

The Iowa Farm Family Health and Hazard Surveillance Project

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Abstract

The Iowa Farm Family Health and Hazard Surveillance Project was a cross-sectional study that assessed the health and safety status of Iowa farm families and others who lived and worked on those farms. Data were collected using a comprehensive mail-out questionnaire that was sent to 989 representative Iowa farm operators, their families, and hired help. Three hundred and ninety (39%) farm operators returned the questionnaire. Here, we present an overview of the methods of this survey and some illustrative results. We expected that this rural sample would be similar to urban dwellers surveyed during a national health interview in terms of accessing medical care. Instead, this study's farm participants had much less difficulty getting medical care than U.S. farmers questioned in 1987 (3.4% compared with 7.3%, respectively). We found that the average age of all tractors being used by this cohort of Iowa farmers was almost 24 years. Not even 40% of these tractors had Roll Over Protective Structures (ROPS).

Keywords. Farmers, Agricultural workers, Tractor injuries.

Of all occupations, farming is one of the most dangerous for workers. The National Safety Council reported that in 1995 there were 24 deaths per 100,000 agricultural workers and 140,000 disabling farm work-related injuries (National Safety Council, 1996). In Iowa that same year there were 44 fatalities (about 42 per 100,000 agricultural workers) and 2,141 agricultural injuries (SPRAINS, 1996).

Farming is associated with a variety of health effects including respiratory problems, traumatic injuries, dermatological problems, and hearing loss to name the most common. Because home and work often are the same, exposure to these hazards may occur throughout the day.

A variety of farm exposures may cause respiratory problems—exposure to animal and grain dust, irritant gases (such as hydrogen sulfide from manure pits), as well as certain pesticides. Organic Dust Toxic Syndrome—a febrile reaction to moldy dust exposure—is one of the most common causes of respiratory sickness among farm workers. This flu-like illness usually begins six to ten hours after the exposure has

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occurred and can continue for a number of weeks (Merchant, Reynolds, and Zwerling, 1995). Occupational asthma can also be seen in association with grain dust, irritant gases, and organophosphate pesticides (Chan-Yeung and Malo, 1993). Hypersensitivity pneumonitis—also called allergic alveolitis—has been documented in response to exposure to moldy hay or silage (Gruchow et al., 1981; Merchant et al., 1991). Fatal chemical pneumonitis and pulmonary edema have been reported from exposures to ammonia and hydrogen sulfide in animal confinement buildings and to oxides of nitrogen in silos (Merchant, 1986).

Farmers face risk of skin disease from the wide variety of sensitizing plant substances and potentially irritating chemicals they encounter at work. In a survey of occupational injuries and illnesses conducted by the U.S. Bureau of Labor Statistics, dermatoses were responsible for two-thirds of the occupational maladies reported among agricultural workers (Mathias and Morrison, 1988).

Farmers confront an elevated risk for traumatic injury (Stubbs, Harris and Spear, 1985; Stallones, 1990). Machinery designed to cut and chop and haul heavy loads presents special dangers to farmers. In addition, animals can be difficult to work with because of their size and/or temperament. Being stepped on, rammed, or crushed by animals is a common occurrence (Pratt et al., 1992; Waller, 1992; Zhou and Roseman, 1994). Weather also contributes to farm injuries. Farmwork has to be done regardless of the weather, which can make it difficult to maneuver equipment and get around on foot.

Here we describe the Iowa Farm Family Health and Hazard Survey (FFHHS)—one of six cooperative agreements sponsored by the National Institute for Occupational Safety and Health (NIOSH) to monitor the health status of agricultural workers and their families and to assess the health hazards in their environment. In addition, we describe our sample of Iowa farmers and present some illustrative results from the survey.

Methods

The Iowa FFHHS was a cross-sectional study that was designed to: (1) survey the distribution of farming practices, medical symptoms, and traumatic injuries among representative Iowa farm families; (2) collect health data including vital signs, height and weight, serum cholesterol, audiometry, and pulmonary function testing on a subsample of these farming families; and (3) observe the distribution of hazards and monitor environmental exposures to a selected group of stressors (noise, total particulates, and toxic gases) during walk-through observations on the same subsample of Iowa farms.

Target Population

We followed the Bureau of Agricultural Census definition of a farm as “a business where \$1,000 or more in agricultural or livestock produce is sold each year” (1987 Census of Agriculture). The FFHHS project targeted Iowa principal farm operators and all adults and children over the age of six, who lived and/or worked full-time on the farm.

