

Trends in Hip Fracture Mortality in Wisconsin and the United States, 1999-2017

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ABSTRACT

Introduction: Hip fracture affects >300,000 Americans each year, and the mortality rate following these fractures is high.

Methods: Authors searched the Centers for Disease Control and Prevention Wide-Ranging Online Database for Epidemiologic Research (WONDER) for incidences of hip fracture as a contributing cause of death and stratified by sex, age, race, ethnicity, state, month of death, and underlying cause of death across the United States and Wisconsin.

Results: Wisconsin has the third-highest age-adjusted death rate for hip fracture in the United States. Those who die from hip fracture are most likely to do so in a nursing home. Hip fracture deaths occur more frequently between October and March and often are associated with respiratory illness.

Conclusion: Hip fracture is a major contributing cause of death. Wisconsin residents are particularly affected by this risk.

INTRODUCTION

Hip fracture is an unfortunately common event, affecting more than 300,000 people annually in the United States;¹ most of these fractures are osteoporosis-related and are caused by a fall. About 30% of people with hip fracture die within the year following the event.²

Hip fracture incidence varies by season in the United States,³ which is possibly attributable to the following:

1. Vitamin D deficiency—During winter months, there is inadequate sunlight for cutaneous production of Vitamin D north of the 37th parallel.⁴

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2. Icy conditions—In colder states, icy conditions create increased risk for falls.

3. Seasonal infections—Afflicted patients are more likely to fall; conversely, patients who have fallen are more likely to be institutionalized/exposed to pathogens.

Many hip fractures are preventable. One of the most effective strategies to prevent hip fracture is simply to prevent falls.⁵ There are also several pharmaceutical agents approved for treatment of those at high fracture risk that can significantly reduce risk of hip fracture.⁶ High-risk patients include those with history of fragility fracture, osteoporosis by T-score, or osteopenia with FRAX-predicted 10-year risk of major fracture >20% or hip fracture >3%.

The US hip fracture incidence, which had been declining for years, recently plateaued.⁷ Hip fracture-associated mortality followed a similar pattern as hip fracture incidence in the late 1990s and early 2000s.² However, hip fracture incidence trends in Wisconsin have not been characterized. Thus, the purpose of this report is to examine the epidemiology of hip fracture-associated mortality in Wisconsin and the United States, including temporal/geographic trends and underlying causes of death associated with hip fracture.

METHODS

The Centers for Disease Control and Prevention Wide-Ranging Online Database for Epidemiologic Research (WONDER) is a data hub and query system containing deidentified information from US death certificates for 1999-2017, for use in analysis of public health data. We searched the WONDER Multiple Cause

of Death Database for hip fracture as a “Contributing Cause of Death” (CCOD) on death certificates using diagnostic codes S72.0 (fracture of the femur), S72.1 (fracture of the femur, peritrochanteric fracture), and S72.2 (fracture of the femur, subtrochanteric fracture). The death rate associated with hip fracture was calculated using the number of deaths containing mention of one of these diagnostic codes per 100,000 people in the live population at the time queried.

We stratified deaths in Wisconsin and the United States by age, sex, race, and Hispanic status—the latter 3 were age-adjusted—and looked at trends over time. Age-adjustment compares the proportion of the population in each state to the 2000 US standard population and allows for comparisons of similar age groups across states that might have varying age demographics. Microsoft Excel was used to create a map display wherein states with higher death rates are displayed in darker color. We characterized the 15 leading underlying causes of death (UCOD), the incidence of influenza/pneumonia as co-contributors to death (ICD-10 codes J09-J18 for UCOD or CCOD), and the location where the death occurred (ie, home, institution) for those who had a hip fracture as a contributing cause.

Deaths were analyzed by month for the United States, Wisconsin, and Florida. Florida was chosen for comparison in order to identify variation in seasonal trends between a state with freezing winter temperatures and inadequate sunlight exposure for vitamin D synthesis (Wisconsin) and a state with winter temperatures predominantly above freezing and increased sunlight exposure (Florida).

