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The Medical Costs of Fatal Falls and Fall Injuries among Older Adults

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Abstract

Older adult falls are a common, serious, and growing public health problem. Falls often result in substantial medical expenditures to treat falls related injuries. With the aging of the population, both the number of falls injuries and the resulting expenditures are expected to increase substantially. This study estimated the medical expenditures attributable to older adult falls using a methodology that can be updated annually to track these expenditures over time. In 2015, the estimated medical costs attributable to both fatal and nonfatal falls was approximately $50.0 billion. For nonfatal falls, Medicare paid approximately $28.9 billion, Medicaid $8.7 billion and private and other payers $12.0 billion. Overall medical spending for fatal falls was estimated to be $754 million. Measuring the medical costs attributable to falls will provide vital information about the magnitude of the problem and the potential financial impact of effective prevention strategies.

Keywords

Older adults; falls; medical costs; Medicare; Medicaid

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Introduction

Older adult falls are a common, serious, and growing public health problem. About 30% of older adults aged 65 and older fall each year [1, 2], and these falls often result in serious injuries, decreased mobility, and loss of independence [3, 4]. Only one-third of those who fall seek medical care [5]. With the aging of the "boomer" generation, the growth of the older population in the United States is accelerating. Problems with mobility, balance, and loss of muscle strength contribute to the likelihood of falling. In addition, people are living longer and living with chronic conditions like cardiovascular disease, diabetes and arthritis. These illnesses, as well as many of the medications used to treat them, can increase fall risk.

The high incidence, long-term effects, and costs of falls will impact our health care system increasingly as time goes on. Over the next 20 years, both the number of falls and the associated costs are projected to increase substantially [6]. This study estimates falls-attributable medical costs using a methodology that can be updated annually to track the impact of this rapidly evolving public health problem.

Although a number of studies have calculated the cost of fall injuries [7–12], the results are difficult to compare and update. Methods for estimating the medical costs of falls vary due to the differing methods used to identify falls or fall injuries, the treatment facilities and populations that are included, the perspective from which costs are measured (e.g. societal, payer, provider) and variations in modeling methods. For example, two recent studies estimated the health care costs for falls across all types of health care providers [13, 14]. These studies used multiple data sources to estimate the rate of falls and their associated costs, where falls were estimated using ICD 9 diagnosis and external cause codes. Research has shown that the fall rate estimated using ICD 9 and external codes can vary substantially based on the combination of codes used [15]. Another approach is to include all fall costs in a defined period following a medically treated fall by comparing fallers to non-fallers [7, 8, 16]. These studies have the benefit of measuring changes in costs induced by a fall, but use data that is specific to certain health care payers, and do not estimate costs for all health care spending associated with falls.

In this study, we proposed a different approach for estimating the costs of nonfatal falls by using data that contained comprehensive information on health care spending and collected information on non-fatal falls: the Medicare Current Beneficiaries Survey (MCBS). MCBS includes information on actual payments to hospitals and health care providers, including those excluded by other data sources (e.g. payments for professional services and actual payments received by hospitals). The MCBS was used to estimate the attributable fraction (AF) of medical expenditures associated with a reported non-fatal fall in the previous year, using the same methodology employed to estimate the health care costs attributable to smoking [17] and obesity [18]. This method treats falls as a risk factor for increased healthcare spending, and does not attempt to match falls to specific health care events. These estimates were then applied to data from the National Health Expenditure Accounts (NHEA) to derive the total health care expenditures associated with falls [19]. To measure the cost of fatal falls, we used the Web-based Injury Statistics Query and Reporting System (WISQARS) to obtain the latest counts and costs of fatal falls. This study produced estimates that are similar in

magnitude to prior estimates, but can be updated annually using vital statistics and national health care spending data.

Methods and Data

The incidence and costs of fatal and nonfatal falls were calculated separately because no single data source measured both fatal and nonfatal falls.

