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# Risk Factors for Falls in Homebound Community-Dwelling Older Adults

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## Abstract

**Objective:** To examine risk factors associated with falls among homebound community-dwelling older adults, a vulnerable population often possessing functional disabilities and chronic conditions.

**Design:** The study was a cross-sectional study utilizing round 6 data of the National Health and Aging Trend Study (NHATS). Descriptive statistics and multiple logistic regression analyses were conducted.

**Sample:** A total of 1,356 homebound community-dwelling older adults aged 65 and above participated in the NHATS.

**Measurements:** The outcome variable was falls within the last month reported in NHATS. Independent variables were selected based on the NHATS disability conceptual model and literature review, including personal conditions, environmental conditions, and physical functioning limitations.

**Results:** In the sample population, 21.2% reported falls. Males were more likely to experience a fall than females. Hypertension or depression/anxiety increased risk for falls. Older adults with hearing impairment or balance problems limiting activities were also more likely to fall.

**Conclusions:** Public health nurses need to conduct thorough fall risk assessment for homebound older adults, especially those with chronic health problems or functioning limitations. Studies are needed to examine the association between home environment and falls in homebound older adults.

**Keywords:** older adults, falls, risk factors, homebound, public health nursing

## Introduction

Fall-related injury leads to impaired mobility, loss of independence, decreased quality of life, and death, especially in older adults. More than one fourth of community dwelling older adults aged 65 and older experience a fall (Bergen, Stevens, & Burns, 2016). Between 2007 and 2016, unintentional injury was the 8<sup>th</sup> leading cause of death among those aged 65 and older, and more than half (53.5%) of those deaths were fall-related (Centers for Disease Control and Prevention (CDC), 2018). The number of deaths related to falls between 2007-2016 increased at a rate of approximately 3% each year (Burns & Kakara, 2018). According to CDC estimates, approximately 3 million emergency department visits per year are related to falls (Hoffman, Hays, Shapiro, Wallace, & Ettner, 2017). A vicious cycle ensues as the initial fall results in potential weakness, instability, isolation, fear, subsequent additional falls, and

further injury – including death. In the United States, the financial impact of falls is significant. In 2015 it was estimated that fall related medical expenditures cost \$50 billion, with approximately 75% paid by Medicare and Medicaid (CDC, 2015; Florence et al., 2018). As the “baby boomer” generation continues to age, it is likely these injury and cost metrics will also rise.

Physiological changes associated with normal aging, as well as pathological aging, are associated with increased risk for falls. Uncorrected sensory changes to vision, hearing and balance make it difficult for obstacles to be observed or avoided while declining muscle strength and poor reflex response impair reactions (Ambrose, Paul, & Hausdorff, 2013). Significant risk factors for falls in older adults include impaired balance; chronic health conditions such as arthritis, depression, or anxiety; issues related to moving around in the home; a history of previous falls; and other functional limitations (Zhao, Alderden, Lind, & Kim, 2018). Many antihypertensive, analgesic, antidepressant, and anxiolytic medications are known to have neurologic side effects including blurred vision and dizziness, or are associated with impaired balance due to orthostatic hypotension (Ambrose et al., 2013).

While only about 20% of older adults are homebound or semi-homebound, older adults do spend the majority of their daily life at home, according to previous research (Cohen-Mansfield, Shmotkin, & Hazan, 2012; Musich, Wang, Hawkins, & Yeh, 2015). Other observational studies have found an association between being homebound and fall risk (Deandrea et al., 2010; Zhao et al., 2018), and several other studies have found an association between increased fall risk and functional disabilities due to multiple chronic diseases (Qiu et al., 2010; Vu, Dean, Mwamburi, Au, & Qiu, 2013). Home environment fall hazards such as poor lighting, loose floor rugs, clutter, and unstable furniture put homebound older adults at increased risk for falls (Ambrose et al., 2013; Ornstein et al., 2015). Falls associated with walking in the home, at ground level, are associated with the greatest mortality in older adults, mostly due to head injuries and hip fractures (Deprey, Biedrzycki, & Klensz, 2017).

