

## ORIGINAL ARTICLE

# Gender differences for non-fatal unintentional fall related injuries among older adults

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**Objectives:** To quantify gender differences for non-fatal unintentional fall related injuries among US adults age 65 years and older treated in hospital emergency departments (EDs).

**Methods:** The authors analyzed data from a nationally representative sample of ED visits for January 2001 through December 2001, available through the National Electronic Injury Surveillance System All Injury Program (NEISS-AIP). For each initial ED visit, coders record one principal diagnosis (usually the most severe) and one primary part of the body affected.

**Results:** Based on 22 560 cases, an estimated 1.64 million older adults were treated in EDs for unintentional fall injuries. Of these, approximately 1.16 million, or 70.5%, were women. Fractures, contusions/abrasions, and lacerations accounted for more than three quarters of all injuries. Rates for injury diagnoses were generally higher among women, most notably for fractures which were 2.2 times higher than for men. For all parts of the body, women's injury rates exceeded those of men. Rate ratios were greatest for injuries of the leg/foot (2.3), arm/hand (2.0), and lower trunk (2.0). The hospitalization rate for women was 1.8 times that for men.

**Conclusions:** Among older adults, non-fatal fall related injuries disproportionately affected women. Much is known about effective fall prevention strategies. We need to refine, promote, and implement these interventions. Additional research is needed to tailor interventions for different populations and to determine gender differences in the underlying causes and/or circumstances of falls. This information is vital for developing and implementing targeted fall prevention strategies.

F all related injuries among adults age 65 years and older are a major health concern. Statistics on fatal falls have been readily available since 1968 through the National Center for Health Statistics death certificate data. However, national statistics for non-fatal falls were not available until 2000 when the National Electronic Injury Surveillance System All Injury Program (NEISS-AIP) was implemented. A prospective study in New Zealand,<sup>1</sup> and retrospective studies in Finland,<sup>2</sup> Australia,<sup>3</sup> and the US<sup>4</sup> have observed gender disparities in fall risk and fall related hospitalizations among different populations. This is the first US study to use national data to quantify gender differences for non-fatal, unintentional, fall related injuries among adults age 65 years and older treated in emergency departments (EDs). This study goes beyond previous reports and characterizes these injuries by diagnosis, part of the body affected, and disposition.

More than a third of older adults fall each year<sup>5–6</sup> and 10–20% of falls cause serious injuries such as fractures or head traumas.<sup>7</sup> Fall injury rates increase sharply with age<sup>3–8</sup> and these injuries are associated with significant morbidity, reduced mobility, decreased functioning, and loss of independence.<sup>9</sup> One study found that 12% of older adults who fell subsequently required long term nursing home care.<sup>10</sup> Currently, 34.8 million Americans are 65 years of age and older; by 2040, this number will more than double.<sup>11</sup> As the population ages, the numbers of fall related injuries will increase. In 1994, the total cost of all fall related injuries among adults 65 years of age and older was \$27.3 billion, and by 2020 the cost is expected to reach \$43.7 billion (in 2002 dollars).<sup>12</sup>

## METHODS

We analyzed data from NEISS-AIP for non-fatal injuries for January 2001 through 31 December 2001, the first complete

year of data available, and characterized unintentional fall related injuries among US older adults (defined as people aged 65 years and older) by gender and age. NEISS-AIP, operated by the US Consumer Product Safety Commission, collects data on initial visits for all types and causes of injuries treated in US EDs. For each initial ED visit, coders record one principal diagnosis—usually the most severe—as determined by the ED physician or healthcare provider and as recorded in the ED chart, and one primary part of the body affected. NEISS-AIP data are drawn from a nationally representative subsample of 66 out of 100 NEISS hospitals, which were selected as a stratified probability sample of hospitals. These hospitals have a minimum of six beds, provide a 24 hour ED, and are located in the United States and its territories.<sup>13</sup> NEISS-AIP provides national estimates based on approximately 500 000 injury and consumer product related ED cases each year.

