

Self-reported Noise Exposures Among Ohio Cash Grain Farmers

J. R. Wilkins III, H. L. Engelhardt, J. M. Crawford, G. L. Mitchell, L. C. Eicher, T. L. Bean, L. A. Jones

Abstract

As part of the NIOSH-funded Ohio Farm Family Health and Hazard Survey (OFFHHS), self-reported noise exposure data were collected from more than 1,700 Principal Operators (POs) of cash grain farms. Information on exposure to occupational and non-occupational noise sources was obtained by means of a statewide mixed-mode survey. With respect to occupational sources, nearly all survey respondents reported a history of cabless tractor operation, approximately 80% had operated a chain saw, and approximately 70% had operated a combine. About 1/3 respondents reported current employment in a noisy job in addition to farming, while nearly 20% reported a history of non-agricultural noisy employment. The most frequently reported non-occupational sources of noise exposure were hunting (51.5% of respondents), motorcycle riding (21.2%), and target shooting (20.5%). Self-reported equipment-specific data on total years of operation or use, days of operation or use per year, and mean hours of operation or use per day were used to estimate lifetime hours of exposure to noisy activities/tasks. Of the more than 61 million cumulative lifetime hours of exposure reported by the 1,700+ respondents, more than half was accounted for by operation of cabless tractors. In addition, 2/3 respondents reported they *never* wear hearing protection when they operate or are around noisy farm equipment. Attempts to identify factors associated with use of hearing protection revealed that although the prevalence of usage varied by age and education, use was poor across all subgroups examined, suggesting that agricultural workers of all ages and levels of education would benefit from interventions designed to reduce the incidence of noise-induced hearing loss.

Keywords. Noise exposure, Hearing loss, Farmworkers.

Occupational exposure to noise was recognized as a public health hazard as early as the 18th century (McCunney, 1992), although regulations designed to control noise exposure were not established until 1956 by the U.S. military (U.S. Air Force, 1956). Noise limits for civilian occupational exposure were not defined until 1969 under an amendment to the Walsh-Healey Public Contracts Act of 1936 (NIOSH, 1996). In 1970, the Occupational Safety and Health

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Administration (OSHA) was established to serve as the federal agency responsible for enacting and enforcing occupational safety and health regulations, whereas the National Institute for Occupational Safety and Health (NIOSH) was created in the same year to conduct research and develop recommendations upon which occupational safety and health regulations would be based. This led to the first published criteria for a recommended noise standard by NIOSH (1972), which specified an 8-h time-weighted average (TWA) of 85 dBA with a 5 dB exchange rate. In 1996, revised criteria reaffirmed the 85 dBA 8-h TWA, but the exchange rate was reduced from 5 dB to 3 dB (NIOSH, 1996). OSHA adopted a higher standard of 90 dBA 8-h TWA with a 5 dB exchange rate, but currently requires hearing conservation programs for occupational exposures at or above 85 dBA (OSHA, 1981; NIOSH, 1996).

It is becoming widely known that farmers and other agricultural workers are likely to experience occupational exposure to noise levels in excess of the standards noted above. For example, in the Broste et al. study (1989) of noise generated by 31 tractors (without cabs or with open windows), only one operated at a sound level less than 85 dBA at full throttle at ear level in the driver's seat; six produced levels greater than 95 dBA. Bean (1995) reports that most tractors tested today have noise levels exceeding 90 dBA, while other farm machinery, such as self-propelled combines, corn pickers, hammermills, and driers, may produce levels in excess of 100 dBA. Similarly, Dennis and May (1995) found the average noise level produced by 41 tractors tested at common throttle to be 92 dBA, further emphasizing the potential noise hazard among agricultural workers. In addition to exposure from tractors, grain driers, harvesting equipment, chain saws, etc., rural residents also frequently participate in noisy recreational (non-occupational) activities that involve, for example, firearms, power tools, snowmobiles, and motorcycles.

There is growing awareness that agricultural exposure to excessive noise levels has adverse consequences. For example, Thelin et al. (1983) found male farmers age 25 to 64 to have significantly higher screening failure rates than office workers at 2000 and 4000 Hz, suggesting a higher prevalence of noise-induced hearing loss (NIHL) among agricultural populations. Similarly, a study by Plakke and Dare (1992) revealed that farmers exposed only to agricultural noise have poorer hearing sensitivity than non-noise exposed workers. Descriptive analyses of self-reported noise exposures, like those reported here, will therefore contribute to the existing knowledge on hearing loss among farm workers by quantifying the duration of involvement with various noisy occupational and non-occupational activities/tasks.

