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Nonfatal Occupational Injuries From Slips, Trips, and Falls Among Older Workers Treated in Hospital Emergency Departments, United States 1998

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Background *Falls are a leading cause of injury among older adults. As the workforce demographics shift to an older population, the dearth of information on occupational falls among older adults must be addressed.*
Methods *A national probability sample of hospital emergency departments (EDs) (National Electronic Injury Surveillance System) was utilized to characterize falls at work.*
Results *Older workers were found not to be at increased risk of a fall injury, but were more likely than younger workers to be hospitalized post-injury. Same-level falls were the most common type of incident among older workers. Falls from height were more prevalent among men than women. The narrative case descriptions for same-level falls to the floor primarily implicated floor contamination and tripping hazards.*
Conclusions *Fall prevention programs targeted to older workers must examine extrinsic sources of falls, particularly surface traction, contaminant control, and footwear.* Am. J. Ind. Med. 46:32–41, 2004. *© 2004 Wiley-Liss, Inc.*

KEY WORDS: occupational injury; slip, trip, and fall; older workers; injury surveillance; hospital emergency departments

INTRODUCTION

The labor force of the United States is growing older. This aging is largely credited to the population growth during the baby-boom era [Dohm, 2000]. It is estimated that the percentage of the labor force comprised of those 45 years and older will increase from 33% to 45% between1998 and 2008 [Fullerton, 1999; Dohm, 2000]. By 2010, the median age of workers is projected to reach 40.6, surpassing the previous high of 40.5 in 1962, a peak that dropped as the baby-boom generation started entering the labor force [Fullerton and Toossi, 2001]. The average retirement age is also expected to increase, due in part to a healthier older population, increased labor participation of women, declining age discrimination, and gradual increases in age for collecting full social security benefits [Dohm, 2000]. These demographics suggest that issues of aging will become more prominent in occupational safety and health research of the future.

Falls are a leading cause of morbidity and mortality for older adults [Tinetti et al., 1988; Sattin et al., 1998]. There has been an abundance of research on fall-related injury among nonworking older adults, who fall either in extended care facilities or in the community (e.g., outside of a nursing

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home). It has been reported that roughly one of three adults 75 years or older living in the community falls, with risk factors including sedative use, cognitive impairment, and lower extremity disability [Tinetti et al., 1988]. Intervention projects have demonstrated the success of reducing falls among community dwelling elders when study participants are selected based on the presence of intrinsic risk factors for a fall, such as the use of four or more medications and balance impairment [Tinetti et al., 1994; Rizzo et al., 1996]. Intervention studies attempting to assess the relationship between environmental hazards and falls in community dwelling elderly have been less successful [Sattin et al., 1998; Gill et al., 2000].

There are important distinctions between the nonworking and working populations of elders that raise concerns when attempting to extrapolate the findings of the nonworking population to those still active in the labor force. Studies of occupational falls have often identified those 45 or 55 years of age as an ''older'' person compared to 70 or 75 years in studies of the nonworking. The two populations are also exposed to different environments along with the associated extrinsic risks. Additionally, the healthy worker survivor effect suggests that there are differences between the working and nonworking, with older individuals who continue working being healthier than those who leave the workforce at earlier ages [Checkoway et al., 1989; Arrighi and Hertz-Picciotto, 1994].

Over the past decade, there has been increased discussion on occupational falls in the U.S. as seen through several descriptive studies [Agnew and Suruda, 1993; Leamon and Murphy, 1995; Kisner and Pratt, 1997; Layne and Landen, 1997; NIOSH, 2000; Courtney et al., 2001]. Studies focusing on fatalities have reported older workers at higher risk for a fall-related incident [Jenkins et al., 1993; Kisner and Pratt, 1997; NIOSH, 2000; Marsh and Layne, 2001]. The study of nonfatal occupational falls however has been less conclusive and hampered by the lack of nationally representative data with appropriate injury severity measures [Leamon and Murphy, 1995; Layne and Landen, 1997; Courtney et al., 2001]. From one study using data from a private sector insurance company, it was reported that younger workers were at greatest risk of both falls from height and same-level falls, and that workers 61–65 years were at significantly lower risk of both types of falls compared to the population mean of all workers [Leamon and Murphy, 1995].

The objective of this descriptive study is to examine nonfatal occupational falls and slip and trips without a fall to older workers (55+ years), and to compare the risk of these injuries to those of the younger adult workforce (18–54 years). To do so, we have utilized injury data reported to a national probability sample of hospital emergency departments (EDs). Specifically, data were examined to describe the epidemiology, injuries sustained, and circumstances of occupational falls and slips/trips.

