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## SHORT COMMUNICATION

# Respiratory disorders are not more common in farmers. Results from a study on Icelandic animal farmers

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**KEYWORDS**

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**Summary**

**Rationale:** The current prevalence of respiratory disorders and symptoms in Icelandic farmers is unknown, but a high prevalence of respiratory symptoms has been reported in the past. Modern farming practices have been implemented in Iceland in the past decade and the processing of hay has changed markedly leading to less organic dust exposure.

**Objective:** The aim was to estimate the prevalence of respiratory disorders and symptoms in a nationwide study of Icelandic farmers.

**Methods:** We conducted a questionnaire-based study of all Icelandic farmers with a comparison group randomly selected from the national citizen registry of Iceland. The questionnaire included items regarding respiratory symptoms and disorders.

**Results:** Out of 2042 farmers invited to participate, 1107 responded (54%), as did 689 of 1500 controls (46%). Farmers were slightly older and more likely to be male (87% vs. 47%). Smoking rates were significantly lower among farmers than among controls. The prevalence of asthma was not significantly different between the two groups, with a lifetime prevalence of 9.4% ( $n = 104$ ) among farmers compared to 10.2% ( $n = 70$ ) among controls. Medication use for

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asthma was not significantly different. The prevalence of self-reported, physician-diagnosed chronic bronchitis and emphysema likewise did not significantly differ between the groups, but self-reported hay fever was significantly more prevalent among farmers.

*Conclusion:* The prevalence of respiratory disorders and symptoms among Icelandic farmers is currently similar to non-farmers. This may suggest that modernization of the agricultural environment has had a positive effect on workers' health.

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## Introduction

Agricultural workers are reported to have a higher prevalence of respiratory diseases than the general population,<sup>1–4</sup> despite generally lower rates of smoking.<sup>5</sup> This has been ascribed to the result of chronic inhalation exposure to organic dust and other pollutants in their working environment.<sup>6–9</sup>

Previous studies of Icelandic farmers, conducted more than 20 years ago, found a high prevalence of respiratory discomfort while working with hay.<sup>10,11</sup> These studies were done in two places in Iceland for comparison. An area in northwestern Iceland was chosen because of harvesting in a silage and an area of southeastern Iceland was chosen because of exclusive processing of dried hay that was stored in enclosed barns. In northwestern Iceland 19% had respiratory symptoms associated with work and in southeastern Iceland 24%, with no significant differences between the two areas.<sup>11</sup> The most frequently described symptoms were cough, dyspnea and fever. They were most common when the hay was described as moldy. Numerous changes in Icelandic agricultural practices have occurred since these studies were conducted. Importantly, the processing of hay (a mainstay of animal feeds in Icelandic livestock operations) has markedly altered in the past decade. Previously dried hay was stored in enclosed barns, whereas now the use of large bales with vacuum-sealed plastic wraps has been adopted throughout the country, in part with the aim of decreasing the amount of organic dust in the agricultural environment.

The purpose of this study was to assess the respiratory health of Icelandic farmers compared with a group of non-farmers, and to consider the impact of changes in agricultural practice by comparison to older studies.

## Methods

### Background on farming in Iceland

Agriculture in Iceland is centered on livestock (primarily cattle and sheep) for dairy, meat and wool. The climate is temperate and somewhat humid, winters are mild and summers are cool.

### Study design

We performed a survey of all registered farmers in Iceland operating a farm of more than 100 sheep units (40 animal units; (1 animal unit = 1000 lbs milk cow)), with a comparison group, randomly selected from the national citizen registry of Iceland. A total of 2042 Icelandic farmers were registered with the Icelandic Farmers Association (IFA) as

operating a farm larger than 100 sheep units. This cutoff point was utilized by the IFA to designate farmers whose main income stems from farming activities and thus are likely to spend most of their working time on the farm or in farm-related activities. The individuals included in the study were sent a questionnaire, accompanied by a letter explaining the purpose and aim of the study. The comparison group consisted of 1500 individuals from the general population aged 25–70 years old who were sent a similar questionnaire and letter. The study was reviewed and approved by the National Bioethics Committee in Iceland the Icelandic Data Protection Agency and the Institutional Review Board of the University of Iowa, Iowa City, USA.