Although evidence shows that homebound older adults are at higher risk for falls compared to non-homebound older adults, it is unclear what specific factors place homebound older adults at risk for falls. In the literature, few studies focus upon fall risks for homebound older adults in the community. Given the scarcity of evidence, there is a need to investigate the risk factors for falls among homebound older adults.

## Methods

### Design and Sample

The current study is a cross-sectional study. Data for the study were obtained from the National Health and Aging Trend Study (NHATS) website (<https://www.nhats.org>). The NHATS has collected data annually since 2011 (Round 1). Data included in this analysis were from Round 6 conducted in 2016. A total of 7,276 older adults participated in Round 6, and the current study includes the subset of 1,356 homebound community-dwelling older adults from this sample. Non-homebound community-dwelling older adults and those living in alternative residential care such as retirement communities or assisted living facilities are excluded from the study.

Sponsored by the National Institute on Aging, the NHATS is a national representative study intended to foster research to guide efforts to promote health and independent functioning, reduce disability, and improve quality of life in older adults. The NHATS samples consist of older adults aged 65 and older enrolled in Medicare, including oversamples of African Americans and the oldest-old (age > 90). The NHATS collects extensive information on respondents' sociodemographic characteristics, health conditions, physical functions, and home environmental conditions through personal interviews and observations (Kasper & Freedman, 2017).

### Measures

**Homebound Status.** Homebound status was defined based on measures developed by Ornstein and associates (2015), including definitions for total homebound and semi-homebound. Participants were defined as total homebound if they never or rarely went out the home. Semi-homebound participants were those who needed help going out of the home and would “never,” “rarely,” or “sometimes” go out by themselves, or they had “a lot,” “some,” or “a little” difficulty going out by themselves without help.

**Falls.** One or more falls within the last month reported by the participants was the outcome variable. According to the NHATS, falls are defined as any fall, slip, or trip in which the participant loses balance and lands on the floor, ground, or at a lower level (Kasper & Freedman, 2017). In NHATS interview, participants were asked to report if they had experienced such a fall (yes or no) within the past month prior to the NHATS survey.

**Risk Factors.** Potential risk factors for falls were selected based on the NHATS disability conceptual model and literature review. These factors included sociodemographic characteristics, chronic diseases, physical functioning, and environmental factors (Deandrea et al., 2010; Kasper & Freedman, 2017; Wing, Burke, Clarke, Feng, & Skolarus, 2017). All risk factors are based on self-report, except environmental safety hazards which were based on interviewer observation.

**Sociodemographic Characteristics.** Sociodemographic characteristics consisted of age, gender, race/ethnicity, education, and living arrangement. Age was categorized into 5-year groups (65-69, 70-74, 75-79, 80-84, 85-89, and  $\geq 90$ ). Race/ethnicity was classified as non-Hispanic White, non-Hispanic Black, non-Hispanic others, and Hispanic. Education was categorized into 3 groups (less than high school, high school, and higher than high school). Gender (men or women) and living arrangement (living alone or with others) were dichotomous variables.

**Chronic Diseases.** Chronic diseases included physical and mental health conditions. Physical medical conditions consisted of heart attack/heart disease, arthritis, osteoporosis, diabetes, lung disease, stroke, and dementia, each coded as yes or no based on patient self-report. Depression or anxiety was measured with the Patient Health Questionnaire (PHQ-2) or Generalized Anxiety Disorder Scale (GAD-2). The participants were classified as having depression or anxiety problem if either PHQ-2 or GAD-2 score was greater than or equal to 3 (Kroenke, Spitzer, Williams, & Löwe, 2010).

**Functional Status.** Functional status was evaluated with activities of daily living (ADL), instrumental activities of daily living (IADL), and several other physical conditions that limited daily activities. ADL needs (eating, bathing, toileting and dressing) and IADL needs (laundry, grocery shopping, meal preparation, banking or paying bills, and medication tracking) were dichotomous variables, coded as present if the participant reported difficulty with, or needing assistance with, one or more of the included activities.

Four additional potential risk factors reflecting physical limitations were created based on reported limitations due to lower body strength limitations, balance and coordination problems, difficulty moving around the house, or pain (each coded yes or no). Difficulty moving around the house was coded as “yes” if the participant reported needing help moving around the home, holding walls while moving around in the home, or having difficulty getting around without a device.

