

Descriptive Analysis of Fatal Falls of Older Adults in a Midwestern County In the Year 2005

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ABSTRACT

Background and Purpose: Falls in older adults continues to be a serious problem worldwide. Falls are the leading cause of injury related deaths among older adults in the United States. Though, there have been many effective fall prevention programs reported, there is still a gap in the literature that addresses the effectiveness of interventions that prevent fall related deaths. The purposes of this study are to (1) carry out preliminary descriptive analyses on persons who died after a fall in the year 2005 in one Midwest county and (2) compare county data to national and international statistics. **Methods and Materials:** With cooperation of the County Medical Examiner, 103 death certificates and medical records of older adults who died due to complications after a fall from the year 2005 were retrospectively reviewed. Descriptive statistics were developed for: (1) demographics prior to the fall, (2) fall descriptors including activity, place of fall, and outcome of the fall, (3) outcomes after fall including: injuries incurred, cause of death, and days from fall to death. **Results:** Average age of people who died after a fall was 85.4 years. More than 50% of the fatal falls occurred in the home and resulted in a hip fracture. The most common cause of death was complications of a hip fracture with an average of 31 days from fall to death. **Conclusion:** Despite the recommendations regarding fall prevention, there still is a need to investigate the significant number of fatalities after falls.

Key Words: fatal falls, injury, older adults

INTRODUCTION

Falls are the leading cause of injury deaths in older adults.¹ More than 30% of community dwelling adults over 65 years fall each year and those adults living in institutions fall more.^{1,2} Falls are the leading cause of traumatic brain injury and cause the majority of fractures.^{1,3} Hip fractures after a fall cause the greatest number

of deaths.³ Furthermore, less than 50% of patients will regain their prior level of function after a hip fracture due to a fall.^{4,5} In the United States, between 1990 and 1998, the number of fall fatalities among people 65 and over, increased by 20%.⁶

Over the past 20 years there has been considerable investigation of predictors of falls⁷⁻¹³ and interventions to reduce fall risks.¹⁴⁻²⁰ There have also been meta analyses^{21,22} and studies^{23,24} that suggest exercise interventions and multifactorial approaches are effective in reducing falls. Despite this information, prevalence of falls and fall fatalities in older adults continue to be high around the world.²⁵⁻²⁷ Physical therapists are frequently involved in the care of patients after a fall and may be able to play a key role in preventing fall-related fatality. Understanding the sequel of events that lead to a fall and the events that occur shortly after a fall may be helpful in preventing post fall mortality. With this knowledge, physical therapists can tailor their examination to collect important data that may assist them in assessing the future fall risk and post fall complications of their patients and the need for specific interventions or referrals.

In order to understand factors contributing to fall-related mortality in a given community or county, description of fatal falls would be valuable. Descriptive statistics and comparisons can identify variables and trends that lead to further analyses and better understanding of factors that predispose individuals likely to experience complications after falls. Increased awareness of factors that lead to fatal falls has the potential to increase comprehensive post-fall care, update current recommendations on fall predictors, and future fall prevention.

The purposes of this study are to: (1) carry out preliminary descriptive analyses on persons who died after a fall in the year 2005 in a Midwest county, and (2) compare county data to national and international statistics.

SUBJECTS AND METHODS

Subjects were residents of a Midwestern county that has a population of 380,985, 12.9% of whom are 65 years or older.²⁸ Medical charts and death certificates of 103 residents, 60 years or older who died in the year 2005 due to a fall were reviewed and subject data were collected at the County Medical Examiner's office. The Medical Examiner had determined that a preceding fall was the cause of death. Records reviewed included the Medical Examiner's investigation and family communications, hospital, skilled nursing facility, and hospice records, as well as fall incident reports. A confidentiality agreement was developed between the academic institution and County Medical Examiner's office. Approval from the IRB from the author's academic institution was granted.

DATA ANALYSIS

Descriptive statistics (Microsoft Office Excel 2007) were calculated for the following variables: (1) demographics of older adults

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prior to the fall, including anthropometrics, number and types of comorbidities, residence, marital and activities of daily living (ADL) status, and number and type of medications; (2) fall descriptors including activity and place of fall and outcome of the fall; and (3) outcomes after the fall including: injuries incurred due to the fall, cause of death, and days from fall to death.

