

### *Occupational safety and health*

# Fatal occupational injuries to older workers in farming, 1995-2002

*Agricultural workers aged 55 years and older are at a higher risk of fatal occupational injury than their younger counterparts; leading causes of fatalities are transportation incidents, contact with objects or equipment, and assaults, including assaults by animals*

Samuel Meyer

Agriculture is known to be a dangerous industry in which to work.<sup>1</sup> In fact, in the late 1980s, the National Coalition for Agricultural Safety and Health stated, “America’s most productive work force is being systematically liquidated by an epidemic of occupational disease and traumatic death and injury in the face of diminishing local and Federal resources.”<sup>2</sup>

Researchers have found agricultural workers aged 55 years and older to be one of the working populations with the largest risk of fatal injury.<sup>3</sup> In 1994, Scott Richardson and Andrew Schulman concluded that the high overall rate of fatal injuries among older workers appeared to be related to their distribution among certain high-risk occupations and industries, primarily agriculture related.<sup>4</sup> In a 2004 publication, the National Institute for Occupational Safety and Health noted that the fatality rate for agricultural workers 55 years and older differed considerably from the overall rate for private-sector workers in that age group.<sup>5</sup>

The most significant types of injuries to workers over the age of 55 in farming occupations involve machinery and livestock.<sup>6</sup> Farm tractors were previously identified as the most noteworthy source of fatal injury to workers in that age group.<sup>7</sup> Of serious consequence is the fact that two-thirds of all tractors in use are not equipped to protect the operator from rollover injury.<sup>8</sup> A previous study found that more than 40 percent of fatal injuries involving animals involved workers 55 years and older; the study went on to say that the majority of cattle-related deaths were incurred by workers aged 65 years and older.<sup>9</sup>

Other sources of injury involve weather, falls, grain bins and silos, chemicals and toxic gases, and manure pits and wells.<sup>10</sup>

According to data from the Current Population Survey (CPS), 30 percent of workers employed in farming occupations, as delineated shortly, were at least 55 years old. However, more than half of fatal injuries to workers in farming occupations occurred to those 55 years and older. The number of older farm operators has declined, yet older workers represent an increasing percentage of all farm operators. Coupled with a decrease in the exit rate of agriculture workers, this increasing percentage of older workers indicates that the “graying” of the farm sector is continuing.<sup>11</sup>

This article investigates fatal injuries from 1995 through 2002 to workers aged 55 years and older associated with the production of agricultural goods on farms. Farming occupations include four occupations selected from the 1990 Bureau of Census designations, in combination. Census of Fatal Occupational Injury (CFOI) data are examined over the study period in order to elucidate (1) the risk associated with farming, (2) the States reporting the most risk, and (3) the hazards most frequently contributing to fatal injuries. Measures adopted to aid the analysis include fatality rates, relative risks, mortality ratios, employment ratios, and mortality-to-employment ratios. Fatality rates are used to provide a sense of the risk of fatal injury by indicating the number of fatal injuries occurring among a specified number of individuals employed. Relative risk compares the fatality rate for a partic-

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ular group with those of other groups, using the overall rate as a base. Mortality ratios are calculated to indicate each State's fatal injuries to older farming workers in relation to each State's total fatal injuries. Employment ratios indicate the significance of farm employment in each State's economy and are used to index a State's farming employment by its total employment. Finally, mortality-to-employment ratios standardize mortality by employment, accounting for States with more individuals employed in farming. (See the technical appendix at the end of this article.)

## Results

As indicated in the following tabulation, farming workers of all ages incurred an annual average of nearly 550 fatal injuries between 1995 and 2002:

Year	All workers	Workers in farming occupations, all ages	Workers in farming occupations, 55 years and older
Total, 1995–2002 .....	48,193	4,374	2,228
1995 .....	6,275	578	302
1996 .....	6,202	557	301
1997 .....	6,238	581	297
1998 .....	6,055	600	292
1999 .....	6,054	564	280
2000 .....	5,920	476	250
2001 .....	5,915	499	254
2002 .....	5,534	519	252
Mean, 1995–2002 .....	6,024	547	279

A total of 476 fatal injuries was reported in 2000, down 16 percent from 564 fatalities the year before. However, in 2001 and 2002, CFOI recorded a cumulative 9-percent increase in fatal injuries to farming workers. Older farming workers averaged almost 280 fatal injuries per year, with a general downward trend, over the 1995–2002 period. The year 2000 recorded the lowest number of fatal injuries of any year in CFOI's history, 476, of which 250 were to older farming workers, an 11-percent drop from the previous year's figure. The years 2001 and 2002 recorded only slightly more fatal injuries, 254 and 252, respectively. CFOI has reported a decline of 11 percent in fatal injuries to older farming workers during the 11-year period from 1992 to 2002. Older farming workers also experienced less pronounced fluctuations in fatal injuries over time than did farming workers of all ages.

Almost two-thirds of those aged 55 and older and reported to have died in a fatal injury while working were classified as farmers—that is, those who typically own and operate a farm. Farmworkers, typically hired hands, accounted for nearly 1 in 5 of these fatal work injuries. Supervisors and managers, most

frequently employees hired from the outside to supervise workers and manage the establishment, had fewer fatalities from workplace injuries—14 percent of the 2,228 total.

The annual average rate of fatal injuries for all workers in the United States from 1995 to 2002 was calculated to be 4.5 per 100,000 employed.<sup>12</sup> A comparison of the rate for workers 55 years and older in the agriculture industry with workers in the same age group in other major industries reveals that the rate was the highest in agriculture: 44.6 fatalities per 100,000 employed. Selecting for occupations more likely to be involved in agriculture production indicated that workers aged 55 years and older in farming occupations recorded the highest fatal work injury rate of any age group from 1995 to 2002: 47.9 fatal injuries per 100,000 employed.

