

Allergic diseases in farmers' children

Braun-Fahrlander C. Allergic diseases in farmers' children.
Pediatr Allergy Immunol 2000; Suppl. 13: 19–22. © Munksgaard 2000.

Several studies have reported lower rates of allergic sensitization and allergies in children living in rural as compared to urban communities. This has been attributed to the lower levels of air pollution in rural areas. The question arises whether other factors in the rural environment could explain the lower prevalence rates of allergic sensitization and hay fever. A first report from rural South Bavaria in Germany demonstrated that children living in a home where coal and wood were used for heating had a significantly lower risk of suffering from hay fever (odds ratio 0.57 (0.34–0.98)), of being sensitized to common allergens (OR 0.67 (0.49–0.93)) and of having bronchial hyperresponsiveness (OR 0.55 (0.34–0.90)) than their peers living in homes with other heating systems. Subsequently, the Swiss Study on Childhood Allergy and Respiratory Symptoms with Respect to Air Pollution (SCARPOL) tested the hypothesis that farming as parental occupation was associated with a lower risk of hay fever and atopy. A total of 1620 (86.0%) 6–15-year-old schoolchildren living in three rural communities of Switzerland were examined using a standardized questionnaire completed by the parents and IgE antibodies against six common aeroallergens in serum samples of 404 (69.3.0%) of the 13–15-year-olds. Farming as parental occupation was significantly associated with lower rates of reported hay fever symptoms and allergic sensitization. Comparing children from farming with those from non-farming environments, the adjusted OR was 0.34 (95% CI: 0.12–0.89) for sneezing attacks during the pollen season, and 0.31 (95% CI: 0.13–0.73) for a sensitization to allergens. These results have recently been confirmed in a new and much larger survey in rural South Bavaria. Several alternative explanations have to be considered when interpreting these findings, namely, selection bias, the development of tolerance, increased microbial stimulation and a more traditional lifestyle (diet and housing conditions). Based on present knowledge, the underlying environmental factor explaining the protective effect of the farming environment has not yet been identified.

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Key words: hay fever; atopy; children;
farming

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Accepted 13 December 1999

Lower prevalence rates of allergic diseases in rural as compared with urban populations have been interpreted as indicating an effect of air pollution (1, 2). However, the role of air pollution in the development of allergic diseases and sensitization to inhalant allergens is still controversial. The principal literature arguing for a significant role of air pollution comprises toxicologic studies showing increased primary IgE responses in animals exposed acutely to relatively high levels of pollutants, concomitantly with allergen aerosols (3, 4). Several comparative epidemiologic studies in Eastern and Western Europe (5, 6) and a recent

Swiss multicenter study could not demonstrate any association between long-term air pollution and the prevalence of allergic diseases (7). Thus, the question arose whether other factors of the rural environment might influence the development of atopic sensitization and related diseases.

Epidemiologic studies of the farming environment

A first report from rural South Bavaria in Germany (8) demonstrated that children living in a home where coal and wood were used for

heating had a significantly lower risk of suffering from hay fever (Odds ratio 0.57 (0.34–0.98)), of being sensitized to common allergens (OR 0.67 (0.49–0.93)) and of having bronchial hyper-responsiveness (OR 0.55 (0.34–0.90)) than their peers living in homes with other heating systems. The authors concluded that factors directly or indirectly related to the heating system used in rural Bavarian homes decrease the susceptibility of children to becoming atopic and to developing bronchial hyperresponsiveness.

Subsequently, the Swiss Study on Childhood Allergy and Respiratory Symptoms with Respect to Air Pollution (SCARPOL) (9) investigated the prevalence of atopic diseases and sensitization to common allergens among three age groups of children (6–7 years, 9–11 years, and 13–15 years) living in three rural communities in Switzerland (7). A total of 1620 (86%) parents completed a detailed respiratory health questionnaire including the ISAAC core questions on asthma and allergies (10). A total of 404 (69.3%) of the 13–15-year-olds provided serum samples for specific IgE testing (multiscreen test SX1, Pharmacia, specific IgE levels to timothy grass, birch, mugwort, house dust mite, cat and dog dander). In addition, parents indicated whether the family was running a farm and, if so, whether this was a full-time or part-time activity. Ambient air pollution levels were low and meteorologic conditions similar in all communities. Logistic regression analysis was applied to analyze the relation between farming as parental occupation and symptom prevalence and sensitization rates, whilst controlling for potential covariates such as family history of asthma and allergies, parental education, number of siblings, maternal smoking, pet ownership, indoor humidity and heating fuels. Farming as parental occupation was reported for 307 children (19%). After adjustment for covariates, farming as parental occupation was significantly associated with lower rates of sneezing attacks during the pollen season (OR 0.34 (0.21–0.89)) and atopic sensitization (OR 0.31 (0.13–0.73)), whereas the association with wheeze (OR 0.77 (0.38–1.58)) and itchy skin rash (OR 0.86 (0.49–1.50)) was not statistically significant. In addition, the risk of atopic sensitization was lower in children of full-time farmers (OR 0.24 (0.09–0.66)) than of part-time farmers (OR 0.54 (0.15–1.96)). As in the study from South Bavaria, coal or wood as heating fuel was associated with a lower risk of atopic sensitization (adjusted OR 0.77 (0.35–1.64)), but the effect of farming as a parental occupation was stronger.