MATERIALS AND METHODS

Sample and Data Collection

Data for this study were derived from the National Electronic Injury Surveillance System (NEISS)[1] for the year 1998. NEISS gathers data from a national probability sample of hospital EDs across the U.S. Each case in NEISS is assigned a statistical weight corresponding to the inverse probability of the hospital being included in the sample. All analyses in this study are provided as national estimates using the statistical weights for extrapolation [see Jackson, 2001, for more information of NEISS methodology].

Eligible cases included first time visits to hospital EDs for medical treatment of an occupational injury or illness for the noninstitutionalized civilian workforce. An incident was defined as work-related if it occurred while (1) working for pay or other compensation, (2) performing work tasks on a farm, or (3) working as a volunteer for an organized group, including firefighting, healthcare, or a charity group.[2] Work-related cases were identified based on admissions information and medical chart review by hospital coders at the time of initial treatment. Workers' compensation claims were not required for work-related identification.

Incidents involving a fall or slip/trip without fall were identified by the injury event variable coded in accordance to the Occupational Injury and Illness Classification System (OIICS) [Bureau of Labor Statistics, 1992].[3] Narrative information from case records for those 55 years and older were re-examined to confirm that injuries were work-related and correctly classified as the result of a fall (OIICS major division 1) or a slip, trip, loss of balance—without fall (OIICS group 215). No cases were excluded based on the review. Case records for younger adults 18–54 years of age were not manually reviewed but any error is assumed to be relatively small based on the normal quality control in the coding procedures.

There were a total of 47,458 occupational injury records identified in the 1998 NEISS. Of the total, 3,102 involved workers 55 years or older with 839 classified as a fall, or a slip/trip without fall. Of these 839 cases, 4 were deleted as outliers.[4] There were 43,341 cases for younger adults 18–

[1] NIOSH collaborates with the U.S. Consumer Product Safety Commission to collect occupational injury and illness data through NEISS without regard to consumer product involvement.

[2] The hospital coders were also provided with the Operational Guidelines for Determination of Injury At Work as published by the Association for Vital Records and Health Statistics to help determine whether a case meets the definition for work-relatedness [Jenkins et al., 1993].

[3] NIOSH codes the event and source of injury/illness for NEISS work-related cases in accordance with the OIICS based on a brief descriptive narrative accompanying each NEISS case.

[4] These four injuries were valid cases as the injured workers were employees of children's hospitals, injured on the job, and treated in the children's hospital EDs. There were a total of only four injuries captured in the five children's hospitals making up one of the five strata of the NEISS sample, thus removing these cases reduced the number of strata in the sample from five to four.

54 years of age, with 6,353 classified as a fall or slip/trip without fall. The remaining 1,015 cases from the 1,998 total were excluded from this analysis due to either an age of less than 18 or missing information in the age item.

The race and ethnicity items in NEISS are collected in a single question—White, Black, and other, with an accompanying descriptive text field. Other races such as Asian or American Indian, and Hispanic ethnicity are indicated in the free text field. Among workers 55 years or older injured in a fall-related incident (n = 835), there were 42 cases in which the open-ended format included a response of Hispanic, only one of which included a positive response for race of either White or Black. Thus for this analysis, cases were recoded as White non-Hispanic, Black non-Hispanic, Hispanic, and other.

Industry narrative fields were coded for the older worker fall-related cases (n = 835) via a two-phase process. Initially, the Standardized Occupational and Industry Coding software (SOIC) was utilized [NIOSH, 2001] to translate literal narratives into the 1990 Bureau of the Census industry codes. The remaining cases (about one-third) were coded manually. Industry was not coded for younger adults (18–54 years of age), or for older worker cases that did not involve a fall. Occupation information was missing for nearly half of the older worker fall-related cases and not utilized in this report.

Based on a brief narrative of the incident, cases involving older workers (55 years or older) classified as same-level falls to the floor were coded for extrinsic and intrinsic factors related to the falls. Extrinsic categories included floor contamination for water, ice, oil/grease, and wax; tripping over electrical/medical cords, furniture, and rugs/mats; handling materials; and intrinsic factors included issues such as syncope. If the narrative description included only that the worker fell to the floor, it was classified as "no additional information." The narratives for incidents involving falls from height were also examined but detail beyond that available from the OIICS event variable was not ascertainable. Therefore, the cases were not coded for extrinsic and intrinsic factors.

Data Analysis

Data were analyzed using the SAS V8.0 software [SAS Institute, Inc, 2000]. Sample errors for the injury estimates from NEISS were calculated using the PROC SURVEYMEANS procedure. In accordance with CPSC guidelines, weighted estimates were considered statistically unstable and not reported when based on less than 20 cases or if the coefficient of variation was greater than 33%.

