



Falls and Fall Injuries



Among Michigan's Older Adults

Michigan Department
of Community Health



Jennifer M. Granholm, Governor
Janet Olszewski, Director

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State of Michigan

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EXECUTIVE SUMMARY

In 2002, a statewide task force identified unintentional falls among those aged 65 and older as a priority area for injury prevention in Michigan. The task force developed recommendations for infrastructure to support fall prevention, data collection, evidence-based interventions, technical support and training, and public policy. This report addresses the recommendation for data collection by providing a descriptive analysis of falls using death certificates, hospital discharge data, and two population-based surveys. The salient findings are as follows:

Fatal Fall Injuries

- Between 1990 and 2002, the death rate due to elderly falls nearly doubled from 17.9 to 32.5 per 100,000 population.
- An average of 345 older Michigan residents died each year from a fall between 1999 and 2002. Given increasing fall death rates and a Michigan senior population that is growing, there may be a substantial increase in the number of these deaths in the absence of prevention.
- The rate of fatal falls increased dramatically with age. The death rate approximately doubled from one five-year age group to the next.
- Rates were 25% greater for men compared to women; whites had twice the rate of Blacks.

Non-fatal Fall Injury Hospitalizations

- In 2002, falls caused 80% of hospitalizations for injury among those aged 65 and older.
- Nearly all (96%) of hospitalizations were reimbursed by Medicare.
- Most of the injuries sustained were fractures, specifically, hip fractures.
- Women had twice the rate of men.

Fall Incidence and Risk Factors

- Thirteen percent of Michigan seniors reported falling within the past three months. Twenty-seven percent reported falling in the previous year.
- About one-quarter of those who fell required medical attention.
- Falls were reported as occurring most frequently on porch steps.

It is estimated that for every elderly fall injury death in Michigan, there are 33 non-fatal hospitalizations, about 200 seniors who seek non-inpatient medical care, and more than 800 who fall. Falls that occurred in 2002 had estimated medical costs of \$659 million. Including lost worktime and quality life years lost, the total cost was about \$2.5 billion.

Study limitations included incomplete cause of injury coding for hospitalizations, a lack of specificity of fall type on death certificates, survey completion rates of about 50%, and using national cost data to estimate injury costs for Michigan.

The Injury and Violence Prevention Section of the Michigan Department of Community Health is addressing the task force recommendation for evidence-based interventions by funding a three-year fall prevention project. The project involves hospital emergency department staff identifying and referring elderly patients to a multi-component fall clinic that includes the following services: physical and occupational therapy, medication review and adjustment, modification of home hazards, screening for osteoporosis and vision testing. This strategy for reducing falls, if found effective, could be used on a wider scale in Michigan to address this serious health issue.

Questions or comments concerning this report should be directed to Linda Scarpetta, Michigan Department of Community Health, at (517) 335-8397 or e-mail at scarpettal@michigan.gov.

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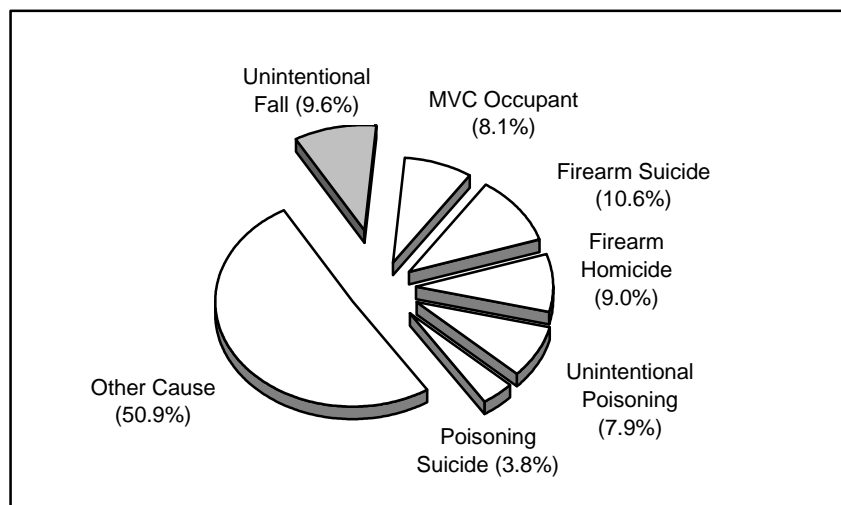
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INTRODUCTION

In October 2000, the Michigan Department of Community Health (MDCH) Injury and Violence Prevention Section received a Core Injury Capacity-Building grant from the Centers for Disease Control and Prevention (CDC). As part of this grant, a statewide taskforce was convened and provided input for the development of a state plan¹ for injury prevention. One component of this process was the identification of priority areas for injury prevention in the state. The taskforce evaluated the magnitude, severity and preventability of various causes of injury and identified four priority areas: 1) unintentional falls in adults age 65 and older; 2) poisonings (unintentional and suicidal); 3) firearm-related suicides and homicides; and 4) motor vehicle crashes (MVC) causing injuries to vehicle occupants.

Figure 1 and Figure 2 illustrate the proportion of priority causes of injury among injury deaths and hospitalizations in 2002 (for all ages). Unintentional falls are the second leading cause of fatal injuries and the leading cause of injury hospitalizations in Michigan.

FIGURE 1
Injury Prevention Taskforce priority causes of injury
Michigan resident injury deaths, all ages, 2002 (N=5,412)

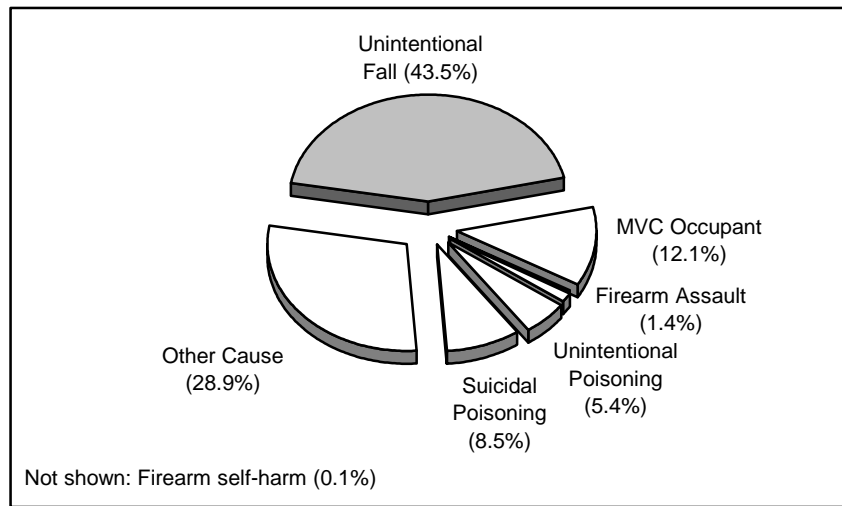


Source: Vital Records and Health Data Development Section, MDCH

While falls are a major cause of injury for all Michigan residents, the taskforce refined the focus to the elderly, specifically, those aged 65 and older. Rates of fall injuries are especially high among this group for both deaths and hospitalizations, as illustrated clearly in Figure 3.

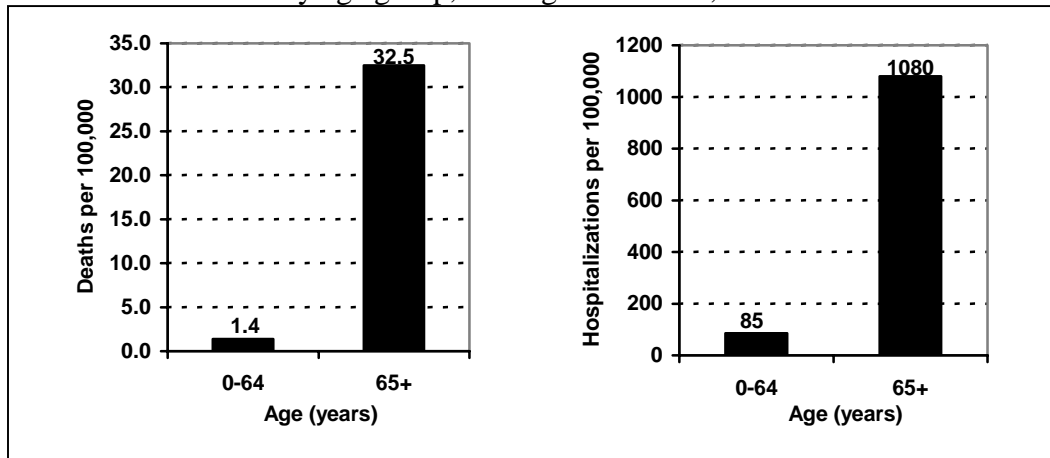
Unless the incidence rate of elderly falls decreases, the number of fall injuries in Michigan will increase substantially over the next few decades. In 2002, those aged 65 and older comprised 12.3% of the state's population. According to estimates by the U.S. Census Bureau, this will increase to 14.3% in 2015 and 18.1% in 2025.²

FIGURE 2
Injury Prevention Taskforce priority causes of injury
Michigan resident non-fatal injury hospitalizations, all ages, 2002 (N=47,718*)



* There were 47,718 hospitalizations for which cause of injury was specified – these are illustrated in the figure. There were another 7,396 injury hospitalizations with no cause of injury information.
 Source: MI Resident Inpatient Files, Division for Vital Records and Health Statistics, MDCH

FIGURE 3
Rates of fall injury deaths and non-fatal injury hospitalizations
by age group, Michigan residents, 2002



This report provides basic descriptive information on unintentional fall injuries among the elderly using available data sources. Establishing an accurate profile of the magnitude of this issue and identifying groups at especially high risk is an essential first step in developing well-targeted interventions.

DATA SOURCES AND METHODS

Data Sources

Death certificates were the source of data for fall deaths. Funeral directors, attending physicians, and medical examiners document cause of death and demographics of the decedent on the death certificate. These data are aggregated and maintained by the MDCH Vital Records and Health Data Development Section. MDCH maintains data on all deaths occurring within Michigan and on Michigan resident deaths occurring out-of-state. Mortality data for the United States were obtained from the Web-based Injury Statistics Query and Reporting System (WISQARS)³ which is managed by the Centers for Disease Control and Prevention (CDC).

The Michigan Inpatient Database (MIDB) was the source of data on hospitalizations. The MIDB is the aggregation of hospital discharge data voluntarily provided to the Michigan Health and Hospital Association (MHA) by virtually every acute care hospital in Michigan (one very small hospital does not participate). In addition, hospitals in contiguous states (Indiana, Ohio, and Wisconsin) submit data on hospitalized Michigan residents to the MHA.

