Risk Factors for Falls and Fall-Related Injuries in Adults 85 Years of Age and Older

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Abstract

Background—Falls are a leading cause of morbidity and mortality in older adults. No previous studies on risk factors for falls have focused on adults 85 years and older, the most rapidly growing segment of adults.

Methods—We examined demographic, health, and behavioral risk factors for falls and fall-related injuries in adults 65 years and older, with a particular focus on adults 85 years and older. We analyzed self-reported information from the Behavioral Risk Factor Surveillance System (BRFSS) for 2008.

Results—Data was available for 120,923 people aged 65 or older and 12,684 people aged 85 or older. Of those aged 85 or older, 21.3% reported at least one fall in the past 3 months and 7.2% reported at least one fall related injury requiring medical care or limiting activity for a day or longer. Below average general health, male sex, perceived insufficient sleep, health problems requiring assistive devices, alcohol consumption, increasing body mass index and history of stroke were all independently associated with a greater risk of falls or fall related injuries. The greater risk of falling in those 85 years and older appeared to be due to the deterioration of overall health status with age; among those with excellent overall health status, there was no greater risk of falling in adults 85 years and older compared to those 65–84 years of age.

Conclusions—Our results suggest that those with risk factors for falls and fall-related injuries may be appropriate targets for evidence-based fall prevention programs.

Keywords

Falls; fall injury; older adults; risk factors

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1.1 Introduction

Falls are a major source of morbidity and mortality in older adults and were the cause of 45.4% of unintentional injury deaths in older adults in the United States in 2006 (CDC, 2009). In 2006, 40% of people over the age of 65 experienced at least one fall; 1 in 40 falls led to hospitalization and half of those hospitalized died within a year (Rubenstein, 2006). Other consequences of falls include mild to severe injury, loss of independence, fear, reduction of activity, and reduced quality of life (Brown, 2006). Injuries from falls are also a significant financial burden. In 2000, the direct medical costs associated with fall-related injuries were approximately $19 billion (Finkelstein and Miller, 2006) and are projected to rise as the population ages (Dubey et al., 1998).

Previous research has examined demographic (CDC, 2006), health and behavioral risk factors associated with falls (Finkelstein et al., 2007), (Stolee et al., 2009). For many factors (Guse and Porinsky, 2003), (Nelson et al., 1992), results have been inconsistent or based on studies in small populations such as one community or care facility (Bernstein et al., 1999), (O'Loughlin et al., 1993). Other studies have been limited to individuals with specific conditions such as osteoporosis (Miazgowski et al., 2008) or neuropathies (Richardson, 2002). A 2006 publication from the U.S. Centers for Disease Control and Prevention (CDC), (CDC, 2008) provides information on demographic risk factors but does not examine many potential risk factors such as behaviors and health status.

Among older adults, the risk of falling and fall-related injury is known to increase with increasing age. Compared with adults 65–69 years of age, adults 80 years or older have about a 50% increased risk of a self-reported fall or fall-related injury (CDC, 2008). Although fall risk increases with age and those aged 85 years and older are the most rapidly growing segment of the older adult population (Bureau of the Census, 2010), little is known of risk factors for falls in this high-risk population. Accordingly, we undertook a detailed analysis of risk factors associated with falls as well as the risk of injury associated with falls in Americans 85 years and older, with an analysis of those aged 65 to 84 for comparison. The large sample size available in the Behavioral Risk Factor Surveillance System (BRFSS) permitted detailed examination of risk factors in this group of the "oldest old" (Campion, 1994).

2.1 Methods

The BRFSS, which is conducted by the CDC in conjunction with state health departments, is a state-based system of telephone surveys that provides information about various health risk behaviors and outcomes. Using a multistage sampling design with random-digit-dialing, the BRFSS obtains a sample of the non-institutionalized adult population. Data is directly weighted for the probability of selection of a telephone number, the number of adults in a household, the number of telephones in a household, and the age and gender distribution of the population of the state. It is conducted monthly in all 50 states, the District of Columbia, and U.S. territories including Guam, Puerto Rico, and the U.S. Virgin Islands. Data is reported yearly via the BRFSS Web site (National Center for Chronic Disease Preventiona dn Health Promotion, 2009). Details of BRFSS procedures have been previously described (Nelson, 2001). The median response rate for all ages in 2008 was 53.3%; response rates increased with increasing age and were higher for females than males (CDC, 2008).