Injury rates were calculated as incidents per 10,000 full-time equivalent (FTE) workers (1 FTE = 2,000 hr per year) using employment estimates from the 1998 Current Population Survey (CPS) [Bureau of Labor Statistics, 1999]. CPS estimates do not include volunteer workers, therefore 13 cases for workers 55 years or older and 47 cases among those 18–54 years were removed from the injury data for the rate calculations.[5] Error estimates for the CPS employment data were calculated according to methods in Employment and Earnings [Bureau of Labor Statistics, 1999]. To incorporate error estimates from both the NEISS injury data and the CPS employment data in the injury rate confidence intervals, the variance from each sample estimate were pooled.

RESULTS

All Injury

An estimated 3.48 million (95% CI ± 685,800) nonfatal occupational injuries were treated in hospital EDs among workers 18 years of age or older in the U.S. in 1998. Workers 55 years or older (55+) comprised 224,800 (±38,400) or 7% of the 3.48 million injuries. The overall nonfatal injury rate (296 ± 59/10,000 FTE) for men and women aged 18–54 years was significantly greater than the rate for those 55+ (151 ± 26). Incidents that involved a slip, trip, or fall (STF) comprised 15% of the total (3.48 million), with 489,000 (±87,500) classified as a fall and 48,700 (±11,600) as slip/trip without fall. Nearly 35% of all injuries to women 55+ were classified as a STF and 20% for men 55+. STF injuries comprised much lower percentage of the total among the younger age groups (Fig. 1). Unlike the proportional distributions however, the injury rates for STF incidents were similar among the different age groups with a rate of 40 (±8)/10,000 FTE for men and women 55+ compared to 43 (±5) for those 18–54. The STF relative risk (RR) for older to younger women (55+ compared to 18–54) was 1.2 (±0.3). The RR for older to younger men was 0.8 (±0.2).

Falls to Older Employees (55+)

Among workers 55 years or older injured in a STF incident, falls comprised 55,800 (±10,200) of the injuries while the remaining 4,000 (±1,300) were slip/trip without fall. By sex, 52% were male and 48% female (Table I). Those aged 55–59 accounted for the majority of cases, median age of 59, ranging from the minimum inclusion age criteria of 55 to a maximum of 88 years. Females 65+ had a RR of 1.3 (±0.5) compared to females 55–64, while the rates for the males 55–64 and 65+ were nearly identical (Table I).

Non-Hispanic Whites comprised the largest racial/ethnic group, constituting 61% (36,500 ± 9,600) of workers 55+. Approximately 11% were non-Hispanic Black and 3% were classified as other. Hispanics represented about 4% of the total. Race/ethnicity was unknown for 22% of the sample.

[5] Volunteers were identified through a keyword search of "volunteer," "volunteers," and "volunteered" in the free text fields.

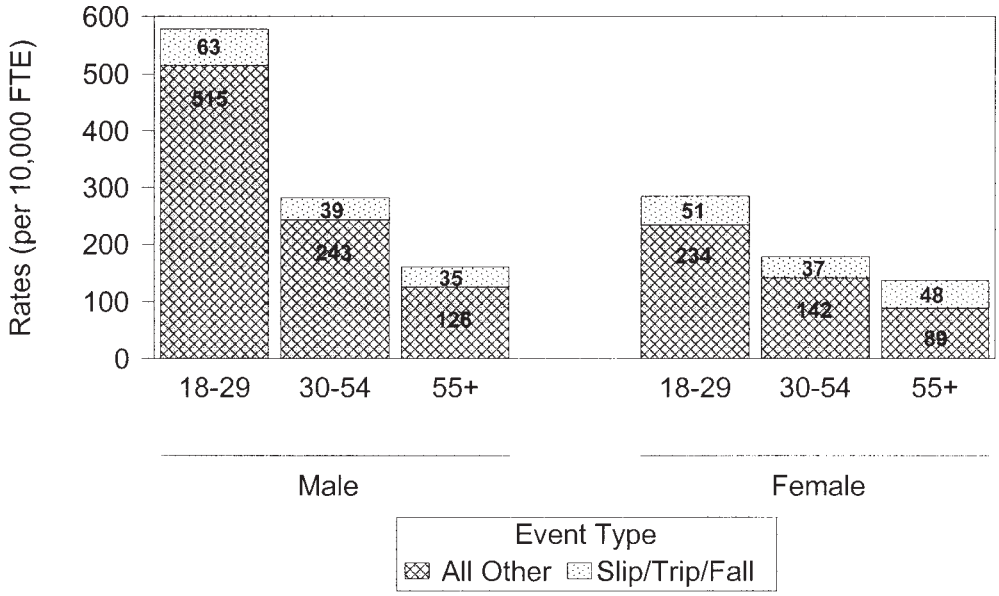

FIGURE 1. Nonfatal hospital emergency department injury rates for slips, trips, and falls compared to all other events, by sex and age group, U.S., 1998.