RESULTS

Description of Subjects

Average age of those who died after a fall was 85.4 ± 6.5 (70-97) years. All were Caucasian. Anthropometrics are listed in Table 1. The average number of comorbidities was 7.70 (SD 3.76, range 0-17). Hypertension (HTN) and cardiovascular disease were the most common comorbidity (73% and 62% respectively). Because there were 140 different comorbidities noted during the review of records, they were grouped into broader categories for descriptive purposes. Categories were determined by systems, such as gastrointestinal disorders, respiratory diseases, and neurological pathology. Those diagnoses that had a high frequency, impacted multiple systems, or have been implicated as specific risk factors for falls were kept as separate categories. For example, cognitive deficits were grouped in a single category, because they are an independent risk factor for falls, although they may be due to neurological or vascular system pathologies.^{29,30} Therefore cognitive deficits were kept as a separate category. The frequency and type of comorbidities prior to the fatal fall are listed in Figure 1.

Table 1. Anthropometrics* (n=103)

	Males		Females	
	Mean \pm SD	Range	Mean \pm SD	Range
Age (yrs)	84.7 \pm 5.9	70-97	85.7 \pm 6.7	71-97
Height (inches)	67.6 \pm 3.3	60.5-75	61.9 \pm 2.9	56-68
Weight (lbs)	163.7 \pm 35	108-260	121.6 \pm 31	65- 210
BMI [#]	25.2 \pm 5.1	16.7-40.4	22.2 \pm 5.0	12.8-33.3

* heights and weights were extracted from Medical Examiners examination post mortem
missing 9 subject's data
[#] BMI= body mass index

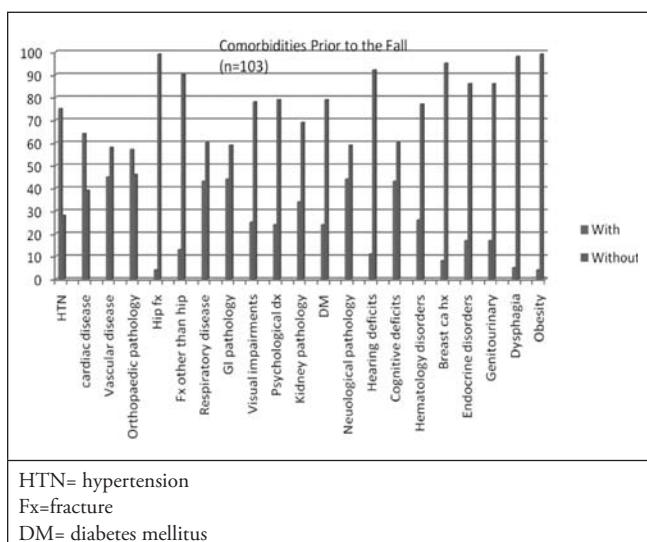


Figure 1. Comorbidities Prior to Fatal Fall (n=103)

Because of its high frequency, hypertension (HTN) was classified as a separate category and not grouped with cardiac or vascular disease. The broad category of orthopaedic pathology category included arthritis and osteoporosis/osteopenia; hip fracture and other fractures were counted as a separate category. Twenty (19.4%) subjects had a diagnosis of degenerative joint disease or arthritis listed in their medical records. When osteoporosis/penia was counted as a separate category there were 24 (23.3%) persons with osteoporosis/penia as a pre-fall comorbidity. The neurological pathology category can be further sorted into specific types of neurological disorders. Seven (6.7%) individuals had been diagnosed with Parkinson disease, 21 (20.3%) had prior cerebrovascular accidents (CVA), and 2 had prior head injuries.

Marital status prior to the fall is listed in Figure 2. At the time of fall, 49% of subjects resided in their own home or apartment, 30% lived in an assisted living facility, and 15% lived in a skilled nursing facility. Less than 2% of subjects were in hospice or hospital care at the time of the fall. No information about residence was available for 4% of the study sample. Fifty seven percent of the study sample was considered independent in their ADLs, including locomotion; 15% required assist for walking and transfers; 1% of the subjects were documented as modified independent in ADLs, and 2% were dependent in ADLs and required a wheelchair for locomotion. Activity of daily living information was not available for 25% of the subjects.