2.1.1 Variables

The dataset was initially restricted to individuals 65 years and older; analyses were then restricted to individuals 85 years and older. We evaluated risk factors for three fall-related outcomes:

- <u>Fall in the past 3 months:</u> A dichotomous falls variable was created with falls defined as having given a numerical answer greater than zero to the question, "*In the past 3 months, how many times have you fallen?*"

- <u>Fall-related injury in the past 3 months:</u> A dichotomous injury variable was created with injuries defined as having given a numerical answer greater than zero to the follow-up question "*How many of these falls caused an injury? By an injury, we mean the fall caused you to limit your regular activities for at least a day or to go see a doctor*." For our main analysis, those who had not fallen in the past 3 months were added to the "no" category for fall-related injury in order to show the total risk of injury from falls, instead of the conditional risk of injury among those experiencing a fall.

- <u>Injury among those falling:</u> A dichotomous variable in which injury was defined as having given a numerical answer greater than zero to the follow-up question "*How many of these falls caused an injury? By an injury, we mean the fall caused you to limit your regular activities for at least a day or to go see a doctor,*" and no injury was defined as answering zero to this question while also giving a numerical answer greater than zero to the question, "*In the past 3 months, how many times have you fallen?*"

In order to maximize the number of subjects included in the statistical analysis and thereby maximize statistical power, categorical variables that included missing data were recoded by reassigning missing values to separate "missing" categories.

Participants were considered not to have diabetes if they answered the question "Have you ever been told by a doctor that you have diabetes," with "no," "no, pre-diabetes or borderline diabetes," or "yes, but female told only during pregnancy." BMI was defined as self reported weight in kilograms divided by height in meters squared. The general health variable was the result of the question "Would you say that in general your health is:" with given options of "excellent, very good, good, fair, poor, don't know/not sure, refused." Health problems requiring assistive devices was defined as "yes" if the subject answered "yes" to the question, "Do you now have any health problem that requires you to use special equipment, such as a cane, a wheelchair, a special bed, or a special telephone? (include occasional use or use in certain circumstances)," "no," if the subject answered "no," and missing if the subject answered "don't know/not sure," or "refused." Activity limitation due to health problem was defined with the question "Are you limited in any activities because of physical, mental, or emotional problems?" Subjects were asked "Which one or more of the following would you say is your race? [Mark all that apply.]" If only one response was given, preferred race was defined as that response. If more than one response was given, preferred race was defined as the response to the question, "Which one of these groups would you say best represents your race?"

2.2 Statistical Analysis

Stata, release 10, was used for all statistical analysis; in particular, survey methodology which accounts for weighted data, was employed. Chi-square tests were used to compare fall risk and overall injury risk with demographic, behavioral, and health-related variables thought to be relevant. Factors associated with an outcome variable with a p-value <0.10 in bivariate analyses were then analyzed in multivariate logistic regression models to estimate odds ratios for the association of each risk factor with the outcome, controlling for the influence of the other factors in the model. Results from the regression models are presented as odds ratios (OR) with their 95% confidence intervals (CI).

To avoid problems with collinearity, associations of fall and injury risk with multiple measures of alcohol use were examined in separate logistic regression models.

3.1 Results

A total of 120,923 people aged 65 or older participated in the BRFSS in 2008. Of those, 20,430 individuals had experienced at least one fall in the past 3 months and 6,389 had experienced at least one fall-related injury. Fall and injury data were available for 12,684 people aged 85 or older. Of those 2,708 had experienced at least one fall and 912 had experienced a fall related injury. 3,026 people were between the ages of 90 and 94 and 480 people were age 95 or older. Complete demographic information for participants 85 years and older is given in Table 1. All subsequent percentages presented in this report reflect nationally representative weighted values.

