Gender Differences in Use of Hearing Protection Devices among Farm Operators

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Abstract

Purpose: Although farm operators have frequent exposure to hazardous noise and high rates of noise-induced hearing loss, they have low use of hearing protection devices (HPDs). Women represent about one-third of farm operators, and their numbers are climbing. However, among published studies examining use of HPDs in this worker group, none have examined gender-related differences. The purpose of this study was to examine gender-related differences in use of hearing protection and related predictors among farm operators. Materials and Methods: Data previously collected at farm shows and by telephone were analyzed using t-tests and generalized linear model with zero inflated negative binomial (ZINB) distribution. Findings: The difference in rate of hearing protector use between men and women farm operators was not significant. There was no difference between men and women in most hearing protector-related attitudes and beliefs. Conclusion: Although men and women farm operators had similar rates of use of hearing protectors when working in high-noise environments, attitudes about HPD use differed. Specifically, interpersonal role modeling was a predictor of HPD use among women, but not for men. This difference suggests that while farm operators of both genders may benefit from interventions designed to reduce barriers to HPD use (e.g., difficulty communicating with co-workers and hearing warning sounds), farm women have unique needs in relation to cognitive-perceptual factors that predict HPD use. Women farm operators may lack role models for use of HPDs (e.g., in peers and advertising), contributing to their less frequent use of protection.

Keywords: Agriculture, health communication, health promotion, hearing loss prevention, hearing protection

INTRODUCTION

Farm operators perform many farm activities that expose them to work hazards such as noise,[1-4] and experience among the highest prevalence rates of hearing loss among all categories of workers.[5] Estimates of prevalence rates for noise-induced hearing loss (NIHL) among farmers vary greatly, and have been reported to be 17,[6] 22,[7] 38,[8] 65,[9] and 72%.[10] Although noise elimination is the most preferred method of prevention of noise-induced hearing loss, it is often not technically or economically feasible in the farm work environment.[11] Consistent use of hearing protection devices (HPDs) is effective in preventing noise-induced hearing loss,[12-14] but use of HPDs among farmers is low.[15-17]

Unlike workers in general industry, most family-owned farms are not protected by the occupational safety and health administration (OSHA) or its Hearing Conservation Standard (i.e., noise level monitoring and a hearing conservation program for at-risk employees which includes audiometric testing, training, and provision of HPDs).[18,19] Most farms in the US are also without labor advocacy for worker hearing health, and there are no work-based health programs. Most farm operators are not schooled in hearing conservation, may not recognize their high susceptibility to damage from noise, and are unprepared to determine when to wear, which types are suitable, where to purchase, and how much to pay for HPDs.[19] Because of this, many farm operators may underestimate their exposure to noise hazards and consequences of noise exposure, and may not be knowledgeable about noise-induced hearing loss prevention techniques. Overall, there are low demand characteristics for use of hearing protection among farm operators.

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youth. Even when the farmer is aware of noise exposure and the hearing health hazard, she is less likely to have tried the various types of hearing protection to select those most suitable.\(^{26}\) Unlike many positions in general industry, farm work is characterized by frequent changes in tasks and noise exposure levels,\(^{21}\) further complicating hearing protection selection and use. For these reasons, HPD use among farm operators is low.\(^{15,16}\)

Attitudes and beliefs about noise and HPDs have been found to predict HPD use. In one study, perceived barriers to use of hearing protection (e.g., difficulty communicating; OR = 0.44, \(P < 0.003\)) were negatively associated with use, while greater access/availability of hearing protectors (OR = 1.75, \(P < 0.010\)) was positively related to use.\(^{16}\) An earlier study\(^{15}\) identified perceived barriers to HPD use and interpersonal influences on HPD use as predictors of HPD use among farm operators. An intervention designed to address these predictors of HPD use was successful in increasing HPD use in this high-risk group.\(^{22}\)

Nationally, women represent 30% of farm operators (people who either do the work or make day-to-day decisions on the farm). There are 969,672 women farm operators in the US. Of the nation’s 2.1 million farms, 14% have a woman principal operator.\(^{23}\) A principal operator is the person in charge of the farm’s day-to-day operations.

