

Risk Factors Associated with Hospitalization for Unintentional Falls: Wisconsin Hospital Discharge Data for Patients Aged 65 and Over

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ABSTRACT

Objective: To identify risk factors associated with hospitalizations for falls in Wisconsin in patients aged 65 and older.

Methods: This study was a cross-sectional study of year 2000 hospital inpatient discharge records for patients aged 65 and older who did not have a diagnosis-related group code indicating rehabilitation, obtained from the Wisconsin Bureau of Health Information. The database includes all discharges from all non-federal Wisconsin hospitals.

Results: Of 223,085 discharged older adults, 6.9% had an unintentional fall diagnosis. Independent predictors of an unintentional fall diagnosis were age, sex, time of year of discharge, region of residence, alcohol-related problems, dementia, Parkinson's disease, mechanical and motor problems, altered consciousness, convulsions/epilepsy, anemia, and glaucoma.

Conclusions: Alcohol-related problems and mechanical and motor problems significantly increased the risk of a fall diagnosis in hospitalized patients aged 65 and over.

INTRODUCTION

Unintentional falls among adults aged 65 and over is an increasing problem in Wisconsin. While the country as a whole saw an increase of 20% from 1990 to 1998 (23.86 to 28.60 per 100,000) in the age-adjusted rate of fall fatalities in the 65 and over age group, Wisconsin

experienced a 90% increase (32.06 to 60.97 per 100,000).¹ Many unintentional falls in this age group lead to significant morbidity as well.² Sattin and colleagues³ reported that only about 50% of those admitted to a hospital following a fall injury event at home were subsequently discharged home.

Previous studies among older adults have identified age;⁴⁻⁸ sex;^{4,5} mobility, gait, and balance problems;^{4-7,9-14} arthritis;^{6,7,12} visual impairment;^{4,5,9,10,15-17} postural blood pressure, dizziness, and syncope;^{4,5,9,10,18} mental/cognitive status;^{4,5,10-12,19} Parkinson's disease;⁷ history of stroke and heart disease;^{5,6,8} chronic lung disease;⁷ and medication use^{5,10,11,21} as factors increasing the risk of a fall.

Sattin and colleagues³ found syncope, conduction disorder/dysrhythmias, chronic ischemic heart disease, anemia, diabetes, hypertension, acute/subacute ischemic heart disease, and urinary tract infection to be common concurrent diagnoses in those hospitalized following a fall injury event.

Reasons for the high rate of fall deaths in Wisconsin, particularly among those aged 65 years and older, compared to national rates are unknown. It has been suggested that the increasing number of independent, active older adults, increasing number of nursing home residents, and medication use may be contributing to this increase.²²

We examined the Wisconsin Bureau of Health Information hospital discharge data for the year 2000 to determine risk factors for an unintentional fall diagnosis code in hospitalized persons aged 65 and over.

METHODS

Hospital inpatient discharges for the year 2000 obtained from the Wisconsin Bureau of Health Information (BHI) were used as the data source. This information is reported by all non-federal Wisconsin hospitals and is drawn from the UB-92 form, a standard billing

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Table 1. Demographic Characteristics of Discharged Patients 65 Years and Older, Wisconsin, 2000

Characteristics	Discharges* (n=223,085)	
	Fall† (n=15,436)	Non-Fall (n=207,649)
Age Group %		
65-69	7.3	17.3
70-74	11.6	21.3
75-79	18.0	22.5
80-84	22.8	19.2
85 and over	40.5	19.7
Female %	71.2	55.0
Admission Source %		
Physician Referral	17.2	40.7
Clinic Referral	1.1	2.8
HMO Referral	0.3	0.7
Transfer from acute care facility	3.7	3.3
Transfer from skilled nursing facility	1.8	1.2
Transfer from other healthcare facility	0.3	0.4
Emergency room	75.1	50.1
Court/law enforcement	0.1	0.2
Unknown	0.5	0.6
Discharge Status %		
Home	24.3	59.0
Transfer to skilled nursing facility	46.5	16.7
Expired	4.0	4.6
Discharge Quarter %		
January–March	25.0	25.8
April–June	23.7	24.5
July–September	25.2	24.6
October–November	26.1	25.1

* Excluding discharges with DRG=462 (rehabilitation)

† All discharges with an unintentional fall diagnosis

form used by hospitals to bill third-party payors. The data was restricted to adults 65 years of age and older. Patients with a diagnosis related group (DRG) indicating that their reason for hospitalization was for rehabilitation (DRG=462) were excluded to lessen the problem of double-counting fall events. Data elements available include age, gender, county of residence, length of stay, quarter of the year in which the patient was discharged, discharge status, payer groups, up to 9 diagnosis codes and an E code, up to 6 procedure codes, DRG, and major diagnostic category. Discharges were defined as having an unintentional fall if an International Classification of Diseases Revision 9 Clinical Modification (ICD-9-CM) code E880-E888, including all fourth and fifth digit sub-codes, was present among the 9 diagnostic codes or in the special E code position.

