Farm-Related Fatalities among Children in California, 1980 to 1989

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ABSTRACT

To evaluate farm-related deaths among children in California and to identify specific risk factors, this study used death certificate tapes to identify 40 farm-related deaths among children under age 15 in California for 1980 to 1989. Mortality rates and odds ratios for cause-specific unintentional farm deaths were calculated. While California's farm-related mortality rate was lower than those in the midwestern states studied, the rate for Hispanic boys was 70% higher than that for non-Hispanics. The odds of death from machinery (81.3), animals (10.1), electricity (5.2), and nontraffic motor vehicles (3.4) were significantly greater than those in nonfarm locations; those from drowning were significantly lower (0.2). Specific factors associated with the lower California mortality rate need to be identified. (*Am J Public Health.* 1995;85:89–92)

Introduction

Increasing attention is being paid to occupational health hazards in agriculture, and especially to fatal and nonfatal injuries.[1–4] Agriculture has one of the highest rates of work-related fatalities of all industries.[5] Children under age 15, who account for 20% of the 6 million people living on farms in the United States,[6] account for 6% to 10% of the country's approximately 1700 annual farm-related fatalities[2,5,7,8]; in some states, up to one fourth of all farm injuries involve children under age 15.[5]

Most studies of farm fatalities have focused on midwestern states.[5,8–11] However, western agricultural commodities are generally more labor-intensive, with most of the labor provided by migrant and seasonal farmworkers.[12] This study was undertaken to evaluate the nature and magnitude of farm-related deaths of children in California, and to determine if these deaths were different in their causal distribution from deaths in other parts of the country.

Methods

Cases included all deaths among children under age 15 that occurred on a farm and were due to an external cause (*International Classification of Diseases* [ICD] E800–949).[13] Deaths due to traffic accidents (E810–819) were excluded. *Farm* was defined as having the "place of injury" on the death certificate coded as "farm." This definition excludes deaths that occurred within a farm residence itself. Hispanic ethnicity was also based on the death certificate classification. Death rates were based on age- and race-specific rural population estimates from the US Census.[14] The 1980 and 1990 censuses were interpolated for a midpoint estimate, which was multiplied by 10 to give the 10-year population at risk.

The principal comparison was the proportion of farm and nonfarm deaths attributed to specific external causes, yielding odds ratios (ORs). Both the farm and nonfarm deaths were treated as random groups, and cause-specific odd ratios were calculated as $p_f/(1-p_f)$, where p_f equaled the probability that a farm-related death would result from a specific cause. Confidence intervals and statistical significance were derived from the Mantel-Haenszel chi statistic.[15]

Deaths among children were considered farm related if they were the result of farm production work or nonwork activities in the farm environment. Cause of death for all deaths was classified by an occupational medicine physician and an industrial hygienist. For the death to be classified as owing to farmwork, the child had to be engaged in work activity related to agricultural production.[16] If the relationship to farm production work was not clear or if the two coders were not in agreement, the case was coded as indeterminate.

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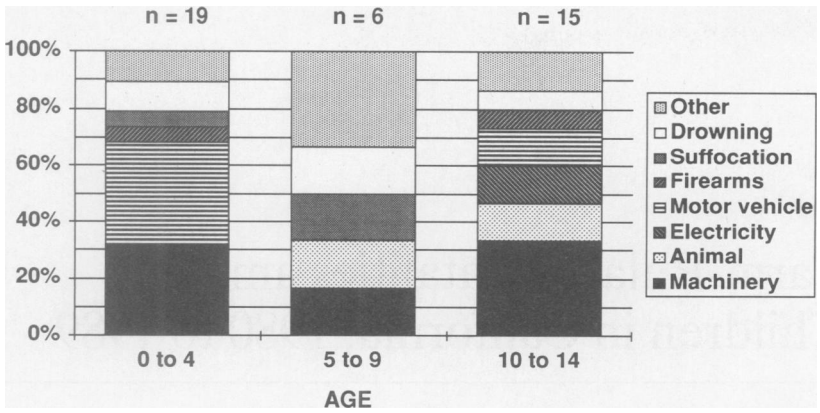

FIGURE 1—Causes of farm-related deaths among California children under age 15, 1980 to 1989.

