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POPULATIONS AT RISK ACROSS THE LIFESPAN: CASE REPORTS

A Pilot Study to Prevent Hearing Loss in Farmers

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ABSTRACT ***Objective:*** Determine the feasibility and outcome of a pilot program to increase farm workers' use of hearing protection when performing activities with high noise exposure. ***Design:*** The study was a quasi-experimental study. ***Sample:*** Eight intervention farmers and 17 comparison farmers participated in the study. ***Measures:*** Before and after the intervention, farmers completed a survey to identify their frequency of use of hearing protection, and their beliefs about hearing loss and use of hearing protection. ***Intervention:*** The intervention consisted of noise assessments, educational sessions, mailed reminders with brochures, and placement of hearing protection on the farm. ***Results:*** The intervention was effective in increasing the use of hearing protection 1 and 2 months after the implementation of the program. ***Conclusions:*** Hearing loss is a serious problem with farmers, and yet many farmers neglect to protect their hearing with the use of protection. The pilot study findings indicate that efforts to increase the use of hearing protection by farmers can be effective.

Key words: farmer, hearing loss prevention, hearing protection.

Background and Significance

Agriculture is a hazardous industry, with large numbers of occupational injuries and illnesses. The National Safety Council (2006) reported that after mining and quarrying, agriculture has the second highest rate of occupational mortality in the United States. In addition to high mortality rates, chronic diseases are prevalent due to exposures to multiple hazards, including agricultural dust, sun, pesticides, powered equipment, and noise (National Institute for Occupational Safety and Health [NIOSH], n.d.a).

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Farmers have frequent exposures to loud noise from machinery and animals, which can lead to hearing loss (Depczynski, Franklin, Challinor, Williams, & Fragar, 2005). Additional variables that increase farmers' risk for hearing loss include exposures to toxic chemicals and recreational noise, aging, disease, use of ototoxic drugs, and trauma. Persons who work on farms have a higher prevalence of hearing loss than the general population (Beckett et al., 2000; Hwang et al., 2001; Williams, Purdy, Murray, LePage, & Challino, 2004). Hearing loss caused by noise exposure is progressive, painless, and permanent, and the insidious nature of the problem leads to minimization of susceptibility and severity by those exposed. In addition to the farm worker, noise injury is a significant problem for the farming community. The impaired communication that results from hearing loss is related to increased accidents, injuries, and tinnitus, and negatively impacts farmers' social and personal lives (Hass-Slavin, McCall, & Pickett, 2005). NIOSH (n.d.b) has identified noise-induced hearing loss as one of the 10 leading work-related diseases and injuries and is a research priority.

Although noise-induced hearing loss can be prevented by using hearing-protection devices, many farmers and their family members do not wear

enough protection to prevent hearing loss. Schenker, Orenstein, and Samuels (2002) found that only 33% of farm workers in California used hearing protection around noise, whereas over 93% used personal protection around chemicals. There have been few intervention studies to test interventions aimed at increasing the use of protection. Whereas certainly the best strategy to reduce hearing exposure is by engineering controls, many farm families lack the resources to adequately reduce noise exposure to acceptable levels using such controls. Use of hearing protection is the next best strategy to prevent hearing loss in this high-risk population.

The purpose of this pilot study was to test the effectiveness of an intervention to increase farm workers' use of hearing protection when exposed to noise on the farm. The research questions were:

1. What are farmers' beliefs about their exposure to noise during farming and recreational activities?
2. What is the frequency of use of hearing protection by farmers when exposed to noise?
3. Are farm workers' feelings of susceptibility, severity, and barriers, related to the use of hearing protection?
4. What is the effectiveness of an intervention to increase farmers' use of hearing protection when performing activities with noise exposure?

The intervention was based on concepts common to the field of behavioral theory and those found in previous studies to be predictors for workers' use of personal protection. These concepts include knowledge, susceptibility, severity, barriers, and interpersonal support (Jones, 2004; McCullagh, Lusk, & Ronis, 2002; Schenker et al., 2002). Use of hearing protection around noise was found to be greater with males, younger workers, and those who perceived the associated risk of nonuse (Schenker et al., 2002). McCullagh et al. (2002) found that interpersonal support, barriers, and situational influences significantly predicted the use of hearing protection with 139 farmers. The framework of this study postulated that like many busy people today, farm workers are more likely to wear hearing protection if it is readily available, if its use is perceived to have significance to their lives, when they are reminded to use the protection, and when they are motivated to do so because of loved ones. Table 1 describes the strategies used to apply the theoretical framework to the intervention.

