

Farm Fatalities to Youth 1995-1997: A Comparison by Age Groups.

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Abstract:

Although a myriad of research illustrates the safety issues related to farm fatalities in youth populations, very little empirical evidence exists to describe farm fatalities to non-working youth and youth under 16 years of age. Research such as that conducted by Myers and Adekoya (2001) and Castillo et al. (1999) utilize surveillance systems such as the National Traumatic Occupational Fatalities (NTOF) Surveillance System and the Census of Fatal Occupational Injuries (CFOI) to provide information on occupational farm fatalities to youth. However, since youth are exposed to hazards both while working and playing on the farm, these studies exclude one critical component - non-occupational fatalities.

Adekoya and Pratt (2001) utilize National Center for Health Statistics (NCHS) Mortality Data to address fatal farm injuries. However, the data do not allow for a delineation between occupational and non-occupational events. In addition, the coding system utilized with these data does not allow for inclusion of transportation or intentional fatalities, and fatalities occurring within the farm home were not included.

To address both occupational and non-occupational deaths on farms, including transportation and intentional deaths, this research will utilize death certificate data collected by the National Institute for Occupational Safety and Health (NIOSH) from all 50 state vital statistics mortality registries. Records satisfying the following criteria were requested: underlying, immediate, or contributing cause of death from an external factor; age of the decedent is less than 20 years of age; and the indicated location of death is a farm. The results include information for 368 fatalities occurring in the years 1995 through 1997.

In addition to providing annual fatality rates and description of the general cause of death, this research will further examine the variation between age groups. In particular, a distinction will be made between youth under 16 years of age and those 16 and over.

Preliminary findings show an average annual fatality rate for all farm youth of 9.76 fatalities per 100,000 youth. The most prevalent causes of death are; machinery (94), drowning (59), motor vehicle (49), nature/environment (25) and suffocation (24). Of all youth fatalities occurring while at work, 34.0% (16) are to youth less than 16 years of age. This same age group accounts for 74.4% (221) of all non-work related fatalities.

This paper will provide farm families and researchers more detailed information on farm hazards that contribute to the deaths of youth. As these youth may encounter hazards while working or playing in their daily environment, identification and elimination of these hazards will increase overall safety on the farm.

Introduction:

According to estimates derived from the 1998 Childhood Agricultural Injury Survey (CAIS), the farm in the United States (U.S.) is both a playground and workplace for approximately 1.9 million youth under 20 years of age living and working on farms. Given the nature of the work done on the farm and the dual role of the farm as a home and a workplace, youth are exposed to many unique hazards while working and playing. According to Adekoya and Pratt (2001) there were 2,174 youth under 20 years of age fatally injured on farms between 1982 and 1996, or an average of approximately 155 deaths annually. Although these authors found that the annual number of deaths appears to be decreasing, the number of deaths remains high. This indicates a continued need for research to identify the dangers that youth face on a daily basis so that effective prevention strategies can be implemented.

Although research exists that describes general farm injuries and fatalities to youth (Adekoya and Pratt, 2001; Myers and Adekoya, 2001; Rivara, 1985), research on youth farm-related fatalities has primarily addressed occupational fatalities (Janicak, 2000; Castillo et al., 1999; Conroy and Sciortino, 1997). By utilizing databases, such as the National Traumatic Occupational Fatalities (NTOF) (which is death certificate-based) and the multiple source Census of Fatal Occupational Injuries (CFOI) surveillance systems, research has been able to provide insightful information on these occupational injuries. Other sources of data include state-specific vital records-based data systems which have been used for local studies. However, since youth are exposed to hazards both while working and playing on the farm, most of the previously mentioned studies exclude one critical component - non-occupational fatalities.

