

Original article

Nonlinear relations between house dust mite allergen levels and mite sensitization in farm and nonfarm children

Background: Low sensitization rates to common allergens have been observed in farm children, which might be due to high exposure to microbial agents. It is not known how microbial agents modify the association between specific allergen exposure and sensitization.

Objective: To examine the relations between house dust mite allergen exposure and mite sensitization in farm and nonfarm children and to assess the effects of microbial agents levels on this association.

Methods: Major mite allergens of *Dermatophagoides pteronyssinus* (Der p 1) and *Dermatophagoides farinae* (Der f 1), endotoxin, $\beta(1,3)$ -glucans and fungal extracellular polysaccharides were measured in mattress dust of 402 children participating in a cross-sectional study in five European countries. Mite allergen (Der p 1 + Der f 1) levels were divided into tertiles with cut-offs 1.4 and 10.4 $\mu\text{g/g}$. Sensitization was assessed by measurement of allergen-specific immunoglobulin E against house dust mite.

Results: Prevalence ratios of mite sensitization for medium and high when compared with low mite allergen levels were 3.1 [1.7–5.7] and 1.4 [0.7–2.8] respectively. Highest mite sensitization rates at intermediate exposure levels were consistently observed across country (except for Sweden) and in both farm and nonfarm children. The shape of the dose–response curve was similar for above and below median mattress microbial agent levels, but the ‘sensitization peak’ appeared to be lower for above median levels.

Conclusions: Our data suggest a bell-shaped dose–response relationship between mite allergen exposure and sensitization to mite allergens. In populations with high microbial agent levels and low sensitization rates, the curve is shifted down.

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Key words: house dust mite; allergens; sensitization; children; microbial agents; endotoxin; glucans; moulds; extracellular polysaccharides; farm.

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Accepted for publication 18 January 2006

Several studies have shown a dose–response relationship between house dust mite allergen exposure and sensitization to house dust mites (1–4). High levels of house dust mites and their allergens have been observed in farm homes (5, 6), whereas the prevalence of sensitization to mite allergens in adult farmers is not higher and possibly even lower than in the general population (5, 7). Specific protective factors of the farming environment, such as elevated exposure to bacterial endotoxin (8), might

account for this discrepancy. Previous studies have shown a protective effect of endotoxin to sensitization (9, 10), but as the association between allergen levels and allergen-specific sensitization was not investigated in those studies, it is unknown in which way microbial agents, like endotoxin, modify the dose–response relationship.

The Prevention of allergy – risk factors for sensitization in children related to farming and anthroposophic

lifestyle (PARSIFAL) study is a cross-sectional survey, conducted in five European countries; Sweden, Switzerland, Germany, Austria and the Netherlands. The aim of the study was to identify factors associated with farming and an anthroposophic lifestyle that confer protection against the development of atopic diseases in children. Children of families with an anthroposophic lifestyle (Steiner school children) were also included in this study, because in these children, like in farm children, a lower prevalence of atopic diseases was observed previously (11). We recently reported that the levels of bacterial and fungal agents in house dust were increased in farm homes, and to a lesser extent in homes of Steiner school children in the PARSIFAL study (12). We also reported a lower prevalence of atopic sensitization to common inhalant allergens in farm [OR 0.53 (0.42–0.67)] and Steiner school children [OR 0.73 (0.58–0.92)] when compared with reference children (13). However, relations between allergen levels and allergen-specific sensitization rates were not addressed in these papers.

In the present study, we investigated (i) whether in the PARSIFAL population dose–response relations could be demonstrated between mite allergen levels in house dust and mite sensitization, (ii) whether the relation was different in the various subgroups; farm, Steiner and reference children and (iii) in which way microbial agents in house dust modified this relationship. For this purpose, we also compared the relations between mite allergen levels and mite sensitization in children with high and low levels of bacterial endotoxin and fungal $\beta(1,3)$ -glucans, both of which have strong immunomodulatory properties (14–20), and extracellular polysaccharides (EPS) from *Aspergillus* and *Penicillium* spp., a general marker of fungal exposure (21).