Vision and hearing difficulty were assessed using several items collected in NHATS. Participants were identified with a vision problem if they wore glasses, contacts, or other vision aids, could not see well enough to recognize someone across the street, could not watch television across the room, or could not see well enough to read newspaper print. Hearing difficulty was defined as the participant having any of the following hearing problems: a) being deaf; b) using a hearing aid; c) not being able to hear well enough to use a telephone; d) not being able to carry on a conversation with a radio or TV playing in a room; e) not being able to carry on a conversation in a quiet room.

**Environmental Factors.** Environmental factors consisted of four bathroom modification factors (grab bar in the shower/ tub, grab bar near the toilet, shower seat in the shower/tub, and raised toilet or toilet seat) and six home safety hazard factors (peeling paint, pests, broken furniture, flooring problems, tripping hazards, and clutter). Each factor was dichotomized based on the presence of one or more bathroom modifications (yes = 0, no =1) and one or more home safety hazard factors observed by an interviewer or reported by a participant (yes =1, no =0).

### **Analytic Strategy**

STATA<sup>®</sup> 14 (StataCorp, 2015) was used for data analyses. Bivariate analyses with a chi-square test were carried out to examine unadjusted associations between falls and different factors. Multiple logistic regression analyses were conducted to identify risk factors for falls in this cohort. Several steps were conducted for final regression model selection. At first, a series of preliminary models were built for each group of independent variables. Model 1 included

14 sociodemographic characteristics. Model 2 had eight chronic diseases. Model 3 included ADLs, IADLs, and other functional status variables. Model 4 consisted of home environmental factors, including bathroom modifications and home safety hazards.

The second step of the analyses was to select variables for combined models. In each preliminary model, variables with  $p$  values  $\leq 0.20$  were selected to be included in the combined models. Prior to the final model determination, multiple combined models were tested by using the Akaike information criterion (AIC) value and the receiver operating characteristic (ROC) curve as the goodness of fit statistics. The final regression model with the best goodness of fit statistics consisted of nine significant variables, including two demographic characteristics (age  $\geq 90$ , male gender), four chronic diseases (depression/anxiety, heart disease, hypertension, dementia), and three functional status factors (difficulty getting out of bed, balance limits activities, hearing difficulty).

## Results

Table 1 lists the results of the descriptive and bivariate statistical analyses. More than one fifth (288) of the 1,356 homebound older adults had a fall within the month prior to the NHATS 2016 survey. The majority of the respondents were older Caucasians. Females accounted for more than 50% in both fallers and non-fallers. Arthritis and hypertension were the two most common diseases among the participants. Difficulty moving around was the most prevalent problem in functional status, and participants reported more IADL needs than ADL needs. Home clutter presented as the most common home safety hazard. More than 50% of the participants had each of the four bathroom modifications except for grab bars in the shower or bath tubs. According to the results of bivariate tests, several sociodemographic (gender, living arrangement) and chronic diseases (depression/anxiety, dementia) were significant predictors, while almost all functional status factors presented as significant except for shopping, cooking, banking, and vision impairment. None of the environmental factors were significant predictors.

Table 2 shows the results of the final logistic regression analysis. The final model included 1,340 of 1,356 participants (98.8%) with nine significant variables. Among sociodemographic and chronic diseases, advanced age ( $> 90$ ) (OR = 0.57,  $p = 0.023$ ) and heart diseases (OR = 0.655,  $p = 0.05$ ) were protective factors, while four factors were significant risk factors including male gender, depression/anxiety, hypertension, and dementia. Male homebound older adults were 50% more likely to fall than their female counterparts (OR = 1.584,  $p = 0.006$ ). Older adults with hypertension (OR = 1.614,  $p = 0.037$ ), depression or anxiety (OR = 1.269,  $p = 0.042$ ), and dementia (OR = 1.628,  $p = 0.017$ ) were at increased risk for falls compared to older people without these health problems. Among functional status factors, difficulty getting out of bed was the strongest significant risk factor (OR=1.804,  $p=0.001$ ). Older adults with difficulty getting out of bed were 80% more likely to experience a fall compared to those without difficulty. Older adults with impaired hearing (OR = 1.558,  $p = 0.035$ ) or experiencing balance problem limiting activities (OR = 1.646,  $p = 0.008$ ) were more likely to fall than those without the functional problems.