During a nine-month period in 2000-2001, the Michigan State University Institute for Public Policy and Social Research (MSU IPPSR) conducted the Michigan Osteoporosis and Arthritis Risk Factor Survey for MDCH. This telephone survey of English-speaking Michigan residents had a sample size of 2,219 and included an oversample (N=1,111) of women age 50 and older. The survey contained a series of questions pertaining to falls (described in *Methods* on page 5). The survey completion rate,^{*} as defined by the American Association for Public Opinion Research (AAPOR), was 45.3% for the general population and 56.8% for the oversample of women age 50 and older.

A second source of information on fall incidence was the 2003 Michigan Behavioral Risk Factor Survey (BRFS). The BRFS is an ongoing telephone survey of residents age 18 and older. All fifty states conduct similar surveys as part of the Behavioral Risk Factor Surveillance System, which is coordinated and supported by the CDC. [Detailed methodological information on the BRFS is available elsewhere.⁴] For the 2003 Michigan BRFS, data were collected quarterly by MSU IPPSR. The total sample size of completed interviews was 3,551. The household-level cooperation rate, a measure that is essentially equivalent to the completion rate,^{**} was 41.1%.

Michigan population figures for 1990-2002 for age, race, and sex and for 1999 county of residence were obtained from bridged-race population estimates of the United States resident population, based on Census 2000 counts.⁵ [A detailed description of the bridged-race population estimate methodology is provided elsewhere.⁶] County of residence populations for 2000-2002 were based on estimates prepared by the U.S. Census Bureau through the Federal-State Cooperative Program for Population Estimates.⁷

* The AAPOR completion rate is defined as: (number of completed interviews / number of eligible households contacted) x 100.

** As of 2004, the AAPOR no longer uses "completion rate" as one of its response rate measures. The most comparable measure is the household-level cooperation rate.

Methods

Deaths

An unintentional fall death was defined as a death to a Michigan resident aged 65 or older for which the underlying cause was coded within the ICD-9⁸ range E880-E886, E888 or the ICD-10⁹ range W00-W19. These ranges also were used to define deaths nationally.

Four years (1999-2002) of mortality data were used rather than a single year to improve the capability to generate statistically valid rates. To examine mortality trends, data for 1990-2002 were utilized. An important consideration when examining mortality trends over this timeframe is that the system of coding deaths changed significantly in 1999. This was the first year in which deaths were coded using ICD-10; from 1979 to 1998, deaths had been coded using ICD-9. The CDC National Center for Health Statistics evaluated the effects of implementing ICD-10 on mortality statistics for selected causes of death.¹⁰ They found that the change from ICD-9 to ICD-10 coding by itself would reduce the number of fatal injuries coded as unintentional falls by 0.09%.¹¹ Thus, the change in coding systems had a negligible effect on the enumeration of unintentional fall deaths.

To calculate mortality rates using the 1999-2002 data, the average annual number of deaths was divided by the average annual population during the four-year period; the result was multiplied by 100,000. For temporal analyses, the annual number of deaths was divided by the state population for that year and multiplied by 100,000. The data for the national number of deaths and corresponding death rates were ascertained directly from WISQARS. (National data were not available for 2002.)

Hospitalizations

An unintentional fall hospitalization was defined as a Michigan resident aged 65 or older who was discharged in 2002 from a hospital in Michigan or a contiguous state for which the principal diagnosis was a traumatic injury and the cause of injury was an unintentional fall. Injury diagnoses were those in the following range of ICD-9-CM:¹² 800.0-909.2, 909.4, 909.9, 910.0-959.9. Hospitalizations with principal diagnoses in the range 960.0 – 995.8, (poisonings and other effects of external causes) were excluded as it was highly unlikely that they were due to falls.* Out-of-state residents and in-hospital deaths were excluded.

Injury diagnoses were categorized according to the Barell Matrix,¹³ a two-dimensional array of ICD-9-CM codes grouped by body region and nature of injury. The Barell Matrix and the ICD-9-CM codes defining each cell are presented in Table C-1 in Appendix C.

According to coding rules, an E-code should be assigned to every hospitalization involving an injury. In 2002, 83% of non-fatal traumatic injury hospitalizations to Michigan residents aged 65 and older were E-coded. It is unknown if the characteristics of the cases for which an E-code was not provided were similar to the characteristics of cases for which this information was provided. Finally, because E-coding rates vary considerably by county of residence, a geographic analysis using hospital discharge data was limited to those counties with coding rates 90% or greater.

MIDB lists primary and secondary payment sources. The first source listed was considered the principal source, except in the following situations: a) workers' compensation was considered

* There were nine hospitalizations coded as unintentional falls that had a principal diagnosis in the range 960.0-995.8.

principal, regardless of where it was listed; b) Medicare was considered principal regardless of where listed (except when in combination with workers' compensation); c) private insurers were considered principal when listed in combination with Medicaid or with self-pay. (Note that the results from using this method differed minimally from simply using the first-listed payer.)

Michigan residents who were hospitalized more than once for the same incident in 2002 were counted for each hospital discharge. Optimally, these cases would have been counted only once to reflect fall incidence. However, there was no way to sort out readmissions or identify patients admitted to different hospitals for the same incident. For this reason, the rates presented in the report represent rates of hospitalization, not fall incidence.

Hospitalization rates were calculated by dividing the number of hospital discharges by the appropriate 2002 population and multiplying by 100,000.

Analyses involving patient race were not performed because this information was unavailable for 18% of the cases.

Fall Incidence

The 2003 Michigan Behavior Risk Factor Survey asked those aged 45 and older if they had had a fall, which was defined prior to the query, in the past three months. Those reporting a fall were asked if they had been injured so that either their regular activities had been limited or they saw a physician (see Table D-1 in Appendix D for this series of questions within the interview instrument). Estimates of fall and injury incidence were calculated along with the corresponding 95% confidence limits for respondents aged 65 and older overall and by age group, gender, education, household income, disability and physical activity level. [Due to insufficient numbers of non-whites aged 65 and older, an analysis by race was not done.]

Household income level categories were "Below \$25,000" and "\$25,000 or More." The national median household income for those aged 65 and older in 2002 was \$23,000.¹⁴ The BRFS used \$5,000 categories, thus \$25,000 was as close to the median as possible. A person was categorized as disabled if they reported being limited in any activities because of physical, mental, or emotional problems, or reported that they required use of special equipment, such as a cane, wheelchair, special bed, or special phone due to a health problem. A person was considered physically active if they reported performing moderate physical activities for a total of 30 minutes at least five days per week or vigorous physical activities for a total of at least 20 minutes at least three days per week while not at work.

The 2000-2001 Michigan Osteoporosis and Arthritis Risk Factor Survey (MOAS) asked subjects how many times they had tripped or fallen in the past twelve months resulting in them hitting the floor or ground. Those who reported falling at least once were asked where the fall(s) occurred and whether injuries were sustained that required medical attention (see Table D-2 in Appendix D for this section of the survey.) Estimates of fall and injury incidence were calculated along with the corresponding 95% confidence limits for respondents aged 65 and older overall and by age group, gender, education, household income, and whether they had osteoporosis. Respondents were defined as having osteoporosis if they reported having been told by a health care provider that they had osteoporosis, bone loss, or thin or brittle bones.

For both surveys, estimates were weighted to adjust for the probabilities of selection and a post-stratification weighting factor that adjusted for the distribution of Michigan adults by age, sex, and race/ethnicity at the state level was utilized. Thus, findings can be considered reasonable approximations of responses from all non-institutionalized Michigan residents aged 65 and older. Differences between groups were tested for statistical significance at the $p < .05$ level using the pairwise T-test.

Survey data were analyzed using SUDAAN,¹⁵ a statistical computing program that was designed for complex sample surveys. Taylor Series linearization with replacement was used for variance estimation.

General

The term “falls” is used interchangeably with “unintentional falls” in the report for brevity. Both terms refer to falls excluding those of assaultive, suicidal, or unknown intent. While the BRFSS requested that respondents report only unintentional falls, the Osteoporosis and Arthritis survey did not include this limitation.

Rates based on less than six cases were not calculated due to the corresponding lack of statistical stability. In the tables, such instances are noted with an “*”. Cells in which no cases occurred are noted by a “-”.

<i>Symbols Used in Tables</i>	
No cases occurred within category	-
Quantity greater than zero but less than 0.5	0
Rate is considered statistically unreliable	*

FATAL FALL INJURIES

Trends

Between 1990 and 2002, the number of injury deaths due to falls among Michigan residents aged 65 and older doubled and the corresponding death rate increased 82% (Table 1). Similar increases occurred at the national level. During this period, Michigan’s rates were slightly lower than national rates (Figure 4). In 1993, and to a lesser extent 1998, the number of incidents in Michigan were notably low relative to the trend line.

Death rates increased for both sexes and all age groups between 1990 and 2002 (Table 2). Rates did not increase for blacks. The one-year decrease in death rates in 1993 and 1998 occurred most notably in the 75-84 year old age group.

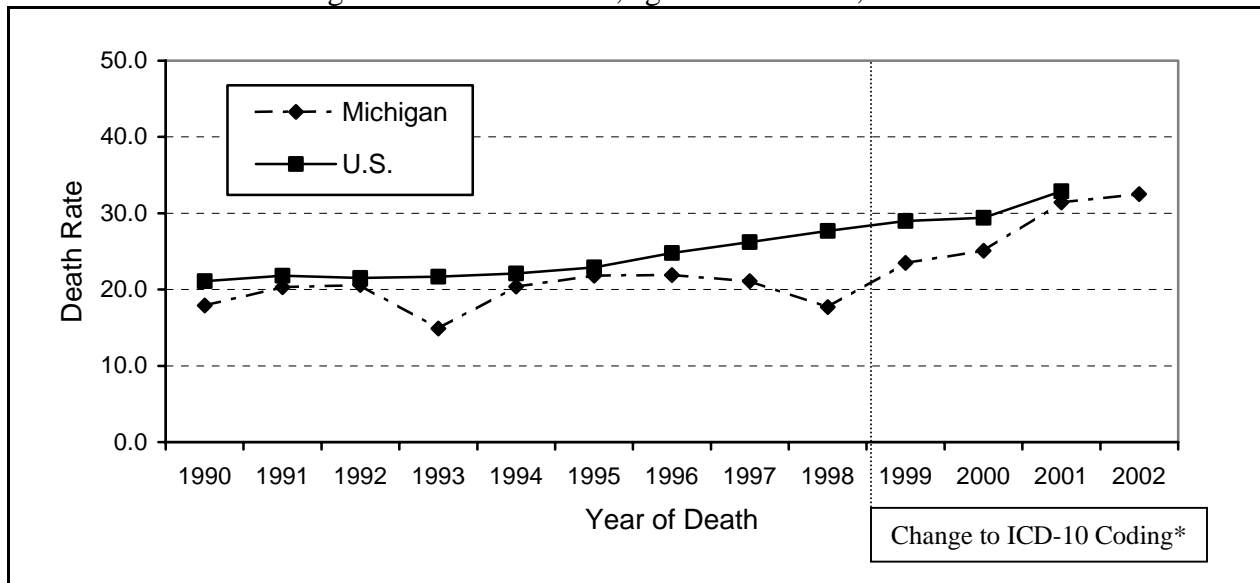
Types of Falls

During 1999-2002, an average of 345 Michigan residents age 65 and older died each year due to unintentional falls. Table 3 lists the average annual number of deaths by type of fall (as identified by ICD-10 codes) for three age groups. For 64% of the cases the type of fall was coded as “Unspecified.” The percentage of deaths coded as unspecified increased with increasing age. It is impractical to characterize the types of falls sustained with this degree of missing information.