The number of deaths in each month over the 19 years surveyed was summed to create a count of the total number of deaths in each calendar month (ie, January 1999 deaths + January 2000 deaths + January 2001 deaths, etc). The number of deaths in each month was normalized to a standard 28-day month by dividing the number of days in the month by 28 and multiplying this by the number of deaths that occurred. Over the 19 years surveyed, there were 5 leap years; thus, February was considered to have 28 and 5/19 days. Deaths associated with hip fracture between

Figure 1. Hip Fracture Age-Adjusted Death Rate (AADR) by State

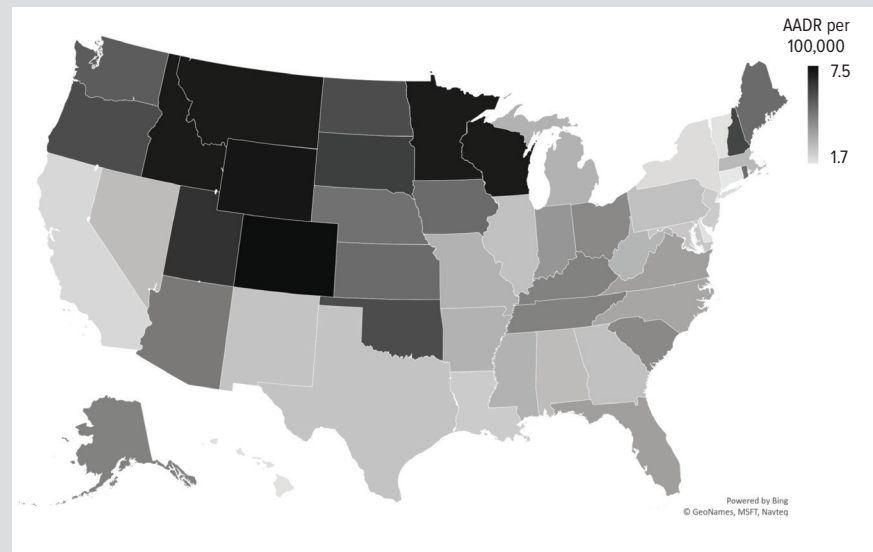


Table. Demographics of Hip Fracture-Associated Mortality, 1999-2017

	Wisconsin		United States	
	No. Deaths	AADR (95% CI)	No. Deaths	AADR (95% CI)
Total	9,749	7.6 (7.4-7.7)	264,356	4.3 (4.3-4.3)
Sex				
Females	6,158	7.4 (7.2-7.6)	167,562	4.2 (4.2-4.3)
Males	3,591	7.9 (7.6-8.1)	96,794	4.3 (4.3-4.3)
Race/Ethnicity				
Hispanic	36	3.1 (2.1-4.3)	6882	1.9 (1.9-2.0)
Non-Hispanic American Indian/Alaska Native	23	6.1 (3.8-9.3)	955	4.0 (3.7-4.2)
Non-Hispanic Asian/Pacific Islander	11	unreliable	2092	1.1 (1.1-1.2)
Non-Hispanic Black	79	2.9 (2.3-3.6)	8175	1.7 (1.7-1.7)
Non-Hispanic White	9,600	7.7 (7.6-7.9)	24,5793	4.8 (4.8-4.8)
	No. Deaths	CDR (95% CI)	No. Deaths	CDR (95% CI)
Age				
<1 year - 44 years	10	unreliable	480	unreliable
45 - 54 years	32	0.2 (0.1-0.3)	1,243	0.2 (0.1-0.2)
55 - 64 years	121	1.0 (0.8-1.2)	4,757	0.7 (0.7-0.8)
65 - 74 years	581	7.5 (6.9-8.1)	1,8014	4.3 (4.3-4.4)
75 - 84 years	2,455	49.6 (47.6-51.6)	73,389	29.3 (29.1-29.5)
85+ years	6,550	304.3 (297.0-311.7)	166,469	167.0 (166.2-167.8)

