Effects of Common Agricultural Activities on Measures of Hearing Loss

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Introduction

Hearing loss is an important occupational illness among farmers.[1,2] Use of agricultural equipment such as grain dryers and tractors, as well as engaging in tasks such as working around livestock, have been associated with hearing loss.[1,3] However, associations between total lifetime exposure duration and hearing loss are not well established among farmers.

The purpose of this study was to examine the effect years participating in common agricultural activities have on measures of hearing loss.

Methods

- Agricultural exposure, covariate and audiometric data were collected from 1,568 adults participating in a large occupational health study of rural residents
- Agricultural exposures of interest were collected using questionnaires and included:
  - Farmer vs. non-farmer
  - Years worked at noisy job other than farming
  - Years hunting or target shooting
  - Years ATV or motorcycle use
  - Years chain saw use
  - Years pneumatic or electric tool use
  - Years lived on a farm
  - Years worked on a farm
  - Years operated tractor without a cab
  - Years operated tractor/combine with a cab
  - Years grain dryer, feed mill, or hay chopper use
  - Years worked with livestock
  - Years worked in hog confinement building
- Hearing loss was ascertained using standard audiometric methods (ANSI 1996b)
- Three pure tone average (PTA) calculations were used to characterize hearing loss from the audiograms:
  - NIOSH = PTA of 1000Hz, 2000Hz, 3000Hz and 4000Hz
  - Low Frequency = PTA of 500Hz, 1000Hz, 2000Hz and 3000 Hz
  - High Frequency = PTA of 3000Hz, 4000Hz and 6000Hz
- Multiple logistic regression analyses were performed to examine associations between agricultural exposures and three dichotomized hearing loss outcomes (PTA >25 dB) while controlling for potential confounders
- Multiple linear regression analyses were performed to examine associations between agricultural exposures and three continuous hearing loss outcomes while controlling for potential confounders

- Farmers had a statistically larger prevalence of hearing loss greater than 25 decibels than the non-farmers (Table 1)
- The mean decibels of hearing loss were significantly higher for the farmers compared to the non-farmers (Table 2)
- In both the farmer and non-farmer groups, hearing loss increased with increasing age (Table 1 and Table 2)
- Of the 13 agricultural exposures investigated, few had a statistically significant association with hearing loss (Table 3 and Table 4)

Table 1. Prevalence of hearing loss >25 dB by age group, farming status, and pure tone average (PTA) calculation method

	NIOSH PTA		Low Frequency PTA		High Frequency PTA	
Age Group	Non-Farmer N=608	Farmer N=959	Non-Farmer N=608	Farmers N=960	Non-Farmer N=608	Farmer N=958
< 50	**29.8**	**70.2**	36.7	63.3	**29.9**	**70.1**
50 to 59	**16.0**	**84.0**	**23.3**	**76.7**	**25.9**	**74.1**
60 to 69	**28.2**	**71.8**	**26.1**	**73.9**	**32.6**	**67.4**
≥ 70	30.0	70.0	**27.5**	**72.5**	31.0	69.0
All ages	**27.8**	**72.2**	**27.8**	**72.2**	**30.3**	**69.7**

* Results in bold indicate a statistically significant difference in prevalence between farmers and non-farmers (Chi Square p-value < 0.05)

Table 2. Mean (SD) decibels of hearing loss by age group, farming status, and pure tone average (PTA) calculation method

	NIOSH PTA		Low Frequency PTA		High Frequency PTA	
Age Group	Non-Farmer N=608	Farmer N=959	Non-Farmer N=608	Farmer N=960	Non-Farmer N=608	Farmer N=958
< 50	**11.9** (12.0)	**15.7** (13.3)	**10.2** (10.3)	**12.0** (10.7)	**18.2** (15.1)	**24.2** (17.8)
50 to 59	**15.7** (10.7)	**23.0** (14.2)	**13.3** (9.12)	**17.2** (11.5)	**23.6** (13.6)	**36.1** (19.4)
60 to 69	**27.7** (18.0)	**33.0** (18.2)	22.9 (16.2)	25.9 (15.0)	**38.7** (21.1)	**45.8** (22.4)
≥ 70	**36.9** (16.6)	**43.1** (17.7)	31.5 (15.7)	34.6 (16.2)	**50.8** (17.4)	**58.3** (19.3)
All ages	**20.1** (17.1)	**27.5** (19.2)	**17.0** (15.0)	**21.5** (16.2)	**28.9** (20.9)	**39.5** (23.7)

*Results in bold indicate a statistically significant difference in mean decibels of hearing loss between farmers and non-farmers (t-test p-value <0.05)

