

# One Wisconsin County's Experience With Fall-Related Mortality

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## ABSTRACT

**Background:** Falls in Wisconsin account for 74.1% of all injury-related deaths for persons 65 years and older. This study describes the rate, demographics, and characteristics of fall-related mortality in one Wisconsin county over an 8-year period from 2005 to 2012.

**Methods:** Retrospective review of 841 death investigation records of Waukesha County residents 65 years and older who died from a fall during the years 2005 to 2012. Data were collected at the Waukesha County Medical Examiner's office.

**Results:** No significant differences in individual demographics, activity, or injury characteristics ( $P > 0.05$ ) in fall-related deaths over an 8-year period.

**Conclusion:** Fall-related mortality in Waukesha County over the past 8 years has demonstrated consistent demographics, fall, and injury characteristics.

65 years,<sup>6,7</sup> the team wanted to identify the demographics and characteristics of why certain falls lead to mortality. Preliminary data collection was initiated in 2005, when there was improved coding of fall-related deaths,<sup>3,4</sup> and expanded to a longitudinal investigation of fall-related mortality in the county.

The purpose of this brief report is to describe the rate, demographics, and characteristics of residents in one Wisconsin county who experienced a fall-related death over an 8-year period.

## BACKGROUND

Fall-related mortality among people 65 years and over has increased significantly over the past decade. Falls are the leading cause of unintentional injury-related deaths in the United States and explain 52.9% of all deaths due to injury.<sup>1</sup> In Wisconsin, falls account for 74.1% of all injury-related deaths for persons 65 years and older, with 904 deaths occurring in the state in 2011.<sup>2</sup> It has been suggested that recent reporting of fall-related deaths is more inconclusive and may better reflect the actual sequel of falls, which may account for some of the increases in fall death rates.<sup>3-5</sup>

The interdisciplinary Elder Care Review Team of Waukesha County has met quarterly to review elderly deaths in the county for the past 15 years and has identified falls as a frequent cause of injury-related deaths among those age 65 and over. Concern for the number of deaths due to falls was the impetus for this investigation. Given that falls occur in 25% to 33% of all adults over

## METHODS

This report is a retrospective review of death investigation records of Waukesha County residents 65 years and older who died from a fall during the years 2005-2012. The data were collected at the Waukesha County Medical Examiner's office. Investigation records reviewed were those residents whose death certificate listed a fall as the underlying cause of death. We followed Public Health Service Act (42 USC 242m[d]) for data use restrictions in which data will be used for health statistical reporting and analysis only and no attempt will be made to learn the identity of any person or establishment included in these data. This retrospective review (IRB #13-016) received Institutional Review Board (IRB) exemption status.

The objective of the records review was to capture the demographics of residents at the time of their fall (not at the time of their death). Records reviewed included medical examiner's investigation and examination records, hospital records, and communication with significant others (health practitioners, paramedics, family members, caregivers, and/or others involved in the safety of the faller).

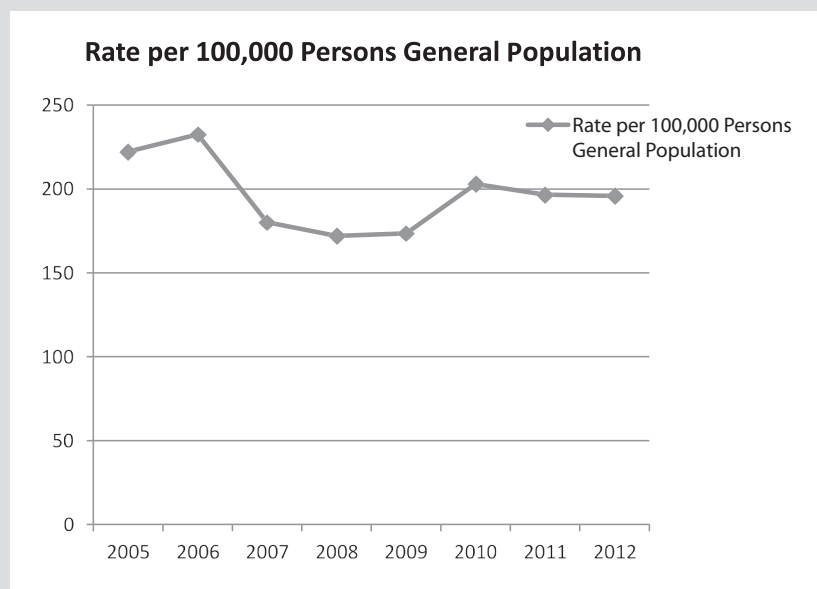
Data extracted from investigation records included gender, age at time of death, body mass index, residence at time of fall, date and place of fall, date of death, cause of death, select comorbidities correlated with falls, and number of medications prescribed at the time of the fall.