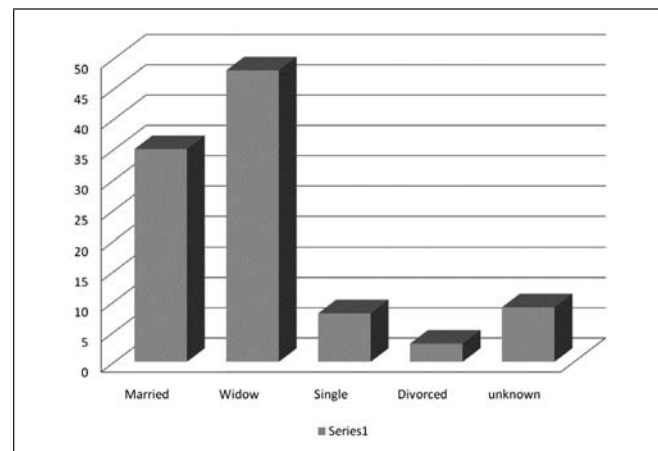


Figure 2. Marital Status

The average number of medications used prior to the fall was 6.5 medications (SD 4.5 range 0-30) (Figure 3). The most frequently used medications were aspirin, Furosemide (Lasix), and Warfarin (Coumadin). There were 13 subjects in which medication information was not available.

Fall descriptors

Activity during or prior to the fall and place of fall are listed in Tables 2 and 3 respectively. Walking was the most commonly reported activity prior to or during the fall; as such a fall could have been due to a slip or trip when walking. Because fall activity was recorded as it was documented in the medical record, slips and trips could be underreported. Walking in the bedroom was the most common activity of a fall and place of fall, with 18.4% of the falls occurring in this room. If the categories of outdoor/community, garage and gas station were combined, outdoors would have the same incidence as falls in the bedroom. In total, 52% of fatal falls occurred in the home.

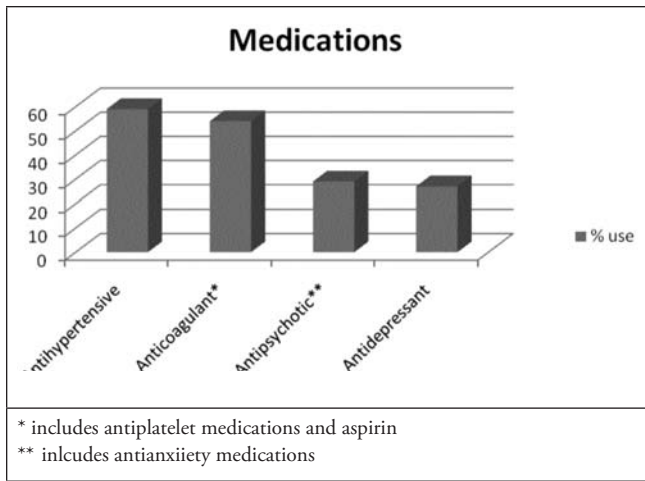


Figure 3. Medication Use

Table 2. Activity During or Prior to Fall

Activity	Frequency
Walking	43
Transfer	15
Tripped/slipped	6
Stairs	5
Sitting	3
Showering	3
Fall off ladder	2
Picking up an object from floor	2
Cooking	1
Standing task	1
Fall from w/c	1
Fall out of bed	1
Unknown	20
n= 103	

Table 3. Place of Fall

Place of fall	Frequency
bedroom	19
bathroom	16
outdoor/community	16
kitchen	7
stairs	5
hallway	3
dining room	2
living room	2
hospital room	2
garage	2
gas station	1
unknown	28
n=103	

Outcomes after fall

Injuries incurred due to the fall are categorized in Figure 4. Most persons (77%) who had a fatal fall suffered a fracture in the fall. The most common cause of death after a fall was complications from a hip fracture (52.4%) or subdural hematoma (17.4%). Frequencies of medical diagnoses as cause and secondary causes of death are listed in Table 4.

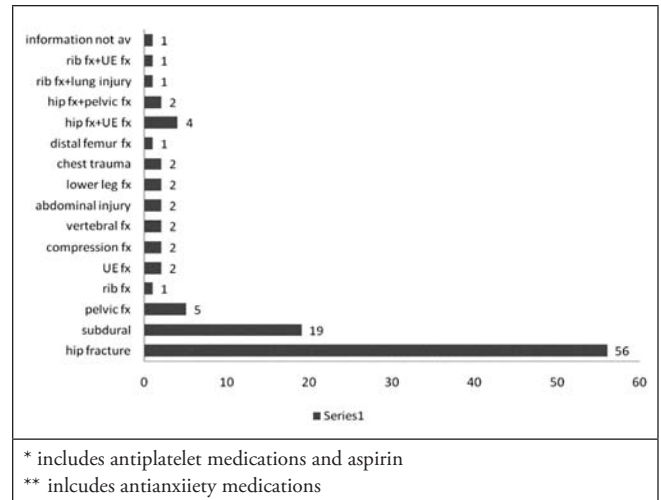


Figure 4. Outcome of Fatal Fall

Table 4. Cause of Death

Diagnosis on Death Certificate	Frequency	
	Primary	Secondary
Complications of hip fx*	54	5
Subdural hematoma/hemorrhage*	18	
Pelvic fracture #	5	
Failure to thrive	4	
Pneumonia	4	
Complication of rib fx	3	
Complications of femur fx	3	
Complications from fall contusions	2	
C1-2 vertebral fracture/Jefferson fx	2	
CVA**	1	
COPD##	1	
Cardiac complications	1	32
Complications of compression fx	1	
Complications of dementia	1	8
Renal failure & respiratory insufficiency	1	
Complications of LE® fx other than hip	1	
Hypertension		13
Diabetes Mellitus		2
Other	1	