One or more falls within the past 3 months were reported by 16.3% of those aged 65 and over, while injuries from those falls were reported by 5.1%. Within the 85 and over age group 21.6% reported at least one fall and 7.1% reported one or more injurious falls.

3.1.1 Fall Risk

In a multivariate analysis of participants 85 years or older, three demographic characteristics were associated with the risk of reporting having fallen in the past 3 months (Table 2). Males showed a 41% greater risk of falling than females. Compared to Whites, those identifying as Asian, Hawaiian, or Pacific Islander were found to have a 74% lower risk of falling. Compared to those 85–89 years of age, those 90–94 years of age had a 26% greater risk of falling (Table 2).

Five health and behavioral factors were associated with a significantly greater fall risk among adults 85 years or older in the multivariate analysis (Table 3). When tested as a continuous variable, increasing body mass index (BMI) was found to be associated with greater fall risk (OR=1.03, [1.02–1.03]) per unit of BMI. Compared to those reporting their general health status as excellent, respondents who said that their health was very good, good, fair, or poor were at increasingly elevated risk. Other factors associated with a greater fall risk included number of days of perceived insufficient sleep in the past month, health problems requiring assistive devices such as canes or walkers, consumption of at least one alcoholic beverage in the past 30 days, and history of stroke.

3.1.2 Injury Risk Among Those Falling

To assess risk factors for injuries among those over the age of 85 who had fallen, we compared those who fell in the past 3 months and suffered an injury with those who fell, but were not injured as a result (Tables 2 and 3). The risk of being injured in the case of a fall was greater in those using assistive devices and less in men and those who smoke every day.

3.1.3 Overall Risk of a Fall-related Injury

To assess risk factors for fall-related injuries in those over the age of 85, we compared those who fell in the past 3 months and suffered an injury from the fall with those who did not, either because they did not fall or because if they did fall, they were not injured as a result. Less than excellent general health status was strongly associated with the risk of a fall injury, with the risk progressively increasing over very good, good, fair, and poor health status. Use of assistive devices and alcohol consumption were associated with a greater risk of a fall injury while smoking every day and Asian, Hawaiian or Pacific Islander race were associated with a reduced risk.

3.1.4 Alcohol

In addition to whether any alcohol was consumed in the past 30 days, we assessed the association of four other measures of alcohol consumption on the risk of falling and of experiencing a fall-related injury. Total days of drinking in the past thirty days, average drinks on days of drinking, days of binge drinking (defined as 5 or more drinks for men and 4 or more drinks for women), and maximum drinks on any occasion were analyzed in separate logistic regressions. No significant associations were found between these other measures of alcohol use and fall risk or injury risk (Table 5).

3.1.5 Effect Modification of Risk Factors by Age

Many risks for falling, being injured if falling, and reporting a fall related injury are similar in those 65–84 years of age and in those in the 85 years and older group. Table 4 shows those risk factors demonstrating significantly different associations with the fall-related outcomes in the two age groups. Less than excellent health status was more strongly associated with both the risk of falling and the risk of a fall injury in those 85 years and older than in those 65 – 84 years of age. In contrast, activity limitations were more strongly associated with falling and fall injury in those 65 – 84 years of age. Males had a greater risk of falling than females in those 85 and older but not in the younger group. The reduction in the risk of falling in those identifying as Asian, Hawaiian, or Pacific Islander was more pronounced in the 85 and older group. In those 85 and older, but not the younger group, every day smoking was associated with a decreased risk of fall injury and of being injured if falling.

4.1 Discussion

Fall-related injuries are recognized as a major health problem of older adults. This large, nationally representative, study identified specific groups of adults 85 years and older who were at a significantly greater risk of falls or fall-related injuries, and compared them to those at increased risk in the 65 to 85 age group. Some factors associated with greater risk, such as BMI, alcohol consumption, and sleep problems are potentially modifiable and should be addressed accordingly. Other factors, such as age and sex are not modifiable, but could serve to identify high risk individuals who could be targeted for evidenced-based prevention programs. Interestingly, the increased risk of falling and fall-related injury associated with aging appeared to be due to the accumulation of other risk factors as people age, rather than intrinsic to aging itself.