Fatal Falls

The 2015 incidence and health care-related costs of unintentional fatal falls among older adults were obtained from WISQARS [20]. Fatal injuries in WISQARS come from the National Center for Health Statistics Multiple Cause of Death (MCD) data. The MCD data are coded using ICD-10 with unintentional falls coded W00–W19. Health care costs for fatal falls were estimated using the WISQARS cost module that estimates the health care costs based on the place of death (on scene/at home, dead on arrival at the hospital, in an ED, in the hospital after admission, in a nursing home, in hospice). All cases, regardless of location of death, were assigned the average cost of coroner or medical examiner administration. Deaths recorded as having an autopsy performed had the average costs of an autopsy added. Deaths that occurred in health care facilities have the average costs for facilities included based on the diagnosis and mechanism of injury. Specific details of how the cost estimates were developed is available elsewhere [21]. All cost estimates were based on 2015 dollars.

Non-fatal Falls

The data source for the incidence and attributable cost of nonfatal falls was the MCBS Cost and Use file. MCBS is a nationally representative rolling cohort survey of Medicare beneficiaries. MCBS combines a survey of Medicare beneficiaries with Medicare administrative data from billing files that include Medicare payments for services provided. Self-reported survey data includes beneficiaries' demographics, living arrangements, health status, and physical functioning, as well as payments made by Medicare supplemental plans (both directly purchased and employer sponsored) and Medicaid for low-income beneficiaries. The survey also collects information on health services not covered by Medicare, most notably nursing home and other long term care. This analysis used data from the 2011 Cost and Use files limited dataset (the most recent survey year of the research team's data use agreement).

Sample

Of the 10,901 respondents in the 2011 MCBS, 10,102 completed the section on health status and functioning. The sample evaluated here included 3,460 individuals. Respondents were excluded if they were: under 65 years of age, employed, died during the survey period, in Puerto Rico, or in a long-term care facility. These exclusions were made because the health care spending measures were unreliable for these groups (e.g. employees may be covered by employer insurance, and it is difficult for employees to report how much the employer plan pays), or full year data were not available and may double count the fatal cost estimates (e.g. deceased during the survey year). Respondents were also excluded if they had a full year of

private managed care insurance or Medicare Advantage. The MCBS does not report spending for these respondents because of capitated payment.

Regression models of health care spending

To estimate the effect of falls on medical spending, we used a regression model with total individual spending as the dependent variable and falls, demographic, health and other factors as control variables. MCBS annually includes two falls questions: “Since (last interview), have you fallen down?” and “Since (last interview), how many times have you fallen down?” Both falls questions are contained within the Survey Health Status and Functioning file and the R61 Health Status Functioning questionnaire section. Because the primary focus of this study was to estimate the health care costs attributable to all falls, and not the increase in costs as the number of falls increases, this analysis used the first question to create a dichotomous variable representing having fallen/not having fallen in the past year.

Control variables included gender, race, age, income, education, region of residence, and health status measures including self-rated health, several chronic conditions (Table 1), and body mass index (BMI). The health status measures are associated with increased medical spending, and if excluded, their costs could incorrectly be attributed to falls. Regression models were estimated by health care payer category (Medicare, Medicaid (conditional on having coverage from this source), private/out-of-pocket/other) and service type category (hospital, physician/other health professional, dental, prescription drugs, and other). The regressions used a Generalized Linear Model (GLM) with a gamma distribution and a log link. In cases where there was a substantial percentage of observations with zero expenditures (for hospital, dental and other service types), a two-part model was used [22], which had a logit regression for any expenditures and a GLM model for expenditure level.

Attributable Fractions

The AF of medical expenditures is the percentage of total expenditures attributable to a particular condition or risk factor. The AF for nonfatal falls was calculated in two steps. First, total expenditures were estimated at the observed values of all independent variables in the regression model. Then, the hypothetical level of expenditures if no falls had occurred was estimated, with the “Any falls” variable=0 and all other independent variables left at their observed values. The AF due to falls was calculated as:

$$Falls\ AF = (Total\ expenditures - Total\ expenditures\ if\ no\ falls)/Total\ expenditures$$

The resulting fraction estimated the percentage of all expenditures that were attributable to falls, controlling for the other variables in the regression model. Bootstrap estimates were replicated 1000 times to develop a distribution of estimates for calculating confidence intervals.