fx=fracture
*one person suffered hip fx and subdural hematoma
two people suffered with pelvic and hip fx
**CVA=Cerebrovascular accident
COPD= Chronic Obstructive pulmonary Disease
® LE= lower extremity

The average time of fall to death was 94.65 days (SD=646.06 range 0-6578). This large standard deviation was due to one subject whose death was attributed to a fall that occurred 18 years prior (this subject suffered a hip fracture). When averaging days of fall to death without this subject, the mean fall to death duration was 31.12 days (SD 40.76, range 0-220 days). When looking only at those subjects (n=60) whose fall resulted in a hip fracture (not including the subject with a hip fracture from 18 years ago), the mean fall to death duration was 30.68 days (SD=41.33, range 1-220 days).

DISCUSSION

This article describes the characteristics of aging adults whose death was attributed to a fall and its consequences in one Midwestern county. The most common description of a person who died after a fall was an 85 year old female who lived alone in her own home or apartment and had an average of 7 comorbidities, most commonly HTN, cardiovascular disease, and orthopedic pathology.

It has been suggested that advancing age is a contributing risk factor of falls.³¹⁻³⁴ This is consistent with what this descriptive study also demonstrated, as the average age of persons that incurred a fatal fall was 85.4 years.

According to United States statistics, there are a greater number of females compared to males in the over 65 age group. Therefore, it is not surprising that the majority of fall fatalities occurred in females. This female bias towards falling is illustrated in numerous studies and statistics that describe subject characteristics of injurious and noninjurious falls in different countries.^{1,32,35,36} According to the Centers for Disease Control (CDC), women are 67% more likely to have a nonfatal fall.¹ However, a study that examined falls in 98 persons receiving home health services in the United States did not find risk for falls greater in females.³⁵ Conversely, one study³⁸ compared older adults that resided in elderly apartments in Taiwan who have fallen (n=52) to those that have not fallen (n=51) found significantly more men than women experienced a fall. The authors do recognize that there is a greater older male to older female ratio in Taiwan. Thus, different findings that older women are at more risk for falls may be due to sample selection.

When looking at national studies, specifically of fatal falls, there continues to be a tendency towards females. According to the Australian trend data,²⁵ female to male ratio for fatal falls was 1.6:1. Similarly Canada's technical report: Death Due to Falls Among Canadians age 65 and Over, demonstrate the rate of fall deaths for women as 12.4 deaths per 10,000 people and males 7.9 deaths per 10,000.³⁹ However, according to United States statistics, males are more likely to die from falls than females.¹ This is in contrast to the current study of 2005 fall fatalities, in which the female to male ratio was 1.86:1.

Categorization of comorbidities in this study was more descriptive than other studies.^{32,37} The most frequent comorbidity in those who had a fatal fall in this study was HTN (72.8%), cardiac disease (62%), and orthopedic pathology (45%) excluding hip fracture. Other comorbidities found in greater than 40% of those who suffered a fatal fall were respiratory diseases, gastrointestinal pathology, neurological and cognitive deficits. Lewis et al³⁷ who investigated nonfatal falls in patients receiving home

care, categorized diagnoses into the broad categories of internal medicine, orthopedic, neurological, cardiovascular, respiratory, and functional limitations. The persons most at risk for falls in the aforementioned study had neurological and cardiovascular impairments. However, the broad categories of Lewis' study³⁷ limited the ability to reveal specific diagnoses that may overlap categories or could be a primary predictor for fall and fatalities. For example, cardiac disease, vascular disease, and HTN were all categorized separately in this study. It was believed that someone with lower extremity (LE) peripheral vascular disease might present with different covariates that predisposes them to falls such as poor LE sensation than someone with myocardial infarction or HTN that may have medication related effects that places them for risk of fatal falls. Haili et al³⁰ had more specific categories of comorbidities and found the most frequent comorbidity in elderly who fell (n=2322) included HTN (70.2%), osteoporosis (65.5%), visual problems(45.3%), and osteoarthritis (42.4%).

