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Agricultural Exposures in Patients with COPD in Health Systems Serving Rural Areas

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Agricultural Exposures in Patients with COPD in Health Systems Serving Rural Areas

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ABSTRACT. *Background*: Agricultural exposure is a risk factor for the development of chronic obstructive pulmonary disease (COPD). However, there are no good estimates of the number of COPD patients with a history of agricultural exposure. *Methods*: We conducted a telephone interview of subjects with COPD identified by reviewing all pulmonary function tests at the Omaha Veterans Administration Hospital between November 2004 and March 2005. Obstructive lung disease was defined as a FEV_1/FVC ratio of less than 70%. The survey detailed demographic data, smoking history, pulmonary symptoms, and history of agricultural exposures. *Results*: Participants included 150 veterans (mean age 68.2 years ±10.8). A history of agricultural exposure was elicited in 68% of subjects. Of those who had worked in agriculture, the types of exposures varied, with 14% in hog confinement barns, 20% on dairy farms, 8% on poultry farms, and 87% exposed to grain dust. There was a trend of diminishing FEV_1 with increasing years of agricultural exposure. *Conclusions*: In health systems that serve rural areas, patients with COPD commonly have a history of agricultural exposures that may contribute to the development of COPD. Health care workers in these areas should include agricultural exposures as an important part of the social/occupational history in these patients.

KEYWORDS. Agriculture, COPD, lung disease, pulmonary function tests, farming

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a major health concern and is the fourth leading cause of death among persons older than 45 years of age in the United States.[1] The majority of COPD is caused by cigarette smoking. However, occupational exposure is also a known risk factor for COPD. Specifically, agricultural workers are at increased risk for developing COPD.[2] An estimated 8% to 32% of these workers develop chronic bronchitis as compared to 4% of non-farming populations.[3] Agricultural workers are more likely to present with respiratory symptoms such as cough and shortness of breath[4] and have diminished pulmonary function.[5] This increased risk of COPD and respiratory symptoms is attributed to the fact that agricultural workers are exposed to a variety of substances that can cause respiratory symptoms. Common agricultural exposures include grain dusts, dust from animal barns, pesticides, fertilizers, engine exhaust fumes, and ammonia and methane from animal wastes.[6]

Many people work in agriculture. Nationally, there are 1.9 million farms and 3.8 million farm workers.[7] Locally in Nebraska, there are 49 375 farms with 70 798 farm owners/operators.[8] Many of these workers have exposures that put them at higher risk for developing COPD. However, there are no good epidemiological studies to estimate the number of COPD patients in which agricultural exposure may have contributed to their disease, either nationally or locally. We performed this study to begin to address this question.

The objective of this study is to estimate the proportion of COPD patients with agricultural exposures in our area. The Veterans Administration Nebraska Western Iowa Health Care System (VA NWIHCS), although located in an urban area, serves a largely rural population. Given this rural population base, we hypothesized that a large proportion of patients with COPD in our system would have agricultural exposure.

METHODS AND MATERIALS

Study Participants

The study population included veterans at the VA Nebraska Western Iowa Health Care System, Omaha Division (VA NWIHCS), who underwent pulmonary function tests between November of 2004 and March of 2005. Subjects were included if they had moderate to severe COPD. This included stage 2–4 COPD, as defined by the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines. By that standard, all patients had FEV_1/FVC ratio of less than 70% of predicted.[1] GOLD stage 1 includes patients with very mild disease, with an FEV_1 greater than 80% predicted. GOLD stage 1 patients were excluded because they have very mild disease. GOLD stage 2 has an FEV_1 50% to 79.9% of predicted, stage 3 FEV_1 is 30% to 49.9%, stage 4 is FEV_1 less than 30% of predicted. This study was approved by the institutional review board at the VA NWIHCS.

Interviews

A telephone interview of each subject was performed by 2 medically trained professionals using a prepared script. Data regarding demographics, pulmonary symptoms, agricultural exposures, and smoking history were obtained. The interview was based on a written survey used previously to investigate organic dust toxic syndrome in farmers.[9] The questions used to ascertain respiratory health were derived from the American Thoracic Society Epidemiology Standardization Project Questionnaire.[10]

Each subject was contacted by telephone and invited to participate in a 15-minute telephone survey regarding agricultural exposures. Those subjects who agreed to participate were administered all questions. Those who had lived or worked on a farm answered additional questions regarding the duration and types of agricultural exposures. Subjects were questioned about current and past agricultural exposure, including details about which crops they raised, and work in swine confinement buildings or on dairy farms.

Statistical Analysis

Descriptive statistics are presented using percentages, means, and standard deviations. Chi-square tests were used to examine associations between agriculture exposure, smoking status, and symptoms. Pulmonary function tests were compared by using t-tests. Linear regression was used to examine the association between pulmonary function tests and agricultural exposure, adjusted for pack-years of smoking. A test for linear trend between years of agricultural exposure and pulmonary function tests, adjusted for age and pack-years, was examined using a general linear model. P-values less than 0.05 were considered to be statistically significant.