TABLE 1
Number of deaths and death rates due to unintentional falls
by year of death, Michigan and U.S. residents, ages 65 and older, 1990-2002

Year	Number		Rate	
	Michigan	U.S.	Michigan	U.S.
1990	199	6,601	17.9	21.1
1991	230	6,922	20.3	21.8
1992	237	6,961	20.6	21.5
1993	174	7,130	14.9	21.7
1994	241	7,370	20.4	22.1
1995	261	7,721	21.8	22.9
1996	264	8,474	21.9	24.8
1997	255	9,023	21.1	26.2
1998	215	9,604	17.7	27.7
CHANGE TO ICD-10 CODING*				
1999	286	10,097	23.5	29.0
2000	307	10,273	25.1	29.4
2001	385	11,623	31.4	32.9
2002	400	not available	32.5	---

FIGURE 4
Death rates due to unintentional falls
Michigan and U.S. residents, ages 65 and older, 1990-2002



Rates are number of deaths per 100,000 population.

1990-1998: ICD-9 codes E880 – E886, E888

1999-2001: ICD-10 codes W00 – W19

Sources: Vital Records and Health Data Development Section, MDCH

Web-based Injury Statistics Query and Reporting System, U.S. Centers for Disease Control and Prevention

U.S. Census Bureau Population Estimates

* Starting in 1999, cause of death has been coded using ICD-10, a completely different coding system than ICD-9. Thus, differences in numbers and rates of death in pre- and post-1999 data may be due to this change in coding systems. The estimated comparability ratio for unintentional falls is 0.9991.¹¹ This ratio implies that the change from ICD-9 to ICD-10 coding by itself would reduce the number of fatal injuries coded as unintentional falls by 0.09%.

TABLE 2
Rates of unintentional fall deaths
by sex, race, age group and year of death
Michigan residents, ages 65 and older, 1990-2002

	1990	1991	1992	1993	1994	1995	1996	1997	1998	Change to ICD-10 Coding	1999	2000	2001	2002
Male	23.3	22.1	25.8	17.5	24.4	26.3	27.0	24.5	20.6		27.5	28.5	36.1	35.3
Female	14.3	19.1	17.1	13.1	17.7	18.8	18.3	18.7	15.8		20.8	22.8	28.0	30.5
White	18.0	20.5	20.6	15.1	20.9	21.8	22.5	21.6	18.6		24.3	26.3	33.3	34.7
Black	16.1	19.3	21.6	13.7	15.2	20.1	16.6	17.4	11.5		17.2	13.1	14.6	13.7
65-74	7.2	6.5	9.9	6.4	7.0	8.7	7.3	7.8	6.6		8.4	7.8	9.4	10.0
75-84	23.0	29.6	26.1	15.1	28.0	21.8	27.8	26.5	18.0		27.3	27.3	35.1	34.9
85+	67.7	73.4	65.7	62.5	70.9	93.2	79.7	70.7	70.5		82.3	95.5	113.1	116.1

1990-1998: ICD-9 codes E880–E886, E888

1999-2002: ICD-10 codes W00-W19

Sources: Vital Records and Health Data Development Section, MDCH
U.S. Census Bureau Population Estimates

TABLE 3
Average annual number of unintentional fall deaths
by type of fall and age group
Michigan residents, ages 65 and older, 1999-2002

ICD-10 Code	Type of Fall	Age Group			Total
		65-74	75-84	85 +	
W00	On same level involving ice & snow	1	2	0	4
W01	On same level from slipping, tripping, stumbling	2	4	7	12
W02	Involving ice-skates, skis, roller-skates, skateboards	-	1	0	1
W03	On same level due to collision with/pushing by another person	-	-	-	-
W04	While being carried or supported by other persons	-	-	-	-
W05	Involving wheelchair	1	1	2	4
W06	Involving bed	1	4	10	14
W07	Involving chair	1	2	3	5
W08	Involving other furniture	0	0	-	1
W09	Involving playground equipment	-	-	-	-
W10	On and from stairs & steps	10	18	12	40
W11	On and from ladder	3	4	1	8
W12	On and from scaffolding	1	-	-	1
W13	From, out of or through building or structure	2	4	3	8
W14	From tree	1	1	-	1
W15	From cliff	-	-	-	-
W16	Dive/jump into water causing non-drowning/submersion injury	0	-	-	0
W17	Other fall from one level to another	2	1	1	4
W18	Other fall on same level	4	9	9	22
W19	Unspecified	31	86	105	221
W00-W19	All Unintentional Falls	57	137	151	345

Totals may not equal sum of columns due to rounding.

Source: Vital Records and Health Data Development Section, MDCH

Demographics

Table 4 lists the average annual number of deaths due to falls during 1999-2002 by age group, sex and race. The corresponding death rates are provided in Table 5. Rates were higher with increasing age, especially for those age 70 and older. Within each age group and among each race, males had higher rates than females. Overall, the rate for males (31.9 per 100,000) was 25% greater than the rate for females (25.5). The rate for whites (29.7) was double the rate for Blacks (14.7).

County of residence

Table 6 presents the average annual number of fall deaths and the corresponding death rates by county of residence. Among the 40 counties for which statistically reliable rates could be calculated, rates were highest in Kalamazoo (87.8 per 100,000), Kent (63.4), and Jackson (50.2).

TABLE 4
Average annual number of deaths due to unintentional falls
by age group, race, and sex
Michigan residents, ages 65 and older, 1999-2002

Age	White			Black			Other			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
65-69	13	8	21	1	1	2	-	0	0	15	9	23
70-74	17	14	31	1	1	2	0	1	1	19	15	34
75-79	31	24	55	3	2	4	1	0	1	34	26	60
80-84	36	37	73	2	2	4	0	0	1	38	39	77
85+	52	92	144	3	4	7	1	1	1	55	96	151
Total	150	174	323	10	9	18	2	2	3	161	184	345

Includes ICD-10 codes: W00 – W19.

Numbers in columns and rows may not total exactly due to rounding.

Decedent with unknown race (n=1) not illustrated but included in totals.

Source: Vital Records and Health Data Development Section, MDCH

TABLE 5
Average annual death rates due to unintentional falls
by age group, race, and sex
Michigan residents, ages 65 and older, 1999-2002

Age	White			Black			Other			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
65-69	10.0	4.9	7.3	*	*	6.1	*	*	*	9.6	5.0	7.1
70-74	14.0	8.9	11.2	*	*	5.4	*	*	*	13.8	8.4	10.8
75-79	32.3	17.4	23.5	24.6	9.8	15.7	*	*	*	31.7	16.6	22.8
80-84	61.0	36.6	45.5	35.2	15.0	22.3	*	*	*	58.7	34.6	43.4
85+	133.6	96.2	107.0	66.6	44.7	51.2	*	*	*	127.9	91.8	102.3
Total	33.2	27.2	29.7	19.6	11.4	14.7	27.4	24.1	25.5	31.9	25.5	28.2

* Reliable rate could not be calculated; see Methods.

Rates are the number of deaths per 100,000 population.

Decedent with unknown race not illustrated but included in totals.

Sources: Vital Records and Health Data Development Section, MDCH

U.S. Census Bureau Population Estimates

TABLE 6
Average annual number of deaths and death rates due to unintentional falls
by county of residence, Michigan residents, ages 65 and older, 1999-2002

County	Number	Rate	County	Number	Rate
Alcona	-	-	Lake	1	*
Alger	1	*	Lapeer	2	26.2
Allegan	4	31.7	Leelanau	-	-
Alpena	1	*	Lenawee	2	13.9
Antrim	1	*	Livingston	3	24.1
Arenac	-	-	Luce	-	-
Baraga	1	*	Mackinac	1	*
Barry	2	22.3	Macomb	24	21.7
Bay	2	10.8	Manistee	1	*
Benzie	0	*	Marquette	4	42.8
Berrien	4	17.1	Mason	1	*
Branch	3	41.4	Mecosta	1	*
Calhoun	5	25.2	Menominee	1	*
Cass	1	*	Midland	2	14.8
Charlevoix	1	*	Missaukee	0	*
Cheboygan	2	31.5	Monroe	3	18.3
Chippewa	1	*	Montcalm	2	23.4
Clare	2	32.3	Montmorency	1	*
Clinton	2	24.6	Muskegon	9	42.4
Crawford	1	*	Newaygo	2	24.3
Delta	2	26.7	Oakland	50	36.5
Dickinson	1	*	Oceana	1	*
Eaton	3	21.0	Ogemaw	-	-
Emmet	1	*	Ontonagon	0	*
Genesee	8	14.6	Osceola	1	*
Gladwin	1	*	Oscoda	1	*
Gogebic	1	*	Otsego	-	-
Grand Traverse	2	21.7	Ottawa	8	30.6
Gratiot	2	30.4	Presque Isle	1	*
Hillsdale	1	*	Roscommon	1	*
Houghton	3	45.7	Saginaw	4	14.1
Huron	3	39.4	St. Clair	4	18.5
Ingham	10	36.8	St. Joseph	2	24.8
Ionia	3	40.3	Sanilac	1	*
Iosco	2	25.4	Schoolcraft	1	*
Iron	1	*	Shiawassee	1	*
Isabella	1	*	Tuscola	1	*
Jackson	10	50.2	Van Buren	4	40.0
Kalamazoo	24	87.8	Washtenaw	13	46.7
Kalkaska	-	-	Wayne	53	21.5
Kent	38	63.4	Wexford	0	*
Keweenaw	-	-	Michigan	345	28.2

* Reliable rate could not be calculated; see Methods.

Includes ICD-10 codes: W00 – W19.

Rates are number of deaths per 100,000 population.

Sources: Vital Records and Health Data Development Section, MDCH
U.S. Census Bureau Population Estimates

Incident Location

Table 7 illustrates the average annual number of fatal falls by type of location for two age groups among those aged 65 and older. Overall and for both age groups, more than half of the incidents occurred at home. For nearly one in five, the incident occurred at a residential institution (such as a nursing home). The proportion of these cases among those aged 80 and older (21.9%) was double the proportion for those aged 65 to 79. For a little more than one in ten cases, the incident location was unspecified.

