Airway Symptoms among Farmers in Central Norway. A comparative study of risks, the HUNT Study.

Abstract

Objectives: The objective of this study was to compare the risk of developing respiratory symptoms in farmers and other occupational groups over a period of 11 to 22 years.

Methods: The study includes data from questionnaires and interviews in HUNT1-3 in The Trøndelag Health study (HUNT). In all three surveys, farmers can be identified. Two control groups are used. Control group 1 consists of all HUNT participants who are not farmers or fishermen. Control group 2 consists of occupational groups who presumably have low exposure to dust, chemicals or gases, but similar educational status as farmers. The data are analysed in SPSS 25 (IBM, Armonk NY), with use of frequency analyses and multiple binary logistic regressions.

Results: Our main finding is that healthy farmers have increased risk of developing respiratory symptoms as wheezing or breathlessness over a period of 11 and 23 years. This increased risk is statistically significant after 11 years of follow-up (HUNT1 to HUNT2), and also after 23 years (HUNT1 to HUNT3). Corresponding results regarding wheezing and breathlessness are found for healthy farmers in HUNT2 after 12 years of follow-up in HUNT3. In a subgroup analysis, we find a highly significant difference in both wheezing and shortness of breath when at work, in believing that the symptoms are caused by work, and in having to change jobs or quit because of breathing problems.

Conclusion: Farmers have more respiratory symptoms than controls, and the main symptom is attacks of wheezing or breathlessness. Preventive measures such as ventilation and respiratory protection should be implemented on the farm.

Introduction

Farmers have a variety of work tasks, dependent on type of farm. Keeping farm animals and working with grains and vegetables are some of the more exposed tasks. In their job farmers are exposed to a variety of occupational hazards, including organic dust (containing allergens, endotoxins, and other microbial matter), gases, chemicals, and diesel exhaust. Exposure varies according to the type of farming, production size, and state of buildings and equipment [1]. These exposures can lead to inflammation and damage in upper and lower airways. Work-related airway symptoms among farmers are well documented [2-5]. Farming is associated with the development of cough, wheeze, and reduced lung function, as well as respiratory diseases such as chronic obstructive pulmonary disease (COPD), asthma, and hypersensitivity pneumonitis [3,7-13]. In farming, COPD can be caused by excessive organic dust exposure, especially in farmers who work with livestock such as cattle, swine, and poultry [11,14-17]. There is also substantial evidence indicating that farmers are at an increased risk of developing asthma. Farm exposures that enhance this risk seem to be similar to COPD. Growing up on a farm tends to prevent the development of allergies [8,18], and asthma in farmers is often non-IgE-mediated [2,9,10]. However, in Finland, allergic asthma is frequent among milk-producing farmers, and it is thought that allergy to cow dandruff is due to Finnish farmers' habit of brushing their cows [10,19]. There are few studies that give the incidence of occupational asthma in farmers, but a study of incidence rates of occupational asthma from Finland in 2000, showed an incidence rate of 112cases /100 000 among men in agriculture, and 169 cases/100 000 in women. Occupational asthma in the total work force was 17.4 cases/100 000 workers. [6]. Incidence of COPD in farmers is to our knowledge not known. There are few recent studies from Norway about farmers and their respiratory health. A study from 1997 by Melbostad et al, showed that exposure factors in farming and other dust-producing occupations increased the risk of developing chronic bronchitis two- to three-fold for workers [20]. A 2001 study by Melbostad et al, showed that work-related respiratory symptoms are common in farmers and are associated with exposure to dust, fungal spores, and endotoxins [1]. A 2004 study by Eduard et al, showed that exposure to endotoxins and fungal spores appeared to have a protective effect on atopic asthma, but may induce non-atopic asthma in farmers [21]. In 2009, it was shown by Eduard et al that livestock farmers were at an increased risk of developing chronic bronchitis, COPD, and a reduced FEV1 [12].

In our country most farmers are self employed, and for them there is no mandatory occupational health service. It is therefore important to show that farm exposure can harm the airways, in order to underline the need for protective measures.

Earlier studies have mainly been cross sectional, and we have not found studies that look at the development of respiratory symptoms over time. . The objective of this study was to compare the risk of developing respiratory symptoms in farmers and other occupational groups over a period of 11 to 22 years.