### Questionnaire

The questionnaire was mailed out to participants in February 2004 and was based on the Icelandic version of the European Respiratory Health Survey (ERHS) instrument<sup>12</sup> and on similar questionnaires from earlier studies.<sup>10,11,13</sup> Specific questions relevant to the present study are shown in Appendix A. Basic demographics were obtained as well as smoking status, size of farm and type of livestock.

### Statistics

The chi-square test was used for dichotomous variables. Logistic regression models were created using the Statistical Package for the Social Sciences (SPSS) version 12.01. In the models the presence of respiratory disorder, or not, was used as an independent variable, while as a dependent variable, age in ten-year groups, smoking history, ever smoked more than one year (yes/no), gender, were placed in the model and finally, farmer or non-farmer. We controlled for type of livestock and geographic location of the farm. An index of respiratory symptoms was calculated, combining dyspnea, wheezing, chest tightness and cough into a numeric value between 0 and 4 for the purposes of logistic regression modeling.

## Results

### Demographics

A total of 1107 of 2042 farmers responded (54%), while 689 out of 1500 (46%) individuals in the non-farmers comparison group replied. Overall, 85.4% ( $n = 946$ ) of the responding farmers reported raising livestock (sheep, cattle, poultry, or swine) as their main farming activity. Raising sheep was the most common main farming activity ( $n = 517$ , 46.7%)

and dairy farming ( $n = 193$ , 17.4%) the second most frequent. Mixed farms with sheep and dairy farming totaled 236 (21.3%) and other combinations, 161 (14.5%). The mean number of animal units per farm was 133 (sd 6.2).

Demographics are shown in Table 1. The farmer group was older than the non-farmer group ( $p < 0.0001$ ), with fewer farmers in the youngest age category and a higher number in the oldest category, but a relatively even distribution in between. When stratified by gender, smoking rates were significantly lower among farmers than among non-farmers. This was true for both current smoking ( $p = 0.026$  for men and  $< 0.0001$  for women) and for any history of smoking ( $p = 0.005$  for men and  $p < 0.0001$  for women).

## Respiratory disorders

Comparison between farmers and non-farmers is shown in Table 2. The prevalence of self-reported physician-diagnosed asthma was not significantly different between the two groups. The lifetime prevalence of asthma was 9.4% ( $n = 104$ ) among farmers compared to 10.2% ( $n = 70$ ) for non-farmers. No difference in the above prevalences related to asthma was found between farmers and non-farmers after adjusting for age, gender and smoking history (having smoked more than one year).

After adjusting for smoking history, the prevalence of self-reported physician-diagnosed chronic bronchitis and emphysema was not significantly different between farmer and non-farmer groups. Taking smoking history, age and gender into account in a logistic regression model, the prevalence of emphysema and chronic bronchitis was not different between farmers and non-farmers. The prevalence of respiratory disorders did not differ by type of farming.

## Prevalence of respiratory symptoms

Comparison between farmers and non-farmers is shown in Table 2. Nocturnal chest tightness was significantly increased in the non-farmer group. The prevalence of productive morning cough at least 3 months out of the year was also similar between both groups (5.8% vs. 5.1%), and substantially higher than the prevalence of self-reported

**Table 2** Respiratory disorders and symptoms among study participants

Disorder	Farmers, %	Non-farmers, %	<i>p</i> value
Lifetime asthma	9.4	10.2	ns
Current asthma	3.2	3.5	ns
Chronic bronchitis	3.9	4.3	ns
Emphysema	3.8	2.8	ns
Medication use	6.5	4.8	ns
<b>Symptom</b>			
Wheezing	9.4	10.6	ns
Chest tightness	7.8	12.8	<0.001
Morning cough	5.8	5.1	ns
Dyspnea	4.3	5.4	ns

ns, not significant.

physician-diagnosed chronic bronchitis (3.9% vs. 4.3%) ( $p < 0.01$ ).