TABLE 7
Average annual number of deaths due to unintentional falls
by incident location and age group
Michigan residents, ages 65 and older, 1999-2002

Location	Age Group				Total	
	65-79		80+			
	No.	%	No.	%	No.	%
Home	73	62.6	127	55.6	200	58.0
Residential Institution	11	9.7	50	21.9	61	17.8
School/Other Institution/Public Administration Area	6	5.2	8	3.3	14	3.9
Trade & Service Area	3	2.2	3	1.3	6	1.6
Street/Highway	2	1.5	3	1.4	5	1.5
Industrial & Construction Area	2	1.5	0	0.1	2	0.6
Sports & Athletic Area	1	0.7	0	0.1	1	0.3
Farm	1	0.4	0	0.0	1	0.2
Other Specified Area	6	5.2	11	4.8	17	4.9
Unspecified	13	11.2	26	11.4	39	11.3
Total	116	100.0	228	100.0	345	100.0

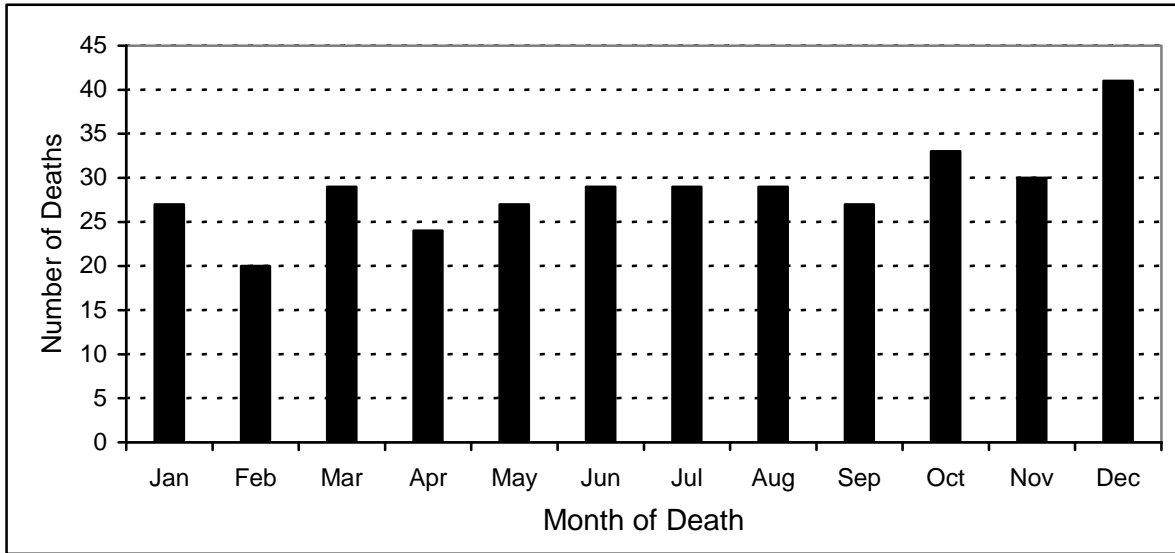
Numbers in columns and rows may not total exactly due to rounding.
Includes ICD-10 codes: W00 – W19.
Source: Vital Records and Health Data Development Section, MDCH

Month and Weekday of Death

Figure 5 illustrates the average annual number of unintentional fall deaths among those aged 65 and older by month of death. (Note: month of incident was unavailable.) Deaths occurring in December comprised 11.8% of the total, notably exceeding other months and the expected percentage (8.5%)*. No weekday was notably prominent (see Tables A-2 and A-3 in Appendix A for data on month and weekday of death).

* 31 days in December / 365 days in year = 8.5%

FIGURE 5
 Average annual number of deaths due to unintentional falls
 by month of death
 Michigan residents, ages 65 and older, 1999-2002



Includes ICD-10 codes: W00 – W19.
 Source: Vital Records and Health Data Development Section, MDCH

NON-FATAL FALL INJURY HOSPITALIZATIONS

In 2002, 13,794 Michigan residents aged 65 and older were hospitalized with an injury that was attributed to a fall. As mentioned in *Methods*, a cause of injury code (E-code) was provided for 83% of injury hospitalizations among this age group. It is unknown how many of the remaining 17% were hospitalizations due to falls. It is also unknown if the characteristics (e.g., demographics) of the injury hospitalizations for which no E-code was provided differed from those for which a code was provided. Injury hospitalizations coded as unintentional falls comprised 3.0% of the 464,735 hospitalizations for any condition for this age group.

There were 503 cases in which the fall injury patient died while hospitalized. The following describes the characteristics of the 13,291 non-fatal fall injury hospitalizations.

Discharge Disposition

Slightly more than one in six (17.7%) patients had “routine” discharges, i.e., to home and/or requiring self-care (Table 8). Routine discharges were much less prevalent among this group than among hospitalized patients of all ages for traumatic injuries (56.1%). Elderly fall patients were most likely to be transferred, especially to a skilled nursing facility (43.0%).

TABLE 8
 Number of non-fatal unintentional fall injury hospitalizations
 by discharge disposition
 Michigan residents, ages 65 and older, 2002

Discharge Disposition	Number	%
Transfer	9,510	71.6
<i>skilled nursing facility</i>	5,721	43.0
<i>inpatient rehabilitation facility</i>	1,257	9.5
<i>intermediate care facility</i>	429	3.2
<i>acute care hospital</i>	304	2.3
<i>long-term care facility</i>	71	0.5
<i>certified provider for Hospice services</i>	21	0.2
<i>another type of institution</i>	1,707	12.8
Home	3,706	27.9
<i>self-care</i>	2,352	17.7
<i>health care</i>	1,342	10.1
<i>Hospice service</i>	8	0.1
<i>IV provider</i>	4	0.0
Skilled nursing within same hospital	21	0.2
Against medical advice	5	0.0
Unknown	49	0.4
Total	13,291	100.0

Source: MI Resident Inpatient Files, Division for Vital Records and Health Statistics, MDCH

Length of Stay

The median length of stay among elderly patients with fall-related injuries was five days, with a range of one to 80 days. In contrast, the median length of stay among traumatic injury patients of all ages was three days (range: one to 262 days).

Types of Falls

The most common types of falls (43.1%) were those that occurred on the same level from tripping, slipping, or stumbling (Table 9). Certain fall types seemed to be associated with age. As a proportion of all falls within each age group, those involving stairs or steps were most prevalent in the youngest age group and least prevalent in the oldest age group: 65-74 year olds – 12.0%, 75-84 year olds – 9.0%, 85 years and older – 4.9%. A similar trend was apparent for falls involving ladders or scaffolding (5.1%, 1.2%, 0.3%, respectively). Conversely, falls of unspecified type (E888.9) increased proportionately with increasing age (24.9%, 30.8%, 34.4%).

Types of Injuries

Table 10 illustrates the number of fall injury hospitalizations for each body region and injury type. Fractures comprised 85.1% of all injuries. More than half (58.0%) of fractures were to the hip. There were 955 cases of traumatic brain injury, most of which did not involve skull fracture.

TABLE 9
Number of non-fatal unintentional fall injury hospitalizations
type of fall by age group
Michigan residents, ages 65 and older, 2002

ICD-9-CM Code	Type of Fall	Age Group			Total
		65-74	75-84	85 +	
E880	On or from stairs or steps	321	507	246	1,074
E880.0	Escalator	1	0	1	2
E880.1	Sidewalk Curb	12	42	20	74
E880.9	Other stairs or steps	308	465	225	998
E881	On or from ladders or scaffolding	135	69	15	219
E881.0	Ladder	130	67	15	212
E881.1	Scaffolding	5	2	0	7
E882	From or out of building or other structure	13	9	1	23
E883	Into hole or other opening in surface	2	6	1	9
E883.0	Diving or jumping into water	0	0	0	0
E883.1	Into well	0	0	0	0
E883.2	Into storm drain or manhole	0	0	0	0
E883.9	Into other hole or opening	2	6	1	9
E884	Other fall from one level to another	270	503	528	1,301
E884.0	From playground equipment	2	0	0	2
E884.1	From cliff	0	1	0	1
E884.2	From chair	50	105	125	280
E884.3	From wheelchair	41	93	99	233
E884.4	From bed	64	164	208	436
E884.5	From other furniture	9	18	8	35
E884.6	From commode	19	33	38	90
E884.9	Other fall from one level to another	85	89	50	224
E885	On same level from slipping, tripping, or stumbling	1,103	2,478	2,162	5,743
E885.0	From non-motorized scooter	0	0	1	1
E885.1	From roller skates	1	2	0	3
E885.2	From skateboard	0	0	2	2
E885.3	From skis	3	0	0	3
E885.4	From snowboard	1	3	1	5
E885.9	Other fall from slipping, tripping, or stumbling	1,098	2,473	2,158	5,729
E886	On same level from collision/pushing/shoving w/other person	3	15	13	31
E886.0	In sports	0	2	1	3
E886.9	Other and unspecified	3	13	12	28
E888	Other and unspecified fall	817	2,034	2,040	4,891
E888.0	Fall resulting in striking against sharp object	3	6	2	11
E888.1	Fall resulting in striking against other object	48	71	71	190
E888.8	Other	102	227	245	574
E888.9	Unspecified	664	1,730	1,722	4,116
E880-E886, E888	All Unintentional Falls	2,664	5,621	5,006	13,291

Source: MI Resident Inpatient Files, Division for Vital Records and Health Statistics, MDCH

TABLE 10
Number of non-fatal unintentional fall injury hospitalizations
by body region and injury type (based on principal diagnosis), Michigan residents, ages 65 and older, 2002

Body Region	Fracture	Dislocation	Sprain/ Strain	Internal	Open Wound	Amputation	Blood Vessels	Contusion/ Superficial	Burn	Nerves	Unspecified	TOTAL
Brain - Type 1 TBI ¹	72			765						0		837
Brain - Type 2 TBI ²	18			89								107
Brain - Type 3 TBI ³	11											11
Other Head					32				0	0	75	107
Face	72	0	0		35				0			107
Eye					15			12	0	0		27
Neck	0		0		2				0	0		2
Head, Face, Neck Unspecified							3	64	0	0	2	69
Cervical Spinal Cord Injury (SCI)	12			25								37
Thoracic/Dorsal SCI	10			1								11
Lumbar SCI	6			0								6
Sacrum Coccyx SCI	1			0								1
Spine & Back Unspecified SCI	0			3								3
Cervical Vertebral Column Injury (VCI)	97	11	4									112
Thoracic/Dorsal VCI	186	0	2									188
Lumbar VCI	339	4	16									359
Sacrum Coccyx VCI	54	0	0									54
Spine & Back Unspecified VCI	5	0										5
Chest	321	0	1	111	0		0	44	0	0		477
Abdomen				33	0		0	17	0	0		50
Pelvis & Urogenital	834	2	12	4	0		0	1	0	0		853
Trunk	0				0			2	0	0	21	23
Back & Buttock			0		1			27	0			28
Shoulder & Upper Arm	715	31	46		0	0		8	0		3	803
Forearm & Elbow	320	4	1		4	0		8	0			337
Wrist, Hand & Fingers	17	4	1		4	1		0	0		0	27
Other & Unspecified Upper Extremity	0				0	0	3	1	0	3	0	7
Hip	6,564	8	26					151				6,749
Upper Leg & Thigh	560	0				0		18	0			578
Knee	148	2	10					30	0			190
Lower Leg & Ankle	891	0	17			0		14	0			922
Foot & Toes	55	1	1		4	2		1	1			65
Other & Unspecified Lower Extremity	0		45		17	0	0	7	0		34	103
Unspecified	0	0	3	1	0		0	15	0	0	5	24
TOTAL	11,308	67	185	1,032	114	3	6	420	1	3	140	13,291

1. Type 1 Traumatic Brain Injury: recorded evidence of an intracranial injury or a moderate or a prolonged loss of consciousness (LOC), shaken baby syndrome or injuries to the optic nerve pathways.