HPDs are recognized as a means of noise control and reducing the risk of NIHL in regulatory policies and best practice guidelines.\(^{24-26}\) There are few studies examining the gender-related differences in HPD use, and fewer reporting gender-related cognitive-perceptual factors related to use. Women workers have been found to have lower use of HPDs\(^{27,28}\) although there was no difference in use between men and women blue collar workers\(^{29}\) or boy and girl adolescent farm workers.\(^{30}\) On the basis of these observations, we anticipate that women farm operators may have lower use of hearing protection than their opposite gender counterparts. Examination of HPD use and modifiable (i.e., attitudinal and cognitive) factors that serve as predictors of HPD use among women farm operators could yield important information for use in the development of interventions to increase HPD use among farmers of both genders and their families. The purpose of this study was to (1) compare use of HPDs among men and women farm operators; and (2) identify differences in cognitive-perceptual predictors of HPD use between men and women farm operators.

**Materials and Methods**

HPD use and its predictors among farm operators were examined in two previous studies using the same instruments. In Study 1, a convenience sample of farm operators attending a regional trade show in the Midwest responded to paper-and-pencil survey instruments.\(^{15}\) In Study 2, a random sample of farm operators in selected US states responded by telephone to the same set of instruments.\(^{16}\) Survey responses from the two studies were combined and analyzed in a secondary analysis. The purpose of both studies was to identify factors related to HPD use. The parent studies used the same set of instruments.

The combined data set (\(N = 686\)) included 513 men and 173 women farm operators. Power analysis indicated the total sample size was sufficient to test the model’s multiple predictors.

**Instruments**

Use of HPDs and related cognitive-perceptual factors were measured using a variety of self-administered survey instruments designed for use with farm operators. A description of the instrument development can be found elsewhere.\(^{15}\) Related cognitive-perceptual factors that were measured included perceived barriers to HPD use, perceived benefits of HPD use, self-efficacy of HPD use, situational influences on HPD use, and interpersonal influences (i.e., norms, modeling, and support) for HPD use. Use of HPDs when in high noise areas was self-reported as the percent of time (0–100) participants used hearing protectors while in high noise in selected farm work locations: barn, field, grain handling system, and shop. High noise areas were defined as environments in which a person has to shout to be heard by another at least three feet away. A summary of instruments and their reliability coefficients appears in Table 1.

Perceived barriers to action are real or imagined notions about the inconvenience, cost, difficulty, or time-consuming nature of a specific behavior.\(^{31}\) The Farmers’ Perceived Barriers to Use of HPDs instrument\(^{15}\) is an adaptation of an instrument used previously to study barriers to use of HPDs among factory workers for use with farmers.\(^{32}\) The instrument measures 18 items on a 6-point Likert scale. A sample statement from the barriers scale is, “Hearing protectors are difficult to use when the weather is extremely cold.” Response options range from strongly disagree to strongly agree. Theta coefficient reported for Study 1\(^{15}\) was 0.89; in Study 2,\(^{16}\) Cronbach’s alpha was 0.81.

Perceived benefits of use of HPDs are positive or reinforcing consequences of a behavior.\(^{31}\) Farmers’ Perceived Value of

| Scale                  | Number of items | Mean (SD)     | Cronbach’s alpha |
|------------------------|-----------------|---------------|------------------|
| Barriers               | 18              | 3.1 (0.8)     | 0.80             |
| Self-efficacy          | 10              | 4.3 (0.7)     | 0.51             |
| Situational influences | 7               | 3.9 (1.1)     | 0.63             |
| Value of use           | 5               | 28.2 (33.5)   | 0.99             |
| Interpersonal norms    | 5               | 2.5 (0.5)     | 0.66             |
| Interpersonal modeling | 2               | 2.6 (0.9)     | 0.52             |
| Interpersonal support  | 4               | 1.4 (0.4)     | 0.68             |

**Table 1: Instruments**
Use of Hearing Protection was derived from a similar instrument used with construction and factory workers. The participant was asked to rate the importance of five outcomes of HPD use such as, “protection of inner ear” on a 10-point scale. Response options range from slightly important to highly important. Theta coefficient for Study 1 was 0.85; in Study 2, Cronbach’s alpha was 0.82.

