Increased Fall-Related Mortality Rates in New Mexico, 1999–2005

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ABSTRACT

Objective. In 2000, fall injuries affected 30% of U.S. residents aged ≥65 years and cost $19 billion. In 2005, New Mexico (NM) had the highest fall-related mortality rate in the United States. We described factors associated with these elevated fall-related mortality rates.

Methods. To better understand the epidemiology of fatal falls in NM, we used state and national (Web-based Injury Statistics Query and Reporting System) vital records data for 1999–2005 to identify unintentional falls that were the underlying cause of death. We calculated age-adjusted mortality rates, rate ratios (RRs), and 95% confidence intervals (CIs) by sex, ethnicity, race, and year.

Results. For 1999–2005 combined, NM's fall-related mortality rate (11.7 per 100,000 population) was 2.1 times higher than the U.S. rate (5.6 per 100,000 population). Elevated RRs persisted when stratified by sex (male RR=2.0, female RR=2.2), ethnicity (Hispanic RR=2.5, non-Hispanic RR=2.1), race (white RR=2.0, black RR=1.7, American Indian RR=2.3, and Asian American/Pacific Islander RR=3.1), and age (≥50 years RR=2.0, <50 years RR=1.2). Fall-related mortality rates began to increase exponentially at age 50 years, which was 15 years younger than the national trend. NM non-Hispanic individuals had the highest demographic-specific fall-related mortality rate (11.8 per 100,000 population, 95% CI 11.0, 12.5). NM's 69.5% increase in fall-related mortality rate was approximately twice the U.S. increase (31.9%); the increase among non-Hispanic people (86.2%) was twice that among Hispanic people (43.5%).

Conclusions. NM's fall-related mortality rate was twice the U.S. rate; exhibited a greater increase than the U.S. rate; and persisted across sex, ethnicity, and race. Fall-related mortality disproportionately affects a relatively younger population in NM. Characterizing fall etiology will assist in the development of effective prevention measures.

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Falls are the leading cause of nonfatal injuries (2001–2007) and the third most common cause of unintentional injury-related death (with motor vehicle crashes and poisoning ranking first and second, respectively) among all ages in the United States (1999–2007).[1] Falls are also a leading cause of injury-related death in other developed countries.[2,3] Older adults are most affected by fall-related mortality. In 2000, 30% of U.S. residents aged ≥65 years sustained a fall-related injury, and these injuries cost approximately $19 billion.[4]

We observed that New Mexico (NM) had the second-highest fall-related mortality rates in 1999–2005 and conducted this analysis to better characterize the epidemiology of fatal falls in this state. Some factors identified as potentially associated with this observation included racial/ethnic health disparities, age and sex structure of the population, and decreased access to care (because of distant location to a health-care facility or cost of care). Understanding the epidemiology of fatal falls is important for prioritizing public health resources. It also enhances the ability to evaluate the effectiveness of interventions that are intended to reduce fall-related deaths and injuries.

METHODS

We analyzed death certificate data for 1999–2005 from the Bureau of Vital Records within the NM Department of Health and from the Centers for Disease Control and Prevention's (CDC's) Web-based Injury Statistics Query and Reporting System (WISQARS),[1] a national database system that uses data from the national mortality database compiled by the CDC's National Center for Health Statistics. Both data sources included information on sex, race, ethnicity, and age. Race was categorized as white, black, American Indian, Asian American/Pacific Islander, and other. (The other category was not available for the U.S. through WISQARS.) An unintentional fall-related death was defined using International Classification of Diseases, 10th Revision (ICD-10) codes[5] as the underlying cause of death (codes W1–W19).

Vital records data from the NM Department of Health were used to compare fall-related mortality with all-cause mortality by age, sex, race, ethnicity, and county, as well as to analyze the distribution of specific fall-related death codes. WISQARS data were used for NM and the U.S. to compare fall-related mortality between the state and national rates and also to compare with other states' fall-related mortality rates.