The overall estimates for this study were based on weighted data for 22 560 older adults treated for fall related injuries at NEISS-AIP hospital EDs during 2001. For the analyses by gender, three cases were excluded because sex was unknown. Each case was assigned a sample weight based on the inverse probability of the hospital being selected. Confidence intervals (CIs) were calculated by using a direct variance estimation procedure that accounted for the sample weights and complex sample design. Rates per 100 000 population were calculated using 2001 US Census Bureau population estimates.<sup>11</sup>

**Abbreviations:** ED, emergency department; NEISS-AIP, National Electronic Injury Surveillance System All Injury Program; TBI, traumatic brain injury.

**RESULTS**

In 2001, based on 22 560 cases, we estimated that 1.64 million older adults (95% CI 1.38 to 1.90 million) were treated in EDs for unintentional fall related injuries. Of these, approximately 1.16 million (95% CI 0.96 to 1.35 million), or 70.5%, were women (table 1). Injury rates increased sharply with age although rates for women were higher in all age categories. Overall, the rates for adults 85 years and older were four to five times that of adults aged 65–69 years.

Table 1 shows gender differences for fall related injury diagnoses. Fractures, contusions/abrasions, and lacerations resulted in more than three quarters of all injury diagnoses. Fractures, the most frequent diagnosis, accounted for 37.8% of women’s and 28.3% of men’s injuries. Except for lacerations where rates for men and women were similar (RR = 1.1), rates for diagnoses were generally higher among women, most notably for fractures which were 2.2 times higher than for men.

For all parts of the body, women’s injury rates exceeded those of men. Rate ratios were greatest for injuries of the leg/foot (2.3), arm/hand (2.0), and lower trunk (2.0). Among men and women, injury rates were highest for head/neck injuries. Most fall related injuries did not result in hospital admissions. About three quarters of all patients seen for fall related injuries were treated and released while only one in five was hospitalized. However, the hospitalization rate for women was 1.8 times that for men. Furthermore, women’s hospitalization rates were 2.3 times higher than men’s for fractures (878.7 v 387.7) and 2.1 times higher for lower trunk injuries (614.1 v 288.2) (data not shown).

Rates for all fall related injury diagnoses increased with advancing age (table 2.) For people aged 85 and older, the rates were four to five times higher than for those aged 65–74. Within each age category, rates for all diagnoses except laceration injuries were higher among women. Both men’s

and women’s rates for all injury diagnoses (except strain/sprain) doubled with each decade of age. In each age group and for all parts of the body, women’s injury rates exceeded men’s. The greatest gender difference in the 65–74 age group was for leg/foot injuries and in the 85 and older age group, it was for lower trunk injuries. Within each age group, hospitalization rates for women were twice that for men. With each decade of age, hospitalization rates for both men and women increased about 2.7 times.

**DISCUSSION**

Using national data, this study quantified gender differences in non-fatal, unintentional fall related injuries among adults aged 65 years and older treated in EDs. The extent of these differences was striking. Women sustained fall related injury rates 40–60% higher than men of comparable age. Women’s hospitalization rates for fall injuries were about 81% higher than men’s, suggesting that women sustained more severe injuries. However, hospitalization per se is only a rough proxy for injury severity. Severity may be more accurately reflected by the length of hospital stay, type of treatment needed (for example, surgery), need for rehabilitation services, and whether, after release, the patient returned home or was transferred to a long term care facility. However, factors such as the presence of other medical conditions certainly can affect these outcomes. Data about such outcomes were not available through NEISS-AIP. Consequently, we could not ascertain to what extent patients were functionally impaired nor could we predict the impact that fall related injuries might have on future health and wellbeing.

Some of the observed disparity may reflect gender differences in levels of physical activity. Muscle weakness and loss of lower body strength, often caused by inactivity, is a well known risk factor for falling.<sup>14</sup> Data on older adults from the 1982–84 National Health and Nutrition

**Table 1** Non-fatal unintentional fall related injuries among adults aged 65 years and older treated in US emergency departments, 2001