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Figure 1. Rate of Fatal Falls in County's 65+ Population



Rate<sub>65+ population</sub> = No. of fall-related deaths X 10<sup>5</sup> / >65+ population.

### Data Analysis

Descriptive statistics were used for continuous variables, and frequencies were used for categorical data. Independent samples *t*-test or one-way between groups analysis of variance (ANOVA) was used to compare continuous variables. Chi-square was used to explore relationships and proportions between categorical variables ( $P < 0.05$ ). SPSS version 21 (SPSS; Chicago, Illinois) and Microsoft Excel 2010 were used for statistics and graphing. A *P*-value of  $< 0.05$  was considered statistically significant.

### RESULTS

According to the latest 2012 census, Waukesha County has a population estimate of 392,477 residents, with 15.3% (60,049) of the residents 65 years and older.<sup>1</sup> There were a total of 842 fall deaths from 2005 to 2012. One subject's fall occurred 18 years prior to the person's death and accurate records of fall events could not be ascertained. Therefore, this person was excluded from further data analysis. Thus, 841 records were analyzed for characteristics and trends in this study.

#### County Population and Prevalence of Fall-related deaths

The older adult population in Waukesha County has increased 31% over the last 8 years.<sup>1,8</sup> Using yearly county census data and number of fall-related mortalities, we were able to calculate the rate of death from falls in the county.<sup>1</sup> In 2005 the county fall mortality rate for persons 65 years and older was 222.2 cases per 100,000 persons per year, and in 2012 the rate was 195.9 cases per 100,000 per year (Figure 1).

### Demographics

The average age at death after a fall was 86.02 years (SD 7.23, range 65-104); 61.2% were female. There were no statistical differences ( $P = .639$ ) between the age of subjects during the years 2005 through 2012,  $F_{8,833} = 0.738$ . An independent sample *t* test was used to compare ages between men and women. Men were statistically younger at death after a fall, mean = 84.48 years (SD = 7.31), than women, mean = 86.99 years (SD = 7.02),  $t(839) = -4.94$ ,  $P = .00$ .

The overall average post fall survival time (number of days between the date of the initial fall to the date of death) was 36.17 days (SD 112.58, range 0-2565). There were no statistical differences between survival time after a fall for each of the 8 years,  $F_{0,726} P = 0.65$ . However, due to the large standard deviation, we excluded 2 cases whose survival days were greater than 4 standard deviations from the mean.

The new calculated mean for survival time is 31.24 (SD = 44.83, range 0-389). Mean body mass index (height and weight taken at death) was 23.46 kg/m<sup>2</sup> (SD 5.83, range 8.90-58.58) (Table 1).

Persons on average were prescribed 6.23 medications (SD 3.60, 0-21). Over each of the 8 years, more than two-thirds of all residents were diagnosed and/or treated for hypertension. Less than one-third was diagnosed with osteoporosis, and over half of the residents had a neurological diagnosis such as stroke, Parkinson's disease, dementia, or neuropathy, that may have put them at risk for falls.

### Fall Characteristics

Consistently each year more than half (55.6%) of the people who experienced a fall-related death lived in their own home, 22.8% resided in an assisted living facility, 19.5% resided in a nursing home, and 2% of falls occurred while a person was a patient in a hospital or hospice.

In each of the 8 years, walking (including slips and trips) was the most common activity during which a fall occurred. Transfers were the next most frequent activity every year in which a fatal fall occurred, with 53% of the fall-related mortality due to transfers occurring in nursing homes (63 of 119 falls due to transfers occurred in nursing homes) (Table 2).