Access to care was estimated by the following three proxy measures: location of death (categorized as at home or another facility [i.e., inpatient, emergency department, outpatient, or nursing home]), poverty (defined as the percentage of families living below the federal poverty level), and population density. Location-of-death data were available at the patient level. Poverty and population data were available at the county level in NM for 2000 and obtained from the Census Bureau.[6] Fall-related mortality rates in NM were, therefore, limited to 2000 when comparing the rates with poverty and population density data obtained from the Census Bureau.

Mortality rates, 95% confidence intervals (CIs), and rate ratios (RRs) age-adjusted to the 2000 U.S. population (using five-year age groups to age ≥85 years) were calculated for NM, compared with the U.S. rates, and stratified by sex, race, ethnicity, and year. We also calculated age-stratified rates and RRs. We analyzed age both in five-year age groups and dichotomized into those aged <50 years and ≥50 years. Odds ratios (ORs) were calculated to assess the association between the location of death (categorized as residence of the decedent vs. all other locations) among fall-related deaths vs. all other causes of death. To describe changes in fall-related mortality rates across time, the percentage increase was calculated for 1999–2005.

We calculated Pearson's correlation coefficients to assess the association between county-specific fall-related mortality rates and poverty and population density. We computed the Mann-Kendall (K) statistic to test the trend in mortality rates over time. Statistical significance was determined at alpha=0.05. We performed data analyses using SAS® version 9.1,[7] Stata® release 8.2,[8] Episheet,[9] and analysis tools provided through the WISQARS website.

RESULTS

As determined by vital records data from 1999–2005, a total of 98,503 deaths from all causes occurred among NM residents, of which 1,440 (1.5%) were fall-related. In Table 1, the distribution of demographic characteristics is compared among fall-related deaths, other unintentional injury-related deaths, and all other causes of death, with the exception of unintentional injury (including falls) deaths. When calculating RRs for NM compared with the U.S. overall in five-year age categories, RRs among those aged 0–49 years were consistently ≤1.4, whereas the RRs among those aged ≥50 years were ≥1.9. Thus, age was dichotomized among those aged <50 years and those aged ≥50 years.

The fall-related mortality rates per 100,000 population by five-year age groups are presented in Figure 1. Demographic characteristics were similarly distributed among the fall-related mortality group and the

Table 1. Demographic characteristics of people experiencing death from falling, other unintentional injury, and all other causes: New Mexico, 1999–2005

	Falls (n=1,440)		*Other unintentional injury[a] (n=5,791)*		*All other causes[b] (n=91,272)*	
Characteristic	N	*Percent (95% CI)*	N	*Percent (95% CI)*	N	*Percent (95% CI)*
Male	745	51.7 (49.1, 54.3)	4,152	71.7 (70.5, 72.9)	46,989	51.5 (51.2, 51.8)
Non-Hispanic	1,033	71.7 (69.3, 74.1)	3,201	55.3 (54.0, 56.6)	63,629	69.7 (69.4, 70.0)
White	1,329	92.4 (90.8, 93.6)	4,689	81.2 (79.9, 82.0)	83,442	91.5 (91.2, 91.6)
Black	11	0.8 (0.4, 1.4)	108	1.9 (1.5, 2.2)	1,541	1.7 (1.6, 1.8)
American Indian	90	6.3 (5.1, 7.6)	949	16.4 (15.4, 17.4)	5,820	6.4 (6.2, 6.5)
Asian American/Pacific Islander	8	0.6 (0.2, 1.1)	27	0.5 (0.3, 0.7)	392	0.4 (0.4, 0.5)
Other	1	0.1 (0.0, 0.4)	1	0.02 (0.00, 0.10)	21	0.02 (0.01, 0.04)
Age ≥50 years	1,337	92.9 (91.4, 94.1)	1,617	27.9 (26.8, 29.1)	80,665	88.4 (88.2, 85.6)

[a]All unintentional injury deaths except fall deaths (i.e., International Classification of Diseases, 10th Revision codes V01–X59, Y85, Y86, but not W01–W19)

[b]All causes of death except unintentional injury deaths (i.e., falls and other unintentional causes)

CI = confidence interval

all-cause (except unintentional injury) mortality group. One exception was that those having a fatal fall were older than the all-cause mortality group. However, the distribution of these same demographic characteristics differed between fall-related deaths and other unintentional injury-related deaths (Table 1).

