

SHORT REPORT

Health-based selection for asthma, but not for chronic bronchitis, in pig farmers: an evidence-based hypothesis

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ABSTRACT: In cross-sectional surveys among pig farmers an elevated prevalence of chronic bronchitis is usually reported, but not of asthma, despite many factors promoting the manifestation of asthma.

To investigate this apparent contradiction a postal questionnaire survey was performed among 239 pig farmers and 311 rural controls.

Pig farmers reported an elevated prevalence of symptoms of chronic bronchitis (20.2 versus 7.7%, $p < 0.001$), but not of asthma (5.9 versus 5.5% for chest tightness). Among pig farmers the use of disinfectants (prevalence odds ratio (POR) 9.4, 95% confidence interval (CI) 1.6–57.2 for quaternary ammonium compounds) and aspects of the disinfecting procedure were associated with the prevalence of asthma symptoms. Compared with controls, pig farmers reported fewer allergies to common allergens (4.6 versus 14.6%, $p < 0.001$ for pollen) and fewer symptoms of atopy in childhood (9.9 versus 17.2, $p < 0.05$ for one or more of four symptoms). Atopy in childhood was strongly associated with the prevalence of asthma symptoms (POR 4.1, 95% CI 2.2–7.7), but not with chronic bronchitis.

Health-based selection of nonasthmatics for pig farming, which tends to mask a work-related hazard for asthma, is offered as an explanation for these results.

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Indoor confinement of pigs leads to high levels of air pollutants within the buildings, including toxic and irritant gases and dust, with toxins from micro-organisms and antigens from the pigs [1–5]. Pig farmers spend many hours each day in this environment, often raising pollutant levels by their presence through increased activity of the pigs. The exposure to dust and gases leads to an increased prevalence of chronic bronchitis [6]. Considering the abundance of environmental factors and the frequent use of disinfectants [7, 8] that will make a predisposition to asthma (e.g. atopy) evolve into clinically manifest asthma, a high incidence of asthma would also be expected. However, most studies reported an elevated prevalence of chronic bronchitis only, and not of asthma [6–7, 9]. Therefore, a questionnaire survey was conducted to compare a group of pig farmers with nonfarming controls. The hypothesis was that for pig farming there is a negative health-based selection bias for asthma, but not for chronic bronchitis.

Subjects and methods

Design and population

The pig farmers were a nationwide random selection of 400 of those registered as such with the Animal Health Service in the Netherlands. From every village with enlisted pig farmers, an approximately equal number of controls was selected at random and enlisted by telephone if they met the same inclusion criteria as the pig farmers:

male, working or studying, and between 18 and 65 yrs of age. Controls were eligible only if they were working in a nonagricultural job. The questions on eligibility were answered by 641 possible controls. The number meeting the inclusion criteria was 397, of whom 368 agreed to complete a questionnaire.

Questionnaire

The questionnaire contained questions on chronic respiratory symptoms, adapted from the British Medical Research Council questionnaire, and questions on allergies, history of atopy during childhood, atopy in the family and personal characteristics.

Based on the questionnaire responses, cases were classified for: chronic bronchitis, defined as "productive cough on most days of at least 3 months in each of the last 2 years"; and asthma symptoms, defined as at least one positive answer to the questions regarding wheezing for more than 1 week ("Did you have a wheezing chest for more than one week in the last 2 years?"), or chest tightness ("Did you ever have attacks of chest tightness (asthma)?"). This formed an indication for the presence of chronic bronchitis and/or asthma; no clinically confirmed diagnoses of disease were used.

The questionnaire for the pig farmers contained additional questions on aspects of the procedure used for disinfecting, identified in earlier studies as risk factors for chronic respiratory disease [7, 8]. The questionnaire had

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additional questions on occupation and level of education, in order to check for a representative sample of the rural work force. The response rate was 67% for pig farmers and 85% for controls. After exclusion of ineligible respondents, the number used in the analysis was 239 pig farmers and 311 controls. The response rate was higher among controls as they had already agreed during the telephone contact to co-operate.

Analysis

Differences between groups were compared using Chi-squared and t-test statistics. Associations between aspects of disinfecting and the prevalence of asthma symptoms were studied using logistic regression models. Pack-yr's of smoking were defined as the number of years smoked multiplied by the average number of cigarettes per day and divided by 25.

Results

Personal characteristics

The mean age of pig farmers (41.0 yrs) and controls (41.9 yrs) was comparable. Farmers smoked fewer cigarettes than controls (6.8 versus 9.1 pack-yr's). The distribution of the highest level of education of controls was comparable with that of the total work force as reported by the Dutch Central Bureau of Statistics. Compared with controls, those with lower professional education (31 versus 25%) or middle professional education (54 versus 32%) were over-represented among pig farmers. Ninety-six per cent of the pig farmers and 35% of the controls had lived on a farm during at least part of their childhood.