Methods

The Trøndelag Health Study (HUNT) is a collaboration between HUNT Research Centre (Faculty of Medicine and Health Sciences, Norwegian University of Science and Technology NTNU), Trøndelag County Council, Central Norway Regional Health Authority, and the Norwegian Institute of Public Health. It is a longitudinal, population-based health study in Central Norway. In the region of North-Trøndelag, data had been collected in HUNT1 (1984–86), HUNT2 (1995–97), HUNT3 (2006–08) and HUNT4 (2017–19), through extensive

questionnaires and clinical examinations. In HUNT4, questionnaire data were also collected in the region of South-Trøndelag.

This study includes data from questionnaires and interviews collected in HUNT1, 2, and 3.

All inhabitants of North-Trøndelag aged ≥ 20 years were invited to participate in the health study, and the participation rate was 89.4% (N = 77205) in HUNT1, 69.5% (N = 65232) in HUNT2, and 54.1% (N = 50805) in HUNT3.

All three surveys contained questions about occupation, the most detailed being in HUNT3; farmers can be identified as participants in all three surveys. In HUNT1 and HUNT2, the participants indicated which one of 9 (HUNT1) or 10 (HUNT2) occupational categories they belonged to. The category identifying farmers was "farmer or forester" in both HUNT1 and HUNT2. Most foresters in the surveyed area were both farmers and foresters, thus we refer to this whole category as "farmers". In HUNT2, the option to select more than one occupation was available, and some farmers claimed other occupations in addition to farming. We have included every participant claiming the occupation of farmer, regardless of other occupations, as we assumed that they all received hazard exposure as farmers. Farmers who participated in the other surveys might also have had occupations outside of farming, but we did not have access to this information. In HUNT3, the participants were asked about their occupation in interviews at field stations, and occupations were categorized into Statistics Norway's "Standard classification of occupations" from 1998 (STYRK-98). STYRK-98 is based on ISCO-88 (COM) [22], in which occupations are classified in a seven-digit system, where the first digit represents a main group based on level of education, and the following digits specify the occupation. Farmers are easily identified by first digit, 6. We chose to include all farmers working with crops (i.e., grains, vegetables, and fruit), and all farmers working with domestic animals (mainly cattle, pigs, and poultry); many farmers worked with both crops and animals.

We included two control groups: control group 1 (main control group) consisted of all HUNT participants that were neither farmers nor fishermen; control group 2 consisted of occupational groups that had presumably low exposure to dust, chemicals, or gases, but had a similar level of education as farmers. In HUNT1 and HUNT2, this included "non-professional occupation" (shop, office, public services) and "lower professional occupation" (nurse, technician, teacher), while in HUNT3 it included "technicians and associate professionals" (first digit, 3) and "clerks" (first digit, 4). If a HUNT2 participant in a control group was also a farmer, they were excluded from the control group.

Questionnaires

In all three surveys, the participants were sent a questionnaire (Q1) by mail prior to visiting the field stations, and the questionnaire was collected upon arrival. The second questionnaire (Q2) was delivered to all participants at the examination site and was returned in a prepaid envelope. The questions regarding occupation in HUNT1 and 2 can be found in Q2. In HUNT1, there were fewer variables regarding airway symptoms than in HUNT2 and 3. Additional questionnaires used on a subgroup of participants in HUNT2 and 3 contained more detailed questions about symptoms, diagnoses, and medications, and also about symptoms related to occupation [23].

A description of the questionnaires and interviews used is given in Table 1.

When not noted otherwise, the questions used in the analyses were from Q1 and Q2, asked to all participants. Table 2 shows a description of the variables used in the analyses.

Airway symptoms and symptoms of Asthma and COPD are self reported.

Statistics

The data were analyzed in SPSS 25.0 (IBM Corp., Armonk, N.Y., USA), with use of frequency analyses and multiple binary logistic regressions. All regressions were adjusted for gender, age at participation, and smoking burden (number of pack years smoked until time of participation). Both crude and adjusted results are given.