Authors such as Myers and Adekoya (2001), Janicak (2000), Castillo et al. (1999),

Conroy and Sciortino (1997), and Richardson et al. (1997) have studied fatal occupational farm injuries and the impact of variation in activity and age. In general, these authors tend to come to similar conclusions. When studying all farm events, regardless of age, tractors were the leading cause of death on the farm in the U.S. (Jenkins and Hard, 1992; Richardson et al., 1997). Myers and Adekoya (2001) found that, between 1982 and 1994, the three leading causes of on-farm deaths to youth ages 16 through 19 were machinery (29.5%), drowning (23.8%), and firearms (17.5%). Half of all occupational fatalities to youth 16 to 19 years of age involved vehicles, with 23% of vehicle fatalities involving tractors (Castillo et al., 1999). Overall, risk is similar across age groups, but risk factors may vary within age groups.

Adekoya and Pratt (2001) utilized National Center for Health Statistics (NCHS) Mortality Data to address fatal farm injuries. These data do not allow for a distinction between occupational and non-occupational injuries. These authors found that approximately two thirds of all farm fatalities occurred to youth under 15 years of age (1,432 of 2,174 fatalities from 1982 to 1996). In addition, the leading causes of death for younger youth were machinery, drowning, and animals. This research indicates a large number of fatalities in the under 15 age group, and some variation in the likely causes of injury. However, one limitation of this research is that the coding system utilized does not allow for inclusion of either transportation or intentional fatalities. In addition, fatalities which occurred within the farm home were not included. Therefore, these data are likely to under-represent the number of youth fatalities on the farm.

The intent of this research is to re-examine the fatality rate of youth on U.S. farms. In addition to examining fatality rates by cause of death, this research will further examine the variation between age groups. In particular, a distinction will be made between youth 16 and

over and youth under 16 years of age, and will include both occupational and non-occupational fatalities.

Methods:

This research will utilize death certificate data collected by the National Institute for Occupational Safety and Health (NIOSH) from all 50 state vital statistics mortality registries. Records satisfying the following criteria were requested: underlying, immediate, or contributing cause of death from an external factor (International Classification of Diseases, 9th Revision, E800-E999); age of the decedent is less than 20 years of age; and the indicated location of death is a farm. The results include detailed information for 368 fatalities occurring in the years 1995 through 1997. These data contain fatalities incurred by individuals not typically included in other farm fatality studies (i.e., transportation and intentional incidents).

Information from death certificates were automated using double-blind entry. An event was considered occupational if the “injury at work?” item on the death certificate was marked “yes”. NIOSH staff used the narrative information on each death certificate to code each fatality according to the International Classification of Diseases 9th Revision (ICD-9)(WHO, 1977) standards. Descriptive statistics were then calculated to determine the frequency of each cause of death and the percentage of the overall number of fatalities accounted for within each cause of death. The narratives were also used to determine additional information about these deaths (e.g., whether a tractor was involved in a machinery-related death). Finally, Fisher’s Exact tests were utilized to determine the statistical significance of variations in age among these fatalities.

In addition to death certificate data, survey data obtained from the 1998 Childhood

Agricultural Injury Survey (CAIS 1998) were used to determine the approximate population of individuals under 20 years of age living or working on U.S. farms for calculating age-specific fatality rates (Myers and Hendricks, 2001). This survey, conducted for NIOSH by the National



Agricultural Statistics Service (NASS), United States Department of Agriculture (USDA), collected data through a regionally stratified random sample of approximately 26,000 farms. Each selected farm, contacted via telephone, was asked to provide demographic information, including the number of children under 20 years of age living or working on the farm. The resulting estimated population was used to estimate the fatality rate, indicated as an annual rate per 100,000 youths.