TABLE 1. *Application of Theory to Intervention*

Concept	Intervention strategy
Knowledge	The family was provided verbal and written information about noise exposures in their lives (work and recreation). This was done by conducting the noise assessments on the individual farms and the educational sessions at Farm Bureau meetings and the farmers' homes
Susceptibility and severity	Noise levels on the farms were measured and the information was used to educate the families about noisy activities and noisy areas on their farms. In addition, we emphasized the effects of noise at the Farm Bureau meeting and had participants share personal experiences regarding the consequences of noise in their lives. A video that demonstrated what it is like to have hearing loss was played at the Farm Bureau meeting
Barriers	Containers filled with hearing protection (plugs) were placed throughout the farm where noise testing indicated high noise areas and activities. This made the protection more convenient, and eliminated barriers related to cost and storage. The educational session emphasized to farmers that wearing hearing protection would not interfere with their work
Interpersonal support	Farmers and their families were present for the education together. Education emphasized that noise-induced hearing loss affects social relationships as well as work activities. Participants were asked to encourage family members to use hearing protection. A reminder letter was sent to the farmers

Methods

Design, sample, and procedure

The study utilized a quasi-experimental design with an intervention group and a comparison group. After obtaining approval by the university Institutional Review Board, two members of the research team who had agricultural backgrounds with farmers attended Farm Bureau meetings in two counties in south central Kentucky. Eight farmers in one county served as the intervention group and 17 farmers in the other served as the comparison group. Together, they represented 7 intervention farms and 15 comparison farms. During the initial meeting, investigators explained the project and obtained signed consents from the farmers. Farmers in both the intervention group

and the comparison group completed the baseline survey. Following the completion of the baseline survey with the intervention participants, the investigators conducted a brief educational seminar to provide information about hearing and hearing loss in farming. A video narrated by Dr. Deborah Reed, a faculty member with agricultural health expertise at the University of Kentucky, was used so that participants could experience what hearing loss is like for farmers (Reed, n.d.). No intervention was given to the comparison farmers, but they were told they would be receiving two additional surveys in the mail. All surveys were coded for confidentiality and stored in a locked file cabinet in the researcher's office. Only the investigators had access to participants' names and information.

After the group educational sessions, an investigator and industrial hygienist traveled to the six intervention farms and conducted noise assessments wherever the farmer was working that day. Employee noise exposures were determined using Quest Q-400™ data-logging noise dosimeters. Precalibrations and postcalibrations of the Q-400™ noise dosimeters were performed using the Quest QC10 calibrator. The data were retrieved using Quest Suite Professional software. Sampling occurred for approximately 8 hr, with the dosimeters activated as workers began their work shifts and retrieved just before the end of the workday. Noise exposure results for the personal samples were derived from the data-logging units.

Approximately 3 weeks later, the team returned to the six farms to review the noise results with farmers, and provided the following information: summary of the noise assessments and identification of farm activities and places with high noise exposures, review of the consequences of different types of noise exposure, and instruction on the proper use of hearing protection. The participants were then asked to demonstrate their ability to properly use the earplugs. Farmers then accompanied the investigators as they placed the hearing protection at those places identified by the noise assessments to be associated with high-risk activities (e.g., tractors, trucks, shops). Plastic containers filled with many hearing protection earplugs were hung in places that were easily accessible and visible.

Approximately 1 month later, the investigators mailed a colorful brochure to the intervention farmers as a reminder to utilize hearing protection and to contact the investigators if additional earplugs were needed. The containers were replenished with earplugs as requested. One month later, the investigators mailed the second survey to both intervention and comparison participants. This second survey only contained items related to the following study variables: susceptibility and severity, barriers, and use of hearing protection. Approximately 1 month later, the investigators mailed a third survey to both intervention and comparison participants. A small incentive was given to the intervention and comparison farmers after completing the third survey.

Measures

Survey items were adapted from an instrument previously developed and used to collect data from farm workers about their use of personal respiratory protection (Jones, 2004). Multiple-choice items were used for gathering data regarding gender and marital status (single, married, separated, divorced, or widowed). Fill-in-the-blank questions were used to obtain information about age and number of days per week that the participants farmed. Participants were asked to respond with a "yes" or "no" when asked whether they "work around high levels of noise on the farm," "are around high levels of noise while doing recreational activities," and "are around high levels of noise while working at other jobs off the farm." They were also asked to respond with a "yes" or "no" to the questions "have you ever had a hearing problem that you think was related to farming" and "do you know anyone who has had hearing loss due to farming activities."