Respiratory symptoms

Chronic cough and chronic bronchitis were much more prevalent among pig farmers than among controls, whereas asthma symptoms were relatively sparse (fig. 1). Among

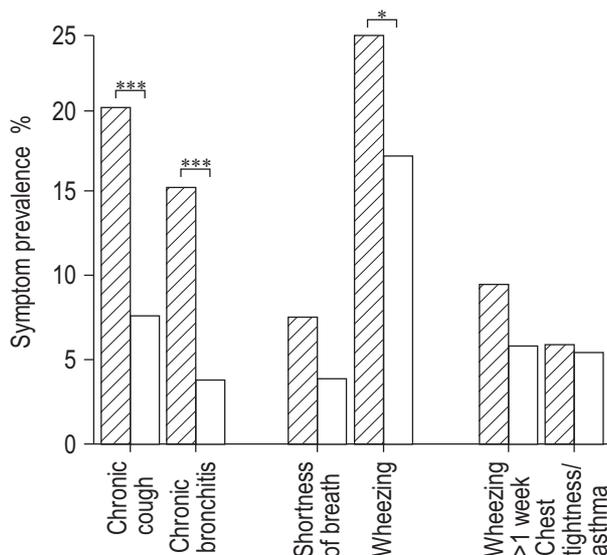


Fig. 1. – Prevalence of chronic respiratory symptoms among 239 pig farmers (▨) and 311 nonfarming neighbourhood controls (□). *: p<0.05; ***: p<0.001.

Table 1. – Univariate associations between aspects of the disinfecting procedure and the prevalence of asthma symptoms (wheezing >1 week and/or chest tightness) in 239 pig farmers

Diagnosis	POR	95% CI
Principal component		
Quaternary ammonium compounds versus none	9.4	1.6–57.2
Other components versus none	4.7	1.1–20.4
Duration of application		
>5 min versus <5 min or none	3.8	1.7–9.0
Pressure applied		
>100 kPa versus <100 kPa or none	2.5	0.9–6.9

Data are shown as prevalence odds ratios (POR) with 95% confidence interval (CI), adjusted for age and pack-yr's of smoking.

pig farmers the use of disinfectants and aspects of the disinfecting procedure were associated with the prevalence of asthma symptoms (table 1).

The total number of pig farmers and controls reporting one or more allergies were nearly equal, but the distribution was significantly different (fig. 2). Pig farmers reported fewer allergies to all of the common allergens. As a matter of course, they were the only group to report allergies to confinement-related materials.

Equally striking was the difference in atopic symptoms during childhood (fig. 3). Pig farmers reported lower prevalences of hay fever, asthma and asthmatic bronchitis than controls in their childhood. After adjustment for age and pack-yr's of smoking, the prevalence of one or more symptoms of atopy in childhood was strongly associated with the prevalence of asthma symptoms (prevalence odds ratio (POR) 4.1, 95% confidence interval (CI) 2.2–7.7). This association was the same among pig farmers and controls. Atopy in childhood was not associated with chronic bronchitis. Comparable differences were found for atopy in the family. One or more atopic diseases in parents or siblings were reported by 27% of pig farmers and 38%

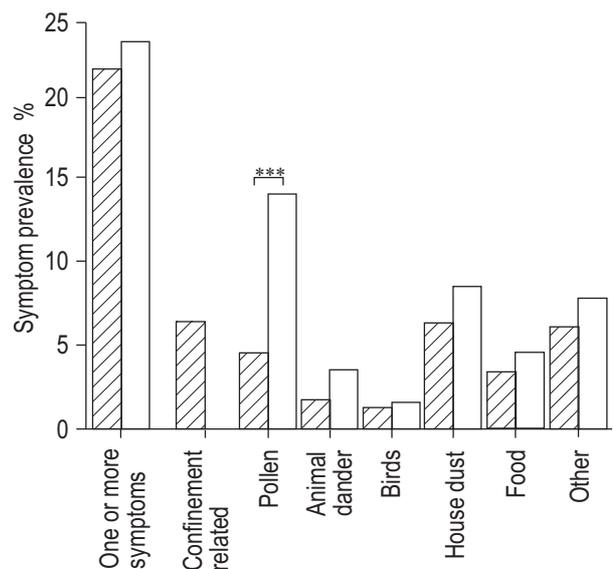


Fig. 2. – Prevalence of symptoms of allergy among 239 pig farmers (▨) and 311 nonfarming neighbourhood controls (□). ***: p<0.001.