Self-efficacy is an individual’s belief in their ability to perform a certain behavior. Self-efficacy for use of HPDs was used in prior research with factory workers and modified for use with farmers. The Farmer’s Self-efficacy for HPD Use instrument consists of 11 statements about using hearing protection such as, “I know how to use my hearing protection so that it works effectively.” The six response options range from strongly disagree to strongly agree. Theta coefficient reported for Study 1 was 0.76; in Study 2, Cronbach’s alpha was 0.75.

Situational influences on HPD use are the individual’s perception of environmental factors as they affect health behavior. The Situational Influences on HPD Use instrument are an adaptation of an instrument previously used to study HPD use among factory workers and modified for use with farm operators. It is a seven-item instrument that measures situational factors influencing HPD use. A sample statement from the Farmers’ Situational Influences on HPD Use of HPDs instrument is, “Ear plugs are available close to high noise areas.” Six response options are given ranging from strongly disagree to strongly agree. Theta coefficient reported for Study 1 was 0.66; in Study 2, Cronbach’s alpha was 0.81.

Interpersonal influences are the individual’s perceptions of the behaviors, beliefs, or attitudes of others who may influence the target behavior. This concept is operationalized in three subscales: interpersonal norms, modeling, and support. Interpersonal norms include the respondents’ beliefs about how much others (e.g., family members, friends, supervisor, and coworkers) think the respondents should wear hearing protection. Interpersonal support refers to encouragement or praise from family, friends, coworkers, and supervisors about the respondents’ use of hearing protection. Interpersonal modeling is how much respondents believe family members and other farmers use hearing protection when exposed to noise. Farmers’ perceived interpersonal influences on HPD use were measured using subscales representing each of these operational terms: (a) Farmers’ Perceived Interpersonal Norms of HPD Use, (b) Farmers’ Perceived Interpersonal Modeling of HPD Use, and (c) Farmers’ Perceived Interpersonal Support for HPD Use. These instruments were adapted for use with farmers by having questions related to the farmer’s family, other farmers, and farm equipment dealers.

Farmers’ Perceived Interpersonal Norms of HPD Use is an instrument that measures how much participants believe other people (family members, healthcare workers, other farmers, equipment dealers, and extension workers) think they should wear hearing protection. The participant is asked to rate, on a four-point scale, how strongly they believe other people think they should use HPDs. Response options include not at all, sort of, a lot, and does not apply. Theta coefficient reported for Study 1 was 0.75; in Study 2, Cronbach’s alpha was 0.63.

The Farmers’ Perceived Interpersonal Modeling of HPD Use instrument contains two items on a four-point scale. The participant was asked to rate how much they think others, such as family members and other farmers, wear HPDs when in high noise. Response options include never, usually not, about half the time, and usually. Theta coefficient reported for Study 1 was 0.68; in Study 2, Cronbach’s alpha was 0.49.

The Farmers’ Perceived Interpersonal Support for HPD Use instrument measures how much certain people encourage or praise the participant’s use of HPDs. This scale contains four statements and two categories of people: family and other farmers. A sample statement from this instrument reads, “My family praises me for wearing hearing protection.” with response options never, sometimes, and often. Theta coefficient reported for Study 1 was 0.73; in Study 2, Cronbach’s alpha was 0.69.

Analysis

Data files were combined in a stacking method using SAS software, version 9.3 (SAS Institute Inc., Cary, NC, USA), and an indicator variable based on individual’s original study (Study 1 or 2) was used to account for differences in studies. In the raw data, the proportions of missing information of HPD use in the various settings tested were at barn (80%), in field (35%), at grain dryer (55%), and in shop (42%). We excluded 100 cases where participants responded No or Not applicable to the four high noise exposure questions, and nine cases with missing gender information, resulting in a sample size of 589.