Quite recently, these results have been confirmed by a new and much larger questionnaire

survey in rural South Bavaria (11) including more than 10 000 5–7-year-old children at their school entry health examination. Children raised on a farm had about half the risk of suffering from hay fever (adjusted OR 0.52 (0.28–0.99)) than their peers living in the same villages. A similar but less strong effect was observed for asthma (adjusted OR 0.65 (0.39–1.09)) and asthma symptoms (adjusted OR 0.55 (0.36–0.86)).

The results have also been supported by an earlier study in Swedish conscripts (12) and a more recent study among Finnish university students demonstrating lower prevalence rates of self-reported rhinitis in students who had been raised on a farm as compared with students from a non-farming environment (13).

Lower rates of sensitization to pollen and animal dander and self-reported hay fever have previously been observed in occupational studies of adult farmers. A study among French farmers reported a low incidence of pollen allergy in farmers when compared with other occupations (14). In a Finnish occupational study, farmers were compared with teachers living in the same county. A panel of 30 allergens was tested and an equal prevalence of sensitization to any of these allergens observed, but the pattern of sensitization was different. Teachers showed more sensitization to mugwort pollen, cat and dog dander and had higher rates of hay fever, whereas farmers were more often sensitized to cow epithelium (15). Several other Scandinavian studies confirmed that allergy to storage mites was predominant in farmers but they had low rates of sensitization to pollen, animal dander and molds (16).

Discussion

The question remains how to interpret these findings. Several alternative explanations have to be considered.

Selection bias

If farmers suffering from allergic diseases such as hay fever move into other jobs, a “healthy farmer” effect might occur. For the adult population this effect cannot be excluded. Farming parents in the Swiss study did show lower rates of atopic diseases. However, the association between atopic sensitization in their children remained significant after adjustment for family history of allergic diseases. In addition, the observed gradient in the prevalence of atopic sensitization from full-time to part-time and non-farming subjects (confirmed by the recent Bavarian study (11)) argues against selection bias. It

seems quite unlikely that a farming family would give up their profession just because one of the children has developed hay fever. Economic constraints are therefore a more likely explanation for farmers moving from full-time to part-time farming or to other professional activities.

Development of tolerance

Farms in the rural communities of Switzerland and South Bavaria are rather small and managed by one family. Farming activities include dairy farming and agriculture. It is therefore conceivable that children living on a farm may be more exposed to pollen when harvesting with their parents or playing outdoors or in barns where hay for feeding cattle is kept. High exposure to pollen allergens may thus contribute to the development of tolerance in these children and explain the reduced risk for suffering from hay fever. Such a mechanism has been demonstrated in animal experiments (17): Repeated exposure of upper respiratory or gastrointestinal mucosae to microgram levels of protein antigen lead to the preferential suppression of Th-2-dependent IgE production via immune deviation.

Increased microbial stimulation

The farming environment may provide increased exposure to microbial antigens, both from commensal organisms and pathogens. In occupational medicine, increased concentrations of bacterial compounds were found in stables where livestock was kept and have been associated with respiratory diseases in farmers (18). Several recent studies have pointed towards the protective role of early childhood exposure to infectious diseases for the development of atopic sensitization and diseases. The inverse association between number of siblings and the prevalence of hay fever and atopic sensitization has been interpreted as indicating increased childhood exposure to microbial infections (19, 20). In a cohort of American children, frequent non-wheezing lower respiratory tract infections in early life were associated with persistently diminished serum IgE levels (21). In addition, a recent study in young Italian men (22) demonstrated an inverse association between hepatitis A seropositivity and the prevalence of atopy, independent of the number of siblings. In hepatitis A seronegatives the effect of number of older siblings was still present, indicating that common infections acquired early in life because of the presence of many older siblings or because of unhygienic living conditions may reduce the risk of developing atopy.

Traditional lifestyle

Farming may be an indicator of a more traditional lifestyle, which has been proposed to explain the differences in atopic sensitization between Eastern and Western European populations (5, 6). Some of the most important socioeconomic and environmental factors such as parental education, passive smoke exposure or heating system had been included in the analyses and did not change the inverse association between farming and atopic diseases. However, uncontrolled confounding may still influence the result. For example, dietary factors are potentially important and have not been assessed in most of the studies. It has been postulated that changes in the consumption of omega-3 fatty acids and fresh foods containing antioxidants and magnesium may be responsible for the higher prevalence of asthma observed in affluent countries (23, 24). The most recent study in South Bavaria included items on dietary habits in their questionnaire (11). The authors reported that the consumption of whole, but not skim, milk (hay fever adjusted OR 0.8 (0.6–0.99); asthma adjusted OR 0.7 (0.6–0.9)) and self produced foods (hay fever adjusted OR 0.7 (0.6–0.9)) was inversely related to hay fever and asthma. However, adjusting for these factors did not substantially change the association with farming as parental occupation.

In conclusion, these studies indicate that children from a farming population represent an informative population to study the role of environmental factors for the development of atopic diseases. Further studies are needed to identify the effective environmental influences explaining the protective effect of the farming environment.

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