Whether HTN is a significant finding for those who suffer a fatal fall is questionable. According to the CDC Trends in Aging Report⁴⁰ over 70% of Americans greater than 65 years have been diagnosed with HTN. Additionally, according to the American Heart Association⁴¹ the incidence of HTN in men and women ages 65-74 years is 58.9% for men and 72.5% for women. For adults 75 years and older, HTN occurs in 68.4% of men and 82.8% of women. Thus, given the prevalence of HTN in the older adult population, HTN may not be a predictor for fatal falls. Complications from the management or control of HTN, for example postural hypotension related to medication adjustments, may be a risk factor for fatal falls.¹²

In this study, most of the fatal falls occurred in the home when walking or transferring, which is consistent with how many falls are reported to have occurred. Since this study collected data after death and frequently greater than 30 days after the fall, details of the fall were not as detailed as other studies that collected data immediately or close to the time of fall. Medical records from this study indicated few instances where home hazards such as rugs on the floor or inadequate lightening contributed to the fall. In contrast, Van Bommel²⁶ looked at risk of falls in 85 year olds (n=480) and found those without a history of previous falls had an increased risk of falling in the presence of 6 or more home hazards. Those who had previous falls, however, did not have an increased risk when home hazards were present. This may partially explain why a meta-analysis²² did not find a reduction of falls in intervention studies that involved environmental modifications. Future studies need to identify the role of environmental modifications in reducing falls.

The common descriptors of fatal falls in this study (age, gender, comorbidities, and number of medications) are consistent with many of the previously identified risk factors for falls.^{11,33,35,36} Similar to other statistics,³ 60% of the injuries due to a fall that resulted in death in this study were hip fractures. Additionally, complications due to hip fracture were the most common cause of death. Though there have been several studies⁴²⁻⁴⁴ that suggest increased mortality after falls resulting in a hip fracture, those studies tracked persons who had experienced a hip fracture who later died. Thus, mortality rates after hip fractures may not parallel all fall related deaths. One of the

most startling findings of this study was the fact that for falls that resulted in hip fracture, death often occurred within 31 days of the fall. Though one study⁴² investigated mortality of 8148 people admitted to 8 different hospitals for fracture from 1994-1998 and found the mortality rate within the first month after fracture was 15%. Keene et al⁴⁴ reported 15% of patients (n=1000) admitted for proximal femur fracture died before hospital discharge. Thus, further investigation is needed for identification of potential complications and risk factors for mortality resulting from hip fracture.

The second most common injury due to a fatal fall was an intracranial injury, most notably subdural hematomas. Due to the age of the subjects, this injury is not surprising. Older adults are likely to suffer subdural hematoma due to the fragility of bridging cerebral veins. As cerebral atrophy develops the brain retracts further from the dura, thus bridging veins are predisposed to tearing due to increased stress.⁴⁵ The use of anticoagulant and antiplatelet medications, used by more than 50% of subjects whose records were reviewed, may have increased the risk of intracranial bleeds.

There are several limitations to this study. First, many of the fall events may have gone underreported or the events of falls may have been unclear. It was not uncommon that events surrounding a fatal fall were inconsistent between hospital notes, physician histories, and medical examiner's interview with family members. This reporting variability limits the reliability of the conclusions that can be drawn from the data. However, all records available were reviewed to ascertain the most precise sequence of events or circumstances. A second limitation to the study was the categorization of medical conditions and medications, which was done after all data were collected. There were over 150 different comorbidities and 200 medications identified during data collection. Comorbidities and medications were generally grouped according to systems or medication categories. There may be specific subcategories or single variables that could be meaningful with further analyses. Lastly, this was a retrospective review that looked only at people who died after a fall. Therefore, the results cannot be extrapolated to represent all people that have fallen. Caution should be observed when using this information to assist in predicting the likelihood of falling. Future studies should correlate the numerous variables to determine the association between falling and death and investigate the role of medications or surgical interventions on predisposing persons to complications after falls.

CONCLUSION

Currently, there are numerous interventions in place that identify persons at risk for falls. However, despite fall prevention efforts, 33% of older adults continue to fall each year. Health professionals need to identify individuals most at risk for death within the larger group of people who fall. Because older adults are often referred to physical therapy after a fall, therapists have a potentially important role in preventing fall-related morbidity and mortality. Trends from this study suggest that a comprehensive PT evaluation must incorporate a detailed fall history and thorough systems review that includes social status, medication review, and comorbidities, so appropriate post-fall follow up and referrals can be implemented that may prevent complications.

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