## Discussion

In this study, we utilized national data to investigate specific factors associated with falls in homebound community-dwelling older adults. To date, this is the first study examining fall risk factors specific to homebound community-dwelling older adults. The previous studies cited here typically include all community-dwelling older adults. As outlined below, for many risk factors our findings are consistent with previous work while in a few areas our findings are different.

We found that advanced age was a protective factor for falls. The oldest-old ( $>90$ ) were 57% less likely to fall than those younger than 90. In the literature, findings on the relationship between advanced age and falls are inconsistent. In general, advanced age is identified as a risk factor for falls in community-dwelling older adults (Ambrose et al., 2013; Deandrea et al., 2010). However, a recent study suggests that increasing age was a protective factor for falls in both homebound and non-homebound community-dwelling older adults (Casteel, Jones, Gildner, Bowling, & Blalock, 2018). The reason that oldest-old are less likely to report falls might be due to their lower level of physical activities (Ramires et al., 2018) or the selective survival bias, in which the oldest-old are more likely to be removed due to death or moving into a nursing care facility because of falls (Glymour & Greenland, 2008). Among demographic factors, male gender was identified as a significant risk factor for falls. This finding is consistent with the findings from several recent studies (Casteel et al., 2018; Zhao et al., 2018) although females were also identified as a fall risk factor in early studies (Ambrose et al., 2013; Deandrea et al., 2010). More research to investigate the associations between age and gender are needed given the inconsistency in the literature.

We identified several chronic diseases associated with falls. Having depression or anxiety, dementia, or hypertension placed homebound older adults at significant risk for falls. These findings are consistent with the existing literature. The positive associations between falls and depression or anxiety among older adults were identified in several systematic reviews and meta-analyses (Hallford, Nicholson, Sanders, & McCabe, 2017; Kvelde et al., 2013). Findings from a recent study suggested that older adults with cognitive impairment, such as dementia, were at higher risk for falls and injuries due to executive dysfunction and attention deficits. Since activities of daily living and walking require executive function and attention to perform the tasks, cognitively impaired older adults with low performance in attention and executive function are vulnerable to falls (Montero & Speechley, 2018). Hypertension was identified as a significant fall risk factor among chronic diseases. Although previous studies show that older adults with hypertension had less stable gaits and worse performance on the timed Up and Go test (Ambrose et al., 2013), findings from a systematic review on the association of cardiovascular disorders and falls show inconsistent associations between hypertension and falls (Jansen et al., 2016). Considering the increased risk of falls for older adults with dementia, depression or anxiety, when performing fall risk assessment, public or community health nurses need to evaluate older adults' cognitive function and mental health status, including attention and executive function.

Among all factors, we found that having difficulty getting out of bed and balance problems limiting activities were the top two risk factors associated with falls in homebound older adults. It is not surprising that older adults having difficulty getting out of bed were at increased risk for falls. Although no previous studies on the specific association between falls and difficulty getting of bed are identified in the literature, research shows that homebound older adults often have impaired mobility, which is associated with high risk for falls (Ambrose et al., 2013). The finding that having balance problems limiting activities is a fall risk factor is consistent in previous studies (Ambrose et al., 2013; Muir, Berg, Chesworth, Klar, & Speechley, 2010; Tinetti, & Kumar, 2010). Given the strong associations of falls and impaired balance and mobility, especially difficulty getting out of bed, public or community health nurses should pay special attention to homebound older adults' balance and mobility, and take appropriate interventions to prevent falls as needed.

Consistent with the existing literature, hearing impairment was identified as a significant risk factor for falls in homebound community-dwelling older adults (Agmon, Lavie, & Dumas, 2017; Wilson, Garner, & Loprinzi, 2016). Hearing impairment often negatively impacts postural control and balance, which can further cause falls in the older adults (Agmon et al., 2017). Assessing older adults' hearing function and assisting older adults with hearing impairment may help prevent falls in the homebound older adult population.