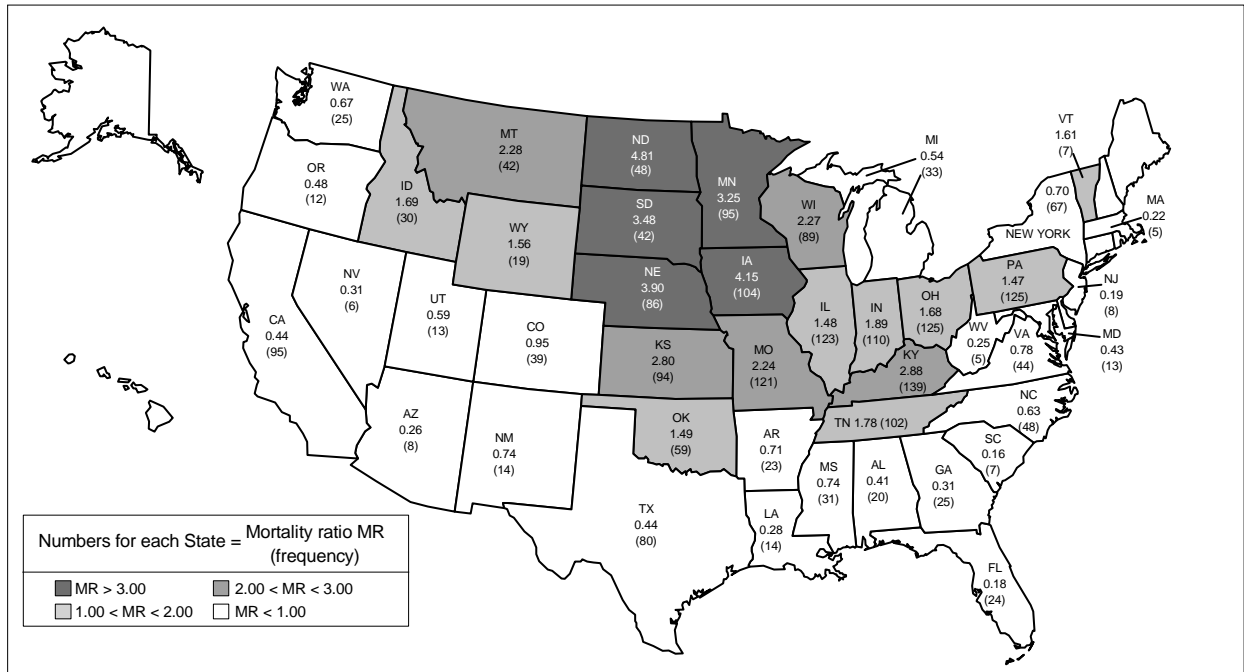
In addition to having the highest fatality rate, older workers represented the majority of fatal injuries in farming occupations from 1995 to 2002. The following tabulation depicts the employment, frequency of fatal injuries, fatality rate, and relative risk of four categories of worker:

Category	Cumulative employment, 1995–2002	Frequency of fatalities	Fatality rate	Relative risk
Total .....	1,062,734,000	48,193	4.53	1.00
Workers 55 years and older, all occupations ....	136,379,000	10,757	7.89	1.74
Workers of all ages, farming occupations .....	15,646,000	4,374	27.16	5.99
Workers 55 years and older, farming occupations ....	4,651,000	2,228	47.90	10.56

A worker aged 55 or older in a farming occupation was more than 10 times as likely to be fatally injured than the total population of workers. The risk of fatal injury decreases as the worker is excluded from either farming occupations or workers aged 55 years and older. Considered independently, the risk of a fatality to a worker in a farming occupation is greater than the overall risk to a worker aged 55 years or older by a factor of more than 3. In accordance with Richardson and Schulman's conclusion, these data indicate that the greatest risk to workers aged 55 years and older in farming occupations may be due to the types of exposure experienced in farming work and not to those workers' ages.

Chart 1 graphically depicts fatal injuries to older farming workers in selected States. Colors are assigned on the basis of the mortality ratios reported and vary from light to dark as ratios increase. Although a countrywide phenomenon, fatalities to workers aged 55 years and older in farming occupations tended to occur more often in Midwestern and Great Plains states. The five States of Kentucky, Ohio, Penn-

**Chart 1. Mortality ratios and frequencies of fatal occupational injuries to workers aged 55 years and older in farming occupations, by State of incident, 1995–2002**



NOTE: Frequencies were not reported for selected States because they did not meet BLS publication criteria.

sylvania, Illinois, and Kansas reported a combined total of more than 28 percent of the 2,228 fatal injuries incurred from 1995 to 2002. Other States with significant numbers of fatal injuries to older workers in farming occupations were California, New York, and Texas.

Mortality ratios depicted in chart 1 provide an additional indication of selected States' fatal workplace experience in proportion to each State's overall experience. While States in the Midwest reported high frequencies of fatal injuries to workers aged 55 years and older in farming occupations, States in the Great Plains region reported disproportionately more fatal injuries to workers in this age group.

For example, Ohio reported 125 fatal occupational injuries, representing about 6 percent of fatal injuries to the older farming workers. However, Ohio recorded 1,614 total fatal injuries, only about 3 percent of total injuries in the United States. Thus, the ratio of Ohio's proportion of fatal workplace injuries among older workers in farming occupations to the State's proportion of all fatal workplace injuries is 1.7. By contrast, Iowa reported 104 fatal injuries to older workers in farming occupations in the years 1995 through 2002, about 5 percent of the U.S. total of 2,228. Over the same period, Iowa reported a total of 542 fatal occupational injuries, slightly more than 1 percent of the U.S. total. On the basis of these

proportions, the mortality ratio for Iowa farming workers aged 55 years and older is calculated to be approximately 4.2, indicating that the proportion of fatal workplace injuries to workers aged 55 years and older in farming occupations is 4 times Iowa's total proportion.