RESULTS

Subject Characteristics

A total of 405 pulmonary function tests were completed between November 2004 and March 2005, and 225 subjects with obstructive lung disease meeting stage 2–4 GOLD criteria were identified. We were able to contact 154 (69%) by telephone. All potential subjects were called a minimum of 5 times at different times of day. Of the 154 subjects, 150 (97%) consented to participate and completed the entire interview.

The demographic data of the study subjects are summarized in Table 1. The mean age of the participants was 68 years ±10.8. The majority of the study participants were male (99%) and Caucasian (93%), representative of the demographics of the VA Nebraska Western Iowa Health Care System. The majority of subjects had a smoking history, with 95% of participants smoking at one time in their life. Most subjects, 69%, were former smokers (no smoking in the last 6 weeks), and only 26% were current smokers. The former smokers had smoked an average of 59 pack-years ±39. The current smokers had a history of smoking 54 pack-years ±28.8.

Overall, the group of subjects with agricultural exposures was very similar to those without (Table 1). The number of current smokers, former smokers, and never smokers was the same in each group. They also had similar rates of chronic cough and symptoms of allergies.

TABLE 1. Study Population Demographics: Comparison Between subjects with and Without Agricultural Exposure*

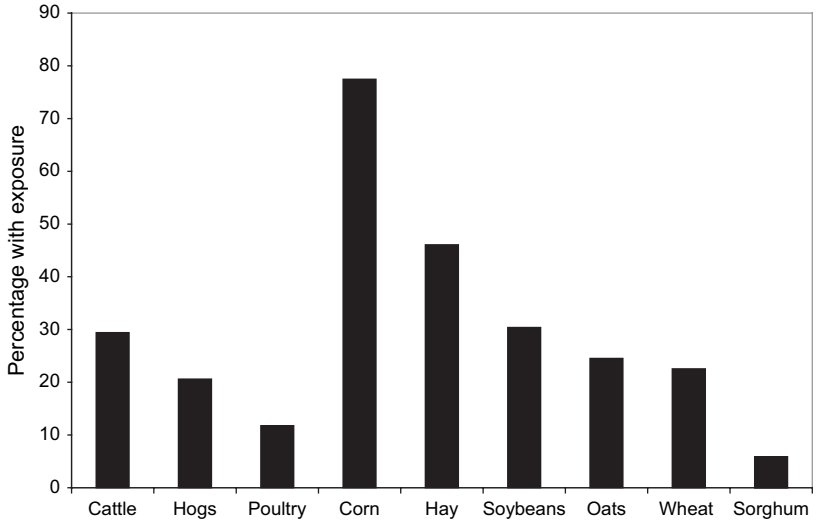
Characteristic	No Agricultural Exposure (n = 48)	Agricultural Exposure (n =102)	*p*-Value
Male: *n* (%)	47 (98%)	101 (99%)	0.95
Mean age (± standard deviation)	65.8 (±10.8)	69.8 (±11.8)	
Race: *n* (%)			
Caucasian	44 (92%)	95 (93%)	0.86
African American	3 (6%)	6 (6%)	
Native American	1 (2%)	1 (1%)	
GOLD stage: *n* (%)			
2 (50% < FEV_1 < 80%)	31 (64.5 %)	56 (55%)	0.25
3 (30% < FEV_1 < 50%)	11 (23%)	37 (36%)	
4 (FEV_1 < 30%)	6 (12.5%)	9 (9%)	
Smoking status:			
Never smokers: *n* (%)	5 (10%)	3 (3%)	0.99
Current smokers: *n* (%)	13 (27%)	24 (24%)	
Former smokers: *n* (%)	30 (63%)	75 (74%)	
Pack-years of smoking			
Mean (±standard deviation)	54 (±39.3)	56 (± 43.4)	

*Agricultural exposure defined as ever living or working on a farm.

Agricultural Exposure

Agricultural exposure was defined as ever living on a farm or doing farm work. Overall, 68% of subjects had agricultural exposures, and 53% of subjects had lived on a farm in their lifetime. Of those that had ever lived on a farm, 81% had grown up on a farm. Only 14% still lived on a farm. Sixty-three percent of subjects had done farm work during their lifetime. Of those who did farm work, their exposures were varied (Figure 1). The majority, 74%, had two or more exposures. Common crop exposures included corn, hay, soybeans, sorghum, barley, wheat, and oats. Common animal exposures included hogs, cattle, poultry, and horses.

FIGURE 1. Specific exposures among subjects who have lived or worked on a farm (n = 102).



Interestingly, 6% of respondents had exposures to products not typically grown commercially in the Midwest, including grapes, cotton, tomatoes, peas, and peanuts.