As a part of Phase 1 of the Ohio Farm Family Health and Hazard Survey (OFFHHS), self-reported data on noisy activities/tasks were collected from more than 1,700 Principal Operators (POs) of cash grain farms by means of a statewide survey (Wilkins et al., 1997). As discussed in this article, POs were questioned about the frequency and duration of exposure to occupational and non-occupational sources of noise. In addition, attempts were made to identify factors associated with the use of protective hearing devices to suggest directions for future interventions designed to reduce the incidence of NIHL among agricultural workers.

Materials and Methods

A mixed-mode survey (i.e., a self-administered, mailed questionnaire with telephone follow-up of non-respondents) of 4,860 cash grain farms/farmers in Ohio selected by stratified random sampling was conducted during the period

June–November 1993. As previously reported (Wilkins et al., 1997), a complete description of the survey design and methods to obtain data on a broad range of occupational hazards among workers on cash grain farms (41.6% of all Ohio farms are cash grain farms) and numerous agricultural hazards. 1,782 male POs (mean age 54.0 years) provided usable responses to the survey. Response rates ranged from 43.6% to 71.4%, depending on the survey item.

Questionnaire items pertaining to occupational involvement with noisy occupations (e.g., grain driers, chain saws) and non-occupational activities (e.g., motorcycle, snowmobiling, playing sports) were also obtained. In addition, demographic data of years, days per year, and hours per year of exposure to noisy devices were also obtained. In addition, information on past history of employment in noisy occupations and job where shouting is sometimes required were selected as part of a collaborative effort with the National Health and Nutrition Examination Survey (NHIS).

To account for the stratified sampling design (Shah et al., 1995) was used in the analysis of descriptive statistics (means and standard deviations). Lifetime hours of exposure to occupational noise were calculated for each subject by multiplying the number of hours per day over the total number of days indicated. Cumulative lifetime hours of exposure were calculated across all subjects.

Table 1 summarizes the findings of the survey. In nearly all respondents report exposure to noise (design-adjusted % responding a

Table 1. Self-reported noise exposures

Questionnaire Item
Ever operate
Cabless tractor?
Chain saw?
Combine?
Tractor with cab?
Grain drier?
Currently have noisy job in addition to farming?
Had noisy job other than farming?
Ever had job involving firing weapons?

* Number responding in any way to item.
 † Unadjusted number (and %) responding.
 ‡ Design-adjusted percentage responding.

ve as the federal agency responsible and health regulations, whereas the Health (NIOSH) was created in the recommendations upon which could be based. This led to the first standard by NIOSH (1972), which of 85 dBA with a 5 dB exchange dBA 8-h TWA, but the exchange (1996). OSHA adopted a higher change rate, but currently requires al exposures at or above 85 dBA

and other agricultural workers are se levels in excess of the standards study (1989) of noise generated by only one operated at a sound level e driver's seat; six produced levels ost tractors tested today have noise achinery, such as self-propelled , may produce levels in excess of d the average noise level produced 92 dBA, further emphasizing the ers. In addition to exposure from in saws, etc., rural residents also (occupational) activities that involve, and motorcycles.

posure to excessive noise levels has (1983) found male farmers age 25 rates than office workers at 2000 noise-induced hearing loss (NIHL) study by Plakke and Dare (1992) rural noise have poorer hearing riptive analyses of self-reported efore contribute to the existing by quantifying the duration of on-occupational activities/tasks. Family Health and Hazard Survey /tasks were collected from more n farms by means of a statewide article, POs were questioned about onational and non-occupational o identify factors associated with ections for future interventions gricultural workers.

Methods

ed, mailed questionnaire with ash grain farms/farmers in Ohio onducted during the period

June-November 1993. As previously reported (see Wilkins et al., 1997, for a complete description of the survey's methods), the purpose of this effort was to obtain data on a broad range of agricultural health- and hazard-related factors among workers on cash grain farms in Ohio, which predominate in the state (41.6% of all Ohio farms are cash grain) and involve the potential for exposure to numerous agricultural hazards. Results presented in this article are based on 1,782 male POs (mean age 54.0 ± 13.0; mean farm size 304.9 ± 186.9 acres) who provided usable responses to the questionnaire. Overall, the survey response rate ranged from 43.6% to 71.4%, depending on the definition (Wilkins et al., 1997).

