efforts to reduce the prevalence of late-life disabilities in the U.S. population.[41] They cited falling as an example of an adverse event with targetable risk factors with evidence of effective general multidisciplinary treatment approaches. They noted that implementation of falls prevention management strategies globally might have a high impact on reducing disability at the population level. By expressing the maximum level of difficulty experienced for each of the six self-care activities, stages might form strata for which specific risk reduction strategies might be formed. Alternatively, surveillance by stage might prove effective in monitoring the effects of such programs over time. We further believe that stage strata may provide clinicians with a simple screening instrument for falls risk and that various guidelines might eventually be established for the care and disability management of people according to each ADL stage. Finally, predictive associations of the ADL stages along with predictive associations of the perception of unmet needs for home accessibility features as provided by the explanatory models presented are clinically important because they yield a deeper understanding of the combined functional and environmental factors that seem to place people at greater risk of falling.

Consistent with the bio-psycho-ecologic framework, predisposition to falling seems to be influenced by the magnitude and types of ADL limitations experienced and individuals' perceptions that needed home accessibility features are lacking. Consistent with the systematic review of findings from 74 studies,[44] our findings underscore that many factors are associated with falls. Moreover, as in multiple studies,[44] the estimated associations in our study were generally stronger for recurrent fallers than for single fallers. This could indicate that whereas people may fall once by chance, repeated falling in particular suggests a high-risk state. This interpretation is brought home by our finding that the few people at ADL-IV who fell at all fell multiple times.

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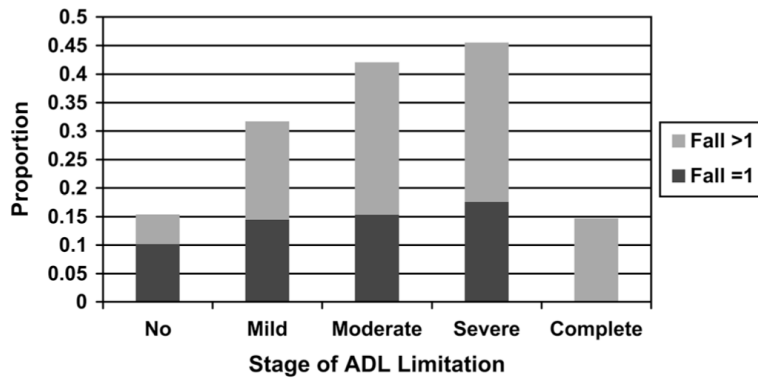
FIGURE 1.
The proportion of history of falling (once or multiple times) in the past year stratified by ADL stage. ADL, activity of daily living.

TABLE 1

Instructions for ADL stage assignment

Stages for ADLs	Threshold Definitions for ADL Stages
ADL-0 = no difficulty: no, absent, or negligible ADL limitation	The individual is able to eat, toilet, dress, transfer, bathe, and walk without difficulty (all = 0).
ADL-I = mild difficulty: slight or low-level ADL limitation	The individual is able to eat and toilet without difficulty (=0), dress and transfer with no more than some difficulty (1), and bathe and walk with no more than a lot of difficulty (2).
ADL-II = moderate difficulty: medium or fair ADL limitation	The individual is able to eat without difficulty (=0), use the toilet, dress, and transfer with no more than a lot of difficulty (2), and possibly be unable to bathe and walk (3).
ADL-III = severe difficulty: high or extreme ADL limitation	The individual is able to perform at least one ADL (i.e., eat, toilet, dress, transfer, bathe, or walk) with or without assistance but does not meet the defined threshold for stage II.
ADL-IV = complete difficulty: total ADL limitation	The individual must be unable to eat, toilet, dress, transfer, bathe, and walk (all = 3).

A similar version of this table appeared in Stineman MG, et al. (NIHMSID:281837).[31]

A rating of 0 for an activity indicates no difficulty, 1 indicates some difficulty, 2 indicates a lot of difficulty, and 3 indicates unable. ADL, activity of daily living.

TABLE 2

History of falling in the past 12 mos in community-dwelling persons 70 yrs or older[a]