The outcome variable, self-reported HPDs use, was calculated using the mean of the non-missing four percentages of HPD use at the shop, barn, grain, and field. The distribution of the dependent measure and HPD use were highly skewed, with almost 46% reporting zero use [Figure 1]. The outcome data (use of hearing protection) were treated as count data for subsequent analysis. Total scores were calculated for seven predictor variables (barriers, self-efficacy, situational influences, value, norms, modeling, and support). Two sample t-tests were used to determine whether there was any statistically significant difference between genders in mean scores of HPD use or cognitive-perceptual factors related to HPD use.

There were some differences in demographic composition between the two study populations. Study 2 comprised of comparatively older, and more racially and gender diverse differences. However, there was no difference in the reporting of high noise exposure in the barn, field, shop, and grain dryer, or in percent use of HPDs between the two study groups.
Zero inflated negative binomial (ZINB) distribution is obtained by mixing a distribution to degenerate at zero with a negative binomial distribution, by allowing the incorporation of explanatory variables in both the zero process and the negative binomial distribution. ZINB regression was used to assess potential predictors on HPD use, and to explore the gender effect on HPD use while adjusting for the combined data from two studies.

**RESULTS**

Participants ($n = 589$) were primarily men (77%) [Table 2]. There was a significant difference by gender in mean age (men $52.0 \pm 12.1$; women $48.5 \pm 10.8$, $P = 0.002$). Years in farm work since age 18 ranged from 1 to 72 years ($27.7 \pm 13.0$). Women, on average, reported significantly fewer years in farming since age 18 ($23.3 \pm 12$) than men ($29.0 \pm 13$). Participants in the combined parent studies were overwhelmingly (91%) Caucasian. Most of the study participants farmed $<500$ acres (44%). The majority of participants identified their role on the farm as manager (83%), followed by non-paid worker (8%), full-time paid (5%), and part-time paid (4%) worker. Of the women, 27% identified themselves as non-paid workers, whereas 3% of the men worked as non-paid workers. Regarding HPD use, women self-reported less frequent use of HPDs ($23.5 \pm 34.4$) compared to men ($25.2 \pm 32.9$), but differences were not significant. Women reported more non-use of HPDs than men (51 vs. 44%).

To test for differences between men and women in HPD use and related cognitive-perceptual factors, t-tests and chi-square tests were performed [Table 3]. Women participants reported less frequent HPD use than men; however the difference was not significant. There was no difference between men and women in most hearing protector-related cognitive-perceptual factors, with some exception. While perceptions of barriers to use, situational influences, and self-efficacy toward hearing protector use were similar, men had higher Perceived Value of Use scores (18.7 vs. 31.1; $P = 0.0001$), while women had higher interpersonal modeling scores (2.8 vs. 2.5; $P = 0.0025$).

Results from ZINB regression were displayed in Table 4. In the model we accounted for the fact that the combined data set emerged from two distinct studies, as well as other factors such as age, size of farm, and cognitive-perceptual factors related to HPDs.

Three out of the seven cognitive-perceptual factors were significant predictors of self-reported HPD use. Risk of HPD use decreased by 22% with each one unit increase in the barrier scale (RR = 0.78). Increasing situational influences and interpersonal modeling scores by one unit resulted in an increase in HPD use by 26% (RRs = 1.26) and 33% (RR = 1.33), respectively. However, there is no significant difference between men and women with regard to HPD use after adjusting for age, acres farmed, barriers scale, and the seven cognitive-perceptual factors ($P$-value $= 0.63$ for gender in the count model of the ZINB regression).

**DISCUSSION**

Not surprisingly, the low rate of HPD use in this study is consistent with earlier studies of farm operators.[2,21,27,34] Half of the women (50.3%) and less than half of the men (48.9%) in the current study reported ever wearing HPDs. Few farm operators used HPDs at a rate that could be expected to effectively protect their hearing. The lower rate of HPD use among women as a sub-group of farm operators was consistent with a previous study of workers in multiple industry sectors.[27]