Questionnaire items pertaining to noise exposure assessment included history of involvement with noisy occupational (tractors with and without cabs, combines, grain driers, chain saws) and non-occupational (hunting, target shooting, riding a motorcycle, snowmobiling, playing in a rock band) activities/tasks. Data on number of years, days per year, and hours per day of exposure and use of protective hearing devices were also obtained. In addition, respondents were asked to report present and past history of employment in a noisy job in addition to farming, defined as a job where shouting is sometimes required to be understood. Survey questions were selected as part of a collaborative effort between NIOSH and the FFHHS states and, when possible, were taken from national surveys such as the National Health and Nutrition Examination Survey (NHANES) and the National Health Interview Survey (NHIS).

To account for the stratified random sampling methodology, SUDAAN (Shah et al., 1995) was used in the statistical analysis of the survey data. All descriptive statistics (means and percentages) presented are thus design-adjusted. Lifetime hours of exposure to occupational and non-occupational sources of noise were calculated for each subject by summing the annual number of exposure hours per day over the total number of years of exposure for each source, task, or activity indicated. Cumulative lifetime hours were derived by summing lifetime exposure hours across all subjects.

Results

Table 1 summarizes the findings for the questions about those occupational activities on farms known to be associated with noise exposure. As can be seen, nearly all respondents reported a history of cabless tractor operation (design-adjusted % responding affirmatively = 97.8). More than 80% of respondents

Table 1. Self-reported noise exposures among Ohio cash grain farmers: Occupational sources

Questionnaire Item	N*	Crude n (%)†	%‡
Ever operate			
Cabless tractor?	1,773	1,734 (97.8)	97.8
Chain saw?	1,743	1,462 (83.9)	82.8
Combine?	1,743	1,325 (76.0)	69.5
Tractor with cab?	1,743	1,178 (67.9)	56.4
Grain drier?	1,703	702 (41.2)	32.0
Currently have noisy job in addition to farming?	1,713	466 (27.2)	32.2
Had noisy job other than farming?	1,771	265 (15.0)	18.2
Ever had job involving firing weapons?	1,778	544 (30.6)	31.5

* Number responding in any way to item.

† Unadjusted number (and %) responding affirmatively to item.

‡ Design-adjusted percentage responding affirmatively to item.

(MCLH), respectively. Total tractor operation (with and without cabs) explains nearly 70% of all cumulative lifetime hours, demonstrating the relative importance of this source. With respect to sheer numbers of cumulative lifetime hours, the two most important non-occupational activities are hunting (approximately 1.4 MCLH) and target shooting (approximately 0.5 MCLH). Hunting accounted for more than half of all non-occupational hours and target shooting for approximately 20%, but each represents only 2.2% and 0.9% of all cumulative lifetime hours, respectively.

Data on the frequency of employment in noisy jobs in addition to farming are presented in table 5, by industry and census code. A total of 242 (13.6%) POs indicated current employment in jobs where shouting is sometimes required to be understood. Industries most commonly reported include durable manufacturing (n = 74) and construction (n = 52), or 34.3% and 19.0% of the 242 holding a noisy job in addition to farming, respectively. Nondurable manufacturing; "other" industries; and transportation, communication, and other public utilities were also frequently reported, as follows: 29 (13.5%), 28 (10.3%), and 21 (9.1%) respondents indicated employment in these industries, respectively. Fewer than 9.1% of respondents with noisy jobs in addition to farming reported they were currently working in agriculture, forestry, and fisheries; mining; durable and nondurable wholesale; or were on active military duty. For about 5% of the 242, classification by industry was not possible.

Summary data are given in table 6 on the use of hearing protection in association with exposure to noise sources. Overall, 65.6% of respondents exposed to all the agricultural noise sources investigated never wear hearing protection, about 1/4 wear hearing protection occasionally (< 50% of the time), and only 9.8% report usual use (≥ 50% of the time). Data on use of hearing protection in association with specific agricultural activities (for example, during cabless tractor operation) were not obtained as part of the survey.