The greater disproportions in the Great Plains States may be largely a reflection of more people at risk of fatal injury in farming occupations. Table 1 sheds some light on this issue. The next-to-last column gives the ratio of a State's proportion of U.S. farm employment to its proportion of U.S. nonfarm employment. The last column standardizes a State's mortality ratio on the basis of its employment ratio.

From the table, although Ohio recorded a high number of fatal injuries, its mortality ratio was calculated to be low relative to those of some other States. However, when farming employment is taken into account, Ohio is seen to have a mortality ratio to employment ratio (or, simply, mortality-to-employment ratio) of 2.2, one of the highest. By contrast, Iowa's mortality ratio (4.2) divided by its employment ratio (3.0) yields a relatively low mortality-to-employment ratio (1.4). In this case, Iowa's high mortality ratio is tempered by its high proportion of farming.

Once farming fatalities are standardized by employment, calculations reveal a high risk of fatal injury for States from

**Table 1.** Frequencies, mortality ratios, employment ratios, and mortality-to-employment ratios, selected States, 1995–2002

State	Frequency, 55 and older, farming	Mortality ratio			Employment ratio	Mortality-to-employment ratio
		All farmers	Older workers	Older farmers		
Total .....	2,228	...	...	...	...	...
Pennsylvania .....	125	1.3	1.1	1.5	0.6	2.5
Illinois .....	123	1.2	1.1	1.5	.6	2.4
Ohio .....	125	1.5	1.2	1.7	.8	2.2
New York .....	67	.7	.9	.7	.3	2.2
Minnesota .....	95	2.9	1.3	3.2	1.7	2.0
Indiana .....	110	1.5	1.2	1.9	1.1	1.8
Wisconsin .....	89	2.4	1.3	2.3	1.5	1.5
Nevada .....	6	.4	.9	.3	.2	1.5
Maryland .....	13	.5	.9	.4	.3	1.5
Iowa .....	104	3.6	1.5	4.2	2.9	1.4
Massachusetts .....	5	.2	1.0	.2	.2	1.4
Vermont .....	7	1.5	1.0	1.6	1.2	1.3
Missouri .....	121	1.7	1.2	2.2	1.8	1.3
Nebraska .....	86	3.4	1.5	3.9	3.1	1.3
Tennessee .....	102	1.3	1.1	1.8	1.4	1.3
Kansas .....	94	2.2	1.4	2.8	2.5	1.1
North Dakota .....	48	4.8	1.7	4.8	4.5	1.1
Virginia .....	44	.8	.9	.8	.7	1.1
Colorado .....	39	1.0	1.0	1.0	.9	1.0
Kentucky .....	139	2.3	1.3	2.9	2.8	1.0

<sup>1</sup> Selected States are those which had a mortality-to-employment ratio of at least 1.0, based on mortality ratios for farming workers aged 55 years and older.

the Middle Atlantic, Midwest, Northeast, and Great Plains divisions. Some States with high mortality ratios, such as Minnesota, Wisconsin, and North Dakota, also show mortality-to-employment ratios greater than 1.0, indicating that fatal injuries were incurred disproportionately on the basis of total fatal workplace injuries and farming employment.

Although Texas and California reported a combined total of 175 fatal injuries to older farming workers, each of those States was calculated to have a mortality ratio under 0.5 and thus was not listed in table 1. The relatively low mortality ratio may be due to a number of reasons, including larger numbers of total fatalities annually, younger migrant farmworker populations, and agricultural production making up smaller proportions of each State's gross State product, resulting in a smaller proportion of employed individuals at risk of this type of fatal injury.

Table 1 also provides a clue to each State's experience by separating out farming from age. In most of the States listed, greater disproportions of fatal injuries were attributed to farming-related risks rather than age-related risks. In the majority of States, older farming workers were disproportionately fatally injured than were workers of all ages in farming occupations, indicating that a mixture of risks associated with farming and age contributed to high mortality ratios for older farming workers.

*Industry.* The three major agriculture industries in which workers in farming occupations toiled from 1995 to 2002 were crop production, livestock production, and agricultural services.

Within the crop production industries, establishments reporting the most fatal injuries included general farms with a significant amount of sales coming from the production of crops (984 fatalities), cash grain farms such as wheat and corn farms (101 fatalities), and field crop farms such as cotton and tobacco farms (126 fatalities). Establishments involved in livestock production accounted for 581 fatalities to workers aged 55 years and older in farming occupations. Farmers in this industry incurred nearly 350 fatalities, many of which occurred on beef cattle farms. Agricultural service establishments, such as labor contractors, accounted for a relatively small amount of fatal injuries to workers aged 55 years and older in farming occupations. Farmworkers represented a majority of these fatalities.

Across all occupations, fatally injured workers were more evenly distributed among establishment sizes. Older workers were represented 11 percent more than workers under 55 years in establishments with 10 or fewer employees. For farming occupations, unquestionably the majority of fatally injured workers were employed by establishments with 10 or fewer employees (68 percent).

**Occupation.** As seen in chart 2, the occupation of fatally injured workers varied by age. Deaths to workers meeting the definition of “farmer” were distributed more among older workers, including some over 90 years of age. Farm managers fatally injured during the time of this analysis also were of older ages. Supervisors of farmworkers recorded a distribution of injuries similar to that of most supervisors in the U.S. economy, with the majority being between 55 and 65 years of age. In contrast, fatally injured farmworkers tended to be younger, with the highest incidence among those between the ages 15 and 19 years.