TABLE 1—Average Annual Age-Specific Farm Fatality Rates[a] in Children, by Race/Ethnicity and Sex per 100 000 Rural Population in California, 1980 to 1989

	All Races		Hispanics		Non-Hispanics	
Age Groups, y	Boys, Rate (n)	Girls, Rate (n)	Boys, Rate (n)	Girls, Rate (n)	Boys, Rate (n)	Girls, Rate (n)
0–4	1.9 (15)	0.5 (4)	2.5 (5)	0.5 (1)	1.7 (10)	0.5 (3)
5–9	0.6 (5)	0.1 (1)	1.0 (1)	0.0 (0)	0.5 (4)	0.2 (1)
10–14	1.2 (10)	0.6 (5)	1.6 (3)	0.0 (0)	1.0 (7)	0.8 (5)
Total	1.2 (30)	0.4 (10)	1.7 (9)	0.2 (1)	1.0 (21)	0.5 (9)

[a]Based on ICD codes E850 to E999.

Results

Among children under age 15, 10 385 died between 1980 and 1989 as a result of external causes. Of this total, 283 (2.7%) were residents of California who died out of state. Forty-seven deaths were recorded on death certificates as occurring on farms from nontraffic external causes (E800–999); however, three of these were excluded because they occurred outside the state and two more were excluded because they were due to aircraft accidents (ICD 841.3) over agricultural areas. Two intentional farm-related deaths—one from assault by a firearm and one from suicide (E953, E965)—also were excluded. Of the remaining 40 deaths, only 3 (7.5%) were coded as being related to farmwork, 19 (47.5%) were coded as *not* being related to farmwork, and 18 (45%) were coded as indeterminate.

Machinery-related deaths were the largest single cause of mortality, accounting for 30% (12/40) of child deaths occurring on farms (Figure 1); eight of these deaths (67%) involved tractors—primarily events in which the child was riding on the tractor. The proportion of machinery-related deaths was greatest among those aged 0 to 4 years and those aged 10 to 14 years (32% each). The next largest category was nontraffic motor (including off-road) vehicle deaths, which accounted for nine fatalities (23%). Drowning accounted for four deaths (10%), and animals and firearms were each the cause of five deaths (13%).

Ten of the 40 deaths (25%) occurred in girls (Table 1). Of the 25% (10/40) of deaths that were among Hispanic children, however, only one (10%) was of a girl, compared with 30% (9/30) of deaths among non-Hispanic children (Table 1).

For boys and girls, average annual age-specific mortality rates were highest among the 0- to 4 and the 10- to 14-year-olds (Table 1). Although the rates among girls were one half or less than those among boys, a similar U-shaped pattern with increasing age was observed. The age-specific rates among Hispanic boys were 60% to 100% higher than those among non-Hispanic boys. For Hispanics as well as for the overall population, however, the mortality rate was lowest for those aged 5 to 9. Because only one death occurred to a Hispanic girl, no meaningful comparison was possible with non-Hispanic girls.

Unintentional deaths caused by machinery (ICD = E919) were approximately 80 times more likely to be recorded as occurring on a farm (OR = 81.3; 95% confidence interval [CI] = 37.2, 177.8) (Table 2). The odds of animal-related deaths (ICDs = E827.8, 905–906), of deaths due to electricity (ICD = E925), and of nontraffic motor vehicle deaths (ICDs = E820–825) were also significantly increased on the farm. However, death from drowning (ICD = E910) was significantly less likely among farm deaths than among nonfarm deaths (OR = 0.2; 95% CI = 0.1, 0.5). The odds ratios for unintentional death from fire and flames (ICD = E890–899) and from suffocation or asphyxiation (ICD = E911–913) were also decreased (ORs = 0.4 and 0.3, respectively), although not significantly. The odds of death from unintentional poisoning (E850–869) and from firearms (E922) showed no difference between the farm and the nonfarm locations.