The attending physician's diagnosis for STF injuries among workers 55+ was most commonly a contusion, abrasion, or hematoma (34%; 20,100 ± 4,700), sprain or strain (26%; 15,500 ± 4,600), fracture (22%; 13,100 ± 5,600), or laceration (8%; 5,000 ± 1,400). Figure 2 displays the diagnosis by major body area. The knee (8,200 ± 2,300) and ankle (4,500 ± 1,400) comprised 43% and 23% of the injuries to the lower extremities. The lower trunk including the hip (8,000 ± 2,700) comprised 46% of the injuries to the trunk and shoulder area, while the wrist (3,900 ± 1,300) was the most commonly injured body part of the upper extremities. Seventy percent of all lacerations occurred to

TABLE I. Slip, Trip, and Fall Incidents by Sex and Age Group, Older Workers (55+ Years), Treated in Hospital Emergency Departments, U.S., 1998

	National estimates			Rate/10,000 FTE	
Demographics	**N**	**95% CI**	**%**	**Rate**	**95% CI**
Total	59,800	11,200	100.0	40	7
Sex					
Male	31,300	6,600	52.3	35	7
Female	28,500	6,000	47.7	47	10
Age Group					
55–59	30,800	7,000	51.5	38	8
60–64	16,800	3,700	28.2	41	9
65–69	6,600	1,500	11.0	42	10
70–74	3,500	1,200	5.9	46	17
75+	2,100	800	3.4	41	19
Sex (age)					
Male (55–64)	25,400	6,000	42.6	35	8
Male (65+)	5,800	1,400	9.7	34	8
Female (55–64)	22,200	5,000	37.1	45	10
Female (65+)	6,300	1,700	10.6	58	17

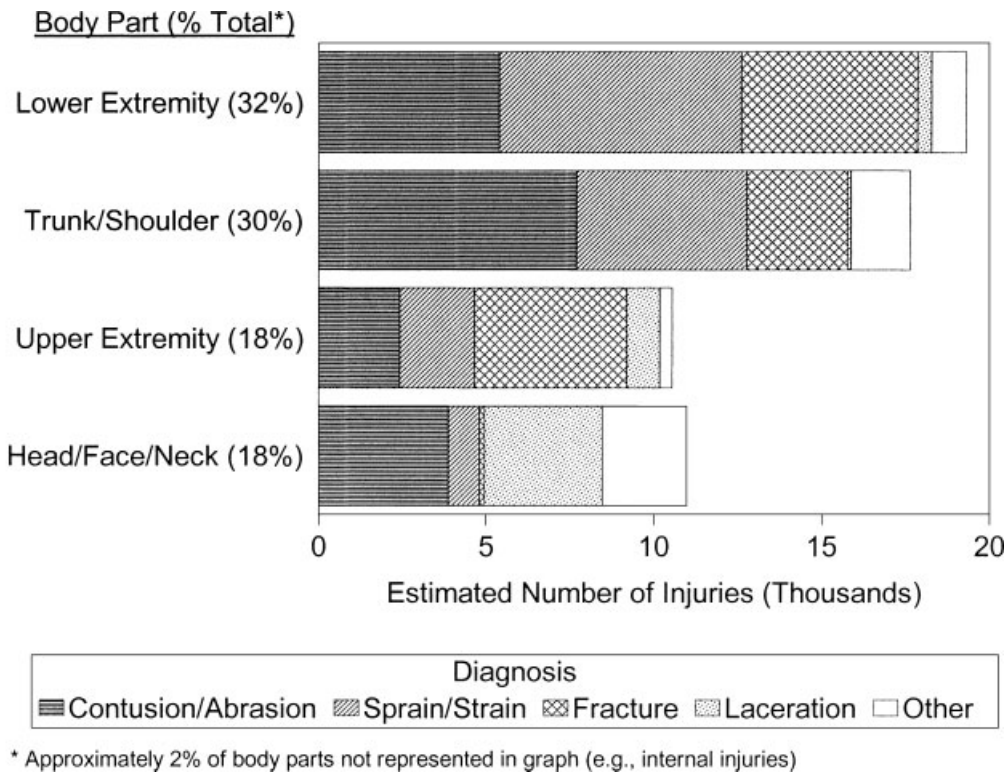

FIGURE 2. Body part by injury diagnosis—nonfatal slips, trips, and falls to workers 55+ years of age treated in hospital emergency departments, U.S., 1998.

the head and neck, accounting for 32% of all injuries to this region. Another 13% of the injuries to the head and neck were classified as a closed head injury (1,400 ± 800).

Compared to workers 18–54 injured in a fall incident, injuries to the head/neck area were more common among those 55+ (12% for 18–54 and 18% for 55+), with an older-to-younger RR for head/neck trauma of 1.5 (±0.5). By nature of injury, fractures were more common among those 55+ (13% for 18–54 and 22% for 55+), with a RR of fractures for older to younger workers of 1.6 (±0.5). Sprains/strains were more common among the younger workers (37% for 18–54 and 26% for 55+), with an RR for sprains/strains of 0.6 (±0.2).