Pulmonary Function Test Data

All subjects included in the study had moderate to severe COPD by GOLD criteria (Table 1). The majority of subjects, 58%, had GOLD stage 2 COPD, 32% had GOLD stage 3, and 10% had GOLD stage 4 COPD. Analysis using linear regression showed no statistically significant association between FEV_1 (p = 0.43), FVC (p = 0.78), or GOLD stage with agricultural exposure, after correcting for pack-years of smoking.

There was an interesting, although not statistically significant (p = 0.37), trend of diminishing FEV_1 and FEV_1% with increasing years of agricultural exposure in those who had agricultural exposure (Table 2). The decrease in FEV_1 does not appear to be due to increasing age of those who have farmed longer, as the ages in each group are quite similar. It also does not appear to be due to heavier smoke exposure, as the pack-years of smoking are also trending down.

Subject's Awareness of Illness

During the telephone interview, we asked each subject if a physician had given them a diagnosis of asthma, COPD, chronic bronchitis, or emphysema. Surprisingly, only 57% of the subjects were aware of such a diagnosis, despite having obstruction on their pulmonary function tests.

TABLE 2. Pulmonary Function Tests by Duration of Agricultural Exposure

Agricultural exposure	*n*	Mean FVC	Mean FVC%	Mean FEV_1	Mean FEV_1%	Mean FEV_1/FVC Ratio	Mean Age (±Standard Deviation)	Mean Pack-years of smoking (±Standard Deviation)
0–5 Years	81	3.04	73.65	1.66	51.36	54.11	66 (± 12.1)	56.56 (± 41.5)
6–10 Years	13	3.00	78.82	1.60	54.41	53.71	70 (± 10.1)	62.8 (± 38.3)
11–19 Years	17	2.95	73.77	1.62	52.38	54.08	72 (± 11.4)	70.7 (± 53.6)
20–49 years	22	2.90	71.95	1.58	50.68	55.09	73 (± 8.2)	53.3 (± 33.6)
50 Years or more	10	2.75	69.30	1.43	46.00	50.70	72 (± 9.9)	45.1 (± 31.4)

DISCUSSION

In this study, we found that 68% of our subjects with COPD had a history of agricultural exposure. This is a large proportion of patients with agricultural exposure for a hospital located in an urban area. However, since the referral base is from primarily rural areas, the majority of our COPD patients have lived or worked on a farm. Not surprisingly, most of our subjects had exposure to corn and soybeans, which are very common cash crops in Nebraska. We were surprised to find that several subjects reported past exposure to cotton, grapes, tomatoes, and peanuts, which are not grown commercially in our area. This highlights the importance of asking patients about agricultural exposure as a part of the occupational history, even if agriculture is not prevalent in the area.

In comparing the agriculturally exposed and nonexposed groups, they had similar demographics, as well as smoking history and respiratory symptoms. We observed no significant differences in pulmonary function testing between subjects with agricultural exposures and those without. This is consistent with the Agricultural Health Study, which reports no difference in morbidity and mortality from COPD in agricultural workers.[11] However, when we stratified subjects by their duration of agricultural exposures, there was an interesting, although statistically insignificant, trend toward worsening lung function in subjects with longer duration of agricultural exposure. One expected explanation for this finding might be increasing age of the subjects who had farmed longer. It is known that FEV_1 and FEV_1% decline with age. The percentage of predicted FEV_1 index only partially removes the effect of age on lung function.[12] What is interesting about our data is that the mean ages of each group we compared were very similar, with mean ages 66 to 73. This makes it much easier to compare the groups and somewhat strengthens the trend that we noted. Unfortunately, this study was not powered to answer this question. It does suggest, however, that the duration of exposure may be important in the development of lung disease. Future studies into the underlying mechanisms and/or pathogenesis of the interplay of agricultural exposures and COPD are necessary.

Our data may seem to contrast with the "hygiene hypothesis." This hypothesis postulates that children who have agricultural exposures early in life have less allergy and asthma. Our study did not attempt to quantify early childhood agricultural exposures, so it is difficult to make comparisons. Our data are more consistent with the Agricultural Health Study,[2] where patients with agricultural exposures were more likely to have obstructive lung disease.

Of note, only 57% of patients were aware of a diagnosis of COPD, although all of them had moderate to severe COPD by pulmonary function tests. It is possible that the survey occurred before the physicians caring for the patient could discuss the findings of their pulmonary function tests. However, in many cases, this was not the patient's first pulmonary function testing. This finding demonstrates the need for continuing education for patients about their lung disease.

This study has several limitations, including small sample size and a limited population. This makes it difficult to make generalizations regarding the results of this study. Further, larger scale studies are necessary to try to understand the complex relationships between agricultural exposure and COPD.

CONCLUSION

We found that 68% of our COPD patients have agricultural exposures. This is a significant finding since agricultural exposures can contribute to COPD and other lung diseases. Health care providers should be aware that agricultural exposures can contribute to COPD and should include agricultural exposure in their occupational histories.

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