A logistic regression model taking into account age, gender and smoking history found no difference between groups with regard to respiratory symptoms. There was no variation in respiratory symptoms among different regions in Iceland nor was there any difference based on type of livestock used. A total of 377 responders indicated any respiratory symptoms on the questionnaire. Using the index of respiratory symptoms as the outcome in a linear model, using age ( $p = 0.956$ ), smoking history ( $p = 0.004$ ), or gender ( $p = 0.312$ ) as exploratory variables did not identify any difference in the prevalence of respiratory symptoms between the two groups (farmer vs. non-farmer,  $p = 0.07$ ).

## Allergic disorders and symptoms

There was no difference in the frequency of physician diagnosed allergic rhinitis between the two groups, 19% for farmers vs. 20.5% for non-farmers ( $n = 185$  vs.  $n = 126$ ). However, symptoms of rhinitis were significantly less common among farmers than non-farmers, 27.1% vs. 33.3% ( $n = 266$  vs.  $n = 206$ ) ( $p = 0.008$ ). The self-reported occurrence of fever and systemic symptoms was more common among farmers than non-farmers, 8.3% vs. 3.0% ( $n = 77$  vs.  $n = 16$ ) ( $p < 0.0001$ ).

## Discussion

In this nationwide study of all Icelandic farmers we found no significant differences in the prevalence of respiratory disorders and symptoms between farmers and non-farmers. We found that smoking was less common in farmers than in the non-farmer group, which is in agreement with previous reports.<sup>5</sup>

Finding no significant difference in the prevalence of respiratory disorders between the farmers and non-farmers is contrary to previous studies.<sup>1-4</sup> The ECRHS studies found farming activities to be a significant risk factor for asthma although a relatively small number of farmers were included in the study.<sup>12</sup> The prevalence of asthma in the current study is similar to results from ECRHS in Iceland where it was 3.4%.<sup>12</sup> The prevalence is much higher for asthmatic symptoms, as

**Table 1** Demographics of study participants

	Farmers, %	Non-farmers, %	<i>p</i> value
Age >50 years	51	39	<0.001
Gender males	77	48	<0.001
Current smoking	13	20	<0.001
Current smoking (men)	14	20	<0.026
Current smoking (women)	8	22	<0.0001
Smoked >1 year	36	50	<0.001
Married or cohabitating	83	82	ns
Number of children	2.18	2.05	<0.042
<18 years	(sd 1.3)	(sd 1.13)	
Spouse works out of home	44	82	<0.001
Education elementary	43	30	<0.001

ns, not significant.

was shown in the ECRHS study.<sup>12</sup> Use of medications is also more common than diagnosis of asthma. All of these factors make it difficult to estimate what is the true prevalence of asthma and if the prevalence is rising or declining.<sup>14</sup> Previous studies on Icelandic farmers from more than two decades ago found high prevalence rates of respiratory symptoms among farmers in all age groups.<sup>10,11</sup> Cough was found in 11% compared to 5.8% in the current study and dyspnea in 7% compared to 4.3%.

The fact that there was no variation in respiratory symptoms among different regions in Iceland or based on type of livestock used would indicate that any possible improvement in respiratory health of farmers is likely to be due to factors impacting on the Icelandic farming population in general rather than regional factors. One such factor is the uniform change in Icelandic farming practices over the past two decades toward utilizing vacuum-sealed plastic wraps for storing hay. Other significant changes include increased automation, the consolidation of smaller farms into larger units and increased levels of education. While improved methods of storing hay and decreased exposure to dust with increased automation are attractive as an explanation to the findings of our study, nothing is currently known about organic dust levels in Icelandic animal farms and the potential length of exposure among farm workers. Farmers' poor respiratory health in the past has been associated with inhalation of organic dust, a complex mixture of environmental pollutants that contains a number of inflammatory mediators.<sup>1,6</sup> This is therefore an important factor to explore further.