Table 2 shows that the distribution of causes of fall-related deaths as coded by ICD-10 differed among those aged <50 years and those aged ≥50 years. The most notable difference was that among those aged ≥50 years, the vast majority (78.5%, 95% CI 76.2, 80.6) of fall-related deaths were coded as W18 (other fall on same level) compared with only 32.0% (95% CI 23.2, 42.0) among those aged <50 years. The percentage of falls from, out of, or through a building or structure (W13) and falls from a tree, cliff, or into water (W14–16) were much higher among those aged <50 years than among those aged ≥50 years. Fall-related deaths coded as W05–08 (fall from a nonmoving wheelchair, bed, chair, or other furniture) were evenly distributed between both age groups (<50 years: 8.7%, 95% CI 4.1, 15.9; ≥50 years: 9.6%, 95% CI 8.0, 11.3).

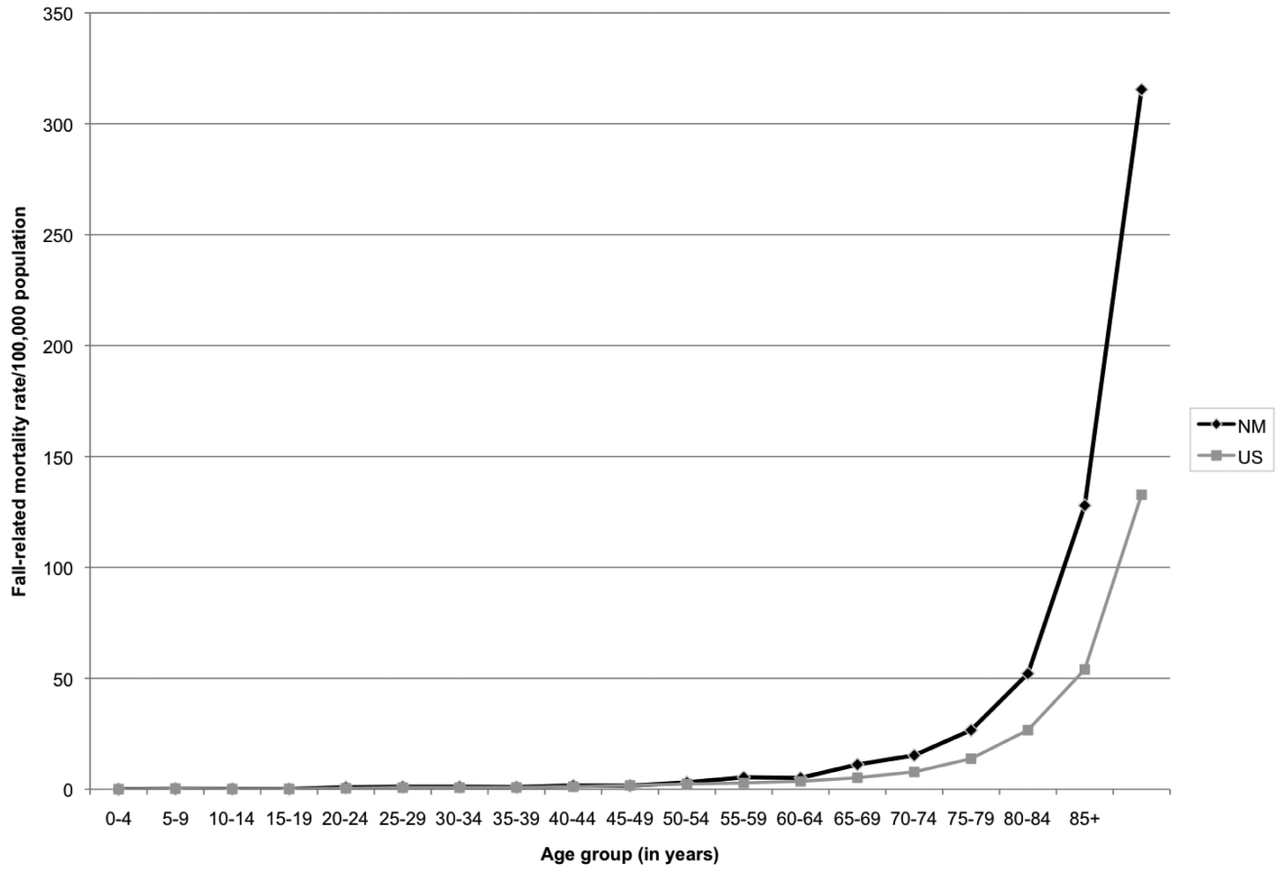
The average annual fall-related mortality rate in NM was 2.1 (95% CI 2.0, 2.2) times higher than the overall U.S. rate during 1999–2005 (Table 3). NM was an exception in the geographic distribution of states with the highest fall-related mortality rates, as the next four highest states were in the north-central part of the country. Specifically, for the period 1999–2005, NM's average annual fall-related mortality rate (11.67 per 100,000 population) was second to Wisconsin (11.73 per 100,000) and followed by Montana (9.61 per 100,000 population), Minnesota (9.29 per 100,000 population), and South Dakota (9.07 per 100,000 population) (data not shown).