Discussion

Farm machinery was the largest single cause of farm fatalities in California, accounting for a similar percentage (30%) as was observed in Kentucky,[17] but a lower percentage than the 63% to 82% of deaths attributed to machinery in Illinois, Wisconsin, and Indiana,[10,18] or the 40% of farm fatalities among children throughout the United States.[8] As in other studies, tractors were the most frequent piece of farm machinery associated with fatalities, and efforts should focus on preventing tractor-related deaths among children.

California's extensive network of irrigation canals may also represent a hazard to children and adults in agriculture. However, the proportion of farm-related deaths from drowning in California (10%) was much lower than that in Kentucky (35% of boys, 15% of girls) or the United States (30%).[8] The low odds ratio for drowning deaths in our study may in part reflect the highly urbanized California

population and the high rate of swimming pool drownings.[19]

Our U-shaped curve for farm fatality rates was similar to the US pattern for boys.[8] National estimates for nonfatal farm injuries have noted increasing rates for boys with increasing age, but the opposite pattern has been found among girls, with the highest rates occurring among those aged 5 to 9 years and declining rates occurring among those in the older age group.[8] These differences may reflect differences in behavior between boys and girls with increasing age.[16] The higher rates among very young children may be owing to hazards of the farm environment, while those occurring among older boys (above 10 years) likely result from the greater risks that are inherent in more actual work responsibilities. Only 10 deaths (25%) occurred among girls in this study, although this was a higher proportion of total deaths than that observed nationally (13%).[8]

The mortality rate among Hispanic boys was 70% greater than that among non-Hispanic boys. This may represent a maximum difference between Hispanics and non-Hispanics because of the undercounting of Hispanics on the census,[20] which may be a particular problem for farmworkers.[12] The higher mortality of Hispanics has not been previously observed and requires further investigation. Preventive efforts for this population will require different language and cultural approaches than those used for non-Hispanic farm families.

One limitation of this study is the use of only death certificates for case ascertainment. Our observed mortality rates are probably an underestimate, and complete detection of cases from all sources would probably yield a higher rate. A similar study in Kentucky found that death certificates alone underestimated childhood agriculture mortality rates by 23%,[16] a proportion similar to the 19% of adult occupational fatalities missed by using only death certificates for case detection.[21] Another potential limitation is the small number of deaths over the 10 years of analysis. However, while the small numbers may have affected some of the less frequent cause-specific findings, the consistency of the results with national patterns for age, sex, and the more common specific causes suggests that the results are valid.

The number and rate of farm-related deaths among children in California are lower than those for other agricultural states for which data are available. Considering only numbers of deaths, the California total is less than the 6 to 16 farm fatalities per year among children in Indiana (1970 to 1981), Wisconsin (1970 to 1984), Nebraska (1969 to 1985), Minnesota (1984 to 1988), or Pennsylvania.[5] The study most comparable to ours found death rates in Illinois and Wisconsin (1979 to 1985) of 3.5 and 1.1 per 100 000 boys and girls aged 0 to 14 (rural population), respectively,[10] or approximately three times the California rates.

The differences in childhood agricultural mortality between California and the midwestern agricultural states are too great to be explained by underestimates of California deaths from using only death certificates. Furthermore, undercounting of the farmworker population by the Census Bureau would result in a greater reduction of the observed mortality rate in California. A plausible explanation for the differences is that many factors associated with the nature of farming in California, such as the larger number of corporate farms and fewer family farms, the milder climate, and differences in crops and agricultural practices, result in lower mortality among children.