Type of Fall

Figure 3 shows same-level falls comprised about two-thirds [39,500 (±8,500)] of the total for workers 55+. Of the same-level fall events (n = 9,500), 66% [26,100 (±5,300)] were to the floor, 15% [5,800 (±2,100)] were onto or against an object, and the remaining 19% were unspecified (a same-level fall without adequate detail to sub-classify). Same-level falls were followed by falls from height [14,500 (±3,300)], and slip/trip without fall [4,000 (±1,300)]. For both same-level falls and falls from height, the nature of injury and body part injured closely followed the overall distribution previously displayed in Figure 2. Slips or trips without a fall primarily involved the lower extremities (65%) with roughly 95% of all slips and trips classified as a sprain or strain.

Figure 4 displays the various types of falls for women 55+. Women 55+ had an injury rate for same-level falls of 39 (±9)/10,000 FTE compared to 29 (±5) among younger women, with an older to younger RR of 1.3 (±0.4). Of all

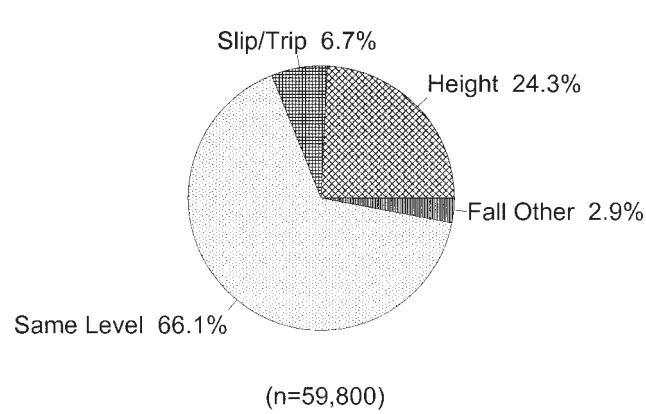

FIGURE 3. Type of fall—nonfatal slips, trips, and falls to men and women 55+ years of age treated in hospital emergency departments, U.S., 1998.

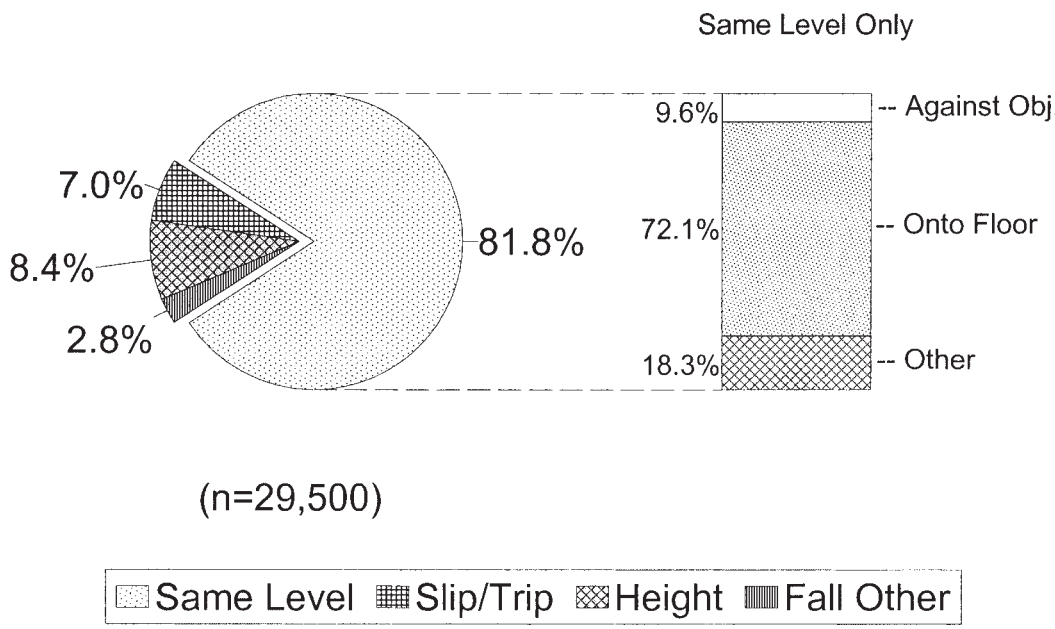

FIGURE 4. Women 55+ years of age—type of nonfatal slip, trip, and fall treated in hospital emergency departments, U.S., 1998.

STF incidents among women 55+, 8% were falls from height with a rate of 4 (±2). For younger women (18–54), 16% were classified as a fall from height with an injury rate of 6 (±1)/10,000 FTE with an older to younger RR of 0.7 (±0.4).