No clear geographic distribution was apparent at the county level within NM. The correlation was weak between the county-specific fall-related mortality rates and the percentage of families living below the federal poverty level (r=–0.27) and population density (r=–0.01). Regarding location of death, for all deaths in NM during 1999–2005, the odds of dying at home in a fall-related death were 0.30 (95% CI 0.26, 0.36) times the odds of dying at home from another cause. There was also no association between month and fall-related mortality rate (p=0.12).

When stratifying the fall-related mortality rate by sex, ethnicity, race, and age, the stratum-specific fall-related mortality rates in NM were consistently twice the same stratum-specific rates as the U.S. overall (Table 3). Exceptions were among black people (RR=1.7, 95% CI 1.0, 3.2), Asian American/Pacific Islanders (RR=3.1, 95% CI 1.4, 6.1), and those aged <50 years (RR=1.2, 95% CI 1.1, 1.4).

When assessing time trends during 1999–2005, NM experienced a greater increase in fall-related mortality (69.5%) than the U.S. overall (31.9%) (Figure 2A). The Mann-Kendall trend statistics, K=2.70 and 2.85, respectively, were both statistically significantly increasing at $p<0.05$. When stratifying by sex, females experienced a greater increase in fall-related mortality than males during this period in both NM (74.3% vs. 61.3%) and the U.S. overall (40.2% vs. 24.2%) (Figure 2B). Similarly, when stratifying by ethnicity, non-Hispanic people had a greater percentage increase in fall-related mortality than Hispanic people in both NM (86.2% vs.

Figure 1. Fall-related mortality rates per 100,000 population in New Mexico and the U.S. by five-year age groups, 1999–2005



NM = New Mexico

43.5%) and the U.S. overall (33.5% vs. 20.7%) (Figure 2C). The increases in trend for each population were statistically significant ($p<0.05$) except among Hispanic people in NM.