Risk factors considered included age, sex, region of residence, discharge quarter, and ICD-9-CM diagnostic codes (see Appendix A for complete list and detailed definitions of ICD-9-CM codes). We excluded osteoporosis as a risk factor, reasoning that screening for osteoporosis is not routinely done, and the condition is more likely to be determined as a result of hospitalization for a fall. This would lead to a different rate of osteoporosis diagnosis between fall patients and other patients.

Seasonality (expressed as quarter of the year) at discharge and region of residence within Wisconsin were included to adjust for weather conditions.²³ Regions were defined by aggregating counties in the same manner as the Wisconsin Department of Natural Resources.²⁴ Out-of-state residents were included since their exclusion had no appreciable effect on the results.

A diagnosis of trauma was defined as the presence of an ICD-9-CM code in the ranges 800-905 or 910-959. This is identical to the definition found in a study by Alexander and colleagues,² with the addition of 2 newer ICD-9-CM codes (958 and 959).

Stepwise multiple logistic regression was used to examine the simultaneous effect of multiple risk factors on an unintentional fall diagnosis. Any risk factor based on an ICD-9-CM diagnostic code that appeared to have a protective relationship with falls (odds ratio <1.0) was eliminated from further consideration, as these factors were not considered truly protective but artifacts of a hospitalized population. Magnitudes of risk factors are presented as odds ratios (OR) with 95% confidence intervals (CI). All analyses were done with Stata 7.0 software.²⁵

RESULTS

There were 223,085 non-rehabilitation discharges in 2000 for patients aged 65 and older. Of these, 6.9% had a diagnosis of an unintentional fall. The median age was 77 (range 65–96) and 56% of the patient discharges were women (Table 1). The distribution of discharges over the quarters of the year was fairly even: January to March, 26%; April to June, 24%; July to September, 25%; and October to December, 25%.

Approximately 71% of those who fell were women, owing in part to a higher percentage of women in this age group and also because the actual fall rates are higher among elderly women than elderly men (Table 2). The majority of the fall patients (73%) were admitted through the emergency department. Physician referrals were the second most frequent admission source (18%). Upon discharge, 46% of the fall patients were

transferred to skilled nursing facilities, 25% were sent home, and 4% died in the hospital. This contrasts to the discharge disposition of the non-fall patients, where 17% were sent to skilled nursing care, 59% were sent home, and 5% died.

Ninety-two percent of those with a fall had some type of trauma recorded. Of these, the majority (73%) suffered a fracture, including 5499 hip fractures. Eight percent had an open wound and 5% had an intracranial injury (excluding skull fracture).

The types of falls found on the patient discharge records are shown in Table 3. A large proportion of records (53%) had no detail as to circumstances of the fall. The second largest proportion of falls (30%) was attributed to slipping, tripping, or stumbling on the same level.

Table 4 shows the results of the multiple logistic regression analysis for the outcome of any type of unintentional fall. The odds of sustaining a fall increased dramatically with age. Compared to those 65-69 years old, those 85 years and older were over 4 times more likely to have a fall diagnosis.

Even after controlling for the other factors in the model, women are shown to be more apt to experience an unintentional fall, with a 1.8 times greater chance than males. The risk factors having the largest odds ratios include alcohol-related problems, with a ratio of 3.1, and mechanical and motor problems, with a ratio of 2.5. Other significant risk factors are shown in the table, along with their odds ratios.

A significant interaction was found between age and alcohol-related problems (Table 5). The negative effects of alcohol-related problems on the occurrence of falls was seen to diminish with increasing age.

DISCUSSION

Most of the factors found to be significant predictors of an unintentional fall diagnosis in this study are similar to those in other studies. However, contrary to previous reports, we did not find that arthritis, visual impairment other than glaucoma, stroke, heart disease, or chronic lung disease were significant independent risk factors. Another exception is our finding that alcohol-related problems were associated with an increased risk for falls in this group. While alcohol use has been found to be a risk factor for falls in those under age 65,²⁶ most studies in those over age 65 have not found a relationship with alcohol use.^{5,7,11,27,28} O'Loughlin and colleagues⁸ found daily alcohol use was associated with a reduced incidence of falls among community-dwelling

Table 2. Fall Rates by Age and Sex (Rates per 10,000 Population)*

Age in Years	Women	Men
65-69	70.8	50.9
70-74	117.0	86.0
75-79	215.9	151.0
80-84	387.1	245.6
85 and over	700.7	535.4

* Based on Wisconsin 2000 Federal Census Data; excluding fall discharges with a DRG code of 462 (rehabilitation).