Same-level falls were also the leading type of STF among men 55+, although falls from height accounted for a larger proportion of falls among men 55+ than for women 55+ (Fig. 5). Falls from height comprised 39% of all STF injuries among men 55+ with an injury rate of 14 (±3)/10,000 FTE, and 41% among men 18–54 with a rate of 18 (±3). The older to younger RR for falls from height was 0.8 (±0.3) for men.

Industry

The services industries (34%) comprised the largest number of falls among older workers with an injury rate of 37 (±9)/10,000 FTE (Table II). The industry distribution was

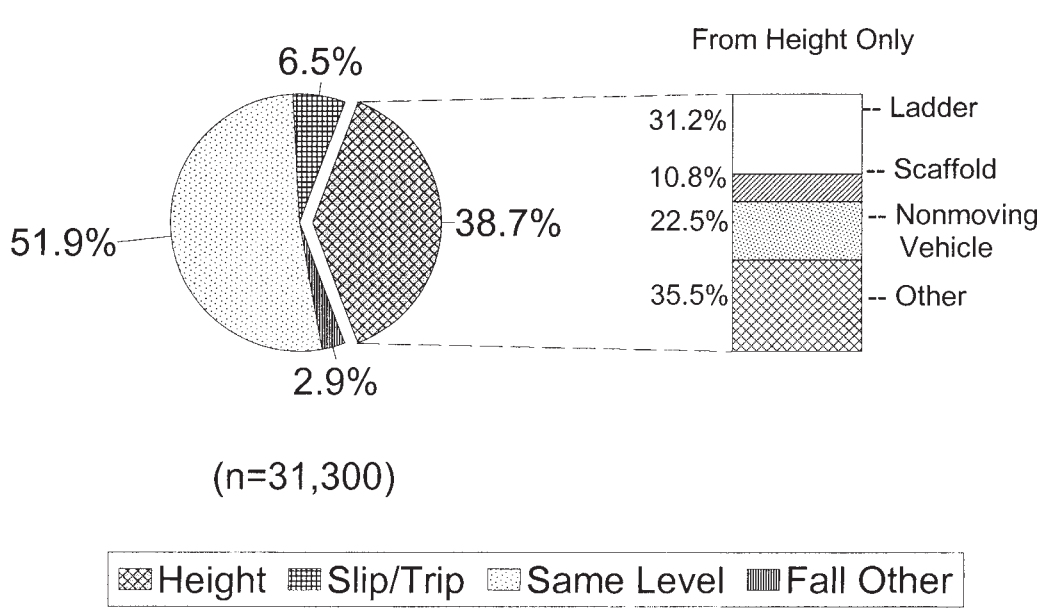

FIGURE 5. Men 55+ years of age—type of nonfatal slip, trip, and fall treated in hospital emergency departments, U.S., 1998.

TABLE II. Slip, Trip, and Fall Incidents by Industry Sector, Older Workers (55+ Years), Treated in Hospital Emergency Departments, U.S., 1998

	National estimates			Rate/10,000 FTE	
Industry	**N**	**95% CI**	**%**	**Rate**	**95% CI**
Total	59,800	11,200	100.0	40	7
Services	20,500	4,600	34.4	37	9
Health	9,400	2,300	15.8	69	18
Hospital	6,200	1,900	10.4	107	41
Nursing home	1,900	900	3.1	87	42
Secondary education	3,900	1,700	6.6	45	20
Business repair	1,900	1,100	3.2	22	12
Personal services	1,700	1,100	2.9	32	21
Retail trades	9,600	3,400	16.0	48	17
Food stores	2,700	1,700	4.5	81	49
Eating and drinking establishments	2,200	1,200	3.7	68	34
Manufacturing	6,400	2,700	10.6	26	11
Construction	4,200	1,700	7.1	52	20
Transportation, communication, public utilities	3,600	1,300	6.1	34	12
Transportation	2,800	1,100	4.6	34	13
Agriculture, forestry, fishing	3,000	1,500	5.0	48	24
Public administration	2,200	900	3.7	32	11

more homogenous among women than for men, with 52% of the injuries to women occurring in services (48 ± 13) and 19% in retail trades (57 ± 21). Within services, the sub-industry category of health services accounted for 29% of the injuries among women with a rate of 84 (±24); hospitals alone comprised 19% of the total for women with a rate of 124 (±45). For men, the largest number of STF incidents occurred in services (18%), manufacturing (14%), retail (14%), and construction (13%). The highest rates for men were in construction (54 ± 22) and agriculture, forestry, and fishing (50 ± 26).

Contributing Factors to Same-Level STF Incidents

Of same-level falls to the floor (previously noted as 26,100 ± 5,300), females comprised 64% (16,800 ± 3,600) with males accounting for the remaining 36% (9,300 ± 2,500). About 60% (15,600 ± 3,500) of the same-level falls to the floor provided additional information about etiologic factors related to the injury, comprised 9,700 (±2,400) incidents involving females and 5,900 (±1,800) involving males.