2. Type 2 Traumatic Brain Injury: injuries with no recorded evidence of intracranial injury, and LOC of less than one hour, or LOC of unknown duration, or unspecified LOC.

3. Type 3 Traumatic Brain Injury: Patients with no evidence of intracranial injury and no LOC.

Total includes 12 cases classified as "System-wide and Late Effects" not illustrated in the table.

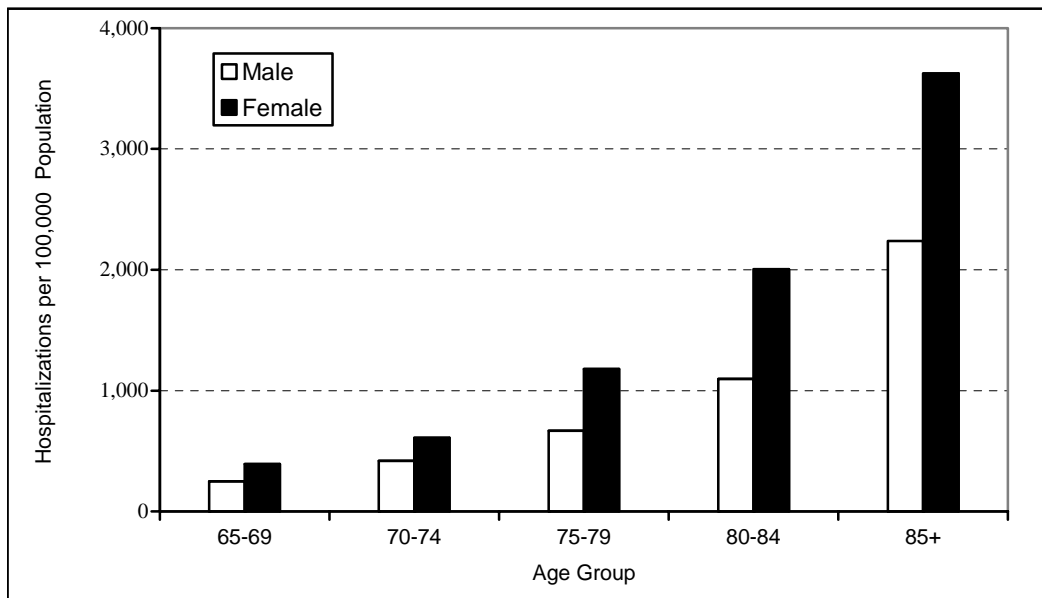
See Table C-1 in Appendix C for ICD-9-CM codes defining cells in this matrix.

Source: MI Resident Inpatient Files, Division for Vital Records and Health Statistics, MDCH

Demographics

Overall and within each five-year age group, elderly women had higher rates of hospitalization for fall injuries than elderly men (Figure 6). (As noted in *Methods*, a demographic analysis including race could not be performed due to the level of missing information.) Rates increased with age, approximately doubling from one age group to the next for both sexes. (See Table B-1 in Appendix B for age and sex specific numbers and rates.)

FIGURE 6
Rate of non-fatal unintentional fall injury hospitalizations
by age group and sex
Michigan residents, ages 65 and older, 2002



Sources: MI Resident Inpatient Files, Division for Vital Records and Health Statistics, MDCH
U.S. Census Bureau Population Estimates

Source of Payment

Medicare was the payment source for nearly all (95.9%) hospitalizations (Table 11) (in most cases, it was listed as the primary payer (94.0%)). Private insurance (managed care and commercial insurance) were the payers for only 3.3% of the hospitalizations.

TABLE 11
 Number of non-fatal unintentional fall injury hospitalizations
 by payment source, Michigan residents, ages 65 and older, 2002

Payment Source	Number	%
Government	12,792	96.2
<i>Medicare</i>	12,746	95.9
<i>Medicaid</i>	24	0.2
<i>Other</i>	22	0.2
Managed Care	254	1.9
Commercial Insurance	186	1.4
Workers' compensation	29	0.2
Self-pay	19	0.1
Other	11	0.1
Total	13,291	100.0

Payment source determined using both payment sources listed; see *Methods*.
 Source: MI Resident Inpatient Files, Division for Vital Records and Health Statistics, MDCH

Month and Weekday of Hospital Admission

Date of hospital admission was examined as a proxy for date of incident. There was nothing unusual about the month of admission (Table B-2 in Appendix B). More admissions occurred in September than any other month (1,162; 8.9%), however, the number of admissions was only slightly greater than what would be expected for that month (1,111). Admissions occurred slightly more often during weekdays (about 15% each day for Monday through Friday) than weekends (about 13% per day). (See Table B-3 in Appendix B.)

FALL INCIDENCE

2003 Behavioral Risk Factor Survey

In the 2003 BRFSS, slightly more than one in eight (13.2%) Michigan residents aged 65 and older reported that they had sustained a fall in the previous three months. About one in four (26.7%) of those who reported a fall (3.5% of adults aged 65 and older overall) stated that they had sustained an injury (Table 12). The survey sought information about the previous three months to limit issues with recall. This design was beneficial for optimizing the accuracy of self-reporting, however, annualized incidence rates cannot be extrapolated.*

The proportion of those reporting a fall increased by five-year age group between ages 65 and 84 (not illustrated). However, the trend did not continue for the oldest group. In fact, the proportion of those aged 85 and older reporting a fall was significantly ($p < .05$) lower than for those aged 65-84. Note

* Extrapolation by simply multiplying the result (e.g., 13.2%) by four assumes that in each three month period, a distinct group of individuals sustained a fall. This is unlikely as some proportion of the individuals who reported a fall within the past three months likely had fallen multiple times throughout the previous twelve months.

that even though they reported falling less frequently, about the same proportion of the oldest group sustained fall injuries (4.1%) as the 65-84 year olds (3.5%).

There was no significant difference between the sexes in reported fall incidence, however, a greater proportion of women reported a fall injury ($p < .005$).

Those who completed high school reported falling at twice the rate as those who did not complete high school ($p < .001$). They were also more likely to report a fall injury ($p < .005$).

Respondents categorized as disabled were more likely to report a fall than those who were considered not disabled ($p < .01$). While the disabled were more likely to sustain a fall injury, this was not statistically significant.

Fall incidence and injury did not vary by household income or by physical activity level.

TABLE 12
Percentage of Michigan residents aged 65 and older
reporting a fall and a fall-related injury within the previous three months
2003 Michigan Behavioral Risk Factor Survey

Characteristic	N	Had a fall (%)	p-value	Had a fall injury (%)	p-value
Total	819	13.2 ± 2.5	-	3.5 ± 1.3	-
Age Group					
65 - 84	765	13.6 ± 2.6	0.0140	3.5 ± 1.3	0.8100
85 and older	54	5.9 ± 5.7		4.1 ± 4.6*	
Sex					
Male	310	11.9 ± 4.0	0.4039	1.5 ± 1.3	0.0036
Female	509	14.1 ± 3.2		5.0 ± 1.9	
Household Income					
Less than \$25,000	328	14.3 ± 4.4	0.3872	3.1 ± 1.8	0.8387
\$25,000 or more	334	11.8 ± 3.5		3.4 ± 1.9	
Education					
Non-high school graduate	142	6.6 ± 3.8	0.0007	1.2 ± 1.3*	0.0044
High school graduate	670	14.8 ± 2.9		4.1 ± 1.5	
Disability					
Yes	313	17.8 ± 4.6	0.0074	5.1 ± 2.5	0.0767
No	502	10.3 ± 2.9		2.5 ± 1.4	
Physically Active					
Yes	312	12.4 ± 4.0	0.7492	2.9 ± 1.7	0.2997
No	459	13.3 ± 3.3		4.2 ± 1.9	

* Confidence interval exceeds possible limits.

For definitions of disability and physically active, see Methods.

Number of total respondents in each category are not equivalent as "Don't Know" responses and refusals were excluded.

2000-2001 Michigan Osteoporosis and Arthritis Risk Factor Survey

More than one-quarter (26.9%) of respondents in the MOAS indicated that they had fallen at least once in the previous year (Table 13). Among those who fell, nearly half (45.2%) reported falling more than once (see Table E-1 in Appendix E for data on number of falls). There were no statistically significant differences in fall incidence by age, sex, household income, education and osteoporosis status. The table also illustrates that about one in thirteen (7.4%) — slightly more than one quarter of those who fell — sustained a fall injury that required medical attention. Fall injury incidence varied significantly for only one characteristic, income. Those with household incomes less than \$25,000 reported fall injuries more than three times as often as those with incomes greater than or equal to \$25,000 ($p < .05$).

TABLE 13
Percentage of Michigan residents aged 65 and older
reporting a fall and a fall-related injury within the previous twelve months
2000-2001 Michigan Osteoporosis and Arthritis Risk Factor Survey

Characteristic	N	Had a fall (%)	p-value	Had a fall injury (%)	p-value
Total	634	26.9 ± 5.7	-	7.4 ± 3.4	-
Age Group					
65-79	506	26.7 ± 6.5	0.8330	6.6 ± 3.3	0.4915
80+ ¹	128	28.1 ± 11.8		10.5 ± 10.3	
Sex					
Male	58	29.6 ± 12.7	0.5043	6.5 ± 7.4*	0.7112
Female	576	25.0 ± 3.8		8.0 ± 2.4	
Household Income					
Less than \$25,000	241	28.3 ± 9.7	0.6124	12.8 ± 8.2	0.0470
\$25,000 or more	235	24.9 ± 9.3		3.7 ± 3.0	
Education					
Non-high school graduate	138	36.0 ± 14.0	0.1333	12.4 ± 10.8	0.2542
High school graduate	489	23.8 ± 5.8		5.7 ± 2.3	
Osteoporosis					
Yes	158	33.8 ± 8.4	0.1473	12.2 ± 5.7	0.1028
No	471	25.7 ± 6.7		6.4 ± 3.9	

* Confidence interval exceeds possible limits.