Table 3. Types of Falls Among those with a Fall Diagnosis and Deaths

Description (ICD-9 Code)	Fall %
Fall on or from stairs or steps (E880)	5.9
Fall on or from ladders or scaffolding (E881)	1.2
Fall from or out of building or structure (E882)	0.2
Fall into hole or other opening in surface (E883)	0.03
Other fall from one level to another (E884)	9.4
Fall on same level from slip, trip, stumble (E885)	29.8
Fall on same level from collision, push, shove by or with another person (E886)	0.2
Other and unspecified fall (E888)	53.4

Table 4. Multiple Logistic Regression Results any Unintentional Fall*

Risk Factor	Odds Ratio	95% CI
Age		
65-69 years	1.0	Referent group
70-74 years	1.3	1.19 – 1.39
75-79 years	1.8	1.70 – 1.97
80-84 years	2.6	2.41 – 2.77
85 and older	4.2	3.90 – 4.46
Female	1.8	1.76 – 1.90
Discharge Quarter		
January – March	0.9	0.90 – 0.98
April – June	0.9	0.90 – 0.99
July – September	1.0	Referent group
October – December	1.0	0.97 – 1.07
Residential Region		
Southeast	1.0	Referent group
South Central	1.2	1.12 – 1.23
West Central	0.9	0.90 – 0.99
North	1.2	1.10 – 1.24
Northeast	1.1	1.07 – 1.17
Missing/Other states	1.0	0.94 – 1.14
Discharge Diagnosis		
Alcohol related problems	3.1	2.79 – 3.44
Dementia	1.7	1.62 – 1.81
Parkinson's disease	1.9	1.71 – 2.04
Mechanical & motor problems	2.6	2.30 – 2.89
Alteration of consciousness	1.8	1.68 – 1.95
Convulsions or epilepsy	1.5	1.36 – 1.63
Anemia	1.5	1.40 – 1.52
Glaucoma	1.1	1.01 – 1.24

*Excluding discharges with DRG=462 (rehabilitation); n=223,085

Table 5. Effect of Alcohol-Related Problems within Age Group

Age (Years)	Alcohol-Related Problems Diagnosis		95% CI for Odds Ratio
	Absent* (Odds Ratio)	Present (Odds Ratio)	
65-69	1.0	3.2	2.6, 3.9
70-74	1.0	3.5	2.9, 4.3
75-79	1.0	3.4	2.8, 4.2
80-84	1.0	2.6	2.0, 3.5
≥85	1.0	1.7	1.1, 2.4

* Referent group

older adults; Grisso and colleagues²⁹ found that heavy alcohol use among men increased the risk of hip fracture in a study utilizing hospital medical charts. In 1998, Wisconsin was in the top 20% of states for per capita alcohol consumption.³⁰ Additionally, Wisconsin Behavioral Risk Factor Surveillance System data show a slight increase in binge drinking in those 65 years and older between 1995 and 1999 (10% to 14.4% consuming 5 or more drinks on 1 or more occasions in the previous month).³¹ Varying amounts of alcohol consumption in different populations may account for the different results regarding a relationship between alcohol intake and falls in previous studies and in our study. Campbell and colleagues⁶ and O'Loughlin and colleagues⁸ postulate that the elderly may cut down on alcohol use due to poor health, and therefore alcohol use in the elderly is an indicator of good health.

Further analysis of our data revealed a significant difference in the association of alcohol-related problems and falls by age group. The odds of a fall were still increased in all age groups for those with a diagnosis of alcohol-related problems, but declined in the 80-85 and 85 and over age groups. This may be due to less frequent reporting of alcohol-related problems in those age groups or dilution of its effect by other age-related factors.

We could not examine such risk factors as medication use directly, but included the diagnoses of hypertension and affective psychoses, where the medication prescribed may contribute to falls. We did not find an association between either of these diagnoses and a fall diagnosis.

Anemia may be both a cause and a result of a fall. Sattin and colleagues³ found anemia to be a relatively frequent concurrent diagnosis among those hospitalized for a fall injury event (8.7%). Chronic anemia may cause dizziness and lead to a fall or a fall may cause sufficient bruising/hemorrhage leading to post-hemor-

rhagic anemia. In a sub-analysis, which examined the predictors of a fall diagnosis among those who also had some type of trauma recorded, anemia was one of the significant independent factors. However, among those discharges for which no trauma was recorded, anemia was not a significant independent factor.