Methods

Study population

The PARSIFAL study included children aged 5–13 years from farmers', anthroposophic and respective reference families in five

European countries, as described previously (13). Shortly, farm children lived on a farm, Steiner children attended a Rudolf Steiner school and references lived near these children, but did not live on a farm or did not attend such a school respectively. Questionnaires were completed by their parents. Allergen-specific immunoglobulin E (IgE) was assessed in a random sample of children whose parents gave consent ($n = 4039$) (13), by Phadiatop (a mix of common inhalant allergens) and fx5 (a mix of common food allergens). Phadiatop-positive samples were further tested for IgE to specific allergens (listed in Table 1) and defined positive if IgE values were ≥ 0.35 kU/l. House dust was collected from mattresses and living room floors in a randomly selected population of 229 children from livestock farms, 122 Steiner children and 60 and 67 of their respective references, with nearly equal numbers per country, as described previously (12). The subpopulation, selected for dust sampling, had essentially the same distribution of determinants (like age of the home, contact to farm animals etcetera) as the total PARSIFAL population (12). For 402 (84%) of these children, IgE analyses were available.

Dust extraction and analysis

Endotoxin, EPS, mite allergens, and glucans were extracted from the dust as described previously (12). Endotoxin was measured in the extracts with the kinetic chromogenic Limulus Amebocyte Lysate test, EPS with a specific sandwich Enzyme Immuno Assay (EIA) for EPS of *Aspergillus* and *Penicillium* spp. (22) and $\beta(1,3)$ -glucan with an inhibition EIA (23). Mite allergens of *Dermatophagoides pteronyssinus* (Der p 1) and *Dermatophagoides farinae* (Der f 1) were measured with sandwich EIAs as described previously (24). The average inter-day/inter-assay coefficients of variation, as determined by testing duplicate extract aliquots of 10% of all samples on another day as the first aliquot, ranged from 14.5% to 30.5%. Results of repeated dust sampling within the framework of PARSIFAL will be described in a separate paper (25), but showed reasonably good correlations between multiple dust samples taken in the same home a few days to several months apart, for levels of allergens and microbial agents.

Few samples (<4%) had levels of microbial agents below the limit of detection, Der p 1 and Der f 1 could not be detected in 103 and 79 of 395 mattress samples (*c.* 65% samples from Sweden) respectively. Non-detectable samples were given an arbitrary value of two-thirds of the lowest observed detectable amount. Mite allergen exposure (Der 1) was calculated as the sum of Der p 1 and Der f 1.

Table 1. Baseline characteristics, including house dust mite allergen levels and sensitization rates by group

	Farm ($n = 197$)	Farm-ref ($n = 50$)	Steiner ($n = 99$)	Steiner-ref ($n = 56$)
Age, mean (SD)	9.3 (1.8)**	9.3 (1.7)	9.0 (1.7)	8.3 (1.7)
Male, n (%)	109 (55.3)	31 (62.0)	42 (42.4)**	35 (62.5)
Der 1 (ng/g), median (p25–p75)	3660 (411–15 865)	2465 (307–8779)	5352 (820–13 391)	3628 (650–13 197)
Sensitization	N (%)	N (%)	N (%)	N (%)
Phadiatop-pos	47 (23.9)**	18 (36.0)	30 (30.3)	23 (41.1)
Cat	9 (4.6)	3 (6.0)	8 (8.1)	5 (8.9)
House dust mite†	27 (13.7)***	10 (20.0)	16 (16.2)	13 (23.2)
Grass pollen	29 (14.7)**	15 (30.0)	15 (15.2)*	17 (30.4)
Tree pollen	24 (12.2)***	11 (22.0)	11 (11.1)***	10 (17.9)
Storage mite‡	11 (5.6)	0	5 (5.1)	3 (5.4)

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.1$ for farm and Steiner children vs combined group of reference children.