### **Limitations**

The limitations of this study are similar to those of all secondary data analyses. As self-reported data, the NHATS data may have reporting errors or recall bias. Data were not collected for the specific purpose of evaluating fall risk and as such did not include all information that would have been desirable. For example, medications were not available in the NHATS data set, which presented a limitation because many medications are associated with impaired balance (Ambrose et al., 2013). The sample included only homebound community-dwelling older adults participating in Medicare services and NHATS oversampled African American older adults. In addition, older adults who experienced a fall that resulted in a prolonged rehabilitation/skilled nursing facility or death were not included in the NHATS data. These individuals may have risk factors different from the study sample. Therefore, the generalizability of the study findings may be limited.

### **Conclusions**

Falls in community-dwelling older adults are a serious public health concern. Homebound adults are a vulnerable population at high risk for falls. This study examined risk factors contributing to falls specifically in homebound community-dwelling older adults. The findings from this study suggested that male homebound older adults, older adults with depression or anxiety, dementia, hypertension, or certain functional problems including balance and mobility problems and hearing impairment were at increased risk for falls. These findings have important implications for public health nursing practice and research. Given the vulnerable status of the homebound older adults, public health nurses need to assess homebound older adults' fall risks by including demographic characteristics, chronic diseases, and functional limitations. Thorough assessments of risk factors for falls will allow public health nurses to develop appropriate fall prevention interventions.

## References

- Agmon, M., Lavie, L., & Dumas, M. (2017). The association between hearing loss, postural control, and mobility in older adults: A systematic review. *Journal of the American Academy of Audiology*, 28(6), 575–588. doi:10.3766/jaaa.16044
- Ambrose, A. F., Paul, G., & Hausdorff, J. (2013). Risk factors for fall among older adults: A review of the literature. *Maturitas*, 75, 51-61. doi:10.1016/j.maturitas.2013.02.009
- Bergen, G., Stevens, M. R., & Burns E. R. (2016). Falls and fall injuries among adults aged  $\geq 65$  years – United States, 2014. *MMWR Morb Mortal Wkly Rep*, 65(37), 993-998. doi:10.15585/mmwr.mm6537a2
- Burns, E., & Kakara, R. (2018). Deaths from falls among persons aged  $\geq 65$  years – United States, 2007-2016. *MMWR Morb Mortal Wkly Rep*, (67)18, 509-514.
- Casteel, C., Jones, J., Gildner, P., Bowling, J. M., & Blalock, S. J. (2018). Falls risks and prevention behaviors among community-dwelling homebound and non-homebound older adults. *Journal of Applied Gerontology*, 37(9), 1085–1106. doi: 10.1177/0733464816672043
- Centers for Disease Control and Prevention (CDC). (2015). Cost for falls among older adults. Retrieved from <http://www.cdc.gov/HomeandRecreationalSafety/Falls/fallcost.html>
- Centers for Disease Control and Prevention. (2018). National Vital Statistics Reports. Retrieved from <https://www.cdc.gov/injury/WISQARS/>
- Cohen-Mansfield, J., Shmotkin, D., & Hazan, H. (2012). Homebound older persons: Prevalence, characteristics, and longitudinal predictors. *Archives of Gerontology & Geriatrics*, 54(1), 55-60. doi:10.1016/j.archger.2011.02.016
- Deandrea, S. Lucenteforte, E., Bravi, F., Foschi, R., La Vecchia, C., & Negri, E. (2010). Risk factors for falls in community-dwelling older people: A systematic review and meta-analysis. *Epidemiology*, 21(5): 658-668. doi: 10.1097/EDE.0b013e3181e89905
- Deprey, S. M., Biedrzycki, L., & Klenz, K. (2017). Identifying characteristics and outcomes that are associated with fall-related fatalities: multi-year retrospective summary of fall deaths in older adults from 2005-2012. *Injury Epidemiology*, 4(1), 21. doi:10.1186/s40621-017-0117-8
- Florence, C. S., Bergen, G., Atherly, A., Burns, E., Stevens, J., & Drake, C. (2018). Medical costs of fatal and nonfatal falls in older adults. *Journal of the American Geriatrics Society*, 66(4), 693-698. doi:10.1111/jgs.15304
- Glymour, M. M. & Greenland, S. (2008). Causal diagrams. In K. J. Rothman, S. Greenland & T. L. Lash (Eds.), *Modern epidemiology* (pp. 183-212). Philadelphia, PA: Lippincott William & Wilkins.
- Hallford, D.J., Nicholson, G., Sanders, K., & McCabe, M.P. (2017). The association between anxiety and falls: A meta-analysis. *Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, 72, 729-741. doi:10.1093/geronb/gbv160
- Hoffman, G. J., Hays, R. D., Shapiro, M. F., Wallace, S. P., & Ettner, S. L. (2017). The Costs of fall-related injuries among older adults: Annual per-faller, service component, and patient out-of-pocket costs. *Health Services Research*, 52(5), 1794-1816. doi:10.1111/1475-6773.12554
- Jansen, S., Bhangu, J., de Rooij, S., Daams, J., Kenny, R. A., & van der Velde, N. (2016). The association of cardiovascular disorders and falls: A systematic review. *Journal of the American Medical Directors Association*, 17(3), 193–199. doi:10.1016/j.jamda.2015.08.022
- Kasper, J. D., & Freedman, V. A. (2017). National Health and Aging Trends Study user guide: Rounds 1-6 final release. Baltimore: Johns Hopkins University School of Public Health. Retrieved from [www.NHATS.org](http://www.NHATS.org).
- Kroenke, K., Spitzer, R. L., Williams, J. B., & Löwe, B. (2010). The patient health questionnaire somatic, anxiety, and depressive symptom scales: A systematic review. *General Hospital Psychiatry*, 32(4), 345–359. doi:10.1016/j.genhosppsy.2010.03.006
- Kvelde, T., McVeigh, C., Toson, B., Greenaway, M., Lord, S. R., Delbaere, K., & Close, J. C. (2013). Depressive symptomatology as a risk factor for falls in older people: Systematic review and meta-analysis. *Journal of The American Geriatrics Society*, 61(5), 694-706. doi:10.1111/jgs.12209
- Montero, O. M., & Speechley, M. (2018). Falls in Cognitively Impaired Older Adults: Implications for Risk Assessment And Prevention. *Journal of the American Geriatrics Society*, 66(2), 367–375. <https://doi.org/10.1111/jgs.15219>
- Muir, S. W., Berg, K., Chesworth, B., Klar, N., & Speechley, M. (2010). Balance impairment as a risk factor for falls in community-dwelling older adults who are high functioning: a prospective study. *Physical Therapy*, 90(3): 338-347.