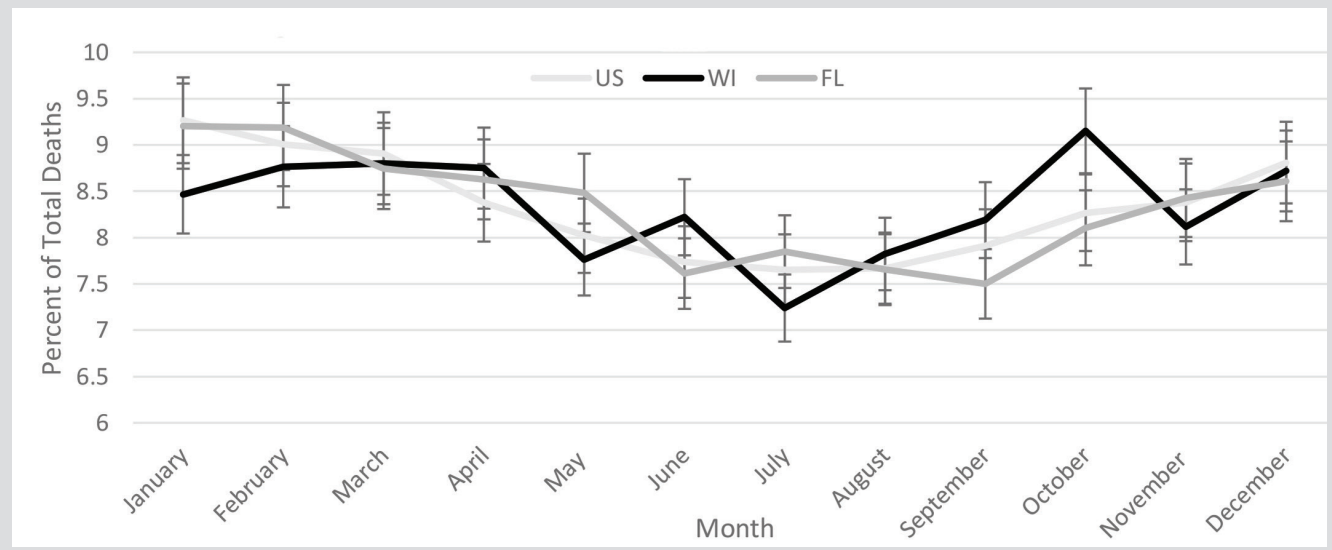
Abbreviations: CI, confidence interval; AADR, age-adjusted death rate; CDR, crude death rate.

October and March were compared to deaths between April and September by 2-tailed paired *t*-test using Microsoft Excel for all 3 geographic areas.

RESULTS

The 1999-2017 age-adjusted death rate (per 100,000 people) for hip fracture as a contributing cause of death is much higher in Wisconsin (7.6; CI, 7.4-7.7) than in the United States as a whole (4.3; CI, 4.3-4.3). Because Wisconsin’s population is older than the standard population, its crude death rate is even higher at

Figure 2. Percent of Deaths with Hip Fractures as a Contributing Cause, by Month



9.1 (CI, 9.0-9.3). Among all states in 2017, Wisconsin was tied for the third-highest age-adjusted death rate for hip fracture as a contributing cause of death, behind only Colorado and Wyoming (Figure 1). Over the years surveyed, the age-adjusted death rate associated with hip fracture was relatively steady in Wisconsin at 7.4 in 1999 and 7.1 in 2017, respectively. In the United States, the rate has decreased: in 1999 it was 4.8 and by 2017 it was 3.4.

The Table demonstrates the actual number of deaths and the age-adjusted death rate for both Wisconsin and the United States by sex, race, and ethnicity for all deaths between 1999 and 2017. The age-adjusted death rate of hip fracture as a contributing cause of death was similar between men and women in both Wisconsin and in the United States. The rate was higher among non-Hispanic whites compared to Hispanics, non-Hispanic blacks, and Asian American/Pacific Islanders. The age-adjusted death rate of hip fracture as a contributing cause of death for people under the age of 44 was negligible but increased significantly with each decade thereafter.