†*Dermatophagoides pteronyssinus*.

‡*Lepidoglyphus destructor*.

Statistical analysis

Differences between groups were evaluated by performing non-parametric Wilcoxon tests (allergen levels, age) and chi-squared tests (sensitization rates, sex), using SAS statistical software (version 8.2, SAS Institute, Cary, NC). Differences in sensitization rates between the groups were also evaluated after adjustment for potential confounders, such as country, age, sex, older siblings, parental education level, parental asthma and/or hay fever, environmental tobacco smoke and smoking of the mother during pregnancy. Mite allergen levels (Der 1) were categorized into three categories, based on tertiles of the distribution of these levels, with cut-offs 1390 and 10 424 ng/g. Median levels within the low, medium and high category were 160, 3828 and 22 317 ng/g respectively. Prevalences of mite sensitization in each category were also calculated stratified by country, parental atopic diseases and disease status of the child, the latter including asthma, wheeze, eczema or hay fever. Prevalence ratios (PRs) for mite sensitization, with the lowest exposure category as reference, were calculated with PROC GENMOD of SAS, with adjustment for age, sex and group, and – in subsequent analyses – country. Mattress microbial agent levels were categorized into above and below median exposure. Smoothed dose–response curves for mite allergen levels and mite sensitization, stratified by dichotomized microbial agent levels, were computed using the generalized additive models procedure of SAS (PROC GAM). The smoothness of the function was initially determined by generalized cross validation (method = GCV), but the number of degrees of freedom was not allowed to exceed a maximum of three to avoid extremely irregular curves. To test effect-modification by microbial agent levels, an interaction variable (categorized mite * categorized microbial agent level) was added to the regression models, and interaction was considered significant if the *P*-value of the interaction parameter was below 0.05.

Results

Table 1 shows mattress mite allergen levels and sensitization rates for farm children, Steiner children and their references. Mite allergen levels were in the same order of magnitude for all groups. Because of similar Der 1 levels and relatively low numbers, the groups of farm reference and Steiner reference children were combined in subsequent analyses. Compared with reference children, farm children were less likely to be sensitized to all tested allergens, except for storage mite, although the difference was not statistically significant for cat allergens and borderline significant for mite allergens and tree pollen (Table 1). Sensitization rates were also lower in Steiner children when compared with references, but the differences were, except for grass pollen, less pronounced. Sensitization rates and differences between groups in this subpopulation with dust analyses were similar to that in the total population with IgE serology (*n* = 4039) (13); for example, mite sensitization rates were 10.1%, 17.3%, 18.7% and 20.9% for the total group of farm, farm reference, Steiner and Steiner reference children respectively. Differences between groups were also observed after adjustment for potential confounders (listed in the *Methods* section). Thus farm children had a low prevalence of mite sensitization despite the fact that they had

similar exposures to mite allergen levels when compared with references.

Figure 1 shows the prevalence of mite sensitization by tertiles of mattress mite allergen levels per gram dust and per square meter, without adjustments for any covariates. Highest sensitization rates were observed at intermediate exposure levels. This was consistent across farm, Steiner and reference children. However, the absolute prevalences were lower for farm children when compared with Steiner children and reference children and differences across exposure categories were not significant among farm children. Similar results were obtained for sensitization rates by tertiles of mite allergen levels expressed per square meter (Fig. 1). When divided in quintiles of mite allergen levels per gram dust, prevalences of mite sensitization were 5.1%, 16.5%, 30.4%, 17.7%, 12.7% for the lowest to the highest category respectively (not shown). Categories of mite allergen levels per gram dust agreed well with categories per square meter (81% of the children was classified into the same exposure category