In 1994, the Iowa Agriculture Statistics Service records showed that there were 101,000 farms in Iowa with 33.2 million acres of land in farms. The average farm size was 329 acres (1995 Iowa Agricultural Statistics Service). Data from the 1992 U.S. Census of Agriculture showed that principal operators were generally white males (99.9% white, 96.1% male) and slightly older than those employed in other occupations with an average age of 50 years (1992 U.S. Census of Agriculture).

Of Iowa's 101,000 farms in 1994, an estimated 77% were involved in the production of grain cash crops. Forty-five percent of Iowa's farms raised cattle and calves, 29% produced hogs and pigs, 29% of farms raised beef cows, 16% of farms raised grain-fed cattle, 6% of farms produced sheep and lambs, and 5% raised milk cows (1995 Iowa Agricultural Statistics Service).

Sample Design

The Iowa FFHHS used a stratified, two-stage cluster sample. First, we stratified by Iowa's nine soil conservation districts (nearly equal divisions attained when the state is divided into three tiers both vertically and horizontally). From each soil conservation district, we randomly selected two counties. We selected farmers using a sampling frame of 95,000 (about 95%) of Iowa farmers maintained by the Iowa Agricultural Statistics Service (IASS). The IASS does not have any information on the other 6,000 Iowa farmers. In 1991, IASS randomly selected 100 farmers from each of the 18 counties and sent them recruitment letters asking them to participate in the study. Due to a delay in obtaining Office of Management and Budget approval, we did not attempt to contact these farmers until 1994. Because of the lag time, the IASS randomly selected 1,500 additional farms in the 18 counties. They called the first 1,203 of these farmers by telephone requesting permission for us to send the farmers our questionnaire. (See table 1, Sample Selection.) Of the 3,017 farmers contacted in 1991 and 1994, 1,139 agreed to participate. One hundred and fifty of those contacted in 1991 dropped out before receiving a questionnaire. Thus, we mailed the Part I questionnaire to 989 Iowa farmers. (See table 2, Summary of Questionnaire Mail-out.) Of those, 390 returned the questionnaire. We had a response rate of 13% (390/3,017) of those ever contacted and a response rate of 39% (390/989) of those who received the Part I questionnaire.

Survey Instrument

Our survey instrument covered 12 domains: demographics, medical care access and health insurance, skin conditions, hearing loss, injuries, respiratory conditions, hazard evaluation, stress and mental health status, neurotoxic effects, muscle and joint pain, reproductive history, and equipment and facilities. Standardized questions from the National Health Interview Survey (NHIS), the National Health and Nutrition Examination Survey (NHANES), the National Medical Care Utilization Survey, and the Centers for Disease Control Behavioral Risk Factor Questionnaire

Table 1. Recruitment summary

	No. Selected	No. Contacted	No. Agreeing
1st selection 1991	1814	1814	715*
2nd selection 1994	1500	1203	424
Total	3314	3017	1139*

* 150 dropped out prior to mail-out of questionnaire.

Table 2. Summary of questionnaire mail-out and response

	Received Part I Questionnaire	Returned Part I Questionnaire
1st selection 1991	565	179
2nd selection 1994	424	211
Total	989	390

were supplemented with questions developed specifically for this study. Nearly all of the questions were close-ended and no telephone follow-up was attempted. The entire questionnaire was peer-reviewed by colleagues at the University of Iowa, by NIOSH researchers, and by outside technical experts. In addition, it was piloted among 40 Iowa farmers to assess its clarity and accessibility. On average, the questionnaire took one hour to complete.

Questionnaire Administration

In February and March of 1994, the questionnaire was mailed to 989 farm operators. Mail and telephone reminders were provided for the non-responders to encourage return of the questionnaire. Of the 989 farm operators who received questionnaires, a total of 390 (39%) returned questionnaires for themselves and for all those over the age of six living and/or working on those farms.

Medical Evaluation

Within each of the 18 counties, we randomly chose a fixed proportion of the farms returning questionnaires so that we had a sample of 125 farms and 52 potential replacement farms. The 125 farm families were offered a free medical screening at a conveniently located hospital or clinic. Of the 125, eighty-three (66%) participated. An additional 45 replacement farm families were offered medical evaluations. Of these replacement farm families, 31 participated. Thus, 114 farm families received medical evaluations. These families included 121 adult males, 87 adult females, and 61 children under 18 years of age. Each family member over six years old was offered a hearing examination, spirometry, a blood test for total cholesterol, and measurement of vital signs. Principal operators were offered a methacholine challenge test as well. Results from these examinations were reported to each participant.

Hazard Evaluation

The 128 farm families who were offered participation in the medical screening were also offered an on-farm hazard assessment. Of these 128, 92 (72%) agreed to participate. An additional 39 farm operators, who had filled out the questionnaire but had not had the medical evaluation, were selected as alternates to replace farm operators who had dropped out or refused to participate in the on-farm visit. Twenty-nine of the alternate farms agreed to an on-farm visit. In all, 121 farms were assessed by the same industrial hygienist.