Four Likert scales were used to measure to what extent the participants agreed with 14 statements about barriers for using hearing protection, susceptibility to hearing loss, severity of hearing loss, and knowledge about hearing loss. The respondents' choices to these 14 Likert-type statements included 1 = *not at all*, 2 = *slight extent*, 3 = *moderate extent*, 4 = *great extent*, 5 = *very great extent*, and *not applicable*. Six statements measured barriers for wearing hearing protection, two measured susceptibility of hearing loss, four measured severity of hearing loss, and two measured knowledge. Principal component analysis and varimax rotation used earlier by Jones (2004) established construct validity for the four scales. In addition, Cronbach's αs for the scales exceeded .77.

Three survey questions were used to measure the farmer's frequency of hearing protection use. The first asked "on the average during the past month, how often did you wear hearing protection while working around noise on the farm." The second and third questions were similar but asked about their frequency of hearing protection use "while working around noise doing recreational activities" and "while working around noise doing jobs at other workplaces." Choices for frequency of use included 1 = *never*, 2 = *seldom*, 3 = *sometimes*, 4 = *often*, 5 = *very often*, 6 = *most always*, 7 = *always*, and *not applicable*. The participants were asked to identify in an open-ended question the reasons why they did or did not use hearing protection.

Statistical analysis

Descriptive statistics were used to determine the demographics of the groups, the number of days per week spent doing farm work, responses to the Likert-type items, their beliefs about noise exposures, their personal experiences with hearing loss, and their frequency of use of hearing protection when exposed to noise. Correlations were computed between the Likert scales and the frequency of use of hearing protection when exposed to noise. Dependent *t*-tests were performed to determine whether frequency of use of hearing protection while farming increased from the pretest to posttest measures for the intervention and comparison groups.

Results

Eighty percent ($n = 20$) of the 25 respondents were male and 20% ($n = 5$) were female. Eighty-six percent were married and 14% were single. The mean age of the respondents was 49 yr (range 23–68), and the mean number of days per week farmed was 5.3 (range 1–7). The intervention group was significantly younger ($p < .01$) than the comparison group, with a mean age of 32 versus 54 yr. The composition of the two groups was not significantly different with regard to gender, marital status, number of days farmed, existence of hearing problems, and exposure to noise while farming, recreating, and working other jobs.

Ninety-six percent ($n = 24$) of the participants responded that they were exposed to high noise levels on the farm, 77% ($n = 19$) were exposed to high noise during recreational activities, and 16% ($n = 4$) were exposed to high noise while working at another job. Thirty-six percent ($n = 9$) responded that they currently have or have had a hearing problem related to farming, while 64% ($n = 16$) of the respondents knew someone with a hearing problem related to farming.

At the baseline measurement, 60% ($n = 15$) of the participants responded that they never used hearing protection, 28% ($n = 7$) seldom used hearing protection, 4% ($n = 1$) sometimes used hearing protection, 4% ($n = 1$) often used hearing protection, and 4% ($n = 1$) always used hearing protection while farming. Table 2 describes the responses to the Likert items related to susceptibility, severity, barriers, and

TABLE 2. *Susceptibility, Severity, Barriers, and Knowledge Responses at Baseline (n = 25)*

To what extent[a] do you agree with the following statements . . .	*N*	Minimum	Maximum	Mean	*SD*
It is likely I will develop hearing loss in the future (susceptibility)	25	2	5	3.20	0.957
I am more likely than others to get hearing loss (susceptibility)	25	1	5	3.36	0.952
If I had hearing loss I'd face financial hardship (severity)	25	1	5	2.68	0.988
If I had hearing loss it would affect my ability to work (severity)	25	2	5	3.44	1.044
If I had hearing loss it would interfere with my daily activities (severity)	25	2	5	3.68	0.852
If I had hearing loss it would cause serious stress on my family (severity)	25	0	5	3.32	1.314
Wearing hearing protection causes me discomfort (barrier)	25	0	5	2.60	1.190
Hearing protection cost me too much to buy (barrier)	25	0	5	1.36	1.036
Hearing protection is conveniently located at my worksite (barrier)	25	0	4	1.88	1.364
Wearing hearing protection interferes with my ability to do my job (barrier)	25	0	5	2.24	1.128
Wearing hearing protection takes too much time (barrier)	25	0	5	2.16	1.068
There is no good place to store my hearing protection at work (barrier)	25	0	5	2.20	1.354
I don't know how to correctly use hearing protection (knowledge)	25	0	5	1.84	1.313
I don't know why I should use hearing protection (knowledge)	25	0	4	1.92	1.038

