AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 46:396–399 (2004)

Brief Report

Atopic and Non-Atopic Asthma in a Farming and a General Population

Wijnand Eduard, PhD, MSc,[1]* Ernst Omenaas, MD, PhD,[2] Per Sigvald Bakke, MD, PhD,[2] Jeroen Douwes, PhD, MSc,[3,4] and Dick Heederik, PhD, MSc[4]

Background *In a previous study inverse associations between asthma and exposure to fungal spores and endotoxins in atopic farmers and positive associations with the same factors in non-atopic farmers were documented. No external reference population had been included. We, therefore, compared this farming population with the general population from an adjacent region.*

Methods *Random samples of a farming (n = 2,106) and a rural (n = 351) and urban (n = 727) general population were selected. Atopy was assessed by serum IgE and asthma by questionnaires.*

Results *The asthma prevalence was 4.0% among farmers, 5.7% in the rural, and 7.6% in the urban population. Atopy was similar (9–10%). Most asthmatics were not atopic, 67–75%. Farmers had asthma less often than the general population OR 0.52 (95% CI 0.36–0.75); both atopic (OR 0.33 (95% CI 0.15–0.69)) and non-atopic asthma (OR 0.60 (95% CI 0.39–0.93)).*

Conclusion *This may indicate a protective effect of the farm environment on asthma but a healthy worker effect may also play a role.* Am. J. Ind. Med. 46:396–399, 2004.

KEY WORDS: farmers; asthma; atopy; endotoxins; fungal spores

BACKGROUND

Recent publications have drawn attention to a possible protective effect from growing up on a farm on atopy and asthma in children [Braun-Fahrländer et al., 1999; Riedler et al., 2000; von Ehrenstein et al., 2000; Downs et al., 2001]. It has been speculated that contact with livestock may play an important role probably through respiratory exposure to endotoxins [Lewis, 2000]. Recently significant inverse associations between indoor endotoxin levels and the occurrence of hay fever, atopic asthma, and atopic sensitization have been shown among children living in rural areas [Braun-Fahrländer et al., 2002]. Studies of adult farmers have shown both higher [van Hage Hamsten et al., 1987; Iversen and Pedersen, 1990; Omland et al., 1999; Vogelzang et al., 1999] and lower [Blainey et al., 1988; Iversen et al., 1988; Toren, 1996; Fishwick et al., 1997] occurrences of asthma than in general populations. Exposure data were insufficient to assess the role of biological agents in most of these studies. We found in a previous study of adult farmers inverse associations between animal tending and exposure to fungal spores and endotoxins and the asthma prevalence in atopic subjects whereas the same factors were positively associated

[1]National Institute of Occupational Health, Oslo, Norway
[2]Institute of Medicine, University of Bergen, Norway
[3]Centre for Public Health Research, Massey University, Wellington, New Zealand
[4]Institute for Risk Assessment Sciences, Universiteit Utrecht, The Netherlands
Presented at the 4th Skokloster Workshop Conference: Organic Dusts—Agents, Disease and Prevention, Gothenborg, Sweden, April 7–10, 2003.
*Correspondence to: Wijnand Eduard, National Institute of Occupational Health, Oslo, Norway, P.O. Box 8149 Dep., 0033 Oslo, Norway. E-mail: Wijnand.Eduard@stami.no

Accepted 23 July 2004
DOI 10.1002/ajim.20088. Published online in Wiley InterScience (www.interscience.wiley.com)

with asthma in non-atopic subjects [Eduard et al., 2004]. These findings suggest a protective effect of the farm environment on the development of atopic asthma. However, the same exposures may increase the risk for non-atopic asthma. These findings are based on internal comparisons and it is not known if the asthma prevalence in the farming population differs from the general population. We compared atopic and non-atopic asthma in this farming population [Melbostad et al., 1998] with the general population from an adjacent region which had been studied 3 years earlier [Bakke et al., 1991].

MATERIALS AND METHODS

Random stratified samples of a farming population in South-East Norway (n = 2,106) and the general population in South-West Norway (727 subjects from an urban area and 351 subjects from a rural area) with complete data age 21–69 years were included. These populations had been studied independently in 1991 and 1988, respectively [Bakke et al., 1991; Melbostad et al., 1998]. Farmers who had retired during the preceding 4 years (n = 84) were studied separately to evaluate selection out of the population. Subjects working on farms were excluded from the general population. Atopy was assessed by RAST for IgE to birch, timothy, and house dust mites in serum samples (Pharmacia Diagnostics, Uppsala, Sweden).

Asthma, age, gender, and smoking habits were recorded by self-administrated questionnaires. The asthma question answered by the general population was: ''Have you ever been treated by a physician or in hospital because of asthma?'' The farming population answered the following questions: ''Have you had asthma in the past or now?'' with the follow-up question ''Was asthma diagnosed by a physician?'' The characteristics of the populations are summarized in Table I.