Logistic regression was used to investigate the differences between respiratory symptoms among farmers and controls, and the differences in development of work-related respiratory symptoms among the same groups. . Farmers and members of the control group without respiratory symptoms in HUNT1 were identified in the prospective cohort study, and the risk of developing respiratory symptoms after 11 years (HUNT2) and 23 years (HUNT3) was analyzed by logistic regression. All healthy farmers and controls were also identified in HUNT2. In HUNT3, the association between being a healthy farmer or control in HUNT2 and having respiratory symptoms 11 years later was similarly analyzed by logistic regression with the same adjustments. For the analysis of work-related symptoms, healthy farmers and members of control group 1 in HUNT1 are identified in subgroups in HUNT2 and HUNT 3 (see Table 1). Farmers and controls in these subgroups are compared regarding their work-related symptoms and their risk of needing to change jobs.

Results

Table 3 shows basic demographics and the prevalence of respiratory symptoms. The farmer groups are smaller than the control groups, and they include fewer females, older participants, and more non-smokers.

Table 4 shows the prevalence of cough in farmers and controls. Farmers were more likely than members of control group 1 to report daily cough in HUNT2; likewise, farmers were more likely than members of control group 2 to report morning cough in HUNT1 and daily cough in HUNT2.

Table 5 shows the development of respiratory symptoms from HUNT1 to HUNT2 and HUNT3. Farmers and members of control group 1 (without morning cough in HUNT1) were analysed regarding the presence of airway symptoms after 11 years (HUNT2) and 23 years (HUNT3). We found that more farmers than controls developed attacks of wheezing or breathlessness in HUNT2 and HUNT3. When analysing the smaller, less exposed control group 2, we found a similar increase in reports of attacks of wheezing in farmers in HUNT2 (OR 1.36 [1.21–1.53]), and HUNT3 (OR 1.41 [1.25–1.59]). Compared with control group 2, more farmers in HUNT3 reported daily cough (OR 1.15 [1.02–1.30]) or asthma (OR 1.18 [1.02–1.37]), took medications for asthma, chronic bronchitis, or COPD (OR 1.19 [1.02–1.39]), and had chronic bronchitis, emphysema, or COPD (OR 1.33 [1.02–1.72]).

Table 6 shows the likelihood of symptom development in farmers compared with members of control group 1 from HUNT2 to HUNT3. Except for an increased risk of wheezing, no other significant associations were found.

Table 7 shows the reports of job-related respiratory symptoms in HUNT2 and HUNT3, comparing farmers without cough with members of control group 1 without cough. In HUNT2, farmers were more likely to report wheezing or breathlessness at work, and were also more likely to change jobs due to respiratory symptoms; in HUNT3, farmers were more likely to report work-related respiratory symptoms, and to report that their respiratory symptoms were caused by work.

Discussion

Healthy farmers (without cough) were more likely to develop respiratory symptoms such as cough and attacks of wheezing or breathlessness when compared with healthy controls. These differences are statistically significant after 11 years of follow-up (HUNT1 to HUNT2); in comparison, after 23 years of follow-up (HUNT1 to HUNT3) a similar tendency was found, but differences were statistically significant only for attacks of wheezing. Corresponding results regarding wheezing and breathlessness were found for healthy farmers in HUNT2 after 12 years of follow-up in HUNT3. Farmers were more likely to report asthma than members of control group 2, in which participants had less exposure to occupational hazards. In the subgroup analysis, we found that there were significant differences when it came to reporting wheezing and shortness of breath at work, believing that the symptoms were caused by work, and having to change jobs or quit work because of breathing problems.

Reports of respiratory symptoms were higher at 11 years follow-up than at 23 years. This finding could be a result of farmers who experienced cough quitting their occupation before HUNT3. It could also be influenced by the improvement of working conditions to decrease exposure to hazards prior to HUNT3 [24].

Increased reports of wheezing among farmers have previously been reported [8]. Growing up on a farm has been reported to decrease the risk of allergic asthma and rhinitis [25] — this does not, however, mean that the farm environment protects against upper and lower airway disease. Wheezing may be caused by the stimulation of innate immune mechanisms by microbial agents [8], and a diagnosis of work-related asthma or rhinitis should not be overlooked because of negative allergy test. We assume that the increased reports of wheezing among farmers is a symptom of asthma. When asked specifically about asthma, our results did not suggest an increase in reports, but this can be partly explained by underdiagnosing, either due to patients' low likelihood of seeking medical care, or doctors' lack of awareness of asthma. Farmers may not visit their doctors often as the potential for sick leave, change of work, or compensation for occupational disease is low. It may also be that some asthmatic farmers already have quit their jobs before participating, meaning that it is not reported in our study.