	Men				Women				Rate ratio
	Number (n = 6712)	Weighted estimate (n = 484740)	Crude rate*	95% CI	Number (n = 15845)	Weighted estimate (n = 1157230)	Crude rate*	95% CI	
<b>Age (years)</b>									
65–69	1116	78318	1775.2	1523.6–2026.8	2022	146659	2860.5	2520.4–3200.6	1.6
70–74	1249	90051	2314.9	2014.0–2615.7	2508	179939	3677.0	3139.2–4214.9	1.6
75–79	1399	101854	3326.1	2777.6–3874.6	2942	220551	5050.1	4225.3–5874.9	1.5
80–84	1320	94719	4896.8	4113.9–5679.8	3174	225344	7001.2	5653.1–8349.2	1.4
85+	1628	119797	9071.6	7209.5–10933.6	5199	384738	12300.9	9689.2–14912.5	1.4
<b>Injury diagnosis</b>									
Fracture	1946	137372	939.7	771.7–1107.7	6091	437023	2107.7	1666.4–2549.1	2.2
Contusions/abrasions	1846	134575	920.5	773.1–1068.0	4205	315337	1520.9	1266.2–1775.5	1.7
Laceration	1272	96158	657.8	550.6–764.9	2057	150970	728.1	599.7–856.6	1.1
Strain/sprain	580	39982	273.5	224.9–322.1	1426	101957	491.7	410.0–573.5	1.8
Internal injury	511	31416	214.9	141.0–288.8	957	61088	294.6	201.2–388.1	1.4
Other	549	44567	304.9	230.4–379.3	1098	90182	434.9	308.9–561.0	1.4
Unknown	8	669	†	†	11	673	†	†	†
<b>Part of body affected</b>									
Head/neck	2285	162705	1113.0	913.4–1312.6	4312	308024	1485.6	1230.2–1741.0	1.3
Lower trunk	1410	99389	679.9	545.1–814.6	3821	276361	1332.9	1029.3–1636.4	2.0
Upper trunk	1034	78672	538.1	453.4–622.9	2,002	149204	719.6	602.3–836.9	1.3
Arm/hand	1027	76779	525.2	435.1–615.3	2,883	215425	1039.0	871.9–1206.1	2.0
Leg/foot	860	59373	406.1	357.4–454.8	2,621	190755	920.0	777.2–1062.8	2.3
Other	71	6318	43.2	26.1–60.4	159	14830	71.5	36.6–106.4	1.7
Unknown	25	1504	10.3	4.3–16.3	47	2630	12.7	5.7–19.7	1.2
<b>Disposition</b>									
Treated & released	5253	385930	2639.9	2260.4–3019.4	12272	904423	4362.0	3686.6–5037.4	1.7
Hospitalized	1422	95333	652.1	492.9–811.3	3492	244878	1181.0	854.6–1507.5	1.8
Held for observation/ unknown	37	3476	23.8	3.7–43.8	81	7929	38.2	10.1–66.3	1.6

\*Rate per 100 000 population.

†Unstable estimate because of sample size <20.

**Table 2** Non-fatal, unintentional fall related injury rates\* by age among adults aged 65 years and older treated in US emergency departments, 2001

	Men			Women		
	Age group			Age group		
	65-74	75-84	85+	65-74	75-84	85+
<b>Injury diagnosis</b>						
Fracture	561.7	1170.6	2441.8	1172.0	2218.4	4837.3
Contusions/abrasions	527.0	1097.2	2726.6	891.0	1623.7	3289.3
Laceration	372.7	766.6	2037.9	336.2	778.9	1860.7
Strain/sprain	225.4	314.0	422.5	439.5	500.3	638.4
Internal injury	113.9	254.3	700.8	161.5	291.3	729.2
Other	225.2	328.7	715.6	258.0	460.8	939.0
Unknown	†	†	†	†	†	†
<b>Part of body affected</b>						
Head/neck	616.9	1325.4	3427.9	716.9	1572.4	3737.6
Lower trunk	313.2	878.6	2233.2	510.9	1430.4	3729.9
Upper trunk	398.1	643.0	1021.7	435.0	783.8	1475.7
Arm/hand	356.6	625.7	1205.2	778.9	1102.8	1717.6
Leg/foot	303.8	436.5	934.5	770.0	891.5	1469.5
Other	33.8	†	186.1	41.3	77.6	153.6
Unknown	†	†	†	†	19.4	†
<b>Disposition</b>						
Treated & released	1722.8	3086.7	6714.8	2808.3	4592.5	8780.3
Hospitalized	298.2	821.6	2236.1	438.1	1235.8	3428.5
Held for observation/ unknown	†	†	†	†	49.6	92.0

\*Rate per 100 000 population.

†Unstable estimate because of sample size &lt;20.