The NHEA are produced annually by the Centers for Medicare and Medicaid Services and provide the official measure of the total annual dollar amount of health care consumption in the U.S. The NHEA provides spending amounts by type of service (e.g. hospital care, professional services, etc.) and by source of funds (e.g. out-of-pocket, private health

insurance, Medicare, Medicaid, etc.) annually [19]. The NHEA also provides periodic measures of spending by age, gender, and state of residence. In this study, we used the 2013 NHEA to measure overall health care spending by type of service and source of funds, and the 2012 age and gender report to estimate the share of expenditures for persons age 65 and older [23]. Detailed description of the NHEA methodology is available elsewhere [24].

Overall healthcare expenditure levels for the older adult population were extrapolated from the NHEA using a two-step process. First, the percentage of total national health expenditures for the age 65 and over population was derived from the 2012 estimates [23], which are the most recently published NHEA breakdowns by age. These proportions were estimated separately for each payer and service type category used in our regression models. Then, these proportions were multiplied by the total expenditure from the 2015 NHEA data for each payer and service type category. These calculations can be shown as:

$$\textit{Expenditures for 65 and over} = (\textit{expenditures for 65 and over} / \textit{total expenditures in current year}) * \textit{total expenditures}$$

Once the estimated expenditures for the 65 and over population were determined for each payer and service type category, these expenditure amounts were multiplied by the falls AF to estimate falls attributable expenditures:

$$\textit{Falls attributable expenditures} = \textit{expenditures for 65 and over in current year} * \textit{falls AF}$$

Confidence intervals for the expenditure estimates were calculated by using the upper and lower limits of the confidence intervals of the attributable fraction estimates.

Results

Fatal falls

WISQARS identified 28,486 unintentional fall deaths among people aged 65 and older in 2015. This represented a rate of 59.64 unintentional fall deaths per 100,000 population aged 65 and older. The estimated medical costs associated with these deaths were approximately $754 million in 2015.

Nonfatal falls

A quarter of older adults reported falling in the past year (Table 1). Of those who fell, over half (52.1%) fell once, 21.3% fell twice and 24.1% fell three or more times. Those who fell are significantly more likely to be female, Caucasian, older and lower income. Fallers also have significantly lower self-rated health, and report more chronic conditions. A substantial share of health care expenditures among adults aged 65 and older was attributable to falls (Table 2). Approximately 6.0% of Medicare expenditures, and 8.0% of Medicaid expenditures were attributable to falls. Other sources of payment, which included private insurance and out-of-pocket spending, had 5.0% of expenditures attributable to falls. These percentages suggest falls-attributable expenditures of $28.9 billion for Medicare, $8.7 billion for Medicaid and $12.0 billion for other payment sources. In 2015, the total health care spending attributable to falls totaled more than $49.5 billion dollars. The Medicaid

attributable fraction is only marginally significant ($p<0.10$), which may be due to the relatively small sample of persons covered by the program (n=571).

Health care expenditures attributable to older adult falls varied by service type (Table 3). About 4.4% of hospital expenditures ($12.9 billion), 5.7% of physicians and other health professionals expenditures ($10.8 billion) and 2.0% of prescription drug expenditures ($2.1 billion) were due to falls. The “Other” category had the highest falls AF, which included spending for home health services, long-term care facilities and durable medical equipment. Older adult falls accounted for 11.8% of expenditures in this category, which implied spending of $29.2 billion.

Discussion

Older adult falls impose a large economic burden on the U.S. healthcare system [6]. In this study, the estimated costs of fatal and nonfatal falls combined totaled approximately $50.0 billion. Almost 99% of this cost was attributable to health care for nonfatal falls. In comparison, a 2013 estimate of U.S. healthcare spending on medical events for specific conditions, estimated $38 billion (adjusted to 2015 dollars) in total spending for nonfatal older adult falls [14]. By applying an AF to the NHEA, the current study was able to incorporate a more comprehensive set of healthcare costs, including outpatient expenditures that were not directly associated with a hospitalization or ED visit.