Logistic regression analysis was used to compare the prevalence of asthma and atopy in the populations. Subjects in the farming population were weighted using the reciprocal sampling fractions as weights. Age was categorized in quartiles. The populations were stratified by atopy status in

TABLE I. Characteristics of the General Population of South-West Norway and the Farming Population in South-East Norway

Characteristic	Farming population[a] (n = 2,106)	General population	
		Urban (n = 727)	Rural (n = 351)
Age (year)[b]	46 (10)	43 (14)	42 (14)
Gender			
Female	35%	47%	51%
Male	65%	53%	49%
Smoking			
Never	47%	52%	52%
Former	23%	19%	19%
Current	31%	29%	29%
Specific IgE to			
Birch	3.5%	3.7%	5.4%
Timothy	5.4%	5.1%	4.8%
House dust mite[c]	2.2%	4.1%	4.3%
Atopy: at least one positive IgE test against birch, timothy, or house dust mite	8.9%	10.0%	9.4%
Asthma			
Ever treated for asthma by a physician or in hospital		7.6%	5.7%
Ever asthma diagnosed by a physician	4.0%		
Atopic asthma[d]	1.0%	2.5%	1.7%
Non-atopic asthma[d]	3.1%	5.1%	4.0%

[a]Data adjusted for stratified sampling of the source population.
[b]Arithmetic mean and standard deviation of the population.
[c]*Dermatophagoides farinae* in the general population and *D. pteronysinus* in the farming population.
[d]Asthma defined as physician diagnosed/treated asthma and atopy by any of three specific allergens.

models of atopic and non-atopic asthma in order to evaluate atopy as an effect modifier. The model fit was assessed by the Hosmer–Lemeshow test.

Statistical analyzes were performed by SPSS 9.0 for Windows (SPSS, Inc., Chicago, IL, 1997).

RESULTS

The asthma prevalence was lower in the farming population than in the rural and in the urban general population (4.0, 5.7, and 7.6%, respectively). Atopy was more similar (8.9–10.0%). Most asthmatic subjects were not atopic (67–75%).

Asthma in the farming population was significantly lower than in the urban population after adjustments for possible confounders by logistic regression OR 0.52 (95% CI 0.36–0.75) whereas minor differences were found for atopy. Separate analyzes among atopic and non-atopic subjects showed that the asthma prevalence was reduced among farmers in both groups but the decrease was larger among atopics, ORs 0.33 (95% CI 0.15–0.69) and 0.60 (95% CI 0.39–0.93), respectively (Table II).

A small number of the farmers (2.9%) had retired during the preceding 4 years. The asthma prevalence in his group was 8.3% but asthma was not significantly elevated after adjustment for age, gender, and smoking, OR 1.4 (95% CI 0.83–2.4).

DISCUSSION

This study shows that asthma, both atopic and non-atopic, was less common in adult farmers compared with the general population, especially the general urban population. No clear differences in atopy prevalence were found between the farming and general population.

The studies of farming and the general population [Bakke et al., 1991; Melbostad et al., 1998] have some methodological differences as questions on asthma were not identical, different house dust mite allergens were used, the populations were from different regions and the studies had been carried out 3 years apart. However, the asthma questions answered by the farmers (asthma diagnosis by a physician) probably included more subjects than the question answered by the general population (treatment for asthma). This may have resulted in an overestimation of the asthma prevalences in the farming population and an underestimation of the differences between the populations. Although some of the observed differences between the populations may be due to methodological differences it seems unlikely that this can explain the substantially lower prevalence of atopic asthma found in farmers.

TABLE II. Comparisons of Asthma, Atopy, Atopic Asthma, and Non-Atopic Asthma in General Rural and Urban Populations and a Farming Population* Adjusted for Age, Gender, and Smoking by Logistic Regression, Norway

	Odds ratio (95% CI)			
Factor	**Asthma**	**Atopy**	**Asthma in atopic subjects**	**Asthma in non-atopic subjects**
Age				
21–34	1	1	1	1
35–44	0.95 (0.58–1.6)	0.62 (0.46–0.85)	1.4 (0.60–3.1)	0.98 (0.53–2.0)
45–54	1.0 (0.61–1.7)	0.39 (0.27–0.56)	1.4 (0.50–3.9)	1.3 (0.69–2.6)
55–69	1.7 (1.1–2.7)	0.26 (0.17–0.40)	1.5 (0.46–4.7)	2.7 (1.5–4.8)
Gender				
Female	1	1	1	1
Male	0.96 (0.69–1.4)	0.95 (0.74–1.2)	0.69 (0.33–1.4)	1.1 (0.77–1.7)
Smoking				
Never	1	1	1	1
Former	1.6 (1.1–2.5)	0.81 (0.58–1.1)	1.8 (0.77–4.4)	1.8 (1.1–3.0)
Current	1.7 (1.2–2.5)	0.69 (0.51–0.92)	1.7 (0.78–3.6)	2.0 (1.3–3.1)
Population				
Urban	1	1	1	1
Rural	0.77 (0.45–1.3)	0.89 (0.58–1.4)	0.74 (0.26–2.1)	0.82 (0.44–1.6)
Farming	0.52 (0.36–0.75)	1.0 (0.76–1.4)	0.33 (0.15–0.69)	0.60 (0.39–0.93)

*Weighted for stratified sampling of the source population adjusted for age, gender, and smoking by logistic regression.