Examination Survey (NHANES 1) Follow up Survey established that men were more physically active than women,<sup>15</sup> and a 1993-95 study of 2025 California residents found that men had greater lower body strength.<sup>16</sup> Although non-fatal fall injury rates were higher among women, fatal fall rates are known to be higher among men.<sup>17</sup> Differences in physical activity levels may influence the circumstances or events contributing to men's lower injury rate, as well as help explain their higher mortality.

The greatest gender difference was in women's fracture rate which was twice as high as the rate for men. This difference has been observed by others.<sup>18-19</sup> This finding, along with the gender difference seen for rates of lower trunk injuries, may be due in large part to differences in hip fracture rates. Hip fractures, the most serious type of fall related fracture, is a leading contributor to excess mortality, disability, and reduced quality of life.<sup>20-21</sup> Women's increased likelihood of hip fracture is frequently attributed to reduced bone mass.<sup>22-23</sup> Bone mass for both men and women peaks around age 30 and then declines about 0.5% per year for men and 1% per year for women.<sup>24</sup> Additionally, women suffer a rapid loss of bone density for about five years following menopause. A 1992 study of women in Rochester, Minnesota, found 59% of 153 women over age 60 (and 84% of 50 women over age 80) had osteopenia, a reduction in bone mass two standard deviations below the mean for normal women under age 40.<sup>25</sup> Although reduced bone mass is a significant risk factor, falling sideways onto the hip is usually necessary to cause a hip fracture.<sup>23-26</sup> Specialized hip pads have been developed that reduce the force of impact on the hip joint when a fall occurs<sup>27</sup> and can prevent hip fractures among high risk individuals.<sup>28</sup>

For the part of the body affected, the highest rates for both men and women were for head/neck injuries, although the rate for women was 33% higher than for men. A 1992-94 study of injury related ED visits found that for all ages, falls were the most common cause of traumatic brain injury (TBI).<sup>29</sup> After age 65, the TBI rate for women exceeded that for men while women age 85 and older had the highest rate. Our finding differs from a recent report that found fall

related TBI hospitalization rates in California were higher for men.<sup>30</sup> It is possible that men sustain more severe TBI injuries than women, perhaps due to the underlying causes or circumstances of their falls.

This study of older adult non-fatal fall related injuries is subject to a number of limitations. Firstly, it includes only injuries treated in EDs. ED patients likely suffer more serious injuries; they may be older, more frail, and/or have more chronic conditions than older adults who fall and sustain few or minor injuries. Because NEISS-AIP includes a limited number of variables, it was not possible to compare these patients directly with other groups. Secondly, NEISS-AIP coders record only one injury (generally the most severe) and one part of the body affected. In the case of multiple injuries, some underreporting may occur. The system does not include injuries treated in physicians' offices or other outpatient settings and those that did not require medical attention. Thirdly, we excluded fatal injuries that occurred before or in the ED because NEISS-AIP does not provide detailed information about injury deaths. In addition, we did not include deaths that occurred following treatment because we did not have information about the patient's status after leaving the ED or the hospital. However, deaths represent fewer than 1% of fall related injuries.<sup>31</sup> Although NEISS-AIP does not include information about injury severity, we probably have captured the majority of significant fall related injuries because most serious and costly injuries are treated in EDs. Fourthly, generalizing to the US population may be limited by selection bias because the people who are treated in EDs may differ from the general US population. Finally, the NEISS AIP coding system has a fixed number of categories for primary part of the body affected and for the principal diagnosis relevant to consumer product related injuries. ICD-9-CM diagnosis codes<sup>32</sup> were not available in the medical record at the time these data were collected; therefore, specific types of injuries (for example, hip fracture, TBI) could not be accurately identified. Currently, NEISS-AIP has only one complete year of data but it will be possible to analyze fall related injury trends within a few years as more data become available.

## Key points

- This is the first US study to quantify gender differences for non-fatal unintentional fall related injuries among adults aged 65 years and older treated in EDs.
- Among older adults, non-fatal fall related injuries disproportionately affected the health of older women.
- Rates for injury diagnoses were generally higher among women, most notably for fracture which was 2.2 times higher than the rate among men.
- The hospitalization rate for women was 1.8 times that for men.
- Information about gender differences in locations, circumstances, and events preceding fall related injuries is needed to identify high risk situations and behaviors, and to develop targeted fall prevention strategies.