This study estimated that Medicare spending attributable to nonfatal older adult falls totaled $28.9 billion. This estimate is consistent with estimates from prior studies of $30.8–$34.5 billion (adjusted to 2015) dollars, and validates the approach used here [13, 25]. Previous studies have used methodology similar to the current study and estimated Medicare costs for other causes of disease that are comparable with ours. For example, Finkelstein et al.,[18] estimated that Medicare expenditures attributable to obesity were $39 billion (data inflated to 2015 dollars from published 2008 estimate). Xu et al.,[17] estimated Medicare costs attributable to smoking were $48 billion (data inflated to 2015 dollars from published 2010 estimate). However, the obesity and smoking estimates included all persons covered by Medicare (including disabled persons under age 65), not only older adults as in our estimates.

The methodology used here estimated total health expenditures for falls across all payers and provides a more comprehensive picture of the economic burden of falls. Only two datasets, the MCBS and the NHEA, were required to produce the estimate for non-fatal falls. Since the NHEA is updated annually, this method can be used for yearly older adult falls health care cost estimates. About 10,000 Americans turn 65 each day [26] and people aged 85 years and older are the fastest growing segment of the older population [27] and those at highest risk for falls [1]. Therefore, the economic burden from falls is likely to increase substantially in the coming years [1]. Monitoring cost trends is important, because 75% of the cost of older adult falls is financed through public health insurance programs that are already financially stressed [14].

This study is subject to several limitations. The coding of cause of death for fatal falls may have varied across jurisdictions [28]. Health care costs of fatal falls were derived from secondary sources based on the average cost per case. Nonfatal falls were treated as a risk factor for increased health care spending and were estimated using regression modelling. If the likelihood of falls was correlated with comorbid conditions not in our model or by unobserved individual characteristics in our sample, the fall AF estimates would be biased. The study applied the falls AF based on community dwelling older adults who had fee-for-service Medicare coverage and were not currently employed, to all older adult health expenditures r. Excluded groups, such as those with Medicare Advantage plans or who were institutionalized—could have different fall rates and health care costs. Applying the falls AF to subsequent years of health care expenditure data assumed that the AF was constant over time. Summation of expenditures by service category produced an estimate of total expenditures that was approximately 12% larger than the total when summed by payer type ($55.4 billion). This discrepancy likely is due to the nonlinear models used to estimate the attributable fractions. Somewhat different results were produced when summing across different category definitions. However, the service category total was within the confidence interval of the payer category total (and vice-versa). Finally, there are many costs of older adult falls that are not addressed here, such as reduced quality of life and the cost to informal caregivers.

Preventive strategies that reduce falls among older adults could lead to a substantial reduction in health care spending. Evidence-based strategies including medication management, and strength and balance exercises (e.g., Tai chi), have been associated with reductions in older adult falls [29]. Strength and balance programs usually charge the participant, however some Medicare Advantage plans cover some of these programs. Multifactorial interventions, often conducted in clinical settings, address multiple fall risk factors. These types of interventions have been shown to reduce falls as much as 24% [29]. Screening and assessing for falls risk is one of the minimum requirements for the Medicare Annual Wellness Visit with no patient charge. Medicare also reimburses medication review by a pharmacist. However, most healthcare providers do not routinely screen patients for falls or conduct fall factor risk assessments to identify their patients who would benefit from prevention strategies [30].

To help healthcare providers implement the American and British Geriatrics Societies' clinical guidelines for the prevention of older adult falls, the Centers for Disease Control's Injury Center developed the STEADI (Stopping Elderly Accidents, Deaths, and Injuries) initiative incudes:

1. Screening older patients to identify their fall risk.
2. Assessing at risk patients to identify their modifiable fall risk factors.
3. Intervening by using effective strategies to reduce their patients' fall risk factors.