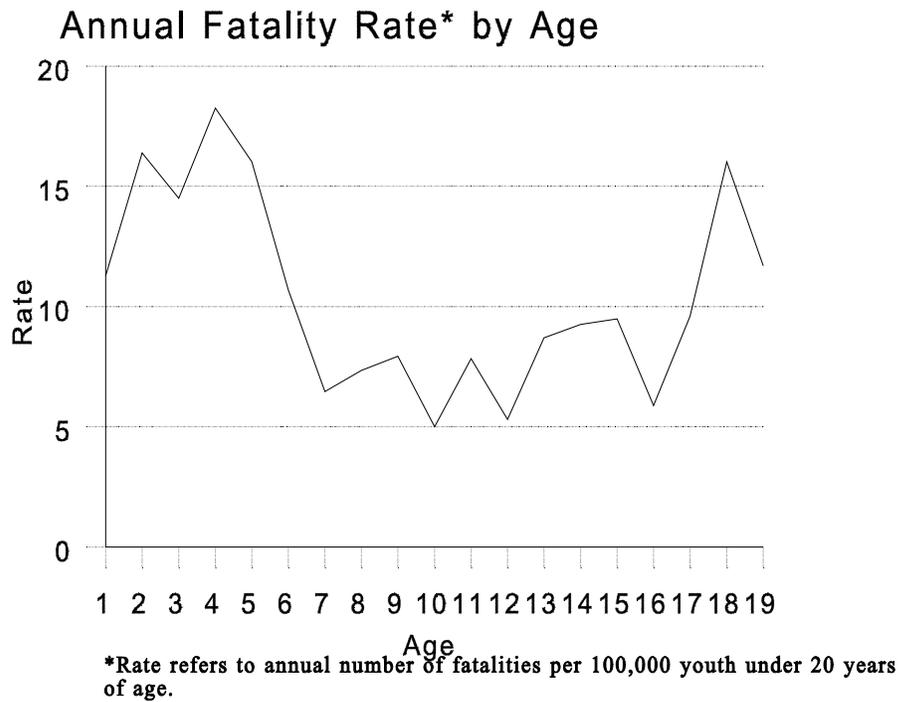
Results:

Demographics:

For the years 1995 to 1997, a total of 368 fatalities for youth under 20 years of age were

identified, however 6 of these records did not contain information useful to determining cause of death and were subsequently dropped from the analysis. Generally the demographic variation among these injuries follows trends common to previous findings. Males accounted for 300 (82%) of these fatalities. As age increases, the ratio of male to female fatalities increases. In the 0-4 age group only 54% of the victims were male, while in the 16-19 age group, 92% of the victims were male. Ninety-three percent of the fatalities studied were to white children. The majority of the events (81%) were deemed to be non-occupational. Three hundred and twenty-three of the fatalities occurred on the farm property, of which only 20 were within the farm house area. Over 40% of all fatalities occurred in the months June through August. Figure 1 shows the temporal trend is similar for both children under 16 years of age and youth 16 to 19 years of age.

In terms of age of the victim, there is a somewhat bimodal distribution of fatality rates (See Figure 2). The highest annual fatality rates by age are generally for children 2 to 5 years of age (ranging from 14.5 annual fatalities per 100,000 in 3 year olds, to 18.3 fatalities per 100,000 in 4 year olds). Otherwise the fatality rates range from 5.0 (10 year old group) to 18.3 (4 year old group) with the lowest rates occurring for youth 7 to 16 years of age. A total of 250 fatalities occurred in children under 16 years of age (9.5 fatalities per 100,000) and 112 (10.5 per 100,000) victims were 16 to 19 years of age. In general, the U.S. farm appears to be just as dangerous to younger children as to older youth.



The vast majority of fatalities on farms (297, 80.7%) were deemed not to be due to the victim's work. Forty-seven fatalities were identified as work-related on the death certificate (12.8%), while in 24 cases, the relation to work was unknown or missing. Of those 47 fatalities that were work related, 16 victims were younger than 16 years of age. However, this variable may not truly indicate whether or not the victim was working, or whether the death occurred as a result of work being performed by others. Additionally, there is no indication whether or not the victim may have been doing normal household chores, which may be considered work. This does, however, indicate that if one only studies fatalities which are recorded as work-related on the death certificate, the majority of on-farm fatalities occurring to younger victims on farms will be missed.

Causes of Death:

As seen below (Table 1), the most prevalent causes of farm-related youth deaths

according to ICD-9 classifications were machine-related (94, 26% of fatalities), drowning (59, 16%), and motor vehicles (49, 14%). This is consistent with known risk factors associated with farming (Adekoya and Pratt, 2001; Myers and Adekoya, 2001; Castillo et al., 1999).

Table 1

Frequency of Cause of Death, by ICD-9 Category
For all victims less than 20 years of age on U.S. Farms, 1995-1997.