Note. [a]0 = *not applicable*; 1 = *not at all*; 2 = *slight extent*; 3 = *moderate extent*; 4 = *great extent*; 5 = *very great extent*.

knowledge. Participants were asked to respond to the open-ended question "why do you use or why do you not use hearing protection." Answers for why participants used hearing protection included "it is an inconvenience," "it is not available," "too much time to use," "never thought it was necessary," "can't hear someone talking," "not exposed for long periods of time," and "didn't think I needed to use it." The reasons for use included "when running a tractor," "I know someone with hearing loss," "when working with machinery," "at tractor pulls," and "when there is too much noise."

Although the purpose of this study was not to document the presence of noise on the farms, the noise assessments of the six intervention farms did find that five farmers exceeded the Occupational Safety and Health Administration (OSHA) action limit of 85 dBA (equivalent to a dose of 50% for an 8-hr workday for occupational noise exposure, without hearing protection). All the intervention farmers included in this study had impact or impulsive noise exposure levels at or above 140 dBA, the OSHA peak sound level that should not be exceeded. Equipment, including tractors, air grinders, and fans, had high-impact or impulsive noise levels.

There were no significant correlations between the frequency of use of hearing protection and the susceptibility, severity, barriers, and knowledge Likert scales. Only one Likert scale item "if I had hearing loss it would cause serious stress on my family" was significantly ($r = .41$; $p < .05$) correlated with the frequency of hearing protection use. Two other items on the baseline survey that were found to be significantly related to the use of hearing protection while farming included the frequency of use of hearing protection during recreational activities ($r = .5$; $p < .01$), and the frequency of use while working at another job ($r = .6$; $p < .01$). Age was not significantly related to use of hearing protection while farming.

The pretest mean for the survey item "frequency of use of hearing protection while farming" was 1.76 ($SD = 1.43$; range 1–7) for both groups ($n = 25$). The choices for frequency of use included 1 = *never*, 2 = *seldom*, 3 = *sometimes*, 4 = *often*, 5 = *very often*, 6 = *most always*, and 7 = *always*. The mean for the frequency of hearing protection use for the intervention farmers was significantly ($p = .04$) higher at the first follow-up measurement at 2 months (3.5) than the comparison group (1.46). At the 3-month measurement, the mean for the frequency of use again increased for the intervention farmers (3.33) and came close to statistical significance ($p = .06$). Comparison farmers again showed no significant change in the mean frequency of use at the 3-month measurement (1.83). See Table 3 for details.

TABLE 3. *Pre- and Postintervention Means for the First, Second, and Third Measurements*

	Frequency of hearing protection use during farming activities			
Comparison	*N*	Mean	*SD*	Range
Preintervention				
Intervention	8	1.75	1.16	1–6
Comparison	17	1.77	1.40	1–6
Postintervention 2 months				
Intervention				
Baseline	5	1.60	1.32	1–6
Follow-up	5	3.50*	1.19	2–5
Comparison				
Baseline	13	1.54	0.66	1–4
Follow-up	13	1.46	0.66	1–4
Postintervention 3 months				
Intervention				
Baseline	6	1.67	1.21	1–6
Follow-up	6	3.33	1.51	2–6
Comparison				
Baseline	12	1.58	0.67	1–4
Follow-up	12	1.83	1.19	1–4

Note. *$p < .05$.

Discussion

The results of this study are consistent with other published research that reports that farmers are at risk for hearing loss due to the prevalence of noise (Beckett et al., 2000; Hwang et al., 2001; Williams et al., 2004). The OSHA noise standard requires that whenever workers are exposed to noise levels that may equal or exceed 85 decibels or a dose of 50%, employers shall develop and implement hearing protection programs. Details of the elements of the hearing protection program are contained in the Noise Standard, 29 CFR 1910.95 (OSHA, n.d.). This study also supports other reports on the infrequent use of protective hearing equipment by farmers (McCullagh et al., 2002; Schenker et al., 2002). Yet, as indicated by the results, farmers are aware that they are exposed to noise both while farming and recreating. In fact, the majority of the farmers in this study either had hearing loss or knew someone with hearing loss. In addition, the majority of farmers knew why and how to wear hearing protection. Several farmers expressed an interest in having their hearing tested, knowing they are exposed to noise. Thus, the study confirms that interventions aimed at increasing knowledge about farm noise are likely to be ineffective in changing behavior or hearing loss.