DISCUSSION

NM had twice the fall-related mortality rate of the U.S. overall during 1999–2005 and led the nation in fall-related mortality rates in 2002 and 2005. This elevated rate in NM was consistently twice the U.S. rate when stratified by sex, ethnicity, race, and those aged ≥50 years. A modest, yet statistically significantly elevated fall-related mortality rate (RR=1.2, 95% CI 1.1, 1.4) persists among those aged <50 years. Although the Asian American/Pacific Islander race category had the highest stratum-specific fall-related mortality RR in NM, this population size is limited and does not account for the overall elevated fall-related mortality rates. Those in NM accounting for the greatest increase across time were non-Hispanic individuals. This finding is similar to trends observed nationally[10,11] and internationally.[12]

Fall-related mortality rates have been reported to increase exponentially with age, starting among those aged 65–69 years in the U.S. (using data for 1992–2002).[13] We observed this increase starting among those aged ≥50–55 years, thus disproportionately affecting those aged 15 years younger than what has been observed nationally (Figure 1). Whether the underlying etiology of the elevated fall-related mortality rates is common across all age groups in NM is uncertain, however unlikely, given the different distribution of code-specific causes of death as reported in Table 2.

We hypothesized that fall-related deaths were associated with lack of access to care in NM (using proxy measures of poverty, county population density, and location of death). This hypothesis implicitly includes that differences may exist in the level of trauma care

Table 2. Distribution of type of fall death as coded by ICD-10 codes, stratified by binary age categories: New Mexico, 1999–2005

	<50 years		≥50 years	
Type of fall death	N	*Percent (95% CI)*	N	*Percent (95% CI)*
W01: fall from tripping, slipping, and stumbling	0	NA	3	0.2 (0.05, 0.65)
W02: pedestrian on foot injured in collision with pedestrian conveyance	5	4.6 (1.6, 11.0)	1	0.10 (0.00, 0.42)
W05-08: fall from nonmoving wheelchair, bed, chair, or other furniture	9	8.7 (4.1, 15.9)	128	9.6 (8.0, 11.3)
W09: fall on and from playground equipment	1	1.0 (0.0, 5.3)	0	NA
W10–12: fall on or from stairs and stepladder or scaffolding	6	5.8 (2.2, 12.2)	60	4.5 (3.4, 5.7)
W13: fall from, out of, or through building or structure	20	19.4 (12.3, 28.4)	29	2.2 (1.5, 3.1)
W14–16: fall from tree, cliff, or into water	14	13.6 (7.6, 21.8)	4	0.3 (0.0, 0.8)
W17: other fall from one level to another	10	9.7 (4.8, 17.1)	12	0.9 (0.5, 1.6)
W18: other fall on same level	33	32.0 (23.2, 42.0)	1,049	78.5 (76.2, 80.6)
W19: unspecified fall	5	4.9 (1.6, 11.0)	51	3.8 (2.9, 5.0)
Total	103	100.0	1,337	100.0

ICD-10 = International Classification of Diseases, 10th Revision

CI = confidence interval

NA = not applicable

or medical management of a traumatic fall. The results from each of these analyses were negative; therefore, they did not lend any evidence to support this hypothesis.

Limitations

There were several limitations in this study. One of the conceivable explanations for these elevated fall-related mortality rates is bias in the coding of cause of death. In NM, the cause of death is provided at the physician/provider level for most deaths, except for a minority of deaths that are examined and coded at the Office of the Medical Investigator, and the National Center for Health Statistics software assigns most of the actual ICD-10 codes for injury and non-injury deaths. All coding for cause of death is conducted by one of two nosologists in the state's Bureau of Vital Records. For bias to account for these findings, there would have to be a systematic tendency for physicians across the state to more frequently ascribe fall-related deaths than their peers in other states. Because no public health initiatives or special emphasis are given to fall-related epidemiology in the state, the probability of coding being the explanation is small. Also, data from before 1999 were excluded in this analysis because of the change in coding when ICD-10 replaced ICD-9 in

Table 3. Average annual mortality rates[a] and rate ratios stratified by sex, race, ethnicity, and age for New Mexico and the U.S. overall: 1999–2005