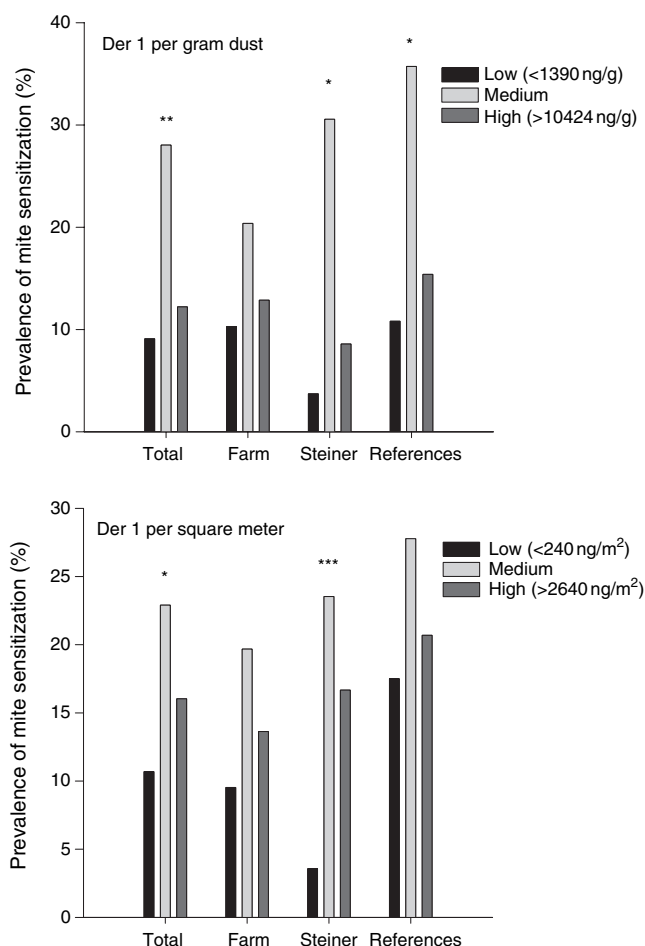


Figure 1. Prevalence of mite sensitization by tertiles of mattress Der 1 levels per gram. ****P* < 0.1; **P* < 0.05; ***P* < 0.01 as compared to low exposure.

as when calculated per gram dust) and results of subsequent analyses are therefore only presented for allergen levels per gram dust.

Table 2 shows the number of mite-sensitized children by tertiles of mite allergen levels by country (because of low numbers, these analyses were not stratified by group). Highest sensitization rates at intermediate allergen levels were observed for each country, except Sweden. The majority of Swedish mattress samples (86%) had low mite allergen levels and only two children were sensitized to house dust mites. Similar results were obtained when using other cut-off levels for sensitization (3.5 instead of 0.35 kU/l) or allergen levels (e.g. 3 and 8 ng/g) or after adjustment for potential confounders (listed in the *Methods* section). Highest sensitization rates at interme-

diate allergen levels were also observed when children whose parents reported any measures to reduce allergen levels were excluded or when results were stratified by parental atopic disease status or by atopic disease status of the child (Table 2). Also for Der p 1 and Der f 1 levels separately, highest sensitization rates were observed at intermediate mite allergen levels (not shown).

To study the dose-response relationship between mite allergen levels and mite sensitization independent of cut-off levels and to study the effects of microbial agents on this relationship, smoothed dose-response curves stratified by dichotomized microbial agent levels were plotted (Fig. 2). The shape of the smoothed dose-response curves was essentially the same for below and above median endotoxin and glucan levels in mattress dust (Fig. 2), with

Table 2. Sensitivity analyses: number of mite sensitized children by tertiles of Der 1 levels per gram mattress dust by country, parental atopic disease status and excluding parents who reported allergen avoidance measures