Knowledge about the circumstances surrounding falls is vital for developing prevention strategies. A number of researchers have reported on types and mechanisms of fall injuries. A study of fall related hip fractures in a homogeneous elderly urban population found that 75% fell "while standing or walking".<sup>33</sup> Another study analyzed the external cause of injury codes (E codes) for California patients hospitalized for fall related injuries.<sup>4</sup> These researchers found that the largest proportion of falls (41%) occurred on the same level, and the hospitalization rate for women was twice the rate for men. However, detailed information about the location, circumstances, or events preceding the fall was not available. A follow up study of people treated in EDs for all fall related injuries could provide such information and help identify high risk situations and behaviors surrounding fall events.

Falls and fall related injuries are age related problems and the world's population is aging rapidly. Between July 1999 and July 2000, the total size of the world's older adult population increased by 9.5 million people.<sup>34</sup> Although the industrialized nations of Europe, North America, and Japan have the highest percentages of older adults, 59% of the world's elderly live in developing countries.<sup>34</sup> Women live longer than men and typically marry men older than themselves. Therefore, virtually all countries have higher numbers of older women than men. It is reasonable to expect that older women in many countries, like those in the US, will be disproportionately affected by fall related injuries.

## IMPLICATIONS FOR PREVENTION

This is the first US study to quantify gender differences for non-fatal unintentional fall related injuries among adults aged 65 years and older treated in EDs. Nationally, an estimated 1.64 million older adults were treated for fall related injuries in 2001 and 340 000 of those treated were hospitalized. And, as our population ages, the number of fall injuries will increase. This represents an enormous burden to individuals, society, and to the healthcare system. Non-fatal fall related injuries disproportionately affect the health and quality of life of older women, who comprise 58% of the US population over age 65.<sup>11</sup> Because the US population is aging, this problem will increase unless we take preventive action.

Much is known about effective fall prevention strategies.<sup>14-35</sup> We now need to refine, promote, and implement these interventions. We also need to learn how to successfully disseminate intervention programs and to promote widespread adoption at local level. In addition, further research is

needed to tailor interventions for populations with differing characteristics and risk factors, and to determine the underlying causes and/or circumstances of falls and how these differ for men and women. Clarifying these differences and obtaining information about the location and events preceding a fall related injury is vital to identifying high risk behaviors and situations, and for developing and implementing targeted fall prevention strategies.

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### Ralph Hingson



**R**alph W Hingson, ScD, MPH is a Professor at the Boston University School of Public Health (BUSPH). Since 2001 he served as Associate Dean for Research and from 1986-2000 he was Professor and Chair of the BUSPH Social and Behavioral Sciences Department. Publications by Dr Hingson and colleagues in the early and mid-1990s helped stimulate passage of federal legislation that provided incentives for all states to make it illegal for drivers under 21 to drive after any drinking. Dr Hingson is a researcher whose work has inspired legislative efforts against drinking and driving.

His more recent studies on the relationship between blood alcohol levels and automobile accidents has factored into proposals in many states to lower the legal blood alcohol concentration (BAC) to 0.08%—now passed by all 50 states. He has also evaluated comprehensive community interventions to reduce alcohol impaired driving.

Dr Hingson serves as a member of the Committee on Alcohol, Drugs, and Traffic Safety for the National Transportation Research Board of the National Academy of Sciences and the National Advisory Council of Mothers Against Drunk Driving (MADD). He has served as National Vice President for Public Policy for MADD and for seven years on their National Board of Directors. Dr Hingson helped to develop MADD’s Rating the States program which grades national and state efforts to reduce alcohol and other drug impaired driving.

In recognition of his research contributions, the Robert Wood Johnson Foundation honored Dr Hingson in 2001 with its Innovators Combating Substance Abuse Award. In 2002, he received the Widmark Award, the highest award bestowed by the International Council on Alcohol Drugs and Traffic Safety, of which he is currently President-Elect. In 2003, MADD instituted the Ralph W Hingson Research in Practice Annual Presidential Award, with Dr Hingson honored as its first recipient.

In the past year, he has joined the National Institute on Alcohol Abuse and Alcoholism as the Director of their Division of Epidemiology and Prevention Research.