The hazard assessments had three components. First, the industrial hygienist followed the principal operator for several hours, keeping a computer-based log of the farmer's activities. Because of weather and scheduling difficulties, these logs were compiled on only 45 (37%) of the 121 farms. On the remaining 76 farms, an observational hazard assessment was conducted for the equipment and facilities. Second, the industrial hygienist made an overall assessment of the safety of all 121 farms. A rating system was developed for this observational phase, which gave each farm an overall rating. The overall farm score was derived by averaging the four scores assigned to each farm based on the following characteristics: (1) status of equipment; (2) status of facilities; (3) operator attitude; and (4) operator practices. Third, the industrial hygienist carried out environmental measurements of noise, total particulates and four toxic gases (ammonia, hydrogen sulfide, carbon monoxide, and methane). These were collected on the same 45 farms for which the computer-based log was generated.

Results

Description of Population

The average age of the FFHHS principal operator was 54. Consistent with Iowa's small number of minorities, all of the principal operators in this sample were white, and there were 385 (98.7%) male and five (1.3%) female principal operators. Three hundred and fifty-three (90%) of the principal operators were married, two (0.5%) were living as married, six (1.5%) were widowed, eight (2.1%) were divorced or separated, and 20 (5.1%) were never married. One principal operator did not respond to the marital status question.

Three hundred sixty-three FFHHS farm operators worked a total of 172,788 acres with an average number of 476 acres (median acres = 360) per farm. Livestock (beef cattle and calves, hogs and pigs, poultry, dairy) were produced on 69% of farms in this sample and 93% of the operations raised crops. Thirty-two and a half percent of the farm operators were in the highest income category (gross annual income greater than \$100,000), 31% were in the mid-income category (gross annual income between \$40,000 and \$100,000), and 36.5% at the lowest income level (gross annual income less than \$40,000).

Comparison of FFHHS Farms with Iowa Agricultural Census Data

The FFHHS principal operators were similar to Iowa farmers with regard to age, gender, and race (table 3). The average age of a farmer in the state of Iowa during 1994 was 50 years old, there were 96.1% male operators, and Iowa farmers were 99.9% white. The study farmers also were similar to the state of Iowa farmers in the amount and type of crops and livestock they raised. On average, the FFHHS farmers operated more acres compared with the state of Iowa average (476 acres FFHHS vs 329 for the state in 1994). During 1994, 88% of the FFHHS farm operators raised cash grains (corn, soybeans, oats, and wheat) compared with 77% of the state of Iowa farmers. (See table 3 for a comparison of demographic characteristics and crops and livestock produced).

Comparison of Respondents with Non-respondents

The IASS had information on farm characteristics of the non-responders. The average size of the responding farms was 353 acres compared to 348 acres for the non-responders. Table 4 shows that the respondents devoted slightly more acres to corn, soybeans, and hay than the non-respondents, but these results were only statistically significant for soybeans. The average number of hogs and beef cattle per farm was similar for respondents and non-respondents. No further information about non-respondents was available.

Access to Medical Care

Only 3.4% of FFHHS respondents reported having difficulty getting medical care compared with 10.1% of urban dwellers and 7.8% of non-urban town dwellers from the 1987 National Health Interview Survey. However, when asked to list their top three health concerns, participants of the FFHHS ranked access to health care as their top concern followed by cancer and injury.

Tractor-related Injuries

Tractor-related injuries and fatalities are a common hazard in the farm workplace. In 1995, 55% of all farm fatalities were caused by tractor overturns with an annual rate of 5.5 deaths per 100,000 tractors (National Safety Council, 1996). In the state

Table 3. Comparison of target population with FFHHS cohort

Demographics*	Principal Operators	
	FFHHS Cohort	State of Iowa
Average age	54	50
Gender (% male)	98.7	96.1
Race (% white)	100.0	99.9

* From 1990 U.S. Ag. Census.

Livestock Produced*	FFHHS Cohort (%)	State of Iowa	
		1992 (%)	1994 (%)
Grain-fed cattle	26	16	15
Beef cows	32.5	28	29
Hogs and pigs	37.6	34	29
Sheep and lambs	9.5	7	6
Dairy cows	6.7	6	5

* From 1992 and 1994 Iowa Agricultural Statistics Service.