The leading cause of same-level falls to the floor involved contamination of the floor surface (24%; 6,100 ± 2,000), consisting primarily of wet floors (12%; 3,100 ± 1,300) (i.e., from spills, mopping, etc.) and ice (9%; 2,200 ± 1,100). Tripping over objects such as cords, equipment, and scrap debris accounted for 14% (3,700 ± 1,000) of the total. Among females, floor contaminants (19% of the total for females; 3,100 ± 1,100) implicated were primarily wet surfaces (12%; 1,900 ± 900) and ice (6%). Falls caused by tripping over objects comprised an additional 18% (3,100 ± 900) of the cases among females. For males, floor contamination (32%; 3,000 ± 1,200) was the leading cause, consisting primarily of ice (14%) and wet surfaces (12%). Handling objects and materials at the time of the fall comprised 7% of all cases to males. Slightly less than 3% of all cases included intrinsic factors such as fainting, seizure, syncope, or dizziness being related to the incident—4% of the cases among females were characterized as such and 1% for males.

Hospitalized Cases

There were 4,800 (±1,700) STF incidents to those 55+ subsequently hospitalized after initial treatment in the hospital ED. Men accounted for 73% (3,500 ± 1,500) of the hospitalized cases and women for the remaining 27%. About 51% (2,500 ± 1,000) of the hospitalized cases resulted from same-level falls and 44% (2,100 ± 1,100) from falls from height. Hospitalized cases resulting from same-level falls comprised 54% men and 46% women. Nearly all hospitalized falls from height involved men. None of the hospitalized cases involved a slip/trip without fall. Fractures specific to the lower extremities accounted for 31% of all the hospitalized cases and fractures to the trunk/shoulder area for another 27% (these same types of injuries accounted for only

5% of the nonhospitalized STF incidents to workers 55+). The hospitalization rate for STF incidents was 3 (±1)/10,000 FTE for those 55+ with a RR of 1.8 (±0.8) compared to the hospitalization rate for younger workers (18–54 years). The rate of hospitalization for all falls from height was similar between the two age groups. Older workers however were more likely to be hospitalized from same-level falls (RR 3.1 ± 1.7).

DISCUSSION

Limitations of the Study

Limitations of ED injury surveillance systems have been discussed elsewhere [Layne and Landen, 1997; MacArthur and Pless, 1999; Stone et al., 1999; Jackson, 2001]. Of the many disadvantages, pertinent to the presented research, is that a substantial portion of medically treated injuries may have been treated in medical venues other than hospital EDs. An in-house analysis of the 1988 National Health Interview Survey (NHIS) Occupational Supplement showed that for self-reported falls to workers 55+, about 23% were seen in an ED as the location of first medical treatment. This compared to 53% of the falls treated in a Doctor's office. Thus, it is unclear how representative the NEISS ED data presented in the study are for all work-related STF incidents, but we suspect that the ED surveillance captures most of the severe fall-related cases. The Bureau of Labor Statistics [1998] reported that about 41,200 falls occurred to private sector workers aged 55+ that involved days away from work in 1998. We reported that 55,800 fall incidents to those 55+ were treated in EDs in 1998, but the NEISS data do not provide a mechanism to examine how many of these cases included days away from work.

The magnitude of falls amongst healthcare workers may be influenced by measurement bias. It is possible that if a healthcare worker falls while working in a hospital, they are more likely to be seen in the ED due to ease of access or hospital policy. As a result, healthcare workers may have been over-represented in our sample.

The manual review of the case descriptions showed that lack of detail in the narrative text was a limitation of this study. Of same-level falls to the floor, about 40% of the cases did not contain the detail needed to address extrinsic or intrinsic risk factors. Additionally, the narrative review was limited to only same-level falls to the floor, thereby excluding a review of cases classified as ''falls same level, unspecified'' (OIICS 130). These cases, by definition, lack the detail needed for classification of risks. Additionally, falls from height were not examined for extrinsic or intrinsic factors due to the lack of detail in the brief injury narratives providing relevant information beyond what can be gleaned from the OIICS codes.

Information for occupation was missing in 46% of the STF cases among older workers and thus was not utilized in this report. Industry reporting was much better with only 13% lacking information for classification purposes. The NEISS system has shown ''name of business'' to be the most useful item for identifying the industry of the injured worker. We believe this item is probably readily available in the ED record due its usefulness for billing of medical expenses. A report from the Bureau of Labor Statistics suggests that occupation may be more important than industry in explaining job-risk patterns [Mitchell, 1988].

Lastly, injury rates based on race were not calculated because race and ethnicity items in NEISS do not match the employment estimates of the CPS. The CPS collection of race and ethnicity follows the two question format (with the item for ethnicity preceding that for race) of the revised guidelines from the Office of Management and Budget [1997]. As previously mentioned, these items in NEISS are collected by a single question, with an accompanying descriptive text field.