Hence, the question remains as to how to increase farmers' use of hearing protection. Many of the farmers believed that they are susceptible to hearing loss and acknowledged in this study that hearing loss would affect their ability to work and carry out activities of daily living and would cause serious stress on their family. The study results indicate that the stressful effects that hearing loss would exert on the family are related to the use of hearing protection. A research study by Jones (2004) also found that severity was a significant predictor for personal protection use. Therefore, hearing loss prevention strategies should emphasize the use of hearing protection to decrease the financial and emotional impact of a hearing loss resulting from noise.

Another variable possibly related to hearing protection use is with regard to the habit of using the protection. This conjecture is supported by the fact that farmers who wore hearing protection while working were more likely to do so while recreating and working other jobs. The frequency of use of hearing protection was not related to the age of the farmer. Four farmers responded to the open-ended question as to why they do not use hearing protection as it is not a habit. Others responded similarly that they just do not make the effort, they are lazy, and that hearing protection is not available. It was interesting to note from the open-ended questions that several respondents stated that they wore hearing protection for loud events that they are exposed to infrequently, such as tractor pulls, trap shootings, running a tractor at high revolutions per minute, and mowing the lawn. These results raise the question as to whether the day-to-day job activities become normalized and lose their relationship with feelings of susceptibility.

The intervention was effective at increasing the use of hearing protection by the farmers while doing farm work. The investigators believe that the success of the project was due to the fact that the intervention was theory-based and that the implementation included strategies that supported partnerships with the farmers and the community. Although the susceptibility and barrier Likert items were not found to be significantly related to the use of hearing protection, there were anecdotal data to support their theoretical use. For example, farmers verbally expressed a great deal of interest in the noise assessments on their farms and were surprised to find high noise readings in certain areas. The noise protectors were being used as indicated by requests for additional protection; one participant admitted that "the use of hearing protection would decline when they used all the devices and the project stopped." In summary, these findings support an earlier statement that the study results suggest that it is important that hearing protection be accessible to increase the habit of using it and that it is important to increase feelings of susceptibility regarding farm noise commonly encountered by farmers.

Another reason for the success of this project is related to the positive relationships that formed during the planning, implementation, and dissemination phases of this project. The importance of using agricultural persons from the research team to access and work with the farming population was a key strategy. This included the hearing loss videotape narrated by Dr. Reed, a farmer and agricultural researcher. The participants could identify with persons who talked the way they talked and shared similar living and working experiences. Furthermore, the participants were especially eager for information and assistance when it was presented in their natural settings: the farm. The participants expressed feeling appreciated and valued by the research team; this was due to our desire to come to them and because we provided incentives for their input. Positive partnerships were also developed between the research team and the Farm Bureau organizations in both the intervention and the control counties and the Cooperative Extension Services in the intervention county. An investigator was invited and shared the study's findings at a County Extension Service/Farm Bureau Field Day, where over 125 local farmers attended. The Noise Project was entered by the women's chair in Farm Bureau for the Kentucky Farm Bureau Safety/Health Award in both counties.

There are several limitations to this pilot study. Owing to the small and convenience sampling of farmers, the findings cannot be generalized to other farm populations. At the baseline measurement, there were three farms that each had two farmers participate in the study; at the second and third measurements, two farms again each had two participants. Because data analysis was conducted at the individual level and did not examine similarities or differences by farm, the findings must be interpreted in light of this limitation.

In addition, the change in hearing protection use could be related simply to the attention given to the intervention farmers by the researchers. The use of a survey could result in a possible subjective reporting bias. The fact that only one survey item was used to measure the frequency of use of hearing protection could also be a limitation. Because of the short time frame for the measurements, no conclusions can be made about the long-term effects of the intervention.

Hearing loss is a serious problem with farmers and yet many farmers neglect to protect their hearing with the use of protection. The piloted intervention appears to be effective in increasing the use of hearing protection 2 and 3 months after the implementation of the program. This pilot study suggests that strategies to increase the use of hearing protection by farmers can be successful. A larger and more rigorous study is needed to confirm the findings from this study.

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