Although there were several similarities in predictors of HPD use between genders (e.g., barriers to HPD use), interpersonal role modeling was a predictor of HPD use among women (but not for men). These factors suggest that while farm operators of both genders may benefit from interventions designed to reduce barriers to HPD use (e.g., difficulty communicating with co-workers and hearing warning sounds), farm women have unique needs in relation to cognitive-perceptual factors.
|                                | Women ($N = 136$) | Men ($N = 453$) | Total ($N = 589$) | $P$ value |
|--------------------------------|-------------------|-----------------|-------------------|-----------|
| Age Mean (SD)                  | 48.5 (10.8)       | 52.0 (12.1)     | 51.2 (11.9)       | 0.0023*   |
| Range (20.0–82.0)              | (20.0–89.0)       | (20.0–89.0)     |                   |           |
| Race/ethnicity                 |                   |                 |                   | 0.6985    |
| White                          | 89%               | 92%             | 91%               |           |
| Asian                          | 1%                | 0%              | 0%                |           |
| Hispanic                       | 1%                | 1%              | 1%                |           |
| Native American                | 9%                | 7%              | 8%                |           |
| Farm size                      |                   |                 |                   | 0.0040*   |
| <500                           | 59%               | 40%             | 44%               |           |
| 500–999                        | 16%               | 17%             | 17%               |           |
| 1000–1499                      | 11%               | 16%             | 15%               |           |
| 1500–1999                      | 5%                | 10%             | 9%                |           |
| 2000+                          | 9%                | 17%             | 15%               |           |
| Farm role                      |                   |                 |                   | <0.0001*  |
| Manager                        | 64%               | 89%             | 83%               |           |
| Full-time                      | 4%                | 5%              | 5%                |           |
| Part-time                      | 5%                | 3%              | 4%                |           |
| Non-paid                       | 27%               | 3%              | 8%                |           |
| Years’ experience since age 18 |                   |                 |                   | <0.0001*  |
| Mean (SD)                      | 23.3 (12.0)       | 29.0 (13.0)     | 27.7 (13.0)       |           |
| Range (1.0–64.0)               | (1.0–72.0)        | (1.0–72.0)      |                   |           |
| Were you exposed to high noise in shop? |   |                 |                   | <0.0001*  |
| Yes                            | 50%               | 73%             | 68%               |           |
| No                             | 46%               | 26%             | 31%               |           |
| Percentage time used HPDs while doing shop work | |                 |                   | 0.5506    |
| Mean (SD)                      | 19.8 (32.3)       | 22.6 (34.2)     | 22.1 (33.9)       |           |
| Range (0.0–100.0)              | (0.0–100.0)       | (0.0–100.0)     | (0.0–100.0)       |           |
| Were you exposed to noise in the field? | |                 |                   | 0.5614    |
| Yes                            | 76%               | 77%             | 77%               |           |
| No                             | 24%               | 22%             | 23%               |           |
| Percentage time used HPDs in field | |                 |                   | 0.6855    |
| Mean (SD)                      | 30.4 (40.0)       | 28.6 (38.3)     | 29.0 (38.6)       |           |
| Range (0.0–100.0)              | (0.0–100.0)       | (0.0–100.0)     | (0.0–100.0)       |           |
| Were you exposed to noise in barn? | |                 |                   | 0.0123*   |
| Missing                        | 6                 |                 |                   |           |
| Yes                            | 31%               | 20%             | 22%               |           |
| No                             | 67%               | 76%             | 74%               |           |
| Time used HPDs in barn         |                   |                 |                   | 0.7842    |
| Mean (SD)                      | 13.9 (29.1)       | 15.4 (28.6)     | 14.9 (28.7)       |           |
| Range (0.0–100.0)              | (0.0–100.0)       | (0.0–100.0)     | (0.0–100.0)       |           |
| Were you exposed to noise at grain dryer? | |                 |                   | <0.0001*  |
| Yes                            | 33%               | 58%             | 52%               |           |
| No                             | 52%               | 37%             | 41%               |           |