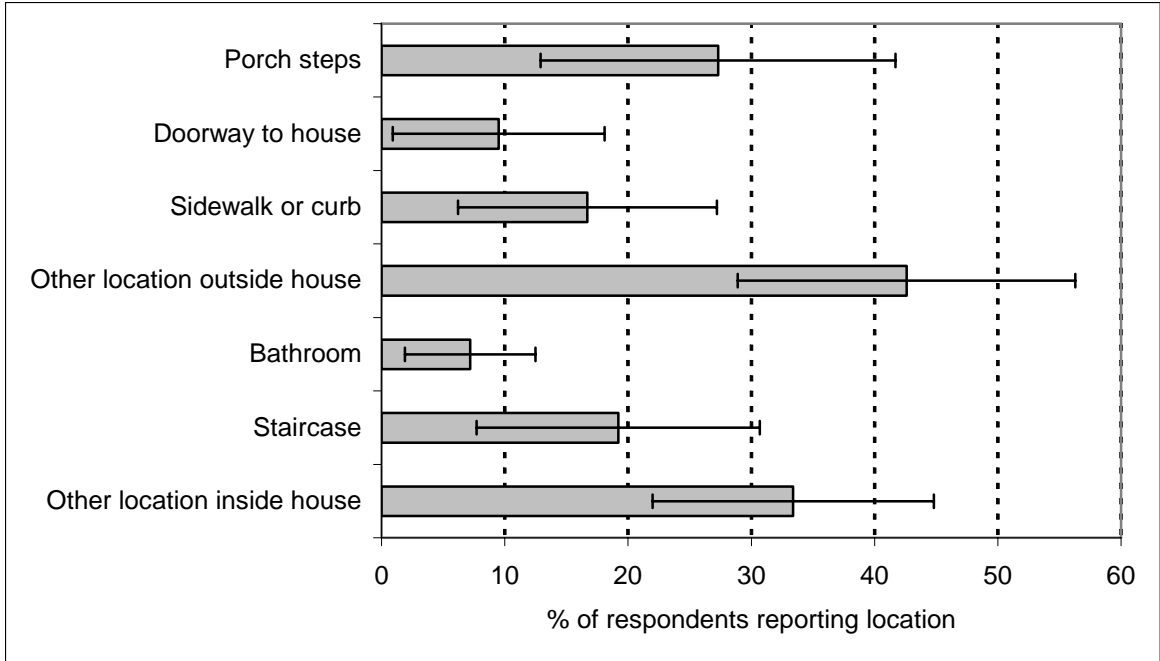
1. An 85+ age group could not be analyzed due to small sample size.

For definition of osteoporosis see Methods.

Number of total respondents in each category are not equivalent as “Don’t Know” responses and refusals were excluded.

The most frequently cited fall location was porch steps (Figure 7). Both stairs and sidewalks/curbs were identified by nearly one-fifth of those who fell. It was not possible to quantify falls occurring within respondents’ homes. (Whether the incident occurred at their home was not asked and some locations (e.g., bathrooms) are not unique to households.) See Table E-2 in Appendix E for a data table illustrating fall locations.

FIGURE 7
 Reported locations of falls, Michigan residents, ages 65 and older,
 2000-2001 Michigan Osteoporosis and Arthritis Risk Factor Survey
 (95% confidence limits also illustrated)



Respondents who reported multiple falls could report multiple locations.

DISCUSSION

Fatal Falls

The rate of fatal falls has increased in Michigan, most dramatically between 1998 and 2002. The system of coding deaths changed in 1999, however, a national study found that by itself this change in coding would have minimal effect on enumerating fall deaths. Michigan doesn't appear to be anomalous as national rates have also been increasing. Rates increased more, on a percentage basis, for females than males, whites than Blacks and those aged 85 and older compared to other age groups. Given the combination of increasing death rates and a growing elderly population, the number of fatal falls can be expected to increase in Michigan.

Cause of injury coding provides information that is vital to prevention efforts. That is, if specific causes of falls are known, interventions can be designed targeting these causes. Unfortunately, for nearly two-thirds of the fall deaths, the specific cause was not specified on the death certificate. For example, vague wording such as "Fell" may be written in the portion of the death certificate labeled "Describe how injury occurred." Better documentation on death certificates is required to allow cause of injury codes to be assigned that would specify type of fall.

Two counties in western Lower Peninsula had the highest fall death rates: Kalamazoo (more than three times the state rate) and Kent (more than twice the state rate). This type of information is useful in helping to target prevention efforts within the state. Compared to the younger elderly (ages 65-79) those aged 80 and older were more likely to sustain their fatal fall in a residential institution and less likely to have their fall occur at home. Finally, more incidents occurred in December than any other month. Note that the number of deaths occurring in the other winter months – January and February - was not excessive.

Non-fatal Fall Injury Hospitalizations

Falls are a major reason that older Michigan residents are hospitalized. Fall injury hospitalizations comprise 3% of all hospitalizations to this group. Perhaps more remarkable is that they comprise 80% of all injury hospitalizations (among those for which a cause of injury code was provided). Most of these hospitalizations are paid for by Medicare (96%). This is especially significant given the costs associated with these hospitalizations (discussed below).

Most of the injuries sustained were fractures (85%), particularly hip fractures. Part of the reason for this is bone strength or lack thereof. Osteoporosis can make bones more apt to fracture. This may partly explain why the injury rates for women were greater than the rates for men – in contrast to the mortality data – as women are more prone to osteoporosis.

Fall Incidence

According to the 2000-2001 Michigan Osteoporosis and Arthritis Risk Factor Survey, about 27% of elderly Michigan residents fell at least once during the previous year. This is slightly lower than estimates from other studies indicating that more than one-third of seniors fall each year.¹⁶⁻¹⁸ There seemed to be an indication that those with osteoporosis were more likely to sustain a fall injury than those without osteoporosis, however, this was not statistically significant. The 2003 Michigan Behavioral Risk Factor Survey found that those with a disability were both more likely to fall and be injured by a fall than those without a disability. Finally, physical activity was neither a risk factor nor a protective factor for falling or having a fall injury.

The two surveys were distinctly different in their identification of age, sex, income and education as risk factors. Taken together, these results preclude a description of the demographics of those at risk for falls and fall injuries. It is unclear why the results differed so diametrically. Note that the two surveys differed in the following ways: a) the specific questions used to ascertain fall incidence and injury; b) the recall period (three vs. twelve months); c) the years in which the surveys were conducted; and d) there was an oversample of women age 50 and older in the MOAS.

Elderly Fall Injury Pyramid

The information ascertained in this report allows an “injury pyramid” to be constructed (Figure 8). This type of figure is often used in the injury prevention field to demonstrate that deaths, which often are the sole outcome examined, represent a small portion of all occurrences.

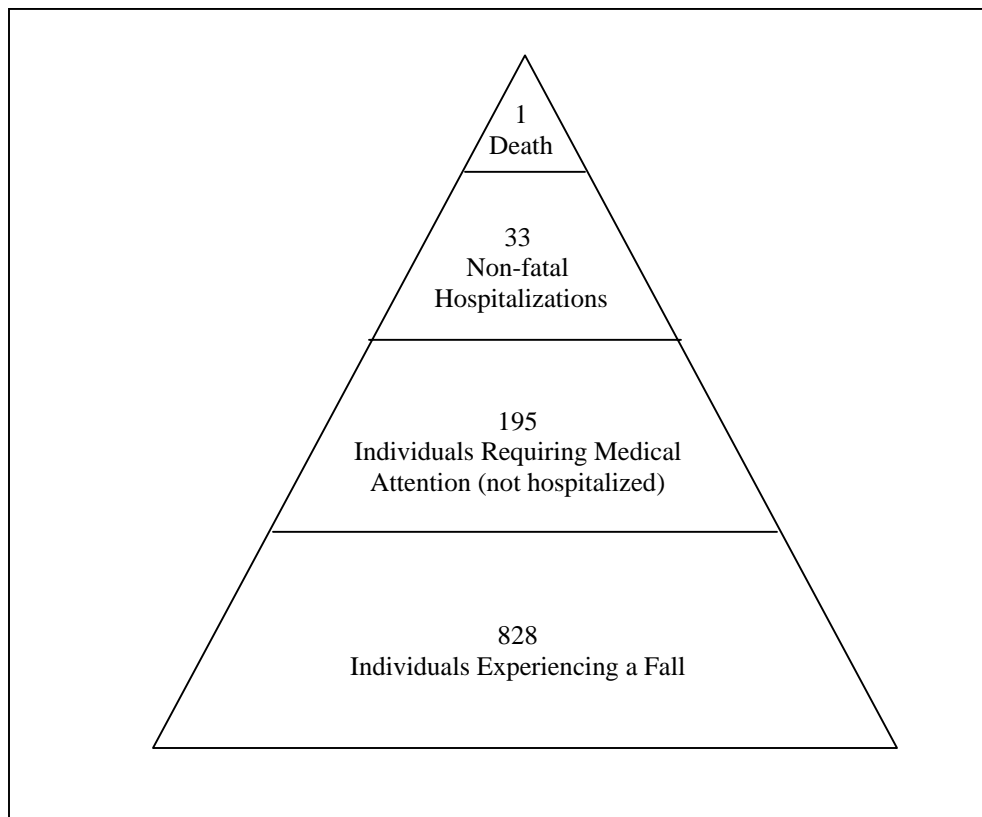
In 2002, there were 400 deaths and 13,291* non-fatal hospitalizations due to fall-related injuries among the Michigan elderly. According to the 2000-2001 MOAS, 26.9% of those aged 65 and older fell at least once and 7.4% sustained an injury requiring medical attention. Applying these results to

* Note that this figure is likely an underestimate as cause of injury codes were missing for 17% of injury hospitalizations.

the 2002 elderly population (1,231,920) yields 331,386 who fell and 91,162 who required medical attention. People requiring non-inpatient medical attention therefore was 77,871 (91,162-13,291). (The values listed in Figure 8 were derived by dividing each of these figures by 400.)

The injury pyramid for Michigan generally resembles national data. In the U.S. in 2001 (the most recent year for which national data are available), there were 11,623 deaths,³ about 388,000 hospitalizations,¹⁹ 1.3 million emergency department visits (non-hospital admissions)³ due to elderly falls, and 11.8 million people who fell (assuming one-third of seniors fell). Thus, for every fall death that year, there were 33 hospitalizations, 112 emergency department visits, and about 1,000 individuals who fell.

FIGURE 8
Injury pyramid for fall injuries
Michigan residents, ages 65 and older, 2002



Sources: Division for Vital Records and Health Statistics, MDCH
MI Resident Inpatient Files, Division for Vital Records and Health Statistics, MDCH
2000-2001 Michigan Osteoporosis and Arthritis Risk Factor Survey

Cost of Elderly Fall Injuries

A 2001 study²⁰ estimated the lifetime costs due to medical care, workloss, and quality-adjusted life years (QALY) lost from all causes of injury among Michigan residents during 1997-1998. The study separately examined fatalities, non-fatal hospitalizations, and non-fatal injuries treated on an outpatient basis only. Definitions of the three cost types are provided in Appendix F. Details on the methodology used to generate cost estimates can be found in the referenced study.