While deaths of children in California agriculture are uncommon, this study provides direction for reducing this preventable cause of mortality. Furthermore, focusing attention on higher risk populations and equipment may help reduce the much larger problem of nonfatal injuries to children in agricultural environments.[22] □

TABLE 2—Farm Mortality Odds Ratios (ORs) and Confidence Intervals (CIs) in Children, by External Cause of Death[a] and by Age Groups, California, 1980 to 1989

External Cause of Death	Age Group, y							
	Total		0–4		5–9		10–14	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Machinery	81.3	37.2, 177.8	120.6	39.3, 370.0	20.6	2.2, 197.1	78.3	19.6, 313.6
Animals	10.1	3.0, 34.2	...	...	12.6	1.4, 115.7	12.0	2.4, 60.1
Electricity	5.2	1.2, 22.1	...	...	...	...	5.9	1.3, 27.9
Motor vehicle, nontraffic	3.4	1.6, 7.3	6.1	2.4, 15.7	...	...	2.5	0.6, 11.6
Accidental poisoning	0.8	0.1, 5.7	...	...	...	...	1.8	0.2, 14.2
Firearms	1.3	0.3, 5.6	5.1	0.7, 39.2	...	...	0.4	0.1, 3.3
Fire and flames	0.4	0.1, 1.5	0.4	0.1, 2.9	0.9	0.1, 7.4	...	...
Suffocation/ asphyxiation	0.3	0.1, 1.3	0.3	0.0, 2.0	2.1	0.2, 17.8	...	...
Drowning	0.2	0.1, 0.5	0.2	0.0, 0.7	0.4	0.1, 3.8	0.2	0.1, 1.6

[a]Excludes ICD E810–819.

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Daylight Saving Time and Motor Vehicle Crashes: The Reduction in Pedestrian and Vehicle Occupant Fatalities

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ABSTRACT

Fatal crashes were tabulated for 6-hour periods around sunrise and sunset, from 13 weeks before the fall change to standard time until 9 weeks after the spring change to daylight saving time. Fatal-crash occurrence was related to changes in daylight, whether these changes occurred abruptly with the fall and spring time changes or gradually with the changing seasons of the year. During daylight saving time, which shifts an hour of daylight to the busier evening traffic hours, there were fewer fatal crashes. An estimated 901 fewer fatal crashes (727 involving pedestrians, 174 involving vehicle occupants) might have occurred if daylight saving time had been retained year-round from 1987 through 1991. (*Am J Public Health.* 1995;85:92–96)

Introduction

When daylight saving time is implemented in the spring, clock times are advanced 1 hour. In the fall, with the return to standard time, clock times are moved back 1 hour. Daylight saving time has been in effect for most of the United States from the first Sunday in April to the last Saturday in October since 1987.

The transition from standard time to daylight saving time in the spring makes 1 more hour of daylight available in the evening and 1 less hour of daylight available in the morning. Because darkness increases the risk of motor vehicle crashes,[1,2] it has been argued that this shift results in fewer motor vehicle crashes in the evening and more crashes in the morning.[3,4] However, there is typically more traffic during the affected evening hours than during the morning; thus, the net effect of daylight saving time should be an overall reduction in crashes.[5,6]

In the current study, the effect of daylight saving time on pedestrian and vehicle occupant fatalities was estimated from a model relating light level during morning and evening hours to fatal motor vehicle crashes. The model accounts for both the abrupt changes in morning and evening light levels associated with the April and October time changes and the gradual day-to-day changes in light level in a given hour with the changing seasons of the year.

Methods

In the early morning, there is a period when it is dark, followed by approximately 1 hour of twilight (slightly longer in the northern United States, slightly shorter in the South), followed by the moment of sunrise, and then by daylight. The reverse is true in the afternoon. The left half of Table 1 shows light conditions on the day just before and the day of the spring time change; the right half shows light conditions on the day just before and the day of the fall time change. In Table 1, the 6 morning and 6 evening hours are termed AM 0–AM 5 and PM 0–PM 5. Actual clock times for fall AM and PM hours (that is, from late summer

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