(Continued)
that predict HPD use. Women farm operators may lack role models for use of HPDs (e.g., in peers and advertising), contributing to their less frequent use of protection. This information may be useful to educators and program planners seeking to increase HPD use among women farm operators. Results of this study suggest that women farm operators are more sensitive to interpersonal influences on use of hearing protection than their opposite gender counterparts. Consequently, programs designed to increase HPD use among women farm operators may benefit from a focus on interpersonal norms, modeling, and support for HPD use. Examples of a focus on interpersonal norms include encouraging family members, educators, health care workers, and other influential persons to verbally express to women their expectations for HPD use when in high-noise environments. Examples of a focus on interpersonal modeling

| Table 2 (Continued)                                                                 | Women \((N = 136)\) | Men \((N = 453)\) | Total \((N = 589)\) | \(P\) value |
|-----------------------------------------------------------------------------------|---------------------|-------------------|---------------------|-------------|
| Percentage of used HPDs while operating grain dryer                                |                     |                   |                     | 0.6206      |
| Mean (SD)                                                                         | 22.1 (36.6)         | 19.4 (34.0)       | 19.8 (34.3)         |             |
| Range (0.0–100.0)                                                                 |                     |                   |                     |             |

*Statistically significant.

| Table 3: HPD use and attitudes and beliefs related to hearing protectors by gender | Women \((N = 136)\) | Men \((N = 453)\) | Total \((N = 589)\) | \(P\) value |
|-----------------------------------------------------------------------------------|---------------------|-------------------|---------------------|-------------|
| Percent use of HPDs                                                               |                     |                   |                     | 0.6105      |
| Mean (SD)                                                                         | 23.5 (34.4)         | 25.2 (32.9)       | 24.8 (33.2)         |             |
| Range (0.0–100.0)                                                                 |                     |                   |                     |             |
| HPD use categories                                                                |                     |                   |                     | 0.2788      |
| No use                                                                            | 51%                 | 44%               | 46%                 |             |
| <50% use                                                                          | 26%                 | 32%               | 30%                 |             |
| 50% or more use                                                                   | 23%                 | 24%               | 24%                 |             |
| Barrier scale                                                                     |                     |                   |                     | 0.1636      |
| Mean (SD)                                                                         | 3.2 (0.8)           | 3.1 (0.8)         | 3.1 (0.8)           |             |
| Range (1.6–5.9)                                                                   |                     |                   |                     |             |
| Self-efficacy scale                                                               |                     |                   |                     | 0.0735      |
| Mean (SD)                                                                         | 4.4 (0.6)           | 4.3 (0.7)         | 4.3 (0.7)           |             |
| Range (2.9–6.8)                                                                   |                     |                   |                     |             |
| Situational influences scale                                                       |                     |                   |                     | 0.0730      |
| Mean (SD)                                                                         | 4.0 (1.2)           | 3.8 (1.1)         | 3.9 (1.1)           |             |
| Range (1.3–6.3)                                                                   |                     |                   |                     |             |
| Perceived value of HPD use scale                                                  |                     |                   |                     | 0.0001*     |
| Mean (SD)                                                                         | 18.7 (25.9)         | 31.1 (35.0)       | 28.2 (33.5)         |             |
| Range (5.4–100.0)                                                                 |                     |                   |                     |             |
| Interpersonal influence norm sub-scale                                            |                     |                   |                     | 0.1812      |
| Mean (SD)                                                                         | 2.5 (0.5)           | 2.5 (0.5)         | 2.5 (0.5)           |             |
| Range (1.0–4.0)                                                                   |                     |                   |                     |             |
| Interpersonal influence support sub-scale                                         |                     |                   |                     | 0.3381      |
| Mean (SD)                                                                         | 1.4 (0.4)           | 1.4 (0.4)         | 1.4 (0.4)           |             |
| Range (1.0–2.8)                                                                   |                     |                   |                     |             |
| Interpersonal influence modeling sub-scale                                        |                     |                   |                     | 0.0025*     |
| Mean (SD)                                                                         | 2.8 (0.9)           | 2.5 (0.9)         | 2.6 (0.9)           |             |
| Range (1.0–4.5)                                                                   |                     |                   |                     |             |

*Statistically significant.
include distributing photos of women wearing HPDs in farming literature, advertising, and the popular press. Examples of a focus on interpersonal support include encouraging family members, educators, health care workers, and other influential persons to provide praise and encouragement to women for wearing HPDs.