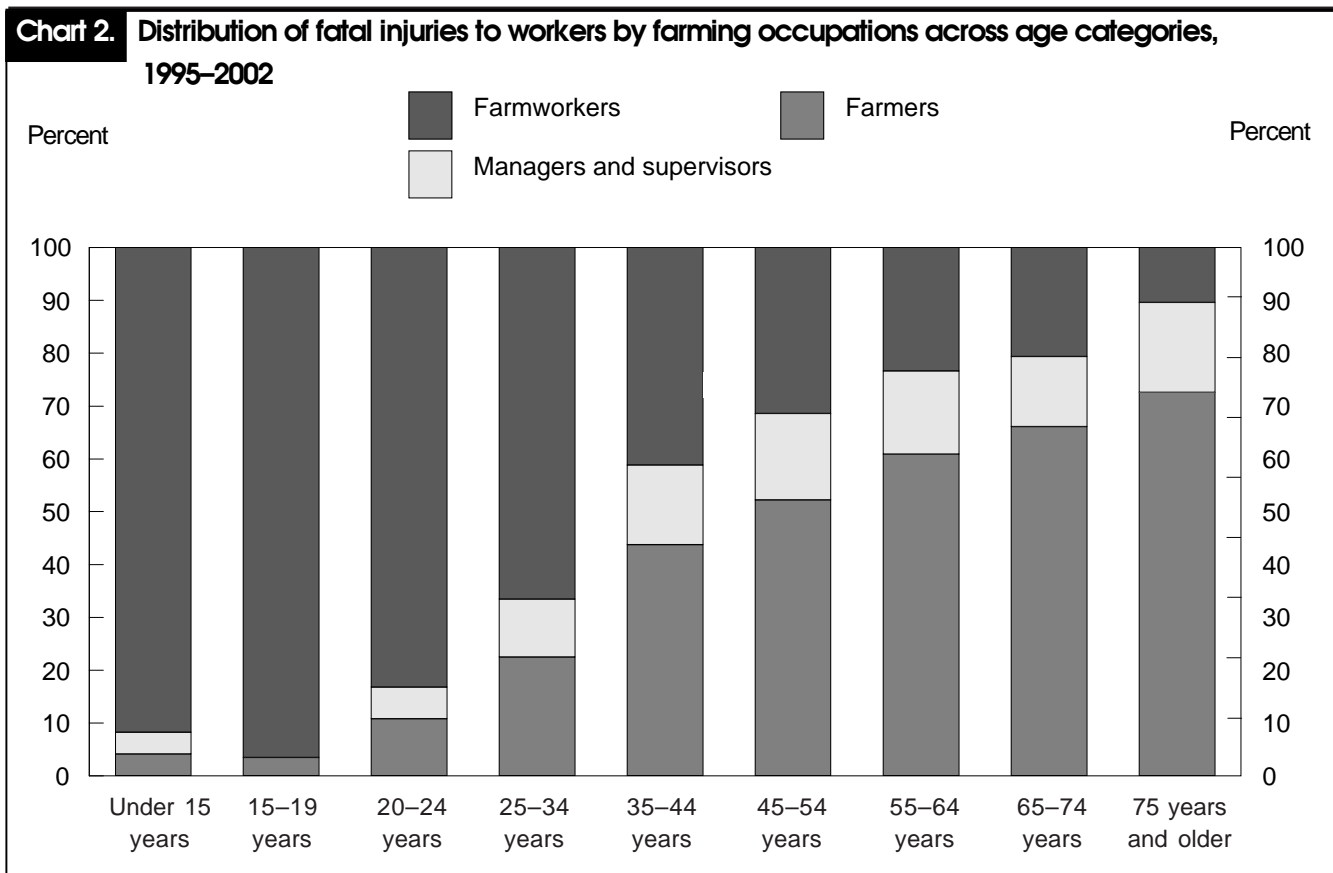
Occupations with the most fatal injuries varied by race and ethnicity. Fatally injured farmers and managers were nearly all self-employed non-Hispanic white males. Most fatalities occurred in Ohio, Pennsylvania, Missouri, and Iowa. More than 65 percent were working in crop production industries. Around 40 percent occurred while the worker was driving or operating a farm vehicle. About 30 percent of fatal injuries to non-Hispanic white farmers involved overturns. Although most incidents occurred on farms, 13 percent of decedents were off farm property at the time of their injury.

Hispanics or Latinos made up 19 percent of fatal injuries to farmworkers (78 fatalities) and 28 percent of fatal injuries to

supervisors (9 fatalities). Thirty-seven percent of fatalities to Hispanic farmworkers took place in California. A large majority of these decedents were between 55 and 65 years of age. Many fatalities to Hispanic farmworkers were due to transportation incidents (17 percent drivers and 17 percent passengers). One-fourth of fatal injuries to Hispanic farmworkers were incurred on streets and highways.

Six percent of farmworkers were non-Hispanic blacks. Many of these workers incurred their fatal injuries in transportation incidents or by being struck by falling objects on the farm. One-third of these fatalities to non-Hispanic black farmworkers occurred away from farm locations, a quarter on streets or highways.

Table 2 displays fatality data by occupation according to the event or exposure resulting in fatal injury. The table reveals that fatal occupational injuries to farmers were classified as transportation incidents, primarily nonhighway overturns. Tractors were directly involved in almost 50 percent of the 1,472 fatalities to workers in this occupation. Managers incurred a disproportionate number of drownings over the years 1995–2002. Most of the fatalities incurred by supervisors occurred while they were driving or otherwise operating trucks or farm machinery. Overturns resulted in 417 fatalities to farmworkers. However,



**Table 2. Fatal occupational injuries incurred by workers aged 55 and older in U.S. farming occupations, by event or exposure, 1995–2002**

Event or exposure	Farming occupations	Farmers	Managers	Supervisors	Farmworkers
Number .....	2,228	1,472	307	32	417
Percent distribution .....	100	100	100	100	100
Transportation .....	54	54	56	41	53
Highway .....	10	9	11	19	12
Collision between vehicles or mobile equipment .....	5	4	7	—	10
Nonhighway .....	38	40	39	16	31
Noncollision .....	35	37	38	—	28
Fell from and struck by vehicle or mobile equipment ....	8	7	9	—	10
Overturned .....	24	26	24	—	14
Assaults and violent acts .....	7	7	7	—	10
Assaults by animals .....	5	5	4	—	7
Contact with objects and equipment .....	27	28	25	31	21
Struck by object .....	15	16	15	22	12
Falls .....	6	6	5	—	9
Exposure to harmful substances or environments .....	4	3	3	—	5

NOTE: Dash indicates no data or data that did not meet publication criteria.

injuries to farmworkers—especially injuries not associated with driving or operating a vehicle—were more evenly distributed across event types, relative to the other occupations. For example, farmworkers suffered a greater proportion of injuries due to animal assaults.