Results

Table 3. Final multivariable logistic regression model of agricultural exposure variables (p-value <0.10) and hearing loss greater than 25 dB using three separate Pure Tone Average (PTA) calculations, adjusted for age, gender, education level and household assets

	NIOSH PTA		Low Frequency PTA		High Frequency PTA	
Exposure Variable	OR (95% CI)	P-Value	OR (95% CI)	P-Value	OR (95% CI)	P-Value
Years at noisy job other than farming (female)	0.97 (0.95-1.00)	0.06	---	---	---	---
Years at noisy job other than farming (male)	1.02 (1.00-1.04)	<.01	---	---	---	---
Years hunting or target shooting	---	---	---	---	1.02 (1.00-1.03)	0.03
Years ridden ATV or motorcycle	1.02 (1.00-1.02)	0.06	---	---	1.02 (1.00-1.03)	0.06
Years operated pneumatic or electric tools	1.01 (1.00-1.02)	0.08	1.01 (1.00-1.02)	0.08	---	---
Years worked with livestock	---	---	1.02 (1.00-1.03)	<.01	---	--

Table 4. Final multivariable linear regression model of agricultural exposure variables (p-value <0.10) and mean decibels of hearing loss using three separate Pure Tone Average (PTA) calculations, adjusted for age, gender, education level, marital status, drinks per day and household assets

	NIOSH PTA		Low Frequency PTA		High Frequency PTA	
Exposure Variable	Parameter Estimate	P-Value	Parameter Estimate	P-Value	Parameter Estimate	P-Value
Years at noisy job other than farming (female)	-0.08	0.24	-0.07	0.27	---	---
Years at noisy job other than farming (male)	0.12	<.01	0.09	0.02	---	---
Years hunting or target shooting	---	---	---	---	0.10	<.01
Years ridden ATV or motorcycle	0.08	0.04	0.07	0.07	0.10	0.04
Years operated pneumatic or electric tools	0.08	0.01	0.06	0.03	---	---
Years worked on a farm (females 25 years of age)	-0.22[1] [2]	---	-0.19[1] [2]	---	---	---
Years worked on a farm (males 25 years of age)	-0.13[1] [2]	---	-0.03[1] [2]	---	---	---
Years worked on a farm (females 50 years of age	-0.11[1] [2]	---	-0.10[1] [2]	---	---	---
Years worked on a farm (males 50 years of age)	-0.01[1] [2]	---	0.06[1] [2]	---	---	---
Years worked on a farm (females 75 years of age)	0.01[1] [2]	---	-0.01[1] [2]	---	---	---
Years worked on a farm (males 75 years of age)	0.11[1] [2]	---	0.15[1] [2]	---	---	---
Years worked on a farm (25 years of age)	---	---	---	---	-0.17[2]	---
Years worked on a farm (50 years of age)	---	---	---	---	-0.04[2]	---
Years worked on a farm (75 years of age)	---	---	---	---	0.09[2]	---
Years worked in hog confinement building	0.08	0.07	0.08	0.06	---	---

[1]Years worked on a farm and gender interaction term for NIOSH (p-value 0.03) and low frequency (p-value 0.09) PTA calculations, PTA calculations, age categories reported to show how the parameter estimate change for the interaction by age

[2]Years worked on a farm for NIOSH (p-value 0.001), low frequency (p-value 0.006) and high frequency (p-value 0.002) PTA calculations, age categories reported to show how the parameter estimate change for the interaction by age

Conclusions

Even though the farmers had more hearing loss than non-farmers, many of the agricultural activities that these farmers reported were not associated with hearing loss.

Odds ratios and parameter estimates for the statistically significant agricultural exposures indicate that relatively long durations were required before substantial hearing loss would develop.

Because actual noise exposure could vary greatly, years engaging in agricultural activities may not be the most appropriate metric for predicting hearing loss. As a result, these agricultural exposures may be a poor representation of actual lifetime exposure to noise. A more accurate analysis of the associations between these agricultural exposures and hearing loss could be conducted if a more audiologically relevant metric for agricultural exposures was used.

Future work is needed to measure the actual noise exposures of these agricultural activities to accurately predict the risk of developing hearing loss.

References

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Acknowledgements

Special thanks to the Keokuk County Rural Health Study conducted within The University of Iowa's Great Plains Center for Agricultural Safety and Health for collecting and sharing the audiometric and agricultural data for the study participants.

Funded in part by the NIOSH Heartland Center for Occupational Health and Safety Training Grant No. T42OH008491.

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