Category	Deaths	Percent	Rate*
Machine	94	26.0	2.53
Drowning	59	16.3	1.59
Motor Vehicle	49	13.5	1.32
Suffocation	24	6.6	0.65
Suicide	22	6.1	0.59
Explosion	20	5.5	0.54
Animal	18	4.7	0.49
Struck by Falling Object	16	4.4	0.43
Homicide	14	3.9	0.38
Electrocution	9	2.5	0.24
Fall	8	2.2	0.22
Air Transport	7	1.9	0.19
Nature/Environment	7	1.9	0.19
Poisoning	6	1.7	0.16
Fire	6	1.7	0.16
Flying Object/Caught In	3	0.8	0.08
TOTAL	362	100	9.76

**Rate refers to annual number of fatalities per 100,000 youth under 20 years of age.*

Examination of the differences in cause of death for youth 16 years of age and older compared to children under 16 shows significant variation for specific causes of death (Table 2).

This is important because individuals less than 16 years of age are generally not accounted for in occupational farm fatality studies. To determine the significance of variation between age groups, among these causes of death, Fisher's Exact test for significance is appropriate. Fisher's Exact test allows for examination of 2 x 2 contingency tables with small numbers within cells from large samples. Significant table probabilities indicate that the distribution is unlikely to occur by chance.

Utilizing Fisher's Exact test for significant variation ($\alpha=0.05$), youth 16 years old and greater appear more likely to die as a result of explosions, falls, homicides, being struck by falling objects, and suicides than children under 16 years old. (Note: All suicides were for youth 14 years of age and older.) Younger youth appear more likely to die as the result of injuries caused by animals, machines, or suffocation. For all other causes of death, including drowning and motor vehicle deaths, there is no significant variation between age groups.

Table 2**Fisher's Exact Results for Frequencies**

For all victims less than 20 years of age on U.S. Farms, 1995-1997.

	Under 16	16 to 19	Table Prob
Machine	76	18	0.0017
Drowning	42	17	0.1169
Motor Vehicle	37	12	0.0823
Suffocation	****	****	0.0068
Suicide	8	14	0.0008
Explosion	10	10	0.0330
Animal	****	****	0.0096
Struck by Falling Object	7	9	0.0197
Homicide	5	9	0.0069
Electrocution	5	4	0.1799
Fall	3	5	0.0496
Air Transport	4	3	0.2353
Nature/Environment	3	4	0.1027
Poisoning	3	3	0.1931
Fire	****	****	0.2948
Flying Object/Caught In	****	****	0.3315
Total	250	112	

*****Not reportable*

For clarification of certain ICD-9 codes, it is important to note the predominant source of injury within specific categories. Explosions generally refer to gunshot wounds, of which many involve hunting activities. It should also be noted that the homicide deaths in this study include situations in which the victim had no relation to the farm prior to death. Machine-related events include incidents involving farm tractors, trailers pulled by tractors on the farm, and equipment. Many of these machine deaths involve injuries sustained from being crushed by farm tractors or other mobile equipment.

To more accurately compare the causes of fatalities between age groups, we calculated annual fatality rates per 100,000 youth within each age group. The two highest annual fatality rates (per 100,000) for both age groups (under 16 and 16-19) are for machine-related deaths and drowning. The third highest fatality rate for youth 16 years of age and older is from suicide

(1.31 annual fatalities per 100,000), while the third highest for children and youth under 16 is from suffocation (0.83 annual fatalities per 100,000). Table 3 provides rates by age for all causes of death. Again, it appears that certain factors pose very similar risks to youth on the farm, regardless of age, but this risk may take a different form (e.g., risk from a motor vehicle incident may vary from an older child driving a car to a younger child being improperly restrained within the car).