- Musich, S., Wang, S. S., Hawkins, K., & Yeh, C. S. (2015). Homebound older adults: Prevalence, characteristics, health care utilization and quality of care. *Geriatric Nursing, 36*(6), 445-450. doi:10.1016/j.gerinurse.2015.06.013
- Ornstein, K. A., Leff, B., Covinsky, K. E., Ritchie, C. S., Federman, A. D., Roberts, L., ... Szanton, S. L. (2015). Epidemiology of the homebound population in the United States. *JAMA Internal Medicine, 175*(7), 1180-1186. doi:10.1001/jamainternmed.2015.1849
- Qiu, W. Q., Dean, M., Liu, T., George, L., Gann, M., Cohen, J., & Bruce, M. L. (2010). Physical and mental health of homebound older adults: An overlooked population. *Journal of the American Geriatrics Society, 58*, 2423-2428. doi:10.1111/j.1532-5415.2010.03161.x
- Ramires, V. V., Wehrmeister, F. C., Wendt Böhm, A., Galliano, L., Ekelund, U., Brage, S., & Mohnsam da Silva, I. C. (2017). Physical activity levels objectively measured among older adults: a population-based study in a southern city of Brazil. *International Journal of Behavioral Nutrition & Physical Activity, 14*, 1-9. doi:10.1186/s12966-017-0465-3
- StataCorp LP (2015). *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LP.
- Tinetti, M. E. & Kumar, C. (2010). The patient who falls: "It's always a trade-off". *JAMA: Journal of The American Medical Association, 303*(3), 258-266. doi:10.1001/jama.2009.2024
- Vu, L. N., Dean, M. J., Mwamburi, M., Au, R., & Qiu, W. Q. (2013). The association between executive function and mortality in homebound elders. *Journal of the American Geriatrics Society, 61*(12), 2128-2134.
- Wilson, S. J., Garner, J. C., & Loprinzi, P. D. (2016). The influence of multiple sensory impairments on functional balance and difficulty with falls among U.S. adults. *Preventive Medicine, 87*, 41-46. doi:10.1016/j.ypmed.2016.02.023
- Wing, J. J., Burke, J. F., Clarke, P. J., Feng, C., & Skolarus, L. E. (2017). The role of the environment in falls among stroke survivors. *Archives of Gerontology & Geriatrics, 72*, 1-5. doi:10.1016/j.archger.2017.04.007
- Zhao, Y. L., Alderen, J., Lind, B. K., & Kim, H. (2018). A comprehensive assessment of risk factors for falls in community-dwelling older adults. *Journal of Gerontological Nursing, 44*(10), 40-48. doi:10.3928/00989134-20180913-04