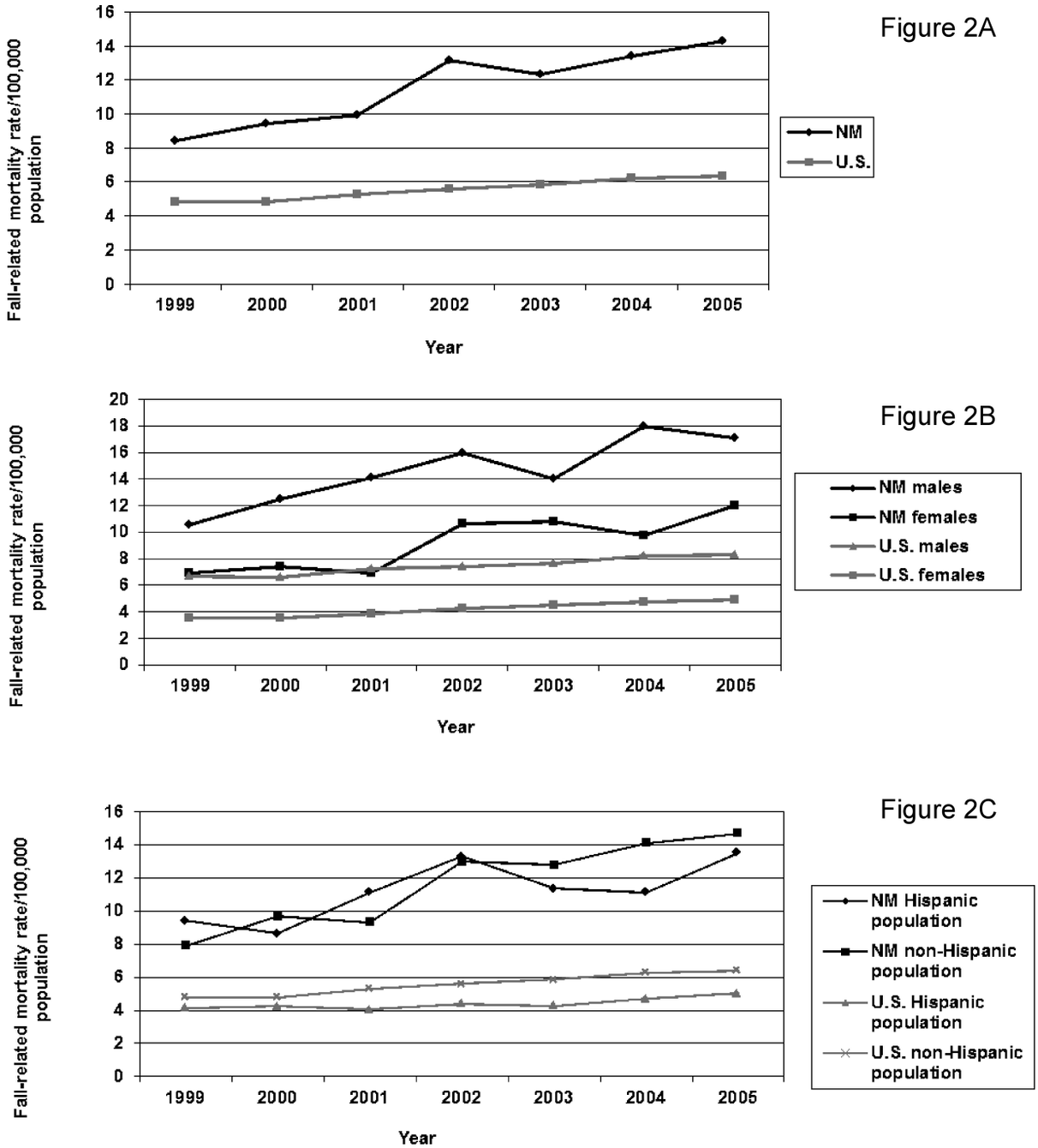
Characteristic	*New Mexico rate (95% CI)*	*U.S. rate (95% CI)*	*RR (95% CI)*
Overall age-adjusted	11.7 (11.2, 12.4)	5.6 (5.6, 5.7)	2.1 (2.0, 2.2)
Male	14.7 (13.6, 15.8)	7.5 (7.4, 7.5)	2.0 (1.8, 2.1)
Female	9.3 (8.6, 10.0)	4.2 (4.2, 4.2)	2.2 (2.0, 2.4)
Hispanic	11.4 (10.2, 12.5)	4.5 (4.3, 4.6)	2.5 (2.3, 2.8)
Non-Hispanic	11.8 (11.0, 12.5)	5.6 (5.6, 5.6)	2.1 (2.0, 2.2)
White	11.6 (11.0, 12.3)	5.8 (5.8, 5.8)	2.0 (1.9, 2.1)
Black	5.8 (2.3, 9.3)	3.4 (3.3, 3.4)	1.7 (1.0, 3.2)
American Indian	12.5 (9.8, 15.1)	5.5 (5.1, 6.0)	2.3 (1.8, 2.8)
Asian American/Pacific Islander	11.9 (3.2, 20.1)	3.9 (3.8, 4.1)	3.1 (1.4, 6.1)
Age ≥50 years	36.2 (35.1, 37.4)	17.8 (17.7, 17.8)	2.0 (2.0, 2.1)
Age <50 years	1.1 (1.0, 1.2)	0.9 (0.9, 0.9)	1.2 (1.1, 1.4)