$n_{\text{sensitized}}/n_{\text{category}}$ (Percentage)	Low (<1390 ng/g)	Medium	High (>10 424 ng/g)
Overall, $n = 395$	12/132 (9.1)	37/132 (28.0)	16/131 (12.2)
Cut-off sensitization 3.5 kU/l instead of 0.35 kU/l	8/132 (6.1)	27/132 (20.4)	7/131 (5.3)
By country			
Sweden, $n = 94$	2/81 (2.5)	0/5 (0)	0/8 (0)
Switzerland, $n = 45$	1/8 (12.5)	4/19 (21.1)	1/18 (5.6)
Netherlands, $n = 76$	2/12 (16.7)	10/40 (25.0)	5/24 (20.8)
Germany, $n = 94$	4/20 (20.0)	12/44 (27.3)	3/30 (10.0)
Austria, $n = 86$	3/11 (27.3)	11/24 (45.8)	7/51 (13.7)
By atopic disease status of the child			
Hay fever, asthma, wheeze or eczema, $n = 203$	9/78 (11.5)	31/73 (42.5)	11/52 (21.2)
No hay fever, asthma, wheeze or eczema, $n = 160$	3/49 (6.1)	5/45 (11.1)	3/66 (4.6)
By parental atopic disease status			
Parents with asthma/hay fever, $n = 154$	5/49 (10.2)	24/58 (41.4)	10/47 (21.3)
Parents without asthma/hay fever, $n = 235$	7/81 (8.6)	13/73 (17.8)	5/81 (6.2)
By allergen avoidance			
Parents who did not report avoidance measures, $n = 350$	115/127 (9.4)	34/108 (31.5)	14/115 (12.2)

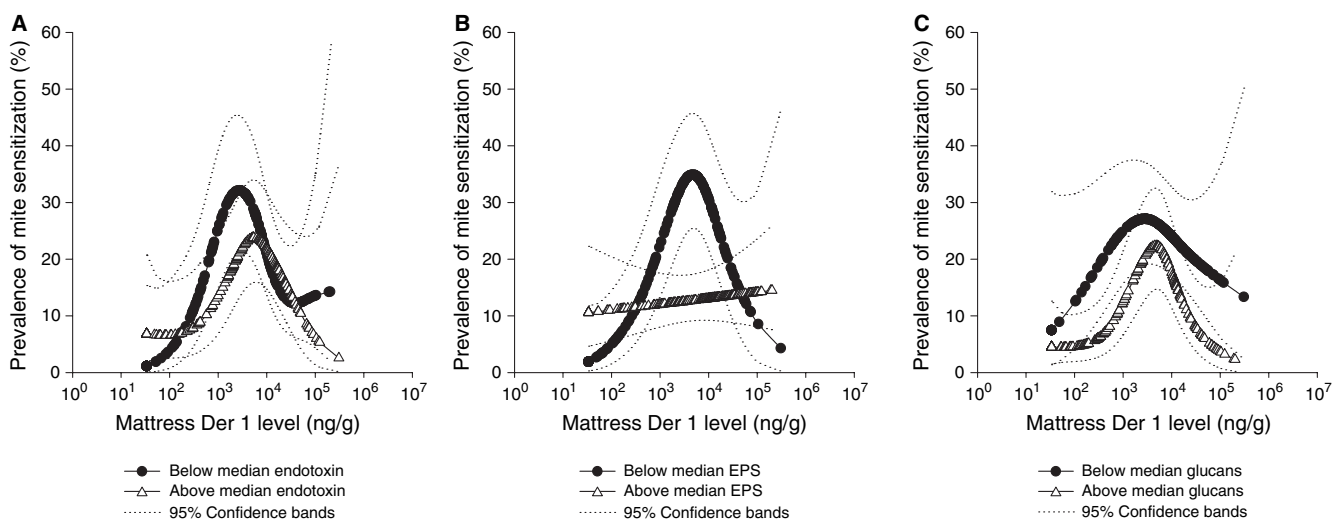


Figure 2. Smoothed plots of the prevalence of mite sensitization in relation to mite allergen levels, stratified by (A) dichotomized endotoxin levels (B) dichotomized EPS levels and (C) dichotomized glucan levels in mattress dust. Smoothness of the plots was determined by generalized cross validation.

somewhat lower curves for above median microbial agent levels. For above median EPS levels, however, no indication of a dose-response association between mite allergen levels and mite sensitization was observed.