Similar results were obtained for use of hearing protection in association with non-occupational sources (table 6), although never use of hearing protection averaged somewhat lower (52.7%) and usual use averaged somewhat higher (12.4%) as compared to occupational sources/settings. Never use ranged from 40.2% for

Table 5. Self-reported noise exposures among Ohio cash grain farmers: Current noisy job in addition to farming*

Industry	Census Codes	Crude		Design-adjusted %
		n	%	
Agriculture, forestry, and fisheries	010-032	10	4.1	2.3
Mining	040-050	4	1.7	1.4
Construction	060	52	21.5	19.0
Manufacturing (nondurable)	100-222	29	12.0	13.5
Manufacturing (durable)	230-392	74	30.6	34.3
Transportation, communications, and other public utilities	400-472	21	8.7	9.1
Wholesale (durable)	500-532	2	0.8	0.8
Wholesale (nondurable)	540-571	5	2.1	2.9
Retail trade	580-691	3	1.2	0.8
Other	700-932	28	11.5	10.3
Active military duty	940-960	1	0.4	0.2
Not classifiable by industry		13	5.4	5.5
TOTALS		242	100.0	100.0

* Noisy job defined as one where shouting is sometimes required to be understood.

Table 6. Use of hearing protection of exposure to noise sources

Type of Exposure	Source/Activity
Occupational	(see footnote)
Non-occupational	Hunting Motorcycle riding Target shooting Snowmobiling

* Results for occupational exposures based on use of hearing protection when you use or are around noisy farm equipment.
 † Defined as use < 50% of the time.
 ‡ Defined as use ≥ 50% of the time.

motorcycle riding to 62.9% for hunting and target shooting to 19.8% for snowmobiling.

A graphic representation of the pattern of hearing protection use (< 40, 40-49, 50-59, 60-69, and 70+) by education level (> high school) is given as figure 1. Further, the propensity to use hearing protection never excels at any level of education. The pattern of hearing protection use is relatively consistent across all levels of education, but considerably lower for respondents 70+ years of age and high school education, respectively, than a high school education were on an age-specific basis.

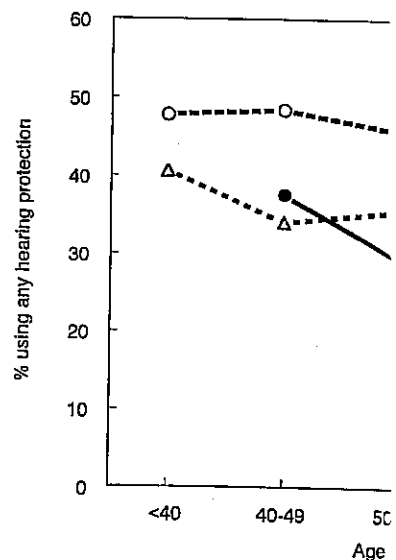


Figure 1—Use of any hearing protection by age and education level

(with and without cabs) explains illustrating the relative importance of cumulative lifetime hours, the two hunting (approximately 1.4 MCLH) Hunting accounted for more than shooting for approximately 20%, but cumulative lifetime hours, respectively. Other jobs in addition to farming are included. A total of 242 (13.6%) POs hunting is sometimes required to be included include durable manufacturing (19.0% of the 242 holding a noisy durable manufacturing; "other" and other public utilities were also included (3.3%), and 21 (9.1%) respondents respectively. Fewer than 9.1% of respondents reported they were currently hunting; durable and nondurable manufacturing (5% of the 242, classification by hearing protection in association with respondents exposed to all the hearing protection, about 1/4 wear hearing protection, and only 9.8% report usual use in association with specific activities (tractor operation) were not included; protection in association with other sources of use of hearing protection ranged somewhat higher (12.4%) for other use ranged from 40.2% for

Ohio cash grain farmers:
farming*

Farming Codes	Crude		Design-adjusted %
	n	%	
10-032	10	4.1	2.3
40-050	4	1.7	1.4
60	52	21.5	19.0
00-222	29	12.0	13.5
30-392	74	30.6	34.3
00-472	21	8.7	9.1
00-532	2	0.8	0.8
40-571	5	2.1	2.9
00-691	3	1.2	0.8
00-932	28	11.5	10.3
0-960	1	0.4	0.2
	13	5.4	5.5
2	100.0	100.0	

to be understood.