Using data provided in the study, unit costs in 2002 dollars were calculated for unintentional falls among those aged 65 and older. Applying these costs to the number of elderly fall injuries occurring in 2002 yields a total cost of nearly \$2.9 billion (Table 14). The total medical costs (\$656 million) were slightly greater than the total workloss costs (\$602 million). The highest costs (\$1.6 billion) were those associated with lost quality-adjusted life years.* Due to their relatively high frequency and unit costs, hospitalizations were by far the most costly outcome, comprising 61% of the total.

TABLE 14
Estimated lifetime costs associated with falls occurring in 2002
Michigan residents, ages 65 and older

Cost Measure	Estimated Cost per Case 1997 ¹ (in \$1,000's)	Estimated Cost per Case 2002 ² (in \$1,000's)	Number of Cases 2002	Estimated Cost 2002 (in \$1,000's)
Medical				656,553
Fatal Injuries	21.5	24.1	400	9,640
Non-fatal hospitalized injuries	38.7	43.4	13,291 ³	576,829
Outpatient-treated injuries	0.8	0.9	77,871 ⁴	70,084
Lost Worktime				602,618
Fatal Injuries	58.1	65.2	400	26,080
Non-fatal hospitalized injuries	19.3	21.7	13,291	288,415
Outpatient-treated injuries	3.3	3.7	77,871	288,123
QALY⁵ Lost				1,627,339
Fatal Injuries	715.9	803.2	400	321,280
Non-fatal hospitalized injuries	60.4	67.8	13,291	901,130
Outpatient-treated injuries	4.6	5.2	77,871	404,929
Total				2,886,510

1. From Robinson.²⁰

2. Assumes inflation rate of 12.2% between July 1997 and July 2002.²¹

3. Cause of injury codes were missing for 17% of injury hospitalizations for those age 65 and older in 2002.

4. Based on Michigan Osteoporosis and Arthritis Risk Factor Survey which measured fall incidence during 2000-2001.

5. Quality-adjusted Life Years

* The Michigan cost of injury study²⁰ notes: "Although QALYs can be converted into dollar estimates and added to other injury costs, this technique is controversial because it places a dollar value on life and health that would comprise about 70% - 80% of total injury costs."

The estimates of costs were generated by applying a nationally developed paradigm to Michigan data. The process did not involve obtaining actual direct or indirect costs associated with injuries occurring in Michigan. Given the number of assumptions involved, they should be considered ballpark figures of cost.

Study Limitations

The primary limitation of this study is the incomplete provision of cause of injury codes (E-codes) within the Michigan Inpatient Database. In 2002, E-codes were missing in 17% of records where traumatic injury was the principal diagnosis for elderly patients. The rate of missing records is as high or higher for those 65 and older than rates for any other age group: (under age 15: 8% missing; 15-44: 11%; 45-64: 17%). When a significant proportion of E-codes are missing, case ascertainment (i.e., identification of fall injury hospitalizations) is incomplete. This not only affects accurate enumeration of hospitalizations, but limits the number of counties for which rates can be calculated, causes an understating of the costs of fall injuries, and brings some question about whether the characteristics of inpatients coded as fallers is representative.

Nearly two-thirds of death certificates did not specify how fatal falls occurred. Thus, when prevention programs are designed, it is unknown whether they are targeting types of falls that most often result in death.

The completion rate for the two surveys was about 50%. It is unknown whether people who respond to a telephone survey have different susceptibility to falling than those who do not respond. The MOAS, which ascertained fall experience in the past year, generated more useful data than the BRFS, which asked about falls occurring in the past three months, because annual incidence could be calculated. However, it is presumably easier for people to recall events that occurred within a three-month period than a year period. It is difficult to directly compare the results of the two surveys given that they had different recall periods, different wording of the question on fall incidence, and were conducted in two separate years.

CURRENT MDCH ACTIVITIES AND FUTURE DIRECTIONS

Current MDCH Activities

Prior to the development of this report, the Injury and Violence Prevention Section (IVPS) of the Michigan Department of Community Health had begun to address fall incidence among Michigan's elderly population. The IVPS received a three-year grant from the Centers for Disease Prevention and Control (CDC), effective October 2002, to develop, implement and evaluate hospital-based geriatric fall prevention clinics using a research design.

Emergency Department staff at two Michigan hospitals evaluate elderly patients for the risk of falling. Eligible patients are either then assigned to intervention or control groups. The intervention consists of counseling, education, assessment of home hazards, review of medications, lessons in Tai Chi, and referrals to other hospital services. Evaluation of the interventions focuses on the outcomes of reducing falls and fall injuries, quality of life issues for older adults and their caregivers and changes in health professionals' knowledge and behavior regarding fall risk assessment and management.

Another component of the IVPS fall prevention program is the development of training courses for interdisciplinary providers to improve their skills in identifying and managing adults aged 65 and older with fall injuries. Program staff have developed courses for nurses, physicians, physical therapists and occupational therapists.

Grant resources fund the unique elements of this initiative: training of medical professionals, implementation of a multi-dimensional fall clinic and the hospital emergency department interface with risk assessment and referral. These services are currently not available in health care systems in Michigan or nationally. This initiative translates a wealth of evidence-based research into health care and clinical practice.

Future Directions

In April 2002, the Michigan Injury Prevention Task Force developed a strategic plan¹ for building a comprehensive injury prevention and control program in the state. One injury priority area identified in the plan was unintentional fall injuries among older adults. The plan includes the following recommendations for infrastructure to support fall prevention, data collection, evidence-based interventions, technical support and training, and public policy:

Infrastructure to Support Fall Prevention

- ❖ MDCH should reconvene and expand the membership of the Fall Prevention Workgroup to include public health, health care, and agencies that work with older adults.
- ❖ The Fall Prevention Workgroup should assist MDCH in implementing the recommendations in the *White Paper on Fall Prevention Efforts in Michigan*, reviewing existing fall prevention efforts in Michigan and nationwide, and providing direction for new fall prevention program development.
- ❖ Resources should be sought to support staff resources devoted to the prevention of injuries among older adults, including fall prevention.
- ❖ Resources should be sought to fund evidence-based community fall prevention projects, public education and training of professionals.

Data Collection

- ❖ The Fall Prevention Workgroup should monitor the magnitude, characteristics and costs of falls and fall injuries specifically for older adults through analysis of existing data sources, including death certificates, hospital discharge, emergency department and risk factor data bases.
- ❖ The Fall Prevention Workgroup should work with the Data Workgroup to improve the level and accuracy of E-coding for fall-related injuries on hospital discharge data and disseminate the results via annual reporting and the MDCH injury website.

Evidence-Based Interventions

- ❖ The Fall Prevention Workgroup should develop and implement criteria for determining effective or promising programs, practices, and interventions in fall prevention for older adults.
- ❖ The Fall Prevention Workgroup should identify, evaluate, and catalog evidence-based fall prevention programs and interventions and develop marketing strategies for dissemination to injury practitioners, health care providers and older adult advocates.
- ❖ The Fall Prevention Workgroup should partner fall prevention programs with other health promotion programs such as physical fitness, osteoporosis education and bone mineral testing, either on the statewide or local level.
- ❖ The Fall Prevention Workgroup should determine the most effective messages, materials and delivery mechanisms for fall prevention public education, focusing on risk factor identification, behaviors that reduce risk and evidence-based treatment and behavioral interventions.

Technical Support and Training

- ❖ The Fall Prevention Workgroup should work with existing professional organizations, injury prevention practitioner groups and older adult advocates to develop and expand resources to meet their training needs for fall risk assessment, data collection and coding and evidence-based interventions.
- ❖ The Fall Prevention Workgroup should determine the most effective strategies for educating injury practitioners, health care providers and older adult advocates in fall risk assessment, interventions to reduce fall risks and interdisciplinary case management of older adults who have fallen.
- ❖ The Fall Prevention Workgroup should establish a network of practitioners, professionals and advocates for older adults at the local level for dissemination of fall prevention information, technical assistance and training.
- ❖ The Fall Prevention Workgroup should make fall prevention resources such as fall risk assessment tools, evidence-based programs and names of fall prevention experts available on the MDCH injury website.

Public Policy

- ❖ Information should be provided to policy makers on fall injury and prevention for older adults.
- ❖ Funding resources should be sought for fall injury prevention programs for older adults.

APPENDIX A

Data Tables for Fatal Fall Injuries

TABLE A-1
 Number of deaths due to unintentional falls
 by sex, race, age group and year of death
 Michigan residents ages 65 and older, 1990-2002

	1990	1991	1992	1993	1994	1995	1996	1997	1998	Change to ICD-10 Coding	1999	2000	2001	2002
Male	104	101	120	83	117	128	133	121	102		137	143	183	180
Female	95	129	117	91	124	133	131	134	113		149	164	202	220
White	178	207	212	158	221	233	242	233	201		263	286	363	380
Black	18	22	25	16	18	24	20	21	14		21	16	18	17
65-74	47	43	66	43	47	59	49	52	43		54	50	60	63
75-84	80	106	96	57	108	86	113	110	76		117	119	155	156
85+	72	81	75	74	86	116	102	93	96		115	138	170	181

1990-1998: ICD-9 codes E880- E886, E888

1999-2002: ICD-10 codes W00-W19

Source: Vital Records and Health Data Development Section, MDCH

TABLE A-2
 Average annual number of deaths due to unintentional falls
 by month of death
 Michigan residents, ages 65 and older, 1999-2002

Month of Death	Number	%
January	27	7.8
February	20	5.8
March	29	8.5
April	24	7.0
May	27	7.8
June	29	8.4
July	29	8.4
August	29	8.5
September	27	7.8
October	33	9.5
November	30	8.8
December	41	11.8
Total	345	100.0

Source: Vital Records and Health Data Development Section, MDCH

TABLE A-3
 Average annual number of unintentional fall deaths
 by weekday of death
 Michigan residents, ages 65 and older, 1999-2002

Weekday of Death	Number	%
Sunday	46	13.3
Monday	46	13.2
Tuesday	49	14.3
Wednesday	52	15.0
Thursday	53	15.5
Friday	51	14.8
Saturday	48	13.9
Total	345	100.0

Source: Vital Records and Health Data Development Section, MDCH

APPENDIX B

Data Tables for Non-fatal Fall Injury Hospitalizations

TABLE B-1
Number and rate of non-fatal unintentional fall injury hospitalizations
by age group and sex
Michigan residents, ages 65 and older, 2002

Age Group	Male		Female		Total	
	Number	Rate	Number	Rate	Number	Rate
65-69	378	251.2	683	392.2	1,061	326.9
70-74	571	420.1	1,032	611.2	1,603	525.9
75-79	728	669.2	1,802	1,179.9	2,531	967.9
80-84	753	1,097.9	2,337	2,004.9	3,090	1,668.9
85+	1,043	2,238.3	3,963	3,626.0	5,006	3,211.2
Total	3,473	680.5	9,817	1,360.5	13,291	1,078.9

Rates are number of hospitalizations per 100,000 population.