*Demographics.* Fatally injured workers in farming occupations registered a median age of 55 years, well over the total population median of 42 years. More than 96 percent of fatally injured workers aged 55 years and older in farming occupations were men. Most of the men fatally injured were non-Hispanic white workers, although Hispanic workers represented 13 percent of the total.

In chart 3, the percent distribution of fatal injuries by employment status for workers in farming occupations is presented for the two age groups consisting of those under 55 years and those 55 years and older. Most older workers were self-employed. The majority of decedents in family businesses were younger than 55 years, but a few were in the older grouping. Of the 2,228 older workers in farming occupations who died from an occupational injury between 1995 and 2002, only 330 were wage or salary workers—half the percentage of those of all ages working for a wage or salary.

More than 85 percent of non-Hispanic white workers in farming occupations were self-employed, while almost 65 percent of non-Hispanic black decedents and nearly 79 percent of Hispanic or Latino decedents worked for compensation. About 65 percent of non-Hispanic white workers and 62 percent of non-Hispanic black workers were 65 years or older, while 66 percent of Hispanic workers were younger than 65.

*Event or exposure.* Table 3 gives details about the types of incidents reported in fatal injuries involving workers in

farming occupations. The table also provides median age figures to accentuate the age differences among categories.

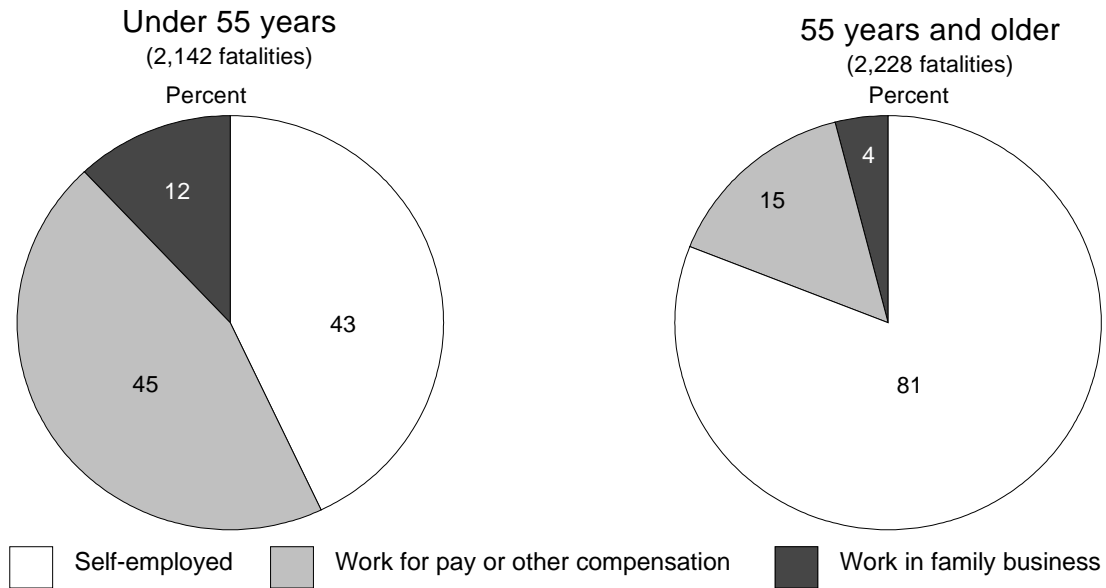
Of the 4,374 fatalities occurring between 1995 and 2002 to workers in farming occupations, the median age for those workers dying in transportation incidents was 57 years. Transportation incidents are separated into two primary categories: highway and nonhighway. Sixty percent of highway incidents involved workers under the age of 55. While this is a large percentage, highway decedents working in farming occupations had a median age of 48, still older than the median for the total labor force.

In contrast, the median age of farming workers killed in nonhighway transportation incidents was 60 years. The greatest number of nonhighway incidents involved overturns (848 fatal injuries), a large majority of which killed those aged 55 years and older. While tractor overturns that kill older farming workers have decreased by nearly 25 percent since 1992, fatal injuries due to overturns continue to fluctuate from year to year and contribute approximately one-fourth of fatal injuries to older farming workers.

Of the total 164 assaults and violent acts occurring to workers aged 55 and older in farming occupations, approximately 7 in 10 were direct assaults from animals. Thirty-five suicides were recorded among this population, which numbered less than half as many as farming workers under the age of 55.

*Worker activity.* CFOI classifies hundreds of activities workers may be performing during the time of a fatal injury. In contrast to the event or exposure, which identifies the manner in which the injury was experienced, worker activity identifies what the individual was doing immediately prior to the event. For older

**Chart 3. Percent distribution of fatal injuries to workers in farming occupations, by employment status according to age group, 1995–2002**



workers in farming occupations, precipitating activities tended to be vehicle operation (1,196 fatalities), tool and machinery use (283 fatalities), and animal care (133 fatalities).

Nearly 44 percent of all injuries that resulted in the death of an older farming worker took place while the worker was operating farm vehicles or machinery (974 fatal injuries). More than half of these injuries were due to overturns. Approximately 14 percent of fatalities involving the operation of farm vehicles occurred when a farming worker fell from a vehicle and then was struck by his or her own vehicle. Workers in farming occupations were operating tractors in an overwhelming majority of the 974 fatal injuries, but other machinery involved in fatalities included mowing machinery attached to tractors, balers, or combines. Other sources causing harm to farming workers while they were operating farm vehicles or machinery included trees, other tractors, ditches, bales, and water. While 11 percent of these events took place on a street or highway, more than 85 percent occurred on a farm, mostly in fields. The majority of workers affected were involved primarily in the production of crops (524), although fatalities also took the lives of dairy workers and those involved in livestock production.