**Table 1.** Sample Characteristics

|                         | Homebound (N =1,356)    |                             | <i>p</i> |
|-------------------------|-------------------------|-----------------------------|----------|
|                         | Fallers<br><i>n</i> (%) | Non-Fallers<br><i>n</i> (%) |          |
| <b>Sociodemographic</b> |                         |                             |          |
| Age                     |                         |                             | .058     |
| 65-69                   | 26 (9.0)                | 75 (7.0)                    |          |
| 70-74                   | 55 (19.1)               | 155 (14.5)                  |          |
| 75-79                   | 52 (18.1)               | 182 (17.0)                  |          |
| 80-84                   | 60 (20.8)               | 207 (19.4)                  |          |
| 85-89                   | 55 (19.1)               | 228 (21.4)                  |          |
| >=90                    | 40 (13.9)               | 221 (20.7)                  |          |
| Gender                  |                         |                             | <.001    |
| Male                    | 116 (40.3)              | 313 (29.3)                  |          |
| Female                  | 172 (59.7)              | 755 (70.7)                  |          |
| Race/Ethnicity          |                         |                             | .192     |
| White, Non-Hispanic     | 175 (60.9)              | 599 (56.2)                  |          |
| Black, Non-Hispanic     | 65 (22.7)               | 310 (29.1)                  |          |
| Other, Non-Hispanic     | 17 (5.9)                | 56 (5.3)                    |          |
| Hispanic                | 30 (10.5)               | 100 (9.4)                   |          |
| Education               |                         |                             | .485     |
| Less than high school   | 100 (37.3)              | 355 (35.7)                  |          |
| High school             | 69 (25.8)               | 293 (29.5)                  |          |
| Higher than high school | 99 (36.9)               | 346 (34.8)                  |          |
| Living arrangement      |                         |                             | .027     |
| Living alone            | 68 (23.6)               | 323 (30.2)                  |          |
| Living with others      | 220 (76.4)              | 745 (69.8)                  |          |

