

Skin-prick test findings in students from moisture- and mould-damaged schools: A 3-year follow-up study

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Dampness and moisture problems in a building may cause growth of moulds, leading to sensitization and symptoms in the inhabitants. The mechanism by which sensitization to moulds takes place has remained obscure; in particular, the role of atopy is not clear. In 1996, 622 pupils (7–13 years of age) attending a school with a moisture problem (index school; 414 pupils) and a control school (208 pupils) were screened using a questionnaire. Two-hundred and twelve children had doctor-diagnosed asthma, parental-reported wheezing or prolonged cough, and they participated in a clinical study, which included skin prick tests (SPT) to 12 moulds. An identical, follow-up study was performed 3 years later in 1999. In the follow-up study, 144 of the original 212 students participated. They were now attending four different schools: the index primary school had been renovated and the control school remained unchanged, but the two secondary schools had moisture and mould problems. The purpose of the study was to evaluate the occurrence of mould allergy in children of school age and to compare sensitization to moulds in relation to age, exposure, asthma, and atopy. In 1999, SPT responses to moulds were demonstrated in 17 (12%) of the 144 children. Six children had SPT reactions ≥ 3 mm and all but one were older than 14 years. During the 3-year follow-up period, mould allergy developed in five children and disappeared in two children. Five of the six children with reactions ≥ 3 mm to moulds had positive responses to other allergens, five had clinical atopy but only two had asthma. Likewise, all six children had been exposed to moisture and dampness in the school buildings. In conclusion, mould allergy diagnosed by SPTs was rare in students. Most reactions to moulds were in students older than 14 years with multiple SPT reactions to common allergens, and there was no significant association with asthma.

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Dampness and moisture problems in a building cause the growth of moulds, producing many potentially harmful fungal products. Because most people spend the majority of their time indoors, it is important to ascertain the health effects of fungal exposure. Thus far, epidemiologic studies have been carried out which have reported positive associations between moisture problems and fungal sensitization, and respiratory symptoms and disorders (1–3). The mechanism by which sensitization to moulds takes place has, however, remained obscure; in particular, the

role of atopy is not clear. We observed in a previous study that skin prick test (SPT) reactions to moulds are rare in children (4) but, when present, there seems to be an association between asthma and mould allergy to indoor moulds (4).

We performed SPTs to 12 mould antigens, 3 years apart, on the same 144 students from a school with a moisture problem and from a control school. The aims of the study were to evaluate the occurrence of mould allergy in children of school age, to compare the sensitization to moulds in relation to age, exposure,

asthma and atopy, and to evaluate the changes in skin test results during the 3-year follow-up period.

Materials and methods

Moisture and mould growth documentation

The first-phase study was carried out from November 1995 to January 1996 in the community of Siilinjärvi in eastern Finland. The index primary school (Siilinjärvi) had moisture problems and another primary school (Vuorela) served as a control school (5). The follow-up study was carried out in February 1999 among the same schoolchildren. They were now attending four different schools. The students under 12 years of age were still in the original index and control primary schools, but those over 12 years of age were attending secondary school. All students from the index school progressed to Siilinjärvi secondary school, and all students from the control school went to Toivala secondary school.

The school environment was characterized by technical and microbial investigations. The occurrence, type, and severity of moisture damage in each school was investigated by trained civil engineers by using a standardized checklist for technical investigations of the buildings. The buildings were classified as damaged if there was visible mould growth, or several observations of minor moisture damage, or at least one observation of extensive moisture damage that necessitated replacement of material. Microbial sampling (15–19 air samples from each school) to determine the total concentrations of airborne viable fungi was performed using an Andersen six-stage impactor on 2% malt extract agar and dichloran glycerol agar. To complete the information on the microbial status of the school buildings, material samples were taken where visible mould growth could be detected by the technical investigator and where dismantling of the structures was possible. These samples were used as additional qualitative information on the microbial flora of the building. The procedures for inspection, dampness measurements, microbiological examination, and criteria for damage classification have been developed by our group and are as described previously (4,6–8).

Study population

In November 1995, questionnaires were sent to the parents of all students aged 7–13 years who were attending the two primary schools: 622 (76%) responded, 414 from the index school and 208 from the control school (5). Two-hundred

and twelve children reported asthma, repeated wheezing attacks or prolonged (>4 weeks) nocturnal cough during the preceding 12 months, and all 212 participated in the clinical study (5). In all, 15 (7%) children were on continuous maintenance medication for asthma.

In January 1999, the same 212 students were identified in the student's register; 182 students had stayed in Siilinjärvi and 30 students had moved. These 182 students were invited to participate in the present clinical study and 144 (79%) agreed: 79 (55%) were male and 65 (45%) were female. Twenty-three students were from the index school, 14 from the original control school, 91 from Siilinjärvi secondary school, and 16 from Toivala secondary school (Fig. 1). The age distribution of the children was as follows: 11–12 years, 12%; 13–14 years, 33%; 15–17 years, 55%.

Questionnaire data

In spring 1999, the same questionnaire was used as in the first phase of the study; it has been validated in previous epidemiological surveys by our study group (4,9). The questionnaire was completed by the parents of the primary school students and by the secondary school students themselves or their parents. The questionnaire included data on respiratory symptoms and doctor-diagnosed respiratory infections, asthma or wheezing symptoms, seasonal rhinitis, seasonal conjunctivitis,