Table 3 shows the effects of microbial agents on the relationship between mite allergen levels and sensitization when investigated by multivariate regression analysis. Results are presented with and without adjustment for country, because of low mite allergen levels in Sweden. Because country was a determinant of mite allergen levels, the estimated effect of intermediate mite allergen exposure was considerably lower after adjustment for country. Farm children had a borderline significant lower prevalence of mite sensitization when compared with reference children, after adjustment for mite allergen levels, and the results were similar when a further adjustment for country was made. Microbial agents appeared to account for the lower prevalence of sensitization among farm children. For Steiner children no significant lower prevalence of mite sensitization was observed.

Above median EPS levels were borderline significantly associated with lower prevalences of mite sensitization. The interaction between mite allergen levels and EPS was not statistically significant, although Fig. 2 suggested

effect modification by EPS. Within farm children, protective effects of EPS [PR 0.47 (0.23–0.97)], glucans [PR 0.42 (0.18–1.00)] and endotoxin [PR 0.76 (0.34–1.73)] were observed. In Steiner and reference children nonsignificant protective effects were observed for endotoxin [Steiner children: PR 0.55 (0.27–1.10)] and EPS [reference: PR 0.50 (0.15–1.63)]. Results were essentially the same when microbial agents were included in the models separately, instead of all three together (not shown).

Discussion

Highest mite sensitization rates were observed at intermediate mite allergen levels. This nonlinear relation was independent of group, common risk factors or microbial agent levels. Only for above median EPS levels, indications of modification of the nonlinear relationship were observed. The prevalence of mite sensitization was lower in farm children than in reference children, which might be associated with levels of EPS and glucans in mattresses.

Our results are not in line with previous cohort studies showing a linear dose-response relationship between mite allergen levels and mite sensitization in children in Germany and the United Kingdom (3, 26). This might be related to differences in allergen levels or differences in study populations. The reported association in the German cohort study refers to allergen levels in living rooms (3), with a median level of 184 ng/g, which is much lower than mattress levels reported in this paper (median 2465–5352 ng/g, depending on group). Mattress allergen levels were not measured until age 5 in the German cohort study, presumably because the mattress on which children sleep tends to change once or more during their first years of life. These levels were comparable with our mattress levels and showed a weaker association with sensitization (3). In our study, living room samples also showed much lower allergen levels (median 221–812 ng/g) than mattress samples and were therefore not further studied. Both the German and English cohort study consisted, in part at least, of children considered at special risk of developing allergy, because of allergy or asthma in their parents. A cohort study conducted in the United States showed that parental allergy or asthma might be an important modifier; for children with a parental history of allergy and asthma, a positive association between mite allergen levels and mite sensitization was observed, whereas the opposite was found for children without a parental history (27). In contrast, our study showed similar dose-response relations for children with and without parental asthma and/or hay fever. Another cohort study from the United Kingdom, which was conducted in a community sample instead of a selection of high-risk children, showed a rising risk of IgE sensitization at low allergen levels and an attenuated risk at high levels, comparable with our results, although the

Table 3. Prevalence ratios (PR) with 95% confidence intervals (CI) of mite sensitization for medium and high mattress Der 1 levels as compared to low levels per gram dust, adjusted for country, age and sex and sequentially group and dichotomized microbial agent levels