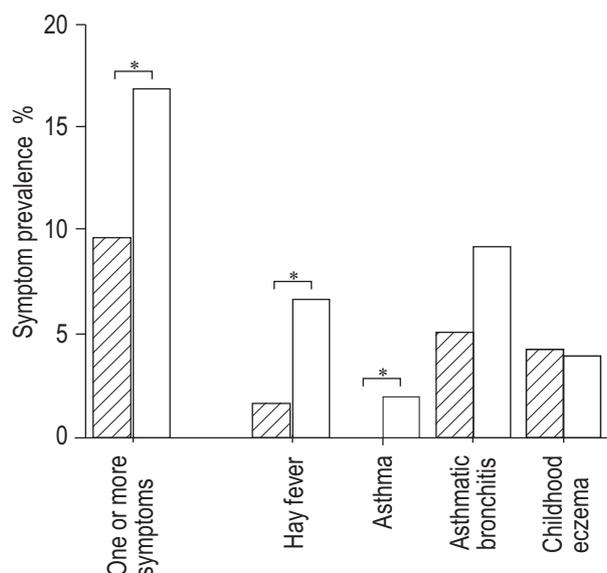


Fig. 3. – Prevalence of symptoms of atopy among 239 pig farmers (▨) and 311 nonfarming neighbourhood controls (□). *: $p < 0.05$.

of controls ($p < 0.05$). The association with asthma symptoms was less strong (POR 2.1, CI 1.1–3.9).

The results remained the same when analyses were repeated including only pig farmers and controls with lower or middle professional education. This excludes a potential confounding effect of socioeconomic status. When only pig farmers and controls with a childhood on a farm were compared, the pattern remained the same, *i.e.* more chronic symptoms, fewer symptoms of allergy to common allergens and fewer symptoms of atopy in childhood in pig farmers than in controls.

Discussion

In this study an increased prevalence of chronic bronchitis was seen among pig farmers compared with controls. The prevalence of asthma symptoms was not increased, despite the fact that pig farmers were exposed to disinfectants associated with an increased prevalence of asthma symptoms. At first sight, these findings confirm the absence of an elevated prevalence of asthma symptoms, despite the abundance of factors promoting its development. This absence, however, may not be real. One would expect the prevalence of asthma symptoms to be lower than it is, in view of the fact that the pig farmers reported fewer symptoms of atopy in childhood and of allergy to common allergens than controls. This suggests a mechanism of vocational selection as an explanation for this phenomenon. Childhood symptoms of atopy can act as a

strong incentive not to choose an occupation with a high exposure to airborne irritants. Alternatively, if young pig farmers should develop symptoms of wheezing and chest tightness, this may very well be dramatic enough to change their career early in working life. However, the exposure of pig farmers results in a roughly equal prevalence. As symptoms of cough and phlegm in chronic obstructive bronchitis normally develop gradually and far less dramatically than those of asthma, an elevated prevalence of chronic bronchitis in pig farmers is usually found, in contrast to that of asthma, in cross-sectional surveys.

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References

1. Donham KJ. Respiratory disease hazards to workers in livestock and poultry confinement structures. *Sem Respir Med* 1993; 14: 49–59.
2. Donham KJ, Scallon LJ, Pependorf W, Treuhaft MW, Roberts RC. Characterization of dusts collected from swine confinement buildings. *Am Ind Hyg Assoc J* 1986; 47: 404–410.
3. Virtanen T, Kalliokoski P, Vilhunen P, Taivainen A, Mäntyjärvi R. Concentrations of specific dusts in swineries and the humoral response of swinery workers. *Allergy* 1990; 45: 1–9.
4. Crook B, Robertson JF, Travers Glass SA, Bothroyd EM, Lacey J, Topping MD. Airborne dust, ammonia, micro-organisms and antigens in pig confinement houses and the respiratory health of exposed farm workers. *Am Ind Hyg Assoc J* 1991; 52: 271–279.
5. Vogelzang PFJ, van der Gulden JWJ, Folgering H, *et al.* Endotoxin exposure as a major determinant of lung function decline in pig farmers. *Am J Respir Crit Care Med* 1998; 157: 15–18.
6. Rylander R, Donham KJ, Hjort C, Brouwer R, Heederik D. Effects of exposure to dust in swine confinement buildings: a working group report. *Scand J Work Environ Health* 1989; 15: 309–312.
7. Vogelzang PFJ, van der Gulden JWJ, Preller L, Heederik D, Tielen MJM, van Schayck CP. Respiratory morbidity in relationship to farm characteristics in swine confinement work: possible preventive measures. *Am J Ind Med* 1996; 30: 212–218.
8. Vogelzang PFJ, van der Gulden JWJ, Preller L, Tielen MJM, van Schayck CP, Folgering H. Bronchial hyperresponsiveness and exposure in pig farmers. *Int Arch Occup Environ Health* 1997; 70: 327–333.
9. Donham KJ. Health effects from work in swine confinement buildings. *Am J Ind Med* 1990; 17: 17–25.