Crop Type*	FFHHS Sample (%)	State of Iowa	
		1992 (%)	1994 (%)
Corn	39.0	39.0	39.0
Soybeans	27.0	24.0	30.0
Oats	1.5	2.6	1.8
Wheat	0.09	0.21	0.17
TOTAL	67.6†	65.8†	71†

* From 1992 and 1994 Iowa Agricultural Statistics Service.

† Remainder of acres was planted in other crops or was included in the Conservation Reserve Program.

Table 4. Comparison of respondents (RS) and non-respondents (NRS)*

Type	RS		NRS		Percent Difference	P
	Mean	S.D.†	Mean	S.D.		
Corn acres	161	183	152	189	+ 6%	0.21
Soybean acres	114	148	99	149	+ 14%	0.01
Hay acres	21	43	19	53	+ 10%	0.15
Total acres	353	349	348	518	+ 1%	0.75
Grain storage on farm (in bushels)	20618	32579	18486	29862	+ 11%	0.08
Hogs (number per farm)	154	367	141	368	+ 9%	0.37
Beef cattle (number per farm)	53	131	55	191	- 4%	0.73
Milk cattle (number per farm)	2	12	3	14	- 50%	0.11

* This is aggregate data from the Iowa Agricultural Statistics Service.

† Standard deviation.

of Iowa in 1995, there were 13 fatalities and 181 injuries cause by tractors (SPRAINS, 1996). Improvements to the design of agricultural equipment, in particular the manufacture of tractors with Rollover Protective Structures (ROPS) beginning in 1985, has made work with tractors safer. According to the Centers for Disease Control and Prevention, the fatality rate associated with farm tractors decreased by half from 1970 to 1989 (CDC, 1993).

More than 10% of the FFHHS principal farm operators reported an injury during the 12 months prior to the survey. Twenty-nine percent of the injuries to FFHHS principal operators occurred during work with equipment. Of these equipment-related injuries, 21% involved tractors.

The Iowa FFHHS questionnaire obtained the year of manufacture for tractors used by study participants. The average age of tractors being used in the FFHHS study was 23.6 years. Only 10% of the tractors being used in this study were seven years old or newer. Fewer than 40% of tractors being used had ROPS, and nearly 70% of the tractors without ROPS were being used more than 100 h per year. Table 5 shows that the oldest tractors continue to be used heavily by farmers and these tractors are some of the most dangerous to operate due to lack of ROPS. Farm Family studies in Kentucky, New York, and Ohio showed similar results (Zwerling et al., 1997).

Discussion

Strengths and Limitations

The Iowa FFHHS was designed as a comprehensive cross-sectional survey. Because of the number of topics covered, we were able to collect information on a large number of potential risk factors for injury and illness on the farm. The breadth of data gathered allowed us to consider risk factors that have not been examined before.

Because we collected clinical data on a subset of participants, we were able to look at this group's medical screening results, in particular the audiometry and lung function results, and at the same time examine the exposures or risk factors that may have affected those results. The clinical results will be reported elsewhere.

This was a population-based survey of farmers in the state of Iowa. Although our response rate was low, we found our farmers similar to all Iowa farmers (table 3) in demographics and farm characteristics. In addition, in comparing respondents with non-respondents (table 4), we found no statistically significant differences in the number of hogs or cattle per farm or in the total number of acres in row crops. The respondents did have 14% more acres planted in soybeans than the non-respondents did. These results suggest that this sample is representative of Iowa's farmers.

Conclusions

We carried out a complex survey of the health of Iowa farmers as well as an assessment of the hazards present on their farms. The detailed results of this survey

Table 5. Age of tractors being used in 1994, number of hours per year of use, and percentage with ROPS*

Tractor Age Deciles	Mean Age (years)	Mean No. of Hours Used per Year	Percentage Using ROPS
0-10%	7.2	418.4	90.6
11-20%	12.8	363.9	66.8
21-30%	15.6	319.2	76.8
31-40%	18.9	321.1	69.8
41-50%	22.0	274.2	64.4
51-60%	25.4	269.5	21.8
61-70%	28.8	310.2	6.5
71-80%	34.9	226.5	2.6
81-90%	40.6	137.9	4.8
91-100%	54.5	74.5	0
All Tractors	23.6	272.6	39.5

* Total of 344 farms reporting 1,128 tractors and hours for 1,060 tractors.

will be reported elsewhere. Here, we presented an overview of the methods as well as some illustrative results.

Work with farm machinery is associated with a high proportion of injuries among agricultural workers. In this cross-sectional survey of Iowa farms, we found that many of the tractors being used are older and most of these tractors lack updated safety features, such as rollover protective structures. The safety of older farm tractors remains a major problem in rural communities.

Surprisingly, few Iowa farmers reported difficulty accessing medical care. However, they reported considerable concern about their health care access.

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