Table 6. Use of hearing protection among Ohio cash grain farmers, by type of exposure and source/activity

Type of Exposure	Source/Activity*	Frequency of Use of Any Hearing Protection (%)		
		Never	Occasionally†	Usually‡
Occupational	(see footnote)	65.6%	24.6%	9.8%
Non-occupational	Hunting	62.9%	25.3%	11.8%
	Motorcycle riding	40.2%	42.5%	17.3%
	Target shooting	50.5%	37.9%	11.6%
	Snowmobiling	47.0%	32.2%	19.8%

* Results for occupational exposures based on responses to question: Do you wear hearing protection when you use or are around noisy farm equipment?

† Defined as use < 50% of the time.

‡ Defined as use ≥ 50% of the time.

motorcycle riding to 62.9% for hunting, whereas usual use ranged from 11.6% for target shooting to 19.8% for snowmobiling.

A graphic representation of the use of any protective hearing equipment by age (< 40, 40-49, 50-59, 60-69, and 70+) and education (< high school, high school, and > high school) is given as figure 1. As can be seen, the percentage of respondents using hearing protection never exceeded 47.8% for any of the subgroups examined. Further, the propensity to use hearing protection decreased with increasing age for all levels of education. The pattern of use for those with no more than a high school education is relatively consistent among the younger farmers, but diverges considerably for respondents 70+ years of age (n = 9 and n = 30 for < high school and high school education, respectively). By contrast, responding POs with greater than a high school education were more likely to report use of hearing protection on an age-specific basis.

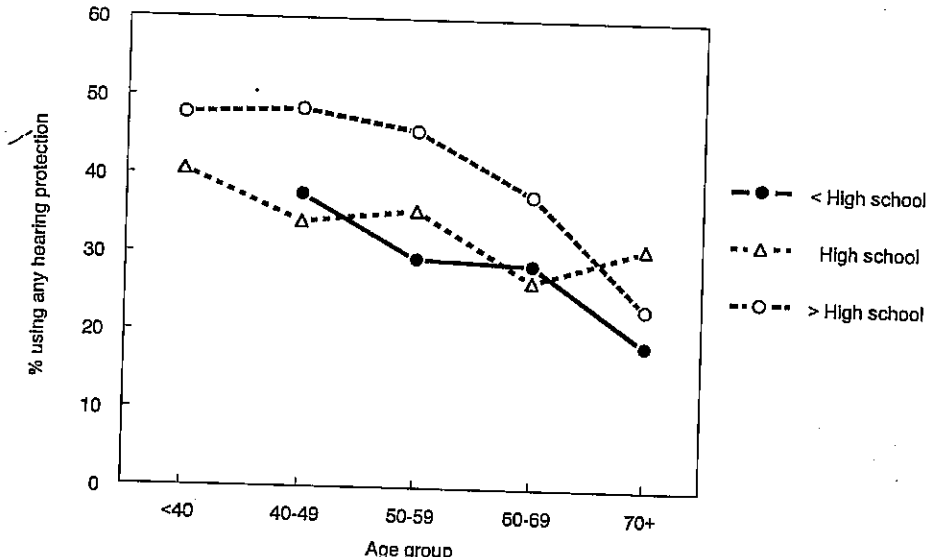


Figure 1—Use of any hearing protection, by age and education.

Discussion

Results of the mixed-mode survey reported here indicate quite clearly that these farmers engage in a wide variety of activities/tasks, both occupational and non-occupational, that are likely to result in exposure to excessive/hazardous levels of noise. In this study of cash grain farmers in Ohio, nearly 62 million cumulative lifetime hours of noisy activities/tasks were reported by the 1,782 responding POs, a testament to the substantial noise hazard faced by workers in the agricultural industry. Although actual noise measurements were not performed in conjunction with the specific activities/tasks investigated, the survey results contribute to the literature by providing evidence of the magnitude and scope of potential noise exposures among farmers as a whole.

Tractor operation was found to dominate all occupational sources, with nearly every respondent reporting ever use of cabled tractors. Previous studies have documented average noise levels to range from 85 dBA to more than 98 dBA during operation of tractors at common to maximal throttle, which well exceeds the NIOSH recommended exposure limit of 85 dBA 8-h TWA (Broste et al., 1989; Bean, 1995; Dennis and May, 1995). In addition, the majority of responding POs reported using tractors with cabs, providing additional evidence of the threat of noise-induced hearing loss (NIHL) from occupational exposure to tractor noise.