Several studies have suggested that chronic bronchitis is more common in farmers than non-farmers and that it is a work-related disease.<sup>1</sup> We did not find this in the present study, which would suggest that the positive change in the work environment of Icelandic farmers has taken place over an extended period given the time needed to develop chronic bronchitis.

The finding of self-reported fever and systemic symptoms at work was more common in farmers than in the non-farmer group. This is not surprising as these symptoms suggest either organic dust toxic syndrome or hypersensitivity pneumonitis, both of which would be expected to be more common in the farming population.<sup>1,9</sup> Symptoms of rhinitis were significantly less common among farmers than non-farmers in the current study. This is similar to other studies.<sup>3</sup>

There are several strengths to this study. It is nationwide, with more than half of the farmers in the country involved. It is therefore a fairly large study group with good statistical power. It is also a fairly homogeneous group with most of the farmers having similar farms and using similar farming practices. The study uses questionnaires that have been standardized in the usual way.<sup>12,13</sup> All the study subjects, both farmers and non-farmers, have the same access to a nationalized health care system.

This study also has a number of weaknesses. The response rate is lower than in previous studies on European animal farmers that have up to 60–80% response rate.<sup>3,4</sup> A relatively low response rate, albeit in a study population including the whole population of farmers in Iceland, raises the possibility of under-representation of individuals with

respiratory disease in the study group or over-representation in the comparison group. Low smoking rates among farmers may result in lower prevalence of respiratory disease and a healthy worker effect may also be a factor in this study. However, a healthy worker effect would likely have been present in other studies and low smoking rates are common in farming populations.<sup>5</sup> Sending the questionnaire to participants in the wintertime and early spring might cause a potential seasonal effect. However, the questions ask about the last 12-month period, suggesting that this is less likely to be a confounding factor.

The high prevalence of respiratory disorders commonly present among the generally healthy low smoking population of agricultural workers found in numerous other studies<sup>1–4</sup> was not present in our study of all Icelandic farmers. Although the potential for bias certainly exists, this improvement may quite possibly be due to widespread changes in farming practices that have taken place over the past two to three decades. The public health implication of this finding, if supported by further studies, is considerable as the high volume of respiratory ailments historically linked with agricultural work may thus be avoided with modernization of farming practices.

## Conflict of interest statement

The authors state that there are no conflicts of interest.

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## Appendix A

Subjects answered either Yes or No to each question.

### Respiratory disorders

Have you ever had asthma?

Was this confirmed by a doctor?

Have you had an attack of asthma in the last 12 months?

Are you currently taking any medicines for asthma, including inhalers, aerosols or tablets for asthma?

Have you been diagnosed by a doctor with emphysema?

Have you been diagnosed by a doctor with chronic bronchitis?

### Respiratory symptoms

Have you had wheezing or whistling in your chest at any time in the last 12 months?

Have you woken up with a feeling of tightness in your chest at any time in the last 12 months?

Have you had an attack of shortness of breath that came on during the day when you were at rest at any time in the last 12 months?

Do you usually cough first thing in the morning in the winter?

Do you cough like this on most days for as much as three months each year?

Do you usually bring up any phlegm from your chest first thing in the morning in the winter?

Do you bring up phlegm like this on most days for as much as three months each year?

### Allergic disorders and symptoms

Have you been diagnosed by a doctor with allergic rhinitis?

Have you had runny nose, stuffy nose, sneezing without having a cold at any time in the last 12 months?

While you are working, do you ever have: fever, chills, muscle or bone pain?

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