The use of E codes to identify injuries has, particularly in the past, been problematic due to incomplete coding. However, Wisconsin law mandates reporting of E codes, when there is a diagnosis code between 800 and 995.89. In our data set, 99.9% of those with a diagnostic code in the range 800 through 995.89 also had an E code.

The falls identified in our data set are likely to be serious, though not so serious as to cause death prior to hospital admission. Sattin and colleagues³ found that approximately 42% of fall injury events resulted in hospital admission. If this percentage is applied to our results, we would project 36,752 fall injury events in the year 2000 (15,436 ÷ 0.42), or 5% of the Wisconsin population of adults aged 65 years and older.

LIMITATIONS

The data contained no patient identifiers; patients may have had more than 1 discharge within the year. Some falls likely occurred during hospitalization for some other condition; we had no way to discern which ones.

This study was cross-sectional where the non-fall subjects were hospitalized patients. A more ideal study design would be a case-control study with randomly selected controls drawn from the same population from which the cases (falls) arise. Hospitalized patients may have a higher prevalence of a risk factor compared to a community population, and this may reduce the ability to show an effect. Comparisons of the prevalence of some risk factors in our data set compared to prevalence reported in the Wisconsin Family Health Survey 2000³⁰ suggest that our hospitalized patients had a higher prevalence of some risk factors (diabetes, congestive heart failure), though not all (stroke, hypertension, myocardial infarction, emphysema, or chronic bronchitis). Wisconsin prevalence data were not available for all conditions.

Some of the risk factors that we considered, such as arthritis, lack of exercise, and obesity, are probably not entered into the discharge record reliably enough to make a good determination of their contribution or lack thereof.

An analysis of risk factors for particular types of falls is hampered by the non-specific coding of the majority of falls.

CONCLUSIONS

Identification of patient risk factors for falls will assist in counseling, educating, and modifying environments for the geriatric population. Knowing these factors can suggest ways to protect the elderly from those fall-instigating threats which cause many of them morbidity and claim many of their lives.³³⁻³⁷ The results of this study suggest that screening for alcohol-related problems and mechanical and motor problems may be important steps in reducing falls among Wisconsinites aged 65 and over. Because of the limitations of this study and the mixed results in previous studies, the relationship of alcohol consumption with unintentional falls merits further study.

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Appendix A. Definitions of Risk Factors

Risk Factor*	Definition (ICD-9-CM codes)
Diabetes	250.xx†
Fluid & electrolyte imbalance	276.x
Obesity	278.xx, 244.9, 253.8, 255.9, 259.9, V77.8
Anemia	280.x – 285.x
Senile and presenile organic psychotic conditions (dementia), Alzheimer's	290.xx, 331.0
Alcoholic psychoses, dependence, abuse, history of alcoholism	291.xx, 303.xx, 305.0, V11.3
Affective psychoses	296.xx
Parkinson's disease, other extrapyramidal disease and abnormal movement disorders	332.xx, 333.xx
Epilepsy, convulsions	345.xx, 780.3
Peripheral neuropathy	356.x
Glaucoma	365.xx
Cataract, congenital anomalies of eye, problems with sight, other eye problems, artificial eye, fitting/ adjustment of spectacles or contact lenses	366.xx, 743.xx, V41.0, V41.1, V52.2, V53.1
Vertiginous syndromes	386.xx
Hypertensive disease	401.x – 405.xx, 437.2, V81.1
Congestive heart failure, cardiomyopathy, Cardiomegaly	402.01, 402.11, 402.91, 425.x, 428.x, 429.3
Acute/subacute ischemic heart disease	410.xx – 413.x
Chronic ischemic heart disease	414.xx
Stroke	436, 435.9, V12.59, V71.7
Hypotension, nonspecific low blood pressure reading	58.x, 796.3
Chronic bronchitis	491.xx
Emphysema	492.x
Asthma	493.xx
Arthritis	714.xx, 715.xx, 716.9, V13.4
Alteration of consciousness, syncope & collapse, dizziness & giddiness	780.02, 780.09, 780.2, 780.4
Sleep disturbances	780.5
Mechanical and motor problems with head, neck, trunk, limbs, abnormality of gait, lack of coordination	V48.2, V48.3, V49.1, V49.2, 781.2, 781.3
Lack of exercise	V69.0

*Risk factors are broadly defined. See an ICD-9-CM manual for details.

†Use of xx above represents all possible fourth and fifth digits.

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