While boarding or alighting a farm vehicle, 42 farming workers aged 55 years and older were fatally injured, mostly due to their vehicles rolling while not in normal operation. Thirty-

four farming workers aged 55 years and older died while riding on farm vehicles, most of which were tractors.

A number of workers in farming occupations died while tending to animals. A large majority of these workers were assaulted by the animals. In 59 percent of the incidents, cattle were the source of injury. Fifty-six incidents involved injuries to the trunk, 37 injuries to the head. Farming workers died while riding a horse in 26 cases. A few of these riders were assaulted by the horse they were riding.

Many workers in farming occupations died while in the act of repairing equipment or performing maintenance measures. One hundred eleven decedents were fatally injured while repairing equipment. Decedents were struck by rolling objects in 32 cases, 10 of which occurred during attempts to jump-start vehicles. A large number of incidents involved tractors, many resulting in internal injuries of the trunk or intracranial injuries. Another 27 farming workers were fatally injured while stopping to resolve a jam-up of equipment or machinery; many of these individuals were subsequently caught in or crushed by collapsing materials.

*Location of injury.* The location most frequently reported as the place of fatal injury to farming workers was the farm. Approximately 35 percent occurred on farmland under cultivation or in fields or meadows. Two-thirds of fatal injuries

**Table 3. Fatal injuries to workers in farming occupations, by age, selected events or exposures, 1995–2002**

Event or exposure	Fatalities	Total, under 55 years	Total, 55 years and older	Median age
Total .....	4,374	2,142	2,228	55
Transportation incidents .....	2,201	998	1,202	57
Highway .....	554	332	222	48
Collision between vehicles, mobile equipment .....	285	163	122	48
Moving in opposite directions, oncoming .....	64	42	22	42
Moving in intersection .....	85	45	40	51
Noncollision .....	227	143	84	47
Jackknifed or overturned .....	183	114	69	47
Nonhighway (farm, industrial premises) .....	1,362	524	838	60
Noncollision .....	1,266	490	776	60
Fell from and struck by vehicle, mobile equipment .....	302	124	178	59
Overturned .....	848	322	526	60
Worker struck by vehicle, mobile equipment .....	224	102	121	59
In parking lot or nonroad area .....	185	81	104	60
Assaults and violent acts .....	381	214	164	51
Homicides .....	78	59	16	39
Shooting .....	65	50	12	38
Suicide, self-inflicted injury .....	113	78	35	47
Assaults by animals .....	190	77	113	62
Contact with objects and equipment .....	1,122	531	591	56
Struck by object .....	546	202	344	61
Falling object .....	278	122	156	57
Rolling, sliding objects on floor or ground level .....	175	37	138	67
Caught in or compressed by equipment or objects .....	437	249	188	50
Caught in running equipment or machinery .....	267	171	96	46
Compressed or pinched by rolling, sliding, or shifting objects .....	68	28	40	61
Caught in or crushed in collapsing materials .....	130	75	55	52
Falls .....	240	102	138	57
Fall to lower level .....	205	87	118	57
Exposure to harmful substances or environments .....	339	260	79	40
Contact with electric current .....	157	139	18	34
Oxygen deficiency .....	73	47	26	44
Drowning, submersion .....	61	44	17	41
Fires and explosions .....	85	33	52	59

NOTE: Numbers may not add to totals due to records with no ages reported.

occurring in fields were transportation incidents, primarily tractor overturns and falls from tractors. Others working in fields were caught in running agricultural machinery, collided with trees while driving tractors, were struck by rolling tractors while boarding or repairing them, were burned in an unintended or out-of-control fire, or were assaulted by cattle.

Fatal injuries also occurred in farm buildings. Most such injuries were the result of falls to lower levels and being struck by falling objects. Slightly more of the fatalities in farm buildings occurred to farming workers engaged in the production of crops as opposed to the raising of livestock. A few fatalities occurred in silos, most of the incidents due to collapsing food products. Still fewer fatalities took place around water; most of these incidents involved tractor overturns that resulted in death by drowning.

About 11 percent of all fatal injuries to workers aged 55 years and older in farming occupations transpired on road-

ways. Ninety-six times farming workers were killed while driving tractors on roadways; eighty times they were killed while driving trucks. In 76 incidents, farming workers collided with another's truck. The majority of fatalities taking place on roadways occurred to workers engaged in crop production.

CFOI DATA FROM 1995 TO 2002 SHOW THAT WORKERS aged 55 years and older in farming occupations were at high risk of fatal injury. Even though fatal injuries to older farming workers have trended downward over time, the fatality rate of these workers is still higher than those of most others. Workers aged 55 years and older represent nearly a third of those employed in farming occupations and more than half of the fatalities in these occupations. The fatality rate for workers aged 55 years and older in farming occupations was about 48 fatalities per 100,000 employed, 10 times the rate for all workers.



Many fatalities occurring to the older population in farming occupations took place among establishments producing mixed goods, primarily crops. More than 200 farming workers were repairing and maintaining machinery when they were fatally injured. In addition, animals fatally assaulted 113 workers in farming occupations. While Midwestern States had a large number of fatal injuries to farming workers aged 55 years and older, Great Plains states had significantly disproportionate numbers of fatal injuries to older farming workers. Accounting for employment, farming workers in Pennsylvania, Illinois, Ohio, and New York were at great risk.