We found a lack of studies reporting use of personal protective equipment by gender. Lack of this information represents a gap in knowledge that is useful in development of programs designed to promote personal protective equipment use and protect the health of workers. There is a need for future research in this area.

The most influential predictor of HPD use among men and women in this study was Barriers to Use. This finding is similar to that of other studies of use of HPDs and other personal protective equipment among farmers and other workers. Other predictors included situational influences and interpersonal modeling. This information is of potential utility to clinicians and program planners interested in increasing HPD use in this population.

Many farm women who characterize themselves as homemakers are regularly engaged in noisy farm work such as working with animals, field irrigation, farm equipment operation, and supervision. Although many farmwomen identify themselves as homemakers, they often do not see themselves as being at risk for injury from farm hazards. Studies such as the one reported here are needed to monitor noise exposure and other hearing hazards, and protective behaviors.

The study had limitations, including use of a convenience sample in one of the parent studies, limiting the generalizability of results. The study primarily included farm operators, that is, hired farm workers, representing a large portion of the agricultural workforce, were underrepresented. The researchers did not validate actual noise exposure levels. Measurement of use of HPDs was by self-report, in other reports, self-report and observations were highly correlated. The respondents’ desire to provide a socially favorable response presented an opportunity for bias, although a recent study indicates that social desirability bias was not present in reports of HPD use among farm operators. Regrettably, educational level, socio-economic status, amount of time working, and educational level were variables not included in one or both of the parent studies; therefore, the effect of these factors on HPD use among this sample of farm operators was not assessed.

Women represent a substantive proportion (30%) of farm operators, and although their work-related noise exposure places them at risk for noise-induced hearing loss, their use of hearing protection is even lower than that of men. While there are similarities in cognitive-perceptual factors predicting HPD use among men and women farm operators, women are more sensitive to interpersonal influences, i.e., interpersonal norms, modeling, and support. This information is useful to educators, policy makers, and program planners who aim to increase HPD use in this high-risk and underserved population of workers.

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### Conflicts of interest

There are no conflicts of interest.

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**Table 4: Results of zero-inflated negative binomial regression on HPD use**

| Predictor           | RR  | 95% confidence limits of RR | P value | OR   | 95% confidence limits of OR | P value |
|---------------------|-----|-----------------------------|---------|------|-----------------------------|---------|
| Intercept           | 15.18 | (4.97, 46.35) | <0.0001* | 0.11 | (0.01, 1.31) | 0.08 |
| Age                 | 1   | (0.99, 1.01) | 0.92 | 1.01 | (0.99, 1.03) | 0.34 |
| Study (1 or 2)      | 0.72 | (0.25, 2.09) | 0.55 | 7.11 | (0.6, 8.47) | 0.12 |
| Gender (woman vs. man) | 0.94 | (0.74, 1.2) | 0.63 | 1.85 | (1.06, 3.24) | 0.03* |
| Acres               | 0.95 | (0.88, 1.02) | 0.14 | 0.93 | (0.77, 1.11) | 0.40 |
| Barriers scale      | 0.78 | (0.68, 0.89) | 0.0002* | 2.69 | (1.93, 3.76) | <0.0001* |
| Self-efficacy scale | 1.04 | (0.86, 1.25) | 0.72 | 1.86 | (1.21, 2.85) | 0.004* |
| Situational influences scale | 1.26 | (1.13, 1.39) | <0.0001* | 0.58 | (0.45, 0.74) | <0.0001* |
| Value of use scale  | 1.01 | (0.99, 1.02) | 0.44 | 0.98 | (0.95, 1.01) | 0.23 |
| Interpersonal norms subscale | 0.92 | (0.74, 1.13) | 0.42 | 1.00 | (0.62, 1.62) | 0.99 |
| Interpersonal support subscale | 1.03 | (0.83, 1.29) | 0.77 | 0.34 | (0.18, 0.61) | 0.0004* |
| Interpersonal modeling subscale | 1.33 | (1.17, 1.52) | <0.0001* | 0.77 | (0.58, 1.02) | 0.07 |

*Statistically significant.
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