Research has shown that it is possible to reduce fall risk through intervention programs (Hill-Westmoreland et al., 2002). Specific programs which have been shown to decrease incidence of falls include multidisciplinary, multifactorial, heal/environmental risk factor screening and intervention, muscle strengthening and balance retraining, home hazard assessment and modification, cardiac pacing, and Tai Chi (Gillespie, 2009). Fortunately, effective fall prevention interventions have been developed that target older adults of varying vigor and health status. For healthier, more active, individuals, exercise and balance programs such Tai Chi have been shown to be effective (Low et al., 2009). For less active individuals or those with a history of falling, multifaceted interventions such as Stepping On are effective (Clemson, 2004). Frailer community dwelling older adults have been shown to benefit from home assessment programs such as Sure Step (Mahoney, 2007). Medication adjustments coordinated with patients' primary care physicians have also been shown to be effective and could be applied to individuals on multiple medications, regardless of their underlying health status (Tinetti et al., 1995). Programs that emphasize exercise and balance have been shown to be particularly effective at decreasing fall related injuries (Low et al., 2009), (Costello and Edelstein, 2008). Our findings suggest interventions that result in

weight loss, specifically, structured exercise programs combined with appropriate diets (Okay et al., 2009) would hold particular promise in older adults who have a BMI greater than or equal to 35.

As reported previously, we found that sleep disturbances are associated with increased fall risk (Latimer et al., 2007). This is an important finding due to the high prevalence of sleep related problems in the elderly (Ancoli-Israel et al., 2008). A study by Stone and colleagues found an increased risk of 2 or more falls in a year in women aged 70 years and older when they slept 5 hours or less a night, independent of the use of benzodiazepines (Stone et al., 2008). Effective treatments for sleep disturbances in older adults include behavioral, exercise, and pharmacologic interventions Montgomery and Dennis, 2003), (Montgomery and Dennis, 2002), (Mottram et al., 2006). It is possible that addressing sleep problems in the elderly would reduce falls and fall related injuries, possibly leading to a significant reduction in injuries.

A number of specific diseases and general indices of health status, including diabetes (Miazgowski et al., 2008), stroke (Thurman et al., 2008), need for assistive devices (Fortin et al., 1998), and activity limitation (O'Loughlin et al., 1993) have been shown to be associated with increased incidence of falls. Our results confirm these findings in a nationally representative study. While use of assistive devices was associated with greater fall risk, previous research suggests that the association is due to factors predisposing older adults to falls, such as older age and decreased physical function being more common in those with a need for an assistive device. This does not suggest that assistive devices cause increased falls, and they may actually decrease fall risk Allman, 2009). Prevention programs should take these factors into consideration when identifying their target demographics.

The apparent lower risk of injury among those falling that was seen in every day smokers was surprising in light of previous research showing an increased risk of fractures in smokers, independent of bone mineral density (Kanis et al., 2009). The prevalence of smoking in adults 75 years and older is 5.1%, much lower than in younger adults (Schonenborn and Adams 2010). Only 2% of respondents 85 and older in this study smoked every day suggesting that those who smoke yet survive to that age are not only uncommon but may be atypical.

Certain risk factors, general health status and male sex, were more strongly associated with the risk of falling in the oldest age groups. For example, after the age of 85, men developed a greater risk of falling when compared to women, which was not seen in men aged 65 and older. Declining general health status increased the risk of both falls and fall related injuries in all people over the age of 65, but had an even greater effect on those over the age of 85. This should be taken into account when evaluating risk of falls and injuries in patients, as well as when designing prevention programs.