In this study, we used data from the North-Trøndelag Health (HUNT) study, and farmers were identified in the first three waves of the study (HUNT1, 2 and 3). A strength of the studies is that farmers can be followed through all three waves, thus providing an accurate picture of the development of respiratory symptoms throughout a farmer's career. The HUNT studies also have a good response rate. The region of North-Trøndelag is mainly rural, with only five small cities of 15,000–24,000 inhabitants in 2021 [26]. We therefore assume good external validity of these results for other rural areas in Norway.

The questions used in the surveys have been used in other Nordic epidemiologic studies, such as the Hordaland County Respiratory Health Study (HCRHS) [27] and Obstructive Lung Disease in Northern Sweden (OLIN) [28]. In HUNT1, there are few questions about respiratory symptoms, and no questions about work-related symptoms; there are more questions about occupation and about respiratory symptoms in HUNT2 and HUNT3, but they

are not identical. Nonetheless, the study provides valuable information about farmers' respiratory health in general, and about respiratory symptoms related to their work.

Because of the lack of detailed data on respiratory health in HUNT1, our definition of "healthy" farmers and controls from that study is represented by participants who answered "no" to the question, "Do you normally cough in the morning?" This definition is broad and may include participants with other respiratory symptoms. We consider the results to still be of interest because the same definition is used for both farmers and controls.

When comparing healthy farmers and controls between HUNT2 and HUNT3, we were able to define "healthy farmer" more precisely, as there were more data on airway symptoms in HUNT2 than in HUNT1. Farmers in HUNT2 were younger and we assumed that the working conditions had improved over time; however, we still saw an increase in reports of wheezing in these farmers, which strengthens our findings.

We chose to use non-farmers as our main control group in each survey. Because farmers and fishermen were both in the same STYRK group in HUNT3, we omitted fishermen from control group 1 in HUNT1 and 2 as well; the total number of fishermen is small, so we did not think this omission would impact the results. Control group 1 included all other occupations, including many occupations with hazard exposure; however, the observed differences in the reports between farmers and the control group strengthen our results. Additionally, in some of the analyses, we analyzed reports of airway symptoms from a control group with presumably less hazard exposure (control group 2) — as expected, the findings were strengthened.

As noted earlier, farmers in HUNT2 may have had other occupations. Farmers from both HUNT2 and HUNT3 are included in Table 6, and as the definition of farmer in HUNT3 is more specific, there is reason to believe that all farmers in this analysis were active farmers.

The questions about work were given only to subgroups including participants reporting respiratory symptoms, disease, or the use of medication. Some random participants are also included in these subgroups. The subgroups are somewhat different in HUNT2 and HUNT3, hence the answers cannot be compared; however, the results in each wave can be analyzed separately. The subgroup in both HUNT2 and HUNT3 contained a high proportion of participants with asthmatic complaints, but this observation was the same for both farmers and controls, we therefore mean that the results are interesting. In HUNT2, the farmer group showed a significant increase in the association between reports of wheezing or shortness of breath in connection to work and needing to change jobs or quit work because of breathing problems. This relationship must take into consideration that many of these farmers may also have had other occupations, and that the reason for quitting work or having shortness of breath may also have been due to other exposures. Nonetheless, the finding that many farmers had to quit work is concerning. In HUNT3, where the definition of farmers was more specific, the farmer group was significantly more likely to report respiratory problems in connection with work. A significantly higher proportion answered that they think their respiratory problems are caused by their job. We believe that these findings strongly support our conclusion that farmers in HUNT have more respiratory symptoms than members of control groups, and that the respiratory problems are therefore related to farm work. Farming has changed over the last 20 years, with fewer farmers, larger farms, and presumably better working conditions. Our findings suggest that respiratory symptoms are still prevalent among farmers, and that preventive measures are needed. Improving work conditions in order to protect farmers' health should be considered just as important as taking care of the farm animals. This is often not the case. Advisory services with regard to farmers' working

environment should be made available to the same extent as adviing all other aspects of the farm work. An occupational health service for farmers exists, but ought to be mandatory and be made affordable for all farmers. Improving buildings, ventilation, safety measures is important, and if needed, correct use of respiratory protection.

Conclusion

Farmers reported more respiratory symptoms than controls, and the main symptoms that they reported were attacks of wheezing and breathlessness. Preventive measures are needed.

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