Predictor Variables	Total Sample (*n* = 9250)	None (*n* = 7287, 78.8%)	Falls 1 (*n* = 1060, 11.5%)	>1 (*n* = 903, 9.8%)	*P*
Sex					
Male	3678 (39.8)	2991 (81.6)	342 (9.1)	345 (9.3)	<.001
Female	5572 (60.2)	4296 (76.9)	718 (13.1)	558 (10.0)	
Race					
White	7912 (85.5)	6206 (78.6)	943 (11.8)	763 (9.5)	<.05
Black	977 (10.6)	786 (79.2)	90 (9.7)	101 (11.0)	
Other	361 (3.9)	295 (81.9)	27 (7.3)	39 (10.8)	
Age, yrs					
70–74	4268 (46.1)	3524 (82.3)	427 (10.1)	317 (7.6)	<.001
75–79	2491 (26.9)	1969 (79.2)	297 (11.7)	225 (9.1)	
80–84	1551 (16.8)	1151 (74.7)	200 (13.0)	200 (12.3)	
85	940 (10.2)	643 (68.3)	136 (14.9)	161 (16.8)	
High school graduate					
Yes	5358 (57.9)	4275 (80.1)	622 (11.5)	461 (8.4)	<.001
No	3892 (42.1)	3012 (77.0)	438 (11.4)	442 (11.5)	
Lives alone					
Yes	3253 (35.2)	2448 (75.4)	439 (13.5)	366 (11.1)	<.001
No	5997 (64.8)	4839 (80.7)	621 (10.4)	537 (8.9)	
Lack of home accessibility features					
Yes	592 (6.4)	343 (57.6)	93 (16.0)	156 (26.3)	<.001
No	8658 (93.6)	6944 (80.2)	967 (11.2)	747 (8.6)	
Stroke					
Yes	764 (8.3)	492 (64.6)	116 (14.9)	156 (20.5)	<.001
No	8486 (91.7)	6795 (80.1)	944 (11.2)	747 (8.7)	
Cardiopulmonary					
Yes	3119 (33.7)	2305 (73.9)	402 (13.2)	412 (12.9)	<.001
No	6131 (66.3)	4982 (81.3)	658 (10.6)	491 (8.0)	

Predictor Variables	Total Sample (*n* = 9250)	Falls			P
		None (*n* = 7287, 78.8%)	1 (*n* = 1060, 11.5%)	>1 (*n* = 903, 9.8%)	
Diabetes					
Yes	1097 (11.9)	789 (71.6)	141 (12.9)	167 (15.5)	<.001
No	8153 (88.1)	6498 (79.8)	919 (11.3)	736 (8.9)	
Cancer					
Yes	1559 (16.9)	1178 (76.4)	183 (11.6)	198 (12.1)	<.001
No	7691 (83.1)	6109 (79.3)	877 (11.5)	705 (9.2)	
Osteoporosis					
Yes	651 (7.0)	444 (68.4)	114 (17.8)	93 (13.9)	<.001
No	8599 (93.0)	6843 (79.7)	946 (11.0)	810 (9.4)	
Hypertension					
Yes	4049 (43.8)	3084 (76.1)	515 (12.8)	450 (11.1)	<.001
No	5201 (56.2)	4203 (80.9)	545 (10.5)	453 (8.6)	
Arthritis					
Yes	4312 (52.2)	3179 (73.6)	582 (13.7)	551 (12.6)	<.001
No	4938 (53.4)	4108 (83.4)	478 (9.5)	352 (7.1)	
Cognitive impairment					
Yes	491 (5.3)	302 (60.5)	66 (13.6)	123 (25.9)	<.001
No	8759 (94.7)	6985 (79.8)	994 (11.4)	780 (8.8)	
Major psychiatric disorders					
Yes	94 (1.0)	60 (62.6)	15 (16.2)	19 (21.2)	.001
No	9156 (99.0)	7227 (79.0)	1045 (11.4)	884 (9.6)	
ADL stage					
0: No	6629 (71.7)	5610 (84.6)	673 (10.2)	346 (5.2)	<.001
I: Mild	1503 (16.2)	1026 (68.3)	218 (14.5)	259 (17.2)	
II: Moderate	659 (7.1)	384 (58.0)	99 (15.3)	176 (26.7)	
III: Severe	414 (4.5)	229 (54.5)	70 (17.6)	115 (27.9)	
IV: Complete	45 (0.5)	38 (85.3)	0 (0.0)	7 (14.7)	

[a]Sample sizes (Ns) are unweighted and the proportions (%s) are weighted. The first column is N (sample weighted column %). The remaining 3 columns are N (sample weighted row %).

TABLE 3

RRRs for the perception of unmet needs for home accessibility features and ADL stages in the multinomial logistic regression after adjusting for sociodemographics and diagnostic categories[a]

Predictor Variable	Outcome: Number of Falls (Reference: No Falls)	
	1	>1
Lack of home accessibility features	1.42 (1.07–1.87)[b]	1.85 (1.44–2.36)[c]
ADL stages		
Mild limitation	1.38 (1.16–1.63)[c]	2.94 (2.38–3.62)[c]
Moderate limitation	1.53 (1.14–2.05)[d]	4.35 (3.38–5.60)[c]
Severe limitation	1.85 (1.32–2.60)[c]	4.30 (3.29–5.61)[c]
Complete limitation	0[e]	1.12 (0.45–2.76)

Values are presented as RRR (95% CI).

ADL, activity of daily living; CI, confidence interval; RRR, relative risk ratio.

[a] Models controlled for sociodemographics, education, living situation, health status, cognitive impairment, and major psychiatric disorder.

[b] $P < 0.05$.

[c] $P < 0.001$.

[d] $P < 0.01$.

[e] No event.