4.2 Limitations

Use of self-reported telephone survey data led to certain limitations in our study. Recollection of falls and fall-related injuries in the past 3 months may tax the memory of certain older adults. A comparison of prospectively collected fall data with six month retrospective data in older adults found an overall agreement of 84% Mackenzie, 2006). The false positive rate of the retrospective data in that study was 4% while the false negative rate was 13%, suggesting that retrospective self-reported on falls may underestimate their occurrence. Self report data on certain risk factors such as alcohol use and BMI, may not be completely accurate. Defining injury as anything which limited activity for at least a day makes it difficult to associate findings with morbidity or mortality because some factors, such as BMI are predictive of certain injuries (wrist fractures) and protective against others

(hip fractures), (Bernstein, et al., 1999). It is theoretically possible that certain factors that we have found associated with a greater risk of injury may have no effect, or even a protective effect against mortality. Further studies evaluating the frequency of falls and fall-related injuries could provide additional information. The restriction of the sample to non-institutionalized patients may influence results for risk factors, such as marital status, that are associated with the likelihood of institutionalization.

Finally, while numerous demographic, health, and behavioral characteristics were determined in the BRFSS, certain important factors were not. Factors such as physiologic profiles (Lord, 2003), past falls, and clinically detected abnormalities of gait and balance (Ganz, 2007), have been show to be associated with increased risk of falls, but were not included in BRFSS data and consequently could not be analyzed.

5.1 Conclusion

While it is commonly accepted that the elderly are more likely to fall, certain groups of elderly people are at even greater risk of falling and of fall related injuries. Continued research is needed on fall reduction strategies not only for those who are traditionally thought to be at increased risk of falling but also for those with deteriorating general health and those with a very high BMI. Further research on those in the oldest age groups is necessary in order to identify those at greatest risk and maximize impact of fall prevention programs.

Acknowledgments

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Table 1

Characteristics of survey participants 85 years of age and older, by falls and fall-related injuries, 2008, BRFSS

Characteristics	Falls		Fall-Related Injuries		Total Population
	Frequency	Percent	Frequency	Percent	
Age (years)					
85–89	1,972	21.2%	661	7.1%	9,301
90–94	610	24.0%	202	7.9%	2546
95+	126	26.3%	49	10.2%	480
Total					12,684
Gender					
Female	1,785	19.8%	645	7.1%	9,036
Male	923	25.3%	267	7.3%	3,648
Total					12,684
Preferred Race					
White	2,451	21.5%	829	7.3%	11,414
Black or African American	116	19.1%	37	6.1%	606
Asian, Hawaiian or Other Pacific Islander	28	16.5%	9	5.3%	170
American Indian or Alaska Native	26	28.6%	10	11.0%	91
Other	40	19.1%	13	6.2%	209
Missing	47	24.2%	14	7.2%	194
Total					12,684
Marital Status					
Married or member of an unmarried couple	586	22.2%	176	6.7%	2645
Divorced or separated	128	23.7%	41	7.6%	539
Widowed	1,888	20.9%	658	7.3%	9,027
Never married	101	23.4%	36	8.3%	432
Missing	5	12.2%	1	2.4%	41
Total					12,684
General Health					
Excellent	154	15.7%	51	5.2%	984
Very good	526	17.7%	161	5.4%	2,969

Characteristics	Falls		Fall-Related Injuries		Total Population
	Frequency	Percent	Frequency	Percent	
Good	881	19.9%	293	6.6%	4,430
Fair	688	24.1%	232	8.1%	2,856
Poor	424	33.2%	165	12.9%	1,277
Total					12,516
Activity limitation due to health problems					
No	1,377	17.8%	446	5.8%	7,747
Yes	1,298	27.0%	454	9.5%	4,799
Missing	94	68.1%	12	8.7%	138
Total					12,684
Number of days of insufficient sleep or rest in the past 30 days					
0	1,496	18.7%	511	6.4%	7,992
1–7	501	22.8%	157	7.2%	2,195
8–14	122	25.9%	46	9.8%	471
15–22	172	30.0%	68	11.7%	582
23–30	258	28.4%	85	9.4%	907
Total					12,147
Health problems requiring assistive devices					
No	1,219	15.8%	362	4.7%	7,694
Yes	1,482	29.8%	547	11.0%	4,970
Total					12,664
Smoking					
Not at all	2,612	21.4%	886	7.3%	12,208
Some Days	24	26.1%	8	8.7%	92
Every Day	55	20.9%	13	4.5%	263
Missing	1	100.0%	0	0.0%	1
Total					12,564
Alcoholic beverage in the past 30 days					
No	1,897	21.1%	646	7.2%	8,986
Yes	799	22.8%	264	7.5%	3,501