Sex was unknown for one patient in the 75-79 year old age group.

Source: MI Resident Inpatient Files, Division for Vital Records and Health Statistics, MDCH

TABLE B-2
Number of non-fatal unintentional fall injury hospitalizations
by month of admission
Michigan residents, ages 65 and older, 2002

Month of Admission	Number	%
January	1,104	8.4
February	1,019	7.8
March	1,076	8.2
April	1,018	7.8
May	1,099	8.4
June	1,100	8.4
July	1,108	8.5
August	1,108	8.5
September	1,162	8.9
October	1,129	8.6
November	1,103	8.4
December	1,065	8.1
Total	13,091	100.0

Not included are 200 admissions that occurred in 2001. (199 of these were in December 2001)

Admissions occurring in December are understated in the table as some patients admitted in December 2002 were discharged in 2003 (thus were outside of the case definition).

Source: MI Resident Inpatient Files, Division for Vital Records and Health Statistics, MDCH

TABLE B-3
 Number of non-fatal unintentional fall injury hospitalizations
 by weekday of hospital admission
 Michigan residents, ages 65 and older, 2002

Weekday of Admission	Number	%
Sunday	1,691	12.7
Monday	1,973	14.8
Tuesday	1,953	14.7
Wednesday	1,951	14.7
Thursday	1,965	14.8
Friday	2,011	15.1
Saturday	1,747	13.1
Total	13,291	100.0

Source: MI Resident Inpatient Files, Division for Vital Records and Health Statistics, MDCH

APPENDIX C

Barell Injury Diagnosis Matrix

APPENDIX D

Questions on Fall Incidence in Two Michigan Surveys

TABLE D-1
Section within the 2003 Michigan Behavior Risk Factor Survey
Pertaining to Fall Incidence

To be asked only of people 45 years or older.

“The next question asks about a recent fall. By a fall, we mean when a person unintentionally comes to rest on the ground or another lower level.”

16.1 In the past 3 months, have you had a fall?

- | | | |
|---|-----------------------|-----------------------------|
| 1 | Yes | |
| 2 | No | [Go to next section] |
| 7 | Don't know / Not sure | [Go to next section] |
| 9 | Refused | [Go to next section] |

16.2 Were you injured? By injured, we mean the fall caused you to limit your regular activities for at least a day or to go see a doctor.

- | | | |
|---|-----------------------|-----------------------------|
| 1 | Yes | |
| 2 | No | [Go to next section] |
| 7 | Don't know / Not sure | [Go to next section] |
| 9 | Refused | [Go to next section] |

TABLE D-2
Section within the 2000-2001 Michigan Osteoporosis and Arthritis Risk Factor Survey
Pertaining to Fall Incidence

Q9_2.

In the past 12 months, how many times have you tripped or fallen, resulting in you hitting the floor or ground?

NUMBER OF TIMES FALLEN _____ If "N"=0 (no falls), Go to Q10_1
DON'T KNOW/NOT SURE.....77 Go to Q10_1
REFUSED.....99 Go to Q10_1

Q9_3.

Where did the fall(s) occur?

Bathroom.....a
Staircaseb
Porch stepsc
Doorway to the housed
From a laddere
Sidewalk or curbf
Other location outside the house (specify).....g
Other location inside the house (specify).....h
DON'T KNOW/NOT SURE7
REFUSED.....9

Q9_4.

Did any of your falls in the last 12 months result in an injury that required medical treatment by a doctor or other health professional?

YES1
NO.....5
DON'T KNOW/NOT SURE7
REFUSED.....9

APPENDIX E

Tables for Survey Data on Fall Incidence

TABLE E-1
 Number of falls within past twelve months
 Michigan residents ages 65 and older
 2000-2001 Michigan Osteoporosis and Arthritis Risk Factor Survey

Number of falls in last 12 months	% (N=634)
0	73.1 ± 5.7
1	14.8 ± 4.5
2	3.7 ± 2.5
3	4.2 ± 3.1
4+	4.3 ± 2.3

Results exclude "Don't know" responses and refusals.

TABLE E-2
 Location of fall
 Michigan residents ages 65 and older
 2000-2001 Michigan Osteoporosis and Arthritis Risk Factor Survey

Incident Location	%	N
Porch steps	27.3 ± 14.4	126
Doorway to house	9.5 ± 8.6	127
Ladder	3.0 ± 5.7*	122
Sidewalk or curb	16.7 ± 10.5	129
Other location outside house	42.6 ± 13.7	135
Bathroom	7.2 ± 5.3	162
Staircase	19.2 ± 11.5	130
Other location inside house	33.4 ± 11.4	134

* Confidence interval exceeds possible limits.

N varies for each location because the number of "Don't know" responses and refusals varied by question and these were removed from the analysis.

APPENDIX F

Definitions of Three Types of Cost Due to Injury

The following descriptions are taken from the report “The Medical Costs of Injury in Michigan.”²⁰ For more detailed information, please refer to the report.

Non-fatal Injuries

Medical Cost

Medical costs include ambulance, emergency medical, physician, hospital, rehabilitation, prescription and related treatment costs, as well as ancillary costs (for crutches, physical therapy, etc.) and administrative costs of processing medical payments to providers.

Work Loss Cost

These losses include victims’ lost wages and the value of lost household work, as well as fringe benefits and the administrative costs of processing compensation for lost earnings through litigation, insurance or public welfare. Work losses by family and friends who care for injured victims also are included.

Quality-adjusted Life Year (QALY) Lost Cost

A QALY is a health outcome measure that assigns a value of one to a year of perfect health and zero to death. QALY loss is determined by the duration and severity of the health problem. To compute it, one estimates the fraction of perfect health lost during each year that a victim is recovering from a health problem, then sums these fractions. QALY loss is subsequently converted into dollar estimates.

Fatal Injuries

Medical Cost

These include many of the costs listed above for non-fatal injuries as well as funeral and coroner/medical examiner costs.

Work Loss Cost

Included are the costs associated with non-fatal injuries. The costs are the present value of all expected costs over the victim’s expected lifespan. For each death, the years of life lost were estimated from a life expectancy table.

Quality-adjusted Life Year (QALY) Lost Cost

As noted above, for the purposes of quantifying health outcome, a value of one is assigned for perfect health, zero for death. Because QALY loss is based on the fraction of perfect health lost, those killed lose a full QALY per life-year.

REFERENCES

1. Esdale A., Scarpetta L. *Michigan's Injury Prevention Plan*. Michigan Department of Community Health. Lansing, Michigan. January 2004.
2. United States Census Bureau, Population Division, Population Projections Branch. See website: <http://www.census.gov/population/www/projections/stproj.html>.
3. U.S. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. Web-based Injury Statistics Query and Reporting System (WISQARS). Data available on the following website: <http://www.cdc.gov/ncipc/wisqars/default.htm>.
4. Detailed information about the national Behavioral Risk Factor Surveillance System (BRFSS) can be found at <http://www.cdc.gov/brfss/>.
5. National Center for Health Statistics. See the following website: <http://www.cdc.gov/nchs/about/major/dvs/popbridge/datadoc.htm>.
6. Ingram DD, Parker JD, Schenker N, Weed JA, Hamilton B, Arias E, Madans JH. United States Census 2000 population with bridged race categories. National Center for Health Statistics. *Vital Health Stat* 2(135). 2003.
7. Data for Michigan based on the Federal-State Cooperative Program for Population Estimates can be found on the website for the Michigan Department of History, Arts and Libraries. See for example: http://www.michigan.gov/hal/0,1607,7-160-17451_28388_28393---,00.html.
8. World Health Organization. *International Classification of Diseases: Manual on the International Statistical Classification of Diseases, Injuries, and Cause of Death*. 9th revision. Geneva, Switzerland. 1977.
9. World Health Organization. *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision*. Geneva, Switzerland. 1992. Updated and corrected by the U.S. National Center for Health Statistics, October 1998.
10. Anderson RN, Minino AM, Hoyert DL, Rosenberg HM. *Comparability of cause of death between ICD-9 and ICD-10: Preliminary estimates*. National vital statistics reports; 49(2). Hyattsville, Maryland: National Center for Health Statistics; 2001. Available from http://www.cdc.gov/nchs/data/nvsr/nvsr49/nvsr49_02.pdf.
11. Anderson RN, Minino AM, Fingerhut LA, Warner M, Heinen MA. Deaths: Injuries, 2001. National vital statistics reports; vol 52 no 21. Hyattsville, Maryland: National Center for Health Statistics. 2004.
12. *International Classification of Diseases, Ninth Revision, Clinical Modification*. Ann Arbor, MI: Commission on Professional and Hospital Activities; 1986.
13. Barell V, et. al. *An introduction to the Barell body region by nature of injury diagnosis matrix*. *Injury Prevention* 2002;8:91-96. [The matrix itself is available at the following website: http://www.cdc.gov/nchs/data/ice/final_matrix_post_ice.pdf.]
14. U.S. Census Bureau, Current Population Survey, 2003 Annual Social and Economic Supplement. http://ferret.bls.census.gov/macro/032003/hhinc/new02_001.htm.
15. Shah BV, Barnwell BG, Bieler GS. *SUDAAN User's Manual*. Release 8.0.2, Research Triangle Institute, Research Triangle Park, NC. January 2003.
16. Hausdorff JM, Rios DA, Edelber HK. *Gait variability and fall risk in community-living older adults: a 1-year prospective study*. *Archives of Physical Medicine and Rehabilitation* 2001;82(8):1050–6.

17. Tinetti, ME, Speechley M, Ginter SF. *Risk factors for falls among elderly people living in the community*. New England Journal of Medicine. 319:1701-1707. 1988.
18. Campbell AJ, Reinken J, Allan BC, et. al. *Falls in old age: A study of frequency and related clinical factors*. Age and Aging. 10:264-270. 1981.
19. National Center for Injury Prevention and Control. See the following website:
<http://www.cdc.gov/ncipc/factsheets/falls.htm>.
20. Robinson RL. *The medical costs of injury in Michigan: An analysis based on Michigan injury data from 1997 and 1998*. Prepared for the Michigan Department of Community Health by the Michigan Public Health Institute. Lansing, MI. December 2001.
21. Rate of inflation between 1997 and 2002 was determined using the Inflation Rate calculator on the following website:
http://inflationdata.com/inflation/Inflation_Rate/InflationCalculator.asp.