n = 391	PR* (CI)	PR† (CI)
Model 1		
Medium mite allergen levels (1390–10 424 ng/g)	1.63 (0.89–2.97)	3.13 (1.71–5.73)
High mite allergen levels (>10 424 ng/g)	0.67 (0.33–1.36)	1.36 (0.67–2.77)
Model 2		
Medium mite allergen levels	1.49 (0.81–2.75)	3.03 (1.66–5.55)
High mite allergen levels	0.67 (0.33–1.37)	1.39 (0.68–2.81)
Group (farm children vs reference children)	0.66 (0.40–1.07)	0.68 (0.42–1.10)
Group (Steiner children vs reference children)	0.77 (0.44–1.36)	0.78 (0.45–1.38)
Model 3		
Medium mite allergen levels	1.62 (0.88–2.98)	2.87 (1.51–5.44)
High mite allergen levels	0.77 (0.37–1.57)	1.35 (0.65–2.81)
Group (farm children vs reference children)	0.87 (0.48–1.56)	0.97 (0.55–1.71)
Group (Steiner children vs reference children)	0.86 (0.48–1.56)	0.92 (0.51–1.64)
EPS level (above vs below 84 333 EPS units/g)	0.65 (0.39–1.08)	0.64 (0.38–1.07)
Endotoxin level (above vs below 10 668 EU/g)	0.82 (0.52–1.30)	0.89 (0.57–1.38)
Glucan level (above vs below 2295 ng/g)	1.04 (0.63–1.72)	0.69 (0.42–1.15)

*Adjusted for country, age and sex.

†Adjusted for age and sex.

trend was not significant (28). A similar pattern was observed for the association between cat allergen levels and cat sensitization (28). Two cross-sectional studies, one in children and one in adults, showed attenuated risks of cat sensitization at high cat allergen levels (1, 29). These studies, however, showed a continuous increasing risk of sensitization with increasing house dust mite allergen levels (1, 29). It was suggested that high exposure to cat allergen may produce a form of tolerance characterized by a 'modified' Th2 response with specific IgG4 production (29). Our data suggest that such a mechanism, if it exists, may also apply to mite allergen levels, depending on mite allergen levels and other possible modifying factors like parental allergy or asthma.

Reasons for our results being different from previous studies, might be high mite allergen levels and the combination of Der p 1 and Der f 1 levels. These levels are not correlated (30), therefore, inclusion of only one of these allergens might result in misclassification. Another reason might be the composition of our study population, which most likely was not representative for the general population in the various participating countries. On the other hand it is difficult to imagine why in these specific populations selected for the PARSIFAL study the dose-response associations would differ much from those in the general population. However, further studies are certainly required to see whether our findings can be confirmed in other populations.

We did not study early exposure to house dust mite allergens, therefore, current mite allergen levels were regarded as a proxy for long-term exposure to house dust mites. Although a previous study, with rather low mite allergen levels, suggested that a single measurement does not accurately reflect long-term exposure to house dust mite (31), one measurement might still give some indication of long-term exposure, given the wide range of mite allergen levels observed in this study. A comparison of dust samples taken within the same home up to 251 days apart in the PARSIFAL study showed reasonably good correlations of Der 1 levels between those two samples (Pearson's r 0.66) (25). Obviously, there is a clear need for longitudinal studies in which house dust allergens are measured at various ages of the children, to assess to which extent exposure levels during prolonged periods are primarily determined by the home in which children live, or by temporal variation.

An alternative explanation for the attenuated risk of mite sensitization at high mite allergen levels could be that families with allergic or asthmatic members maintain a relatively low allergen environment. This is, however, not supported by our data; few families reported allergen avoidance, and the observed pattern did not change by excluding these people. Also, the same pattern was observed in children whose parents did not report asthma or hay fever, although prevalences of sensitization in these children were somewhat lower. Therefore, it is unlikely that allergen avoidance explains the observed

pattern with highest mite sensitization rates at intermediate mite mattress allergen levels. Another source of bias might be the selection of children in these analyses, i.e. those with blood and dust results, from the total PARSIFAL population. Although participation rates in blood sampling differed across countries (13), results were similar across countries. Absolute prevalences of mite sensitization might have been influenced by selection bias, but the authors do not expect that selection bias affects the association between allergen levels and sensitization, which is supported by the data in Table 2, showing similar dose-response relationships for children with and without allergic symptoms.