Characteristics	Falls		Fall-Related Injuries		Total Population
	Frequency	Percent	Frequency	Percent	
Missing	12	17.4%	2	2.9%	69
Total					12,556
Body Mass Index					
<20	262	19.8%	99	7.5%	1,320
≥20, <25	1,153	20.8%	382	6.9%	5,531
≥25, <30	893	22.3%	309	7.7%	4,003
≥30, <35	248	24.8%	67	6.7%	998
≥35	64	28.1%	22	9.7%	227
Missing	88	14.5%	33	5.5%	605
Total					12,684
History of Stroke					
No	2,233	20.1%	746	6.7%	11,102
Yes	456	30.3%	160	10.6%	1,507
Missing	19	25.3%	6	8.0%	75
Total					12,684
Diabetes					
No	2,270	25.3%	646	7.2%	8,986
Yes	429	12.3%	264	7.5%	3,501
Missing	9	13.0%	2	2.9%	69
Total					12,556

Frequencies for falls, injuries from falls, and total population reflect total survey participants, while percentages reflect weighted values.

Differences in totals are due to missing values for certain survey questions.

Prefered racial category is determined by the race participants reported they "most identify with."

Table 2

Demographic factors and risk of falls and fall-related injuries in people 85 years of age and older, 2008 BRFSS data

Characteristic	Fall in past 3 months		Injury among those falling		Fall-related injury in past 3 months	
	Odds Ratio	(95% CI)	Odds Ratio	(95% CI)	Odds Ratio	(95% CI)
Age (years)						
85–89	1.00	Reference	1.00	Reference	1.00	Reference
90–94	1.26	(1.03–1.55)	0.71	(0.51–1.00)	0.92	(0.71–1.21)
95+	1.14	(0.75–1.74)	1.47	(0.73–2.96)	1.28	(0.70–2.35)
Gender						
Female	1.00	Reference	1.00	Reference	1.00	Reference
Male	1.41	(1.18–1.69)	0.59	(0.43–0.82)	0.90	(0.67–1.20)
Preferred Race						
White	1.00	Reference	1.00	Reference	1.00	Reference
Black or African American	0.93	(0.62–1.42)	1.00	(0.47–2.16)	0.97	(0.47–1.98)
Asian, Hawaiian, or Pacific Islander	0.26	(0.13–0.52)	0.91	(0.26–3.21)	0.31	(0.11–0.87)
American Indian or Alaska Native	1.39	(0.62–3.13)	0.97	(0.28–3.31)	1.10	(0.36–3.34)
Other	0.89	(0.47–1.70)	0.70	(0.26–1.87)	0.86	(0.42–1.76)
Missing	1.46	(0.77–2.77)	0.43	(0.13–1.43)	0.75	(0.30–1.89)
Marital status						
Married	1.00	Reference	1.00	Reference	1.00	Reference
Divorced or separated	1.05	(0.72–1.54)	1.17	(0.58–2.36)	1.12	(0.62–2.04)
Widowed	0.90	(0.73–1.10)	1.14	(0.80–1.63)	0.98	(0.70–1.37)
Never married	1.36	(0.83–2.21)	0.75	(0.35–1.62)	1.01	(0.54–1.92)
Missing	1.61	(0.32–8.12)	0.82	(0.09–7.68)	1.27	(0.13–12.62)

Odds ratios for each factor are controlled for the factors shown here and general health, activity limitation due to health problems, perceived insufficient sleep, health problems requiring assistive devices, smoking, alcohol consumption, BMI, diabetes, and history of stroke.