Fifty-one percent of people who died with hip fracture as a contributing cause had an underlying cause of death coded under “Accidents (V01-X59, Y85-86).” The remaining deaths came from underlying causes generally comparable to the leading causes of death in the population at large. The underlying cause was “Diseases of the Heart” (ICD-10 I00-I09, I11, I13, I20-I51) in 19%, “Chronic Lower Respiratory Disease” (ICD-10 J40-J47) in 3.9%, and “Alzheimer’s Disease” (ICD-10 G30) in 3.7%. These same causes of death, respectively, were responsible for 25.6%, 5.4%, and 3.1% of deaths among the general population.

Nearly 10% of nursing home deaths across the United States had hip fracture as a contributing cause. Nursing homes were the most common location of death for Wisconsinites with hip fracture as a contributing cause (38.4%), followed by deaths that

occurred in an inpatient setting (37.2%). Across the United States, 47% of these deaths occurred in an inpatient facility, followed by 32% in nursing home facilities.

More people died related to hip fracture in colder months (Figure 2). In the United States, 52.7% of deaths occurred between October and March, versus 47.3% between April and September ($P < 0.05$). In Wisconsin, 52% of deaths occurred in the cooler months vs 48% of deaths in warmer months ($P < 0.05$), and in Florida, these timeframes represented 52.2% and 47.8% of deaths ($P < 0.05$), respectively. The 15 leading causes of death (which capture about 90% of the deaths with hip fracture as a CCOD) did not change with respect to the season; however, the incidence of influenza as a co-contributor to death (UCOD or CCOD), was considerably higher in the cooler months. Over the survey period, there were 2,970 deaths from hip fracture + influenza/pneumonia in excess of those reported in warmer months. This explains about 22% of the variance between the periods.

DISCUSSION

Hip fracture is a common contributor to death in Wisconsin. While hip fracture-associated mortality has been decreasing across the United States, Wisconsin has not made major strides in reducing deaths from these preventable events.

Effective nonpharmacologic and pharmacologic interventions exist to reduce osteoporosis-related fractures but are not commonly utilized, even after an individual has sustained a fragility fracture.⁸ The STEADI (Stopping Elderly Accidents, Deaths, and Injuries) Toolkit was pioneered in 2015 by the CDC to facilitate detection and prevention of falls by medical providers but has not been maximally implemented in many health systems. Successful implementation has required strong champions, coordination of team member roles/responsibilities, and codification into the

electronic health record.⁹ Additionally, many patients eligible for pharmaceutical therapies are not receiving them, due either to medical oversight or a patient's conscious choice due to misguided beliefs about their adverse effects.¹⁰

Further research could assess whether Wisconsin has excess mortality due to higher numbers of hip fractures or worse outcomes from hip fractures and could also elicit information on intervenable risk factors that predated fracture. Such data could then inform targets for intervention, such as encouraging clinicians to adopt the STEADI toolkit to reduce falls incidence or campaigns to change patients' perception of osteoporosis medications.

Our data also support the importance of considering vaccination for influenza and pneumonia, as hip fracture-associated mortality increases when these infections are present.

Many older adults fear loss of mobility and independence.¹⁰ A high proportion of deaths from hip fracture occur in nursing homes. When disseminating information regarding prevention of hip fracture, it could be useful to appeal to peoples' preference to maintain independence and live at home.¹¹

A limitation of this study is that data from death certificates are only as good as the knowledge of the physician entering this information. If a hip fracture 3 months prior spurred a chain of health decompensation events, by the point of death, that inciting event may not even be recognized. Therefore, a significant number of deaths with hip fracture as a contributing cause may be missing from these data. Additionally, data from patients in Wisconsin are limited by small size; therefore, it was not possible to assess demographic trends over time.

CONCLUSION

Overall, the high death rate from hip fracture and the lack of improvement over the past 2 decades support the need for action in Wisconsin. By intervening on the at-risk population, preventing falls, and preventing fractures, it is likely we can make significant progress in preventing deaths.

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