One's residence was the most common place a fall-related mortality occurred, with the bedroom and bathroom consistently the 2 most common rooms at home (24.5% and 22.1% respectively) in which a fall resulting in death occurred each year (Table 2). Of

**Table 1.** Annual County Resident Demographics of Those Who Sustained a Fall-Related Death

Year	2005	2006	2007	2008	2009	2010	2011	2012
<b>Population 65+</b>	<b>45,897</b>	<b>49,461</b>	<b>51,065</b>	<b>52,883</b>	<b>55,326</b>	<b>55,688</b>	<b>57,968</b>	<b>60,237</b>
<b>Number of falls</b>	<b>102</b>	<b>115</b>	<b>92</b>	<b>91</b>	<b>96</b>	<b>113</b>	<b>114</b>	<b>118</b>
<b>Age (years) mean</b>	<b>85.48</b>	<b>85.61</b>	<b>86.72</b>	<b>85.55</b>	<b>85.89</b>	<b>86.15</b>	<b>87.11</b>	<b>85.64</b>
SD	6.54	6.65	7.42	7.43	6.89	7.98	7.026	7.78
Range	70-97	66-97	67-103	69-101	66-101	65-104	69-99	66-101
<b>Gender</b>								
Males (%)	35.3	39.1	40.2	34.1	46.9	41.6	32.5	40.7
Females (%)	64.7	60.9	58.8	65.9	53.1	58.4	67.5	59.3
<b>Survival time<sup>a,b</sup> mean</b>	<b>31.12</b>	<b>28.64</b>	<b>34.46</b>	<b>29.52</b>	<b>29.2</b>	<b>33.65</b>	<b>36.83</b>	<b>26.57</b>
SD	40.76	34.86	51.1	52.61	42.5	49.76	48.72	37.86
Range	0-220	0-261	0-389	0-381	0-231	0-356	0-228	0-278
<b>BMI (kg/m<sup>2</sup>) mean</b>	<b>23.42</b>	<b>24.48</b>	<b>23.43</b>	<b>22.69</b>	<b>23.81</b>	<b>24.02</b>	<b>22.31</b>	<b>23.4</b>
SD	5.29	6.62	5.13	4.59	5.75	7.27	5.39	5.56
Range	12.89-40.71	13.56-58.58	8.90-41.22	12.81-33.84	12.23-40.76	11.42-58.15	11.77-36.59	12.5-36.44
<b>No. medications mean</b>	<b>5.37</b>	<b>6.27</b>	<b>6.53</b>	<b>6.3</b>	<b>6.85</b>	<b>6.43</b>	<b>6</b>	<b>6.24</b>
SD	3.85	3.8	3.5	3.66	3.54	3.64	3.2	3.3
Range	0-18	0-16	0-16	01-21	0-15	01-18	0-18	0-17
<b>Comorbidities</b>								
Hypertension (%)	74.3	67.3	78.1	78.8	78.4	90.6	76	73.9
Osteoporosis (%)	25	20.4	27.2	24.7	23.6	28	21	19.8
Neurological disorder (%)	56	43.4	62.7	63.5	59.8	67	55.7	54.3

<sup>a</sup> Survival time = number of days from the time of fall to death.

<sup>b</sup> Two cases were excluded as outliers as their mean was greater than 4 standard deviations from the overall mean.

Abbreviation: BMI, body mass index.

people who resided in their own home, 58.2% (201) of the fall-related deaths occurred at home, 32.8% (113) of the falls occurred outside of the home (ie, driveway, yard, or garage) and 9% (31) occurred in the community.

### Fall Outcome

Hip fractures were consistently the most frequent (54.6%) injury incurred from a fall that led to a fatality each of the 8 years. Head injuries were the second most common injury from a fall each year, occurring in 21.6% of all fall-related deaths (Table 2). We also assessed the potential for a seasonal effect for head injuries and hip fractures. A chi-square test for independence showed no relationships between the season that a hip fracture ( $\chi^2=1.276$ ,  $P=0.74$ ) or head injury ( $\chi^2=0.364$ ,  $P=0.95$ ) occurred in Wisconsin. In addition, there was no significant difference in the season in which a fall occurred in each of the 8 years ( $\chi^2=17.3$ ,  $P=0.69$ ).

### DISCUSSION

We have described and analyzed fall-related mortality in one Wisconsin county over an 8-year period. The rate of fall-related deaths in this county is currently 196.0 per 100,000 persons 65 years and older, which is 74% higher than the state and more than 200% higher than national rates; 113.83 and 55.35 per 100,000 people 65+ respectively.<sup>1</sup> Falls as the underlying cause of death are under recognized in other areas of the state and country.<sup>3,9</sup> The high rate in Waukesha County may have to do with education

and appropriate reporting of injury-related deaths. The Waukesha County Medical Examiner's office individually contacts all medical facilities and funeral homes providing presentations to doctors and health care staff to communicate that a preceding injury makes a death reportable for investigation. Thus, the investigations reviewed for this report reveal the relationship between the injury and death and identify the unbroken chain of events from injury to death. We were fortunate to have access to all records associated with a fall injury and not rely solely on death certificates or ICD-10 codes, as others have done,<sup>4,9</sup> which could limit the exact underlying cause of death in other areas of the state. In addition, the consistency and reliability of the county medical examiner's office may have led to better detailed description of fall-related deaths for this report.