Table 3

Health and behavioral factors and risk of falls and fall-related injuries in people 85 years of age and older, 2008 BRFSS data

Characteristic	Fall in past 3 months		Injury* among those falling		Fall-related injury in past 3 months*	
	Odds Ratio	(95% CI)	Odds Ratio	(95% CI)	Odds Ratio	(95% CI)
General Health						
Excellent	1.00	Reference	1.00	Reference	1.00	Reference
Very good	1.67	(1.18–2.37)	1.45	(0.76–2.79)	1.89	(1.01–3.52)
Good	2.15	(1.53–3.02)	1.75	(0.93–3.29)	2.66	(1.45–4.90)
Fair	2.34	(1.64–3.35)	1.96	(1.00–3.80)	3.02	(1.58–5.75)
Poor	3.01	(1.95–4.63)	2.03	(0.98–4.22)	3.90	(1.99–7.64)
Activity limitation due to health problems						
No	1.00	Reference	1.00	Reference	1.00	Reference
Yes	1.13	(0.94–1.36)	0.98	(0.73–1.33)	1.09	(0.85–1.40)
Missing	0.98	(0.45–2.14)	0.56	(0.15–2.05)	0.54	(0.18–1.59)
Perceived insufficient sleep or rest in the past 30 days†	1.01	(1.00–1.02)	0.99	(0.98–1.01)	1.00	(0.99–1.02)
Health problems requiring assistive devices	2.18	(1.82–2.62)	1.65	(1.20–2.29)	2.69	(2.02–3.59)
Smoking						
Never	1.00	Reference	1.00	Reference	1.00	Reference
Some days	1.24	(0.59–2.59)	2.02	(0.73–5.57)	1.90	(0.73–4.93)
Every day	0.83	(0.49–1.41)	0.33	(0.13–0.82)	0.31	(0.15–0.64)
Consumed at least one alcoholic beverage in the past 30 days						
Yes	1.19	(1.00–1.41)	1.19	(0.88–1.61)	1.30	(1.02–1.67)
Missing	4.25	(1.04–17.44)	0.70	(0.10–4.98)	1.67	(0.31–8.88)
BMI						
<20	1.00	Reference	1.00	Reference	1.00	Reference
≥20, <25	1.02	(0.75–1.39)	0.80	(0.49–1.30)	0.88	(0.60–1.30)
≥25, <30	1.00	(0.74–1.37)	0.99	(0.60–1.63)	1.04	(0.69–1.55)
≥30, <35	1.13	(0.76–1.68)	0.48	(0.24–0.99)	0.67	(0.33–1.36)
≥35	1.44	(0.79–2.63)	0.62	(0.21–1.86)	1.06	(0.41–2.77)
Missing	0.82	(0.45–1.48)	1.22	(0.43–3.42)	0.95	(0.39–2.321)

Characteristic	Fall in past 3 months		Injury* among those falling		Fall-related injury in past 3 months*	
	Odds Ratio	(95% CI)	Odds Ratio	(95% CI)	Odds Ratio	(95% CI)
Diabetes						
Yes	1.20	(0.97–1.50)	1.22	(0.82–1.81)	1.35	(0.97–1.87)
Missing	0.43	(0.13–1.37)	1.01	(0.06–17.53)	0.44	(0.05–3.48)
History of stroke						
Yes	1.32	(1.07–1.64)	0.87	(0.60–1.25)	1.13	(0.82–1.55)
Missing	1.66	(0.69–4.04)	0.96	(0.19–4.92)	1.72	(0.44–6.74)

Odds ratios for each factor are controlled for the factors shown here plus age, gender, preferred race and marital status.

*
Fall related injury is defined as an injury from a fall severe enough to cause limited activity for at least a day or require a visit to a physician.

†
Perceived insufficient sleep represents days in the past 30 when participants did not feel they got enough sleep or rest.

Table 4

Analysis of risk factors for falling, being injured if falling and experiencing a fall-related injury within that past 3 months, stratified by age, 2008 BRFSS data