| <b>Homebound (N =1,356)</b>   |                |                    |          |
|-------------------------------|----------------|--------------------|----------|
|                               | <b>Fallers</b> | <b>Non-Fallers</b> | <b>p</b> |
|                               | <b>n (%)</b>   | <b>n (%)</b>       |          |
| <b>Chronic Diseases</b>       |                |                    |          |
| Depression/Anxiety            | 139(48.3)      | 360 (33.7)         | <.001    |
| Heart disease                 | 88 (30.7)      | 351 (33.0)         | .449     |
| Hypertension                  | 245 (85.7)     | 875 (82.0)         | .146     |
| Arthritis                     | 243 (84.4)     | 858 (80.3)         | .12      |
| Osteoporosis                  | 112 (39.0)     | 396 (37.3)         | .590     |
| Diabetes                      | 112 (38.9)     | 386 (36.1)         | .391     |
| Lung disease                  | 83 (28.8)      | 303 (28.4)         | .881     |
| Stroke                        | 19 (6.6)       | 51 (4.8)           | .209     |
| Dementia                      | 76(26.4)       | 188 (17.6)         | .001     |
| <b>Functional Status</b>      |                |                    |          |
| ADL needs                     |                |                    |          |
| Eating                        | 80 (28.7)      | 225 (21.8)         | .017     |
| Bathing                       | 117 (40.6)     | 344 (32.2)         | .008     |
| Dressing                      | 191 (67.7)     | 582 (55.43)        | <.001    |
| Toileting                     | 112 (38.9)     | 338 (31.8)         | .024     |
| IADL needs                    |                |                    |          |
| Laundry                       | 168 (58.3)     | 575 (54.1)         | .20      |
| Shopping                      | 189 (65.6)     | 719 (67.5)         | .559     |
| Cooking                       | 159 (55.2)     | 573 (53.8)         | .682     |
| Banking                       | 146 (50.7)     | 511 (48.0)         | .414     |
| Mediation                     | 135 (48.9)     | 424 (41.5)         | .027     |
| Difficulty moving around      | 265 (92.1)     | 950 (88.9)         | .02      |
| Difficulty getting out of bed | 172 (59.7)     | 480 (44.9)         | <.001    |
| Strength limiting activities  | 183 (63.8)     | 590 (55.4)         | .011     |

| <b>Homebound (N =1,356)</b>  |                     |                     |                 |
|------------------------------|---------------------|---------------------|-----------------|
|                              | <b>Fallers</b>      | <b>Non-Fallers</b>  | <b><i>p</i></b> |
|                              | <b><i>n</i> (%)</b> | <b><i>n</i> (%)</b> |                 |
| Pain limiting activities     | 167 (58.2)          | 540 (50.8)          | .026            |
| Balance limiting activities  | 182 (63.2)          | 489 (46.0)          | <.001           |
| Hearing impairment           | 62 (21.5)           | 166 (15.5)          | .016            |
| Vision impairment            | 103 (35.9)          | 394 (37.0)          | .738            |
| <b>Environmental Factors</b> |                     |                     |                 |
| Bathroom modification        |                     |                     |                 |
| Grab bar in shower/tub       | 108 (37.5)          | 347 (32.5)          | .11             |
| Grab bar near toilet         | 187 (64.9)          | 653 (61.1)          | .24             |
| Shower seat in shower/tub    | 200 (69.4)          | 712 (66.7)          | .383            |
| Raised toilet/toilet seat    | 156 (54.2)          | 544 (51.0)          | .345            |
| Home safety hazards          |                     |                     |                 |
| Peeling paint                | 15 (5.6)            | 40 (4.0)            | .25             |
| Pests                        | 7 (2.6)             | 23 (2.2)            | .76             |
| Broken furniture             | 8 (3.0)             | 23 (2.3)            | .514            |
| Flooring problem             | 23 (8.6)            | 57 (5.7)            | .083            |
| Tripping hazards             | 41 (15.3)           | 125 (12.5)          | .221            |
| Clutters                     | 113 (44.0)          | 373 (40.10)         | .265            |

Abbreviations: ADL = activities of daily living; IADL = instrumental activities of daily living.

**Table 2.** Risk factors of falls among homebound older adults

| Predictors                    | OR (95% CI)          | <i>p</i> |
|-------------------------------|----------------------|----------|
| Advanced Age (>90)            | 0.570 (0.353, 0.921) | .023     |
| Male                          | 1.584 (1.144, 2.194) | 0.006    |
| Depression/anxiety            | 1.269 (1.009, 1.597) | 0.042    |
| Heart Disease                 | 0.655 (0.429, 0.999) | 0.050    |
| Hypertension                  | 1.614 (1.031, 2.529) | 0.037    |
| Dementia                      | 1.628 (1.094, 2.423) | 0.017    |
| Difficulty getting out of bed | 1.804 (1.284, 2.534) | 0.001    |
| Balance limiting activity     | 1.646 (1.146, 2.363) | 0.008    |
| Hearing impairment            | 1.558 (1.032, 2.351) | 0.035    |

Abbreviations: OR = odds ratio; CI = confidence interval.