[a]Rates are age-adjusted per 100,000 population, except when stratified by age.

CI = confidence interval

RR = rate ratio

Figure 2. Age-adjusted fall-related mortality rates per 100,000 population (A) for the general population, (B) stratified by sex, and (C) stratified by ethnicity for New Mexico and the U.S. overall: 1999–2005



NM = New Mexico

1999. No evidence exists that coding fall-related deaths changed in NM or nationally during the study period.[14]

Our study was also limited by the lack of specificity in ICD-10 codes used to describe the nature of the fatal fall. For example, W18 (other fall on the same level) was used to code the cause of death for 75.1% of all fall-related deaths in NM (of which 97.0% were among those aged ≥50 years). Focusing on the etiology of these falls is necessary to address the majority of the fall-related burden of death in NM.

CONCLUSIONS

Additional epidemiologic data are needed to better understand the reasons NM has twice the fall-related mortality rate of the United States. One hypothesis is that the rural and agricultural nature of the state might share risk factors studied by Paulson et al.[15] (e.g., riding animals, falling from tractors and other large machinery, and handling grain) in three other states (Wisconsin, Minnesota, and South Dakota) with elevated fall-related mortality rates. Data regarding occupation, body mass index, osteoporosis, epilepsy, history of stroke, use of long-term anticoagulation medicine,[16] alcohol or drug abuse, and distance to medical care might be helpful in examining their potential associations with fall-related deaths.

This analysis demonstrates that NM has twice the fall-related mortality rate of the U.S. and that this mortality rate is increasing more rapidly there than for the U.S. overall. These elevated mortality rates persist across demographic strata, sex, ethnicity, race, and those aged ≥50 years. The highest stratum-specific fall-related mortality rates are among those aged ≥50 years; males; and American Indian, Asian American/Pacific Islander, and non-Hispanic people. In addition, non-Hispanic people have experienced the greatest percentage increase during 1999–2005. Further research to characterize the etiology of fall mortality is needed.

The authors thank C. Mack Sewell, DrPH, and Frieda Gonzales, MPH, at the New Mexico Department of Health; and Julie Magri, MD, at the Centers for Disease Control and Prevention (CDC), Office of Workforce and Career Development, for their help with this investigation.

The findings and conclusions in this article are those of the authors and do not necessarily represent the views of CDC. This study was Institutional Review Board exempt.

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