Use of combines and chain saws was commonplace among this population, both of which have been documented in previous studies to produce noise levels in excess of 100 dB (Bean, 1995; Dennis and May, 1995). In addition to farm-related occupational exposure, nearly 1/3 respondents previously held a job involving the firing of weapons or were currently employed in a noisy job in addition to farming, further contributing to the potential for NIHL among agricultural workers.

Broste et al. (1989) noted that workers in agriculture frequently participate in noisy activities outside the occupational setting, a finding which is supported in the present investigation. The relative impact of these sources on the risk of noise-induced hearing loss in our study, however, appears small: only 4% of the total cumulative lifetime hours of self-reported noise exposure were attributable to non-occupational sources or activities. It is acknowledged that the noisy non-occupational sources/activities data obtained in our survey cannot be considered comprehensive. Nevertheless, such exposures should not be discounted in light of the evidence indicating that noise-induced hearing loss is cumulative in nature (Consensus Development Panel, 1990). Any excessive noise exposure, however small, may therefore contribute to hearing impairments among agricultural populations.

The results of this investigation also suggest an increased risk of NIHL among agricultural workers due to failure to use protective hearing devices in both the occupational and non-occupational setting. Only 10% of survey respondents reported usual use of hearing protection when around noisy farm equipment, which is less than the 20% consistent use rate reported by Karlovich et al. (1988); use of protection was likewise uncommon during non-occupational noise exposure. In general, reasons commonly cited for not using hearing protection include discomfort (or a fear of discomfort) and interference with speech communication, although these problems can be minimized if care is taken in selecting the proper style and size. Future hearing conservation programs targeting agricultural workers should therefore incorporate this fact so that the propensity to use hearing protection is increased.

Use of protective hearing devices and education, suggesting that greater awareness in recent years may be responsible for the increase among younger and more educated respondents. Age and education category reported in this study that intervention strategies should address. Level of education, especially younger individuals, and the cumulative nature of NIHL.

In summary, results of this study indicate that non-occupational noise sources are commonly exposed, but also the duration of exposure to this survey was disappointing. The difference found between responders and non-responders indicates that the survey results are fairly representative. The collection of actual noise level measurements in the future data may have served to strengthen the need for further research.

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Use of protective hearing devices was found to decline with age and increase with education, suggesting that greater awareness of the harmful effects of noise exposure in recent years may be responsible for the increased likelihood to wear protection among younger and more educated respondents. Only a minority of workers in each age and education category reported use of hearing protection, however, suggesting that intervention strategies should address agricultural workers of all ages and levels of education, especially younger individuals due to the insidious, progressive, and cumulative nature of NIHL.

In summary, results of this study indicate not only the types of occupational and non-occupational noise sources to which cash grain farmers in Ohio are most commonly exposed, but also the duration of these exposures. Although the response rate to this survey was disappointingly low, generally negligible differences were found between responders and non-responders (see Wilkins et al., 1997), implying that the survey results are fairly representative of cash grain farmers across the state. The collection of actual noise level measurements in conjunction with the self-report data may have served to strengthen these findings, and so provides a focus for further research.

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Farm Injury Surveys in Fresno and Monterey Counties

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Because of the known high incidence of occupational injuries among farm workers, and the unique composition of the county surveillance system with respect to occupational injuries, the goals of the study were to identify related work injuries using multiple methods. From a review of identified cases and associated occupational injuries through September 1996, a network of identified cases in Monterey and Fresno Counties was established. During the five-year operation of the surveillance system, 1,000 occupational injuries were identified. Of these injury cases, 319 (32%) were identified. There were approximately twice as many occupational injuries as is consistent with the different population of the counties. Occupational injuries and 319 (6%) hospitalizations were identified. Motor-vehicle accidents involving farm workers (14%), Overexertion (14%) and falls (11%) were the most common. Despite the preliminary nature of the data, the study provided important information about occupational injuries in counties which can be used in injury prevention programs.

Keywords. Agricultural injury, Farm workers, Occupational injury, Fresno County, Monterey County.

The U.S. Public Health Service has identified the occupational health and safety of farm workers as a priority in its Prevention Objectives. In particular, farm workers are a group needing special attention (table 1) because of increases in the fatal injury rate and occupational injury rate compared to the general workforce. The elevated rate among farmworkers.

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