Occupational Injury Prevention of Slips, Trips, and Falls

For prevention of occupational STF injuries, Leamon [1992] suggests a number of strategies including housekeeping walk-throughs for identifying contamination spills. ''Water spills, for example, by drinking fountains, refrigerator cabinets and especially from rain water tracked in on feet, can create a major hazard by either physical interaction with the floor polish, causing softening, or by modifying the coefficients of friction of the shoe material'' [Leamon, 1992]. DiPilla [2001] reports that three controllable factors should be addressed: slip-resistant walking surfaces, slip-resistant shoes, and the presence of contaminants. But as Leamon [1992] points out, the interaction between the various factors leads to a complex array of contingencies. Additionally, there are numerous mechanical testing devices available for measuring walking surface friction but there are no universally accepted standards. And when floor contamination is introduced, not only are the measurements of some friction testing devices of limited use, but shoe materials effective for one type of contaminant may not be effective for another [DiPilla, 2001]. The risk of STF events is further complicated by factors including an individual's health status, anthropometry, recognition of potential slip hazards, and work task or activity being performed.

Advances are being reported for reducing slipperiness through surface roughness of both the shoe and floor [Chang et al., 2001]. These efforts have shown that better traction can be obtained under both dry and various contaminated conditions, including water and oil, using rough surfaces that provide minute peaks for contact between the shoe and floor. For floor contamination, which is often inevitable, the efficacy of cleanup methods should be considered. For instance, the agitation from a deck brush can increase

walkway traction compared to a less abrasive method such as mopping, which can spread contaminants [DiPilla, 2001].

The authors could locate only one study that starts to approach an occupational evaluation study for falls related to slipperiness of walking surfaces [Ballance et al., 1985]. In this study, the kitchen, food service, and hallways of a major university were targeted for intervention based on the magnitude of injuries in these locations. Measurements of several different flooring materials were performed along with the material cost considerations (costs by type of flooring and square footage in need of replacement). The new flooring was of a spiked nature for penetrating the grease contaminants. To appropriately clean the rough surface that trapped contaminants, an electric scrubbing machine was purchased. A buffing machine and different polishing techniques were also evaluated for maximizing friction on wood flooring. At the time of the writing, no injuries had occurred on any of the new flooring.

And while the authors' works cited above are relevant primarily for indoor fall reduction, studies have been performed specific to work outdoors [Bentley and Haslam, 2001a.b]. For outdoor workers, the seasonal weather of the winter months leads to increased fall related injuries [Bentley and Haslam, 2001a]. Walking down steep grades and steps, damaged walking surfaces, obstacles, and steps without handrails have been implicated in increased risk. Mail carriers also reported reading letter addresses while walking as a behavior that increased risk [Bentley and Haslam, 2001a].

Summary

This current study provides a descriptive analysis of the characteristics of work-related nonfatal injuries involving falls and slip/trip without a fall among workers 55+ by nature of injury and body part, industry, fall circumstances, and narrative review of extrinsic and intrinsic factors. Although previous studies on nonfatal work-related falls among older adults are sparse, we did find that our results were for the most part in accordance with available literature [Laflamme and Menckel, 1995; Leamon and Murphy, 1995; Layne and Landen, 1997; McNamee et al., 1997; Kemmlert and Lundholm, 1998, 2001; Courtney et al., 2001].

In this study, workers 55+ had a lower overall risk of injury compared to their younger counterparts. And although a greater proportion of injuries to older workers involved STF incidents, the injury rates for STF events were about equal between the age groups suggesting that older workers are at no greater risk of falling than their younger counterparts. Older workers were however significantly more likely than those 18–54 to incur a STF-related fracture [RR 1.6 ($\pm$0.5)] and to be hospitalized from same-level falls [RR 3.1 ($\pm$1.7)]. The majority of STF injuries among older workers occurred in the services and retail trades industries. Extrinsic factors such as floor contamination were common for same-level fall incidents, while intrinsic factors such as syncope (e.g., dizziness or fainting) were rarely mentioned, 1% and 4% for men and women, the exact percentages reported in an European study [Kemmlert and Lundholm, 2001].

Previous literature has indicated that fall prevention efforts should not discriminate between younger and older people, that the same preventive measures should be incorporated [Kemmlert and Lundholm, 1998]. Our finding of equal risk may provide support for this recommendation. The increased severity of the injuries however may indicate that targeted fall intervention studies for older workers be performed in the industry sectors most prevalent for these events. While this report did not examine injury costs, a recent study estimated that overall workers' compensation costs will decrease as the workforce ages due to the lower risks of older workers offsetting the costs associated with higher injury severity [Tattrie et al., 2000]. With the risk of falls between the age groups being about equal, but a greater probability of an older patient being hospitalized, there may be increased costs specific to STF incidents, but additional data are required to test this hypothesis.

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