Like data from other studies, the national data confirm sig-

nificant numbers of tractor overturns among farming workers aged 55 years and older. Even though retrofitting tractors with rollover protective structures (ROPS) may reduce fatalities up to 99 percent of the time, significant numbers of tractors still overturn. While some older models may not yet have such a structure engineered to fit, other barriers inhibit the effective use of ROPS. Meaningful future research would likely include looking at ways to overcome the “hassle factor”—farmers’ perceived annoyance at the money and time required to be spent purchasing and using ROPS mechanisms. Useful research in this area would likely further encourage the declining trend in overturns.<sup>13</sup> □

## Notes

ACKNOWLEDGMENTS: The author thanks Jessica Sincavage, Mark Zak, Janice Windau, Scott Richardson, Katharine Newman, William Wiatrowski, and Jordan Pfuntner for their input, and Stephen Pegula for his input and data review in the preparation of this article.

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<sup>2</sup> Kelly J. Donham, Burton C. Kross, James A. Merchant, and David S. Pratt, *Agriculture at Risk: A Report to the Nation*, summary report of the Agricultural, Occupational and Environmental Health: Policy Strategies for the Future conference, Des Moines, IA, September 1988, and Iowa City, IA, September 1998; on the Internet at <http://www.public-health.uiowa.edu/agatrisk/>.

<sup>3</sup> McCurdy and Carroll, “Agricultural Injury”; see also Suzanne M. Kisner and Stephanie G. Pratt, “Occupational Fatalities among Older Workers in the United States: 1980–1991,” *Journal of Occupational and Environmental Medicine*, August 1997, pp. 715–21.

<sup>4</sup> Scott Richardson and Andrew Schulman, “Texas Study Finds Older Workers at Relatively High Risk of Fatal Occupational Injury,” *Compensation and Working Conditions*, April 1994, pp. 1–8.

<sup>5</sup> *Worker Health Chartbook, 2004* (National Institute for Occu-

pational Safety and Health, September 2004).

<sup>6</sup> McCurdy and Carroll, “Agricultural Injury.”

<sup>7</sup> Myers and Hard, “Risks of Fatal Injuries.”

<sup>8</sup> Great Plains Center for Agricultural Health, *TRAC-SAFE: A Community-based Program for Reducing Injuries and Deaths Due to Tractor Overturns*; on the Internet at <http://www.public-health.uiowa.edu/gpcah/tracsaf.htm>.

<sup>9</sup> Ricky Lee Langley and James Lee Hunter, “Occupational fatalities due to animal-related events,” *Wilderness and Environmental Medicine*, vol. 12, no. 3, 2001, pp. 168–74.

<sup>10</sup> Occupational Safety and Health Administration, *OSHA Fact Sheet: Farm Safety*; on the Internet at [http://www.osha.gov/OshDoc/data\\_General\\_Facts/FarmFactS2.pdf](http://www.osha.gov/OshDoc/data_General_Facts/FarmFactS2.pdf).

<sup>11</sup> Fred Gale, “The Graying Farm Sector: Legacy of Off-Farm Migration,” *Rural America*, fall 2002, pp. 28–31.

<sup>12</sup> Every year, CROI publishes fatality rates based on preliminary fatality counts. The 4.5 fatal injuries per 100,000 employed is taken as an average of published rates for the years 1995–2002.

<sup>13</sup> E. M. Hallman recently published results of a study looking into just this issue. (See his article “ROPS Retrofitting: Measuring Effectiveness of Incentives and Uncovering Inherent Barriers to Success,” *Journal of Agricultural Safety and Health*, February 2005, pp. 75–84.)

## APPENDIX: Census of Fatal Occupational Injuries

Since its inception in 1992, the BLS Census of Fatal Occupational Injuries (CFOI) has cross-referenced numerous source documents each year, including death certificates and media accounts, to ascertain demographic and other characteristics of workplace fatalities. Data are classified by more than 30 elements, including status of employment, sex, age, and race or ethnic origin. Furthermore, CFOI classifies cases according to the Occupational Injury and Illness Classification System by nature of injury, part of body injured, source of injury, and event or exposure. Other data elements include the location and the activity the worker was engaged in at the time of the injury. Between 1995 and 2002, CFOI classified data according to the 1990 Bureau of Census (BOC) occupations and the 1987 Standard Industrial Classification (SIC) manual.

Beginning with 2003 data, CFOI has adopted the North American Industry Classification System (NAICS) of 2002 and the Standard Occupational Classification (SOC) system of 2000. The result of these changes is a break in series for both industry and occupation. When classified by industry or occupation, data previous to 2003 are not comparable to 2003 data. Therefore, data for 2003–04, the most recently available data, have been excluded from this study.

There are 19 specific occupations, as defined by the BOC, within the broad category of farming, forestry, and fishing occupations.<sup>1</sup> Twelve of these refer to agriculture-related occupations. However, several of the 12 designate work unrelated to agriculture production on farms. Only 4 are consistent with this type of farming: farmers, except horticulture; managers, farms, except horticulture; supervisors, farmworkers; and farmworkers. CFOI identified 4,374 fatal injuries under these occupation categories, of which 2,228 were incurred by those 55 years or older at the time of the injury.

A number of terms are used in this appendix to refer to the special population consisting of workers in the four agricultural farm-related occupations under the category of farming, forestry, and fishing. The four selected occupations in combination will be referred to as farming occupations and, occasionally, as farming or farming workers. Unless otherwise specified, *farmers* will refer to the category of farmers, except horticulture, which is BOC code 473. *Managers* will refer to BOC code 475: managers, farms, except horticulture. *Supervisors* will refer to BOC code 477, supervisors, farmworkers. *Farmworkers* will refer to the farmworkers category (BOC code 479). *Agriculture* will refer to the agriculture industry, which includes, but is not limited to, the farming occupations listed. The term *older* will refer to any population consisting of workers aged 55 or more years.