The effect of intermediate mite allergen exposure was much lower after adjustment for country. In Sweden mite allergen levels were very low and only few children were sensitized to house dust mites. Low sensitization rates at low allergen levels are in agreement with dose-response associations observed in previous studies (1-4), and should not be corrected for, although the results without adjustment for country might be confounded by other factors differing between countries. However, results adjusted for other risk factors than age and sex (older siblings, parental education level, parental asthma and/or hay fever, environmental tobacco smoke and smoking mother during pregnancy) were similar to results adjusted for age and sex alone (PR 2.77 and 1.29 for medium and high mite allergen levels respectively). When Sweden was excluded, highest sensitization rates were still observed at intermediate mite allergen levels (PR 1.70 and 0.74 for medium and high mite allergen levels respectively), also when tertiles were re-calculated excluding Sweden (cut-offs 3.0 and 12.6 $\mu\text{g/g}$, PR's 1.69 and 0.53 respectively).

The prevalence of mite sensitization was low in farm children when compared with reference children, despite the fact that they had similar exposures to mite allergen levels when compared with references. These observations are more or less in line with previous cross-sectional studies in farming or rural populations. The Allergy and Endotoxin study in farm and farm reference children from Germany, Austria and Switzerland, showed five times higher mattress Der p 1 levels in farm children than in reference children. Levels of Der f 1 were somewhat, but not significantly lower in farm children than in farm reference children (10). Despite the high mite allergen levels in farm children, prevalences of mite sensitization were similar in farm children (15.4%) and farm reference children (15.1%, M. Waser, unpublished data). Studies in adult farmers showed high mite counts or high Der p 1 levels in farm homes (5, 6), whereas mite sensitization rates were comparable to the prevalence in the general population (5).

Our data suggest that EPS and glucan levels in mattress dust may explain – at least partially – the protective effect of living on a farm on mite sensitization. Indications of a protective effect of endotoxin were observed as well. Correlation between the microbial agent levels precludes

a firm conclusion on the degree to which specific agents contributed to the observed effects, although the correlation was low (12). In addition, these agents may be markers of a much broader spectrum of microbial agents.

In conclusion, our data suggest a bell-shaped dose-response relationship between mite allergen exposure and mite sensitization, which is shifted down in children exposed to high levels of microbial agents.

Acknowledgments

The authors thank all fieldworkers and other PARSIFAL team members, especially Stina Gustafsson, Eva Hallner, André Lauber,

Wiveka Lundberg, Helena Svensson, Anki Wigh, Annika Zettergren, Anne-Charlotte Öhman-Johansson (Sweden); Susanne Löhlig (University Children's Hospital Zurich), Marianne Rutschi, Stefan Worminghaus (study center support), Michaela Glöckler (head of the medical section of the Goetheanum in Dornach) (Switzerland); Anja Strengers, Siegfried de Wind, Marieke Siekmans, Patricia Jansen-van Vliet, Janneke Bastiaanssen, Marieke Dijkema, Mirian Boeve, Jack Spithoven, Griet Terpstra, Gert Buurman (The Netherlands); Jörg Budde (Germany); Helmut Egger, Martina Burger, Bernadette Burger, Elisabeth Buchner (Austria). We would also like to thank all school physicians and teachers, and all children and parents who contributed to this study. We thank Lützen Portengen for his assistance in data-analysis. This work was supported by a research grant from the European Union QLRT 1999-01391.

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Appendix

Prevention of allergy – risk factors for sensitization in children related to farming and anthroposophic lifestyle (PARSIFAL) study group: Göran Pershagen, Tobias Alfvén, Johan Alm, Anna Bergström, Lars Engstrand, Helen Flöistrup, Marianne van Hage, Niclas Håkansson, Gunnar Lilja, Fredrik Nyberg, Annika Scheynius, Helena Svensson, Jackie Swartz, Magnus Wickman (Sweden); Charlotte Braun-Fahrländer, Marco Waser, Felix

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