Selection effects are particularly important in occupational studies. The participation rates in both studies were high (79–84%) limiting the potential for non-response bias. A ''healthy farmer effect'' by retirement of farmers because of health reasons is expected to be minor because the OR of asthma in retired farmers was only moderately elevated. Selection into the population seems likely, however, because in Norway the first-born child in a farmers' family has the right to inherit the farm and asthmatic children are more likely not to use that right. We have only anecdotic information on this, however. Such selection is probably stronger for atopic asthma than non-atopic asthma because the latter increases more with age. This is in agreement with the relatively larger decrease observed for atopic asthma. Thus, the lower prevalences of atopic and non-atopic asthma may at least in part be explained by selection into the farming population.

The combination of selection effects and both positive and negative effects of exposure to fungal spores and endotoxins on non-atopic and atopic asthma [Eduard et al., 2004] may possibly explain both lower and higher asthma prevalences found in other studies of farmers depending on the strength of the selection effects and the exposure levels.

As these factors are mainly not discussed in most farmer studies there is clearly a need for further studies with better information on selection effects, childhood exposure, and exposure during farm work to elucidate the role of bioaerosol exposure on atopy and asthma in farmers.

CONCLUSIONS

The prevalence of asthma in an adult farming population from South-East Norway was lower than in a general population from South-West Norway. Both atopic and non-atopic asthma were less common among farmers, but atopy was similar. Selection and specific farming exposures may explain these findings, but it is not clear to what extent.

REFERENCES

Bakke P, Eide GE, Hanoa R. 1991. Occupational dust or gas exposure and prevalences of respiratory symptoms and asthma in a general population. Eur Respir J 4:273–278.

Blainey AD, Topping MD, Ollier S, Davies RJ. 1988. Respiratory symptoms in arable farm workers: Role of storage mites. Thorax 43:697–702.

Braun-Fahrländer C, Gassner M, Grize L, Neu U, Sennhauser FH, Varonier HS, Vuille JC, Wutrich B. 1999. Prevalence of hay fever and allergic sensitization in farmers' children and their peers living in the same rural community. Clin Exp Allergy 29:28–34.

Braun-Fahrländer C, Riedler J, Herz U, Eder W, Waser M, Grize L, Maish S, Carr D, Gerlach F, Bufe A, Lauener RP, Schierl R, Renz H, Nowak D, von Mutius E. 2002. Environmental exposure to endotoxins and its relation to asthma in school-age children. N Engl J Med 347: 869–877.

Downs SH, Marks GB, Mitakakis Z, Leuppi JD, Car NG, Peat JK. 2001. Having lived on a farm and protection against allergic diseases in Australia. Clin Exp Allergy 31:570–575.

Eduard W, Douwes J, Omenaas E, Heederik D. 2004. Do farming exposures cause or prevent asthma? Results from a study of adult Norwegian farmers. Thorax 59:381–386.

Fishwick D, Pearce N, D'Souza W, Town I, Armstrong R, Kogevinas M, Crane J. 1997. Occupational asthma in New Zealanders: A population-based study. Occup Environ Med 54:301–306.

Iversen M, Pedersen B. 1990. The prevalence of allergy in Danish farmers. Allergy 45:347–353.

Iversen M, Dahl R, Korsgaard J, Hallas T, Jensen EJ. 1988. Respiratory symptoms in Danish farmers: An epidemiological study of risk factors. Thorax 43:872–877.

Lewis SA. 2000. Animals and allergy (Editorial). Clin Exp Allergy 30:153–157.

Melbostad E, Eduard W, Magnus P. 1998. Determinants of asthma in a farming population. Scand J Work Environ Health 24:262–269.

Omland Ø, Sigsgaard T, Hjort C, Pedersaen OF, Miller MR. 1999. Lung status in young Danish rurals: The effect of farming exposure on asthma-like symptoms and lung function. Eur Respir J 13:31–37.

Riedler J, Eder W, Oberfeld G, Schreur M. 2000. Australian children living on a farm have less hay fever, asthma, and allergic sensitization. Clin Exp Allergy 30:194–200.

Toren K. 1996. Self-reported rate of occupational asthma in Sweden 1990–92. Occup Environ Med 53:757–761.

van Hage Hamsten M, Johansson G, Zetterström O. 1987. Predominance of mite allergy over allergy to pollens and animal dander in a farming population. Clin Exp Allergy 17:417–423.

Vogelzang PFJ, van der Gulden JWJ, Tielen MJM, Folgering H, van Schayk CP. 1999. Health-based selection for asthma but not for chronic bronchitis in pig farmers: An evidence based hypothesis. Eur Respir J 13:187–189.

von Ehrenstein OS, von Mutius Illi S, Baumann L, Bohm O, von Kries R. 2000. Reduced risk of hay fever and asthma among children of farmers. Clin Exp Allergy 30:187–193.