Clinical care is an important component of falls prevention. By broadly implementing and scaling up initiatives like STEADI, we can improve health and decrease the future economic burden caused by older adult falls.

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Table 1

Characteristics of older adults by whether or not they reported falling in the past year, Medicare Current Beneficiaries Survey, 2011

Characteristic	No Fall (% unless otherwise noted)	Fell (% unless otherwise noted)	p-value
Total	76.1	23.9	na
Number of falls			na
1		52.1	na
2		21.3	na
3		10.5	na
4		4.2	na
5		3.7	Na
6+		5.7	Na
Female	55.8	63.0	<.01
Caucasian	86.0	91.7	<.001
Average Age	76.5 years	78.4 years	<.001
Average income	$40,318	$37,688	<.001
Education *			
Less than High school	23.4	25.5	
High school graduate	24.2	23.2	
Some college	23.5	25.0	
College graduate	24.5	21.5	0.4126
Region *			
Northeast	15.7	12.3	
Midwest	23.0	26.1	
South	42.5	42.1	
West	16.6	17.6	0.0660
Self-rated general health *			
Excellent	17.7	11.3	
Very Good	34.1	24.7	
Good	30.7	31.1	
Fair	13.8	23.3	
Poor	3.2	9.3	<.0001
Depression	18.8	33.3	<.001
Hypertension/High BP	71.2	76.1	.01
Diabetes	24.0	32.8	<.001
Osteoporosis	22.3	30	<.001
Emphysema/asthma/COPD	17.7	24.0	<.001
Other heart conditions	11.7	14.4	.05
Stroke/brain hemorrhage	9.8	15.0	<.001

Characteristic	No Fall (% unless otherwise noted)	Fell (% unless otherwise noted)	p-value
High blood pressure within last 12 months	50.9	56.1	.01
Myocardial infarction within last 12 months	1.9	1.8	.8
Stroke/brain hemorrhage within last 12 months	1.7	3.2	.01
Legally blind	.6	.9	.3

na – not applicable

* p value based on a chi squared test of difference of distribution across categories

Table 2

Nonfatal Falls Attributable Fraction of Expenditures and Associated Health Care Spending, by Payer, 2011 Medicare Current Beneficiary Survey and 2015 National Health Expenditure Accounts

Payer	Attributable Fraction (95% CI)	Health Care Spending in billions (95% CI)
Medicare	6.0% (1.9%–10.0%)	$28.9 ($9.1 – $48.6)
Medicaid[a]	8.0% (−2.0% – 18.0%)	$8.7 (−$2.1 – $19.4)
Private/out of pocket/other	5.0% (1.2% – 8.8%)	$12.0 ($2.5 – $21.6)
Total		$49.5 ($9.5 – $89.6)

[a] n=571. AF for Medicaid is statistically significantly different from zero at the 10% level.

Table 3

Nonfatal Falls Attributable Fraction of Expenditures and Associated Health Care Spending, by Type of Service, 2011 Medicare Current Beneficiary Survey and 2015 National Health Expenditure Accounts

Service Type	Attributable Fraction (95% CI)	Health Care Spending (95% CI)
Hospital[a]	4.4% (−0.6% – 9.3%)	$12.9 (−$1.7 – $27.5)
Physician/Other Providers	5.7% (2.5% – 9.0%)	$10.8 ($4.7 – $16.9)
Dental	1.6% (−3.0% – 6.2%)	$0.4 (−$0.7 – $1.4)
Prescription Drugs	2.0% (−1.1% – 5.1%)	$2.1 (−$1.2 – $5.4)
Other[b]	11.8% (2.3% – 21.4%)	$29.2 ($5.6 – $52.9)
Total		$55.4 ($6.8 – $104.0)

[a] statistically significantly different from zero at the 10% level.

[b] Includes Other Health, Residential and Personal Care; Home Health Care; Nursing Care Facilities and Continuing Care Retirement Communities; Durable Medical Equipment; Other Nondurable Medical Products.