Five statistics were calculated that require some explanation. Fatality rates, as calculated here, describe the number of fatal injuries in a particular group per 100,000 employed in that group. The fatality rate is calculated as

$$\left( \frac{FI}{E} \right) \times 100,000,$$

where FI is the number of fatal injuries and E is (full- and part-time) employment. For example, over the 1995–2002 period, 2,228 fatal injuries were identified among workers in farming occupations, and an estimated 4,651,000 were (cumulatively) employed in those same occupations. These numbers yield a fatality rate of 47.9 fatal

injuries per 100,000 employed. The number of employed workers used to calculate the rates, except for the military, are annual averages of employed civilians 16 years and older. A resident military figure, obtained from the Department of Defense, was added to the cps employment total. Because the Bureau of Labor Statistics publishes employment estimates from the cps that are limited to workers at least 16 years old, all rates exclude fatalities to workers under that age.<sup>2</sup>

Relative risks provide a look at the relationship between a selected group in comparison to other groups. The rate for the total population serves as the base. Thus, relative risks are denoted by  $Rate_N/Rate_T$ , where  $Rate_N$  is the fatal work injury rate for a selected worker group and  $Rate_T$  is the fatal work injury rate for the total population. For example, suppose the selected worker group is workers aged 55 years or older in farming occupations, whose fatal work injury rate was  $Rate_N = 47.9$ . Then the relative risk for this population, based on the total working population's fatality rate ( $Rate_T = 4.5$ ), was 10.6, meaning that the selected worker group had a risk of fatal injury 10.6 times that of the total working population.

Mortality ratios represent the ratio of the number of fatalities in one category, as a percentage of that category's aggregate, to the total fatalities in all categories, as a percentage of the total aggregate. The number 1.00 indicates a proportional distribution of fatalities. The mortality ratio can thus be represented mathematically as  $P_{GROUP}/P_{ALL}$ , where  $P_{GROUP}$  is the number of fatal work injuries to the worker group in the State in question, divided by the number of fatalities to that group in the Nation. For example, Ohio reported 125 fatal injuries to workers aged 55 years and older in farming occupations, representing 5.61 percent of the 2,228 fatal injuries to workers nationwide. Ohio also reported 1,614 fatalities to workers of all ages in all occupations, representing 3.35 percent of the 48,193 U.S. total. The percentage of fatalities to older workers in farming occupations, divided by the proportion of fatalities to all worker groups, yields a ratio of 1.68, indicating that fatalities for older Ohio workers in farming occupations were disproportionately higher than were fatalities among all Ohio workers.

Employment ratios were calculated to determine the significance of farm employment in each State's economy. Employment ratios are interpreted as the ratio of a State's proportion of U.S. farm employment to that State's proportion of total employment. This relationship can be expressed as  $(F_{STATE}/F_{US})/(T_{STATE}/T_{US})$ , where  $F_{STATE}$  is the employment estimate of farm operators and laborers in the State in question,  $F_{US}$  is the employment estimate of farm operators and laborers in the United States,  $T_{STATE}$  is the estimate of the total employed in the State in question, and  $T_{US}$  is the estimate of the total employed in the United States. For example, in its 2002 Census of Agriculture, the National Agricultural Statistics Service estimated that 6,151,642 farm operators and laborers worked in the United States in 2002, of which 3.1 percent was estimated for Ohio (188,624/6,151,642). The cps estimated total nonfarm employment to be 130,341,000 in the Nation in 2002, and the BLS Local Area Unemployment Statistics (LAUS) program estimated 5,445,000 employed in Ohio (4.2 percent). The final calculation yields a farm-to-nonfarm employment ratio of 0.73 (3.1/4.2).

Finally, an attempt to standardize mortality ratios was made by using the preceding employment ratios. The standardized mortality ratio is simply the mortality ratio  $M_{STATE}$  for a State, divided by that State's employment ratio  $E_{STATE}$  or  $M_{STATE}/E_{STATE}$ . Thus, a mortality

ratio of 1.68 and an employment ratio of 0.76 yield a mortality-to-employment ratio of 2.2 (1.68/0.76). Due to data limitations, this standardization could not be performed for the group aged 55 years

and older. Therefore, employment ratios for each group include individuals of any age, restricting the significance of the calculation of the mortality-to-employment ratio.<sup>3</sup>

## Notes to the appendix

<sup>1</sup> The following BOC occupation categories were defined for the 1990 census:

Code	Title
473-499	Farming, forestry, and fishing occupations
473-476	Farm operators and managers
473	Farmers, except horticultural
474	Horticultural specialty farmers
475	Managers, farms, except horticultural
476	Managers, horticultural specialty farms
477-489	Other agricultural and related occupations
477-484	Farm occupations, except managerial
477	Supervisors, farmworkers
479	Farmworkers
483	Marine life cultivation workers
484	Nursery workers
485-489	Related agricultural occupations
485	Supervisors, related agricultural occupations
486	Groundskeepers and gardeners, except farm
487	Animal caretakers, except farm
488	Graders and sorters, agricultural products
489	Inspectors, agricultural products
494-496	Forestry and logging occupations

494	Supervisors, forestry and logging workers
495	Forestry workers, except logging
496	Timber cutting and logging occupations
497-499	Fishers, hunters, and trappers
497	Captains and other officers, fishing vessels
498	Fishers, including vessel captains and officers
499	Hunters and trappers

<sup>2</sup> For more information on the calculation of fatality rates and the choice of denominator, see John W. Ruser, "Denominator Choice in the Calculation of Workplace Fatality Rates," *American Journal of Industrial Medicine*, February 1998, pp. 151-56.

<sup>3</sup> Ideally, data on work hours for individuals 55 years and older would be obtained for each State in order to determine the risk of fatal injury to farming workers. Then employment data for individuals 55 years and older would be obtained for each State's totals and farming figures. Unfortunately, these data were not available at the time this article was written. However, the mortality-to-employment ratio is still valuable in standardizing each State's fatal workplace injuries to older farming workers by each State's farming employment. While standardization does not produce an exact match, mortality ratios for all ages of farming workers yielded approximately the same results.