Risk of Falling in the Past 3 Months

	65–84 years			85+ years		
Health Status						
Excellent	1.00	(Referent)		1.00	(Referent)	
Very Good	1.05	0.94	1.17	1.59	1.13	2.23
Good	1.13	1.01	1.26	2.00	1.44	2.78
Fair	1.25	1.10	1.42	2.12	1.51	2.98
Poor	1.63	1.41	1.88	2.68	1.76	4.06
Preferred Race						
White	1.00	(Referent)		1.00	(Referent)	
Black/African American	0.68	0.59	0.80	0.98	0.65	1.48
Asian, Hawaiian, Pacific Islander	0.70	0.48	1.04	0.30	0.16	0.58
American Indian, Alaska Native	1.02	0.74	1.39	1.53	0.67	3.50
Other race	1.04	0.81	1.34	0.96	0.50	1.85
Missing/unknown race	0.68	0.45	1.03	1.80	0.72	4.48
Sex						
Female	1.00	(Referent)		1.00	(Referent)	
Male	1.03	0.97	1.11	1.52	1.27	1.82
Activity Limitations						
No	1.00	(Referent)		1.00	(Referent)	
Yes	1.47	1.37	1.58	1.19	1.01	1.40
Missing	1.31	0.92	1.86	1.11	0.51	2.39

Risk of Being Injured if Fell

	65–84 years			85+ years		
Smoking						
None	1.00	(Referent)		1.00	(Referent)	
Some days	0.85	0.58	1.23	2.17	0.78	6.00
Every day	1.12	0.90	1.38	0.33	0.14	0.78

Risk of a Fall Injury in Past 3 Months

	65–84 years			85+ years		
Health Status						
Excellent	1.00	(Referent)		1.00	(Referent)	

	OR	95% CI		OR	95% CI	
Very Good	1.00	0.81	1.24	1.83	0.97	3.46
Good	1.13	0.92	1.39	2.48	1.34	4.59
Fair	1.39	1.11	1.74	2.67	1.41	5.08
Poor	1.95	1.53	2.48	3.17	1.66	6.07
<u>Activity Limitations</u>						
No	1.00	(Referent)		1.00	(Referent)	
Yes	1.65	1.46	1.86	1.16	0.92	1.48
Missing	1.16	0.67	1.99	0.57	0.20	1.65
<u>Smoking</u>						
None	1.00	(Referent)		1.00	(Referent)	
Some days	0.60	0.44	0.83	1.96	0.78	4.91
Every day	0.93	0.78	1.11	0.31	0.15	0.63

Odds ratios for each factor are controlled for the factors shown here plus age, gender, preferred race and marital status.

*
Fall related injury is defined as an injury from a fall severe enough to cause limited activity for at least a day or require a visit to a physician.

Table 5

Alcohol related factors and risk of falls and fall-related injuries in people 85 years of age and older, 2008 BRFSS data

Characteristic	Fall in past 3 months		Injury[*] among those falling		Fall-related injury in past 3 months[*]	
	Odds Ratio	(95% CI)	Odds Ratio	(95% CI)	Odds Ratio	(95% CI)
Consumed of at least one alcoholic beverage in past 30 days						
No	1.00	(1.00–1.00)	1.00	Reference	1.00	(1.00–1.00)
Yes	1.19	(1.00–1.41)	0.97	(0.86–1.10)	1.29	(1.01–1.67)
Missing	4.16	(1.03–16.86)	0.75	(0.25–2.27)	1.70	(0.32–8.89)
Total days of drinking in the past thirty days	1.00	(1.00–1.00)	1.00	(1.00–1.00)	1.00	(1.00–1.00)
Average drinks on days of drinking	1.05	(0.97–1.15)	1.01	(0.97–1.06)	1.10	(0.98–1.23)
Days of binge drinking	1.02	(0.95–1.08)	1.00	(0.97–1.03)	1.06	(0.99–1.13)
Maximum drinks on one occasion	1.01	(0.98–1.14)	1.00	(0.97–1.05)	1.12	(0.99–1.28)

Odds ratios for each factor are controlled for the factors shown here plus age, gender, preferred race, marital status, general health, activity limitation due to health problems, perceived insufficient sleep, health problems requiring assistive devices, smoking, alcohol consumption, BMI, diabetes, and history of stroke.

[*] All factors measured for past 30 days.

[†] Binge drinking defined as number of days of consumption of 4 or more drinks for women or 5 or more drinks for men.

[‡] Fall related injury is defined as an injury from a fall severe enough to cause limited activity for at least a day or require a visit to a physician.