Discussion:

Data from this study indicate that, in general, youth of all ages face similar overall risk of fatalities on farms. These data allow for a more robust determination of “on farm” fatalities to youth and children. The inclusion of all children less than 16, and the inclusion of non-work related incidents, allows for examination of all risk factors to youth on the farm. The child playing near the running tractor may be at similar risk as the youth driving the tractor while mowing the field. By not accounting for the deaths of children under 16 years of

Table 3

Estimated Fatality Rates for Cause of Death by Age Group

For all victims less than 20 years of age on U.S. farms, 1995-1997

Cause of Fatality	Under 16	Rate	16 to 19	Rate*
Machine	76	2.87	18	1.69
Drowning	42	1.59	17	1.60
Motor Vehicle	37	1.40	12	1.13
Suffocation	****	N/A	****	N/A
Suicide	8	0.30	14	1.31
Explosion	10	0.38	10	0.94
Animal	****	N/A	****	N/A
Struck by Falling Object	7	0.26	9	0.84
Homicide	5	0.19	9	0.84
Electrocution	5	0.19	4	0.38
Fall	3	0.11	5	0.47
Air Transport	4	0.15	3	0.28
Nature/Environment	****	N/A	****	N/A
Poisoning	3	0.11	3	0.28
Fire	****	N/A	****	N/A
Flying Object/Caught In	****	N/A	****	N/A
Total	250	9.5	112	10.5

**** Not reportable

N/A Not Applicable

*Rate refers to annual number of fatalities per 100,000 youth under 20 years of age.

age, or deaths of youths not classified as work-related, we are missing a large number of fatalities essentially caused by similar causes of death as those included in most previous occupational studies. However, this research supports the findings of authors such as Salmi et al. (1989), Pickett et al. (1995), and the Centers for Disease Control and Prevention (CDC b, 1999) that indicate a varied nature of death dependent on age and the need for different prevention strategies based upon age.

Although this study utilized death certificate data for any fatality occurring on, or related to, the farm, there are issues related to the quality of the data which need to be discussed. For example, as noted by Conroy and Sciortino (1997, p. 274), “occupational location is more difficult to identify when workplace is an agricultural environment that has multiple uses”. In other words, we cannot be sure that the determination of “injury at work?” on the death certificate is accurate. Although it is clear that many of the fatalities in this study are recreational (i.e., hunting incidents), there are a number of cases that appear to be work-related but are not coded as such.

Physical size, attention to tasks, experience, and visibility have all been cited as potential factors in the increased risk to youth on farms (CDC a, 1999). Given the nature of the causes of death which are significantly different between the age groups, it appears that children under 16 are likely to die as a result of their size, strength, and ability to assess danger. For example, these children are likely to be run over by tractors or killed by animals. In both instances, their proximity to the hazard and their size and strength are likely to be contributing factors. Among youth 16 and over, causes of death may be related to underestimation of danger, such as the case with the fatalities caused by gunshot wounds (explosions).

Conclusion:

The implication of these findings is that education of farm families as a whole is important. Youth must be made aware of the dangers they face, particularly when participating in recreational activities specific to rural or farm environments. Parents must be made aware of the dangers their younger children face simply by being in proximity to various dangers. As noted by Pickett et al. (1995), younger children are injured or killed when they are: left unsupervised during busy times, left in proximity to unguarded or moving machinery, accompany workers near moving farm machinery, or are asked to perform a task inappropriate to their age.

For the protection of younger children, restrictive play areas should be established and maintained (CDC b, 1999). Each member of the farm family should be aware that, especially during working hours, young children should not be allowed to play outside these areas. In addition, limiting access to hazards through actions such as placing a fence around a body of water could limit hazard exposure for the youngest members of the farm family. Other possible solutions may include increased availability or utilization of child care during the busy seasons (CDC b, 1999). For the older youth, increased supervision and education may lead to a greater understanding of the hazards associated with farming and decrease risky behaviors.

Although it is difficult to effectively study the risk to younger children on the farm, this study shows that in many situations younger children face risk similar to that of older children. In certain areas younger children face a greater risk. Given the nature of farming, particularly the family farm, many of these fatalities result from hazard exposure unique to the farm

environment. Therefore, it is incumbent upon researchers addressing issues of agricultural work-related injuries and fatalities to include all potential victims in their analysis. Only through careful and complete analysis will we be capable of addressing risk in a comprehensive and effective manner.

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