Over the past 8 years, the 65 years and older population has increased by 31% in Waukesha County; however, fall-related deaths have not mirrored this increase. Though fall-related mortality in the county has not declined steadily, and given that previous state and national reports have shown increases in fall-related death rates,<sup>3,9,10</sup> this report identified Waukesha County's rate of fall-mortality trending downward over the 8-year investigational period. This is consistent with what Gagne et al<sup>4</sup> found when analyzing fall-related mortality in Quebec.<sup>4</sup>

Demographics, activity, and injury characteristics of those persons who suffer a fall-related death are very consistent from year to year. Many of the same characteristics that are consistent for

**Table 2.** Characteristics of Falls that Lead to Mortality

Activity of Fall % (n=839)	2005 N=100	2006 N=115	2007 N=92	2008 N=91	2009 N=96	2010 N=113	2011 N=114	2012 N=118
Walking	43	27	45.7	45	38.5	46.9	49.1	45.8
Trip/slip	6	16.5	14.1	14.3	15.6	11.5	5.3	8.5
Transfer	16	15.7	12	12.1	15.6	14.2	15.8	11.9
Stairs	3	5.2	2.2	2.2	9.4	3.5	4.4	9.3
Picking up object from ground	2	3.5	0	1.1	1	2.7	2.6	3.4
Standing task	5	8.7	4.3	4.4	5.2	2.7	3.5	2.5
Bed/couch	4	9.5	8.7	11	5.2	5.3	3.5	5.1
Ladder	2	2.6	0	1.1	1	0.9	1.8	1.7
Unknown/other	19	8	13	8.8	8.3	12.4	14	11.9
Place/Room of Fall % (n=596)	N=77	N=85	N=53	N=64	N=68	N=87	N=64	N=98
Bedroom	28.6	27.1	22.6	25	26.5	26.4	32.8	20.4
Bathroom	20.8	17.7	24.5	15.6	19.1	33.3	14.1	27.6
Living room	2.6	15.3	1.9	14.6	13.2	12.6	9.4	12.2
Kitchen	9.1	10.6	13.2	7.8	7.4	4.6	6.3	6.1
Community	15.6	8.2	7.6	6.3	7.4	4.6	4.7	6.1
Dining room	2.6	1.2	1.9	3.1	1.5	1.5	4.7	5.1
Stairs	5.2	7.1	3.8	4.7	8.8	4.6	7.1	11.2
Hallway	3.9	4.7	7.6	10.9	4.4	8	1.6	3.1
Outside of home	11.7	8.2	17	12.5	11.7	4.6	18.8	8.1
Fall Injuries % (n=834)	N=100	N=114	N=92	N=90	N=96	N=113	N=113	N=116
Hip fracture	60	56.1	57.6	58.9	48.9	52.2	57.5	47.4
Head injury	19	20.2	21.7	16.7	26	26.6	20.4	21.6
Pelvic fracture	5	8.8	5.4	10	5.2	6.2	5.3	5.2
Cervical fracture	3	0.9	6.5	2.2	6.3	2.7	7.1	7.7
Wrist/arm fracture	3	1.8	2.2	6.7	3.1	3.5	1.8	4.3
Lower leg fracture	2	2.6	1.1	3.3	1	2.7	0.9	6
Rib fracture	2	5.3	1.1	1.1	2.1	0	4.4	2.6
Other	3	1.8	2.2	1.1	4.2	4.4	1.8	1.7
Compression fracture	2	2.6	1.1	0	2.1	0.9	0.9	0.9
Distal femur fracture	1	0	1.1	0	1	0.9	0	2.6

fall-related mortality are similar to those who experience falls in general.<sup>5</sup> Why certain residents die after a fall and others do not is still inconclusive. Yet, as data from this report suggests, persons over 85 years who experience a fall resulting in a hip fracture may be at high risk for mortality.

## CONCLUSION

Fall-related mortality in Waukesha County over the past 8 years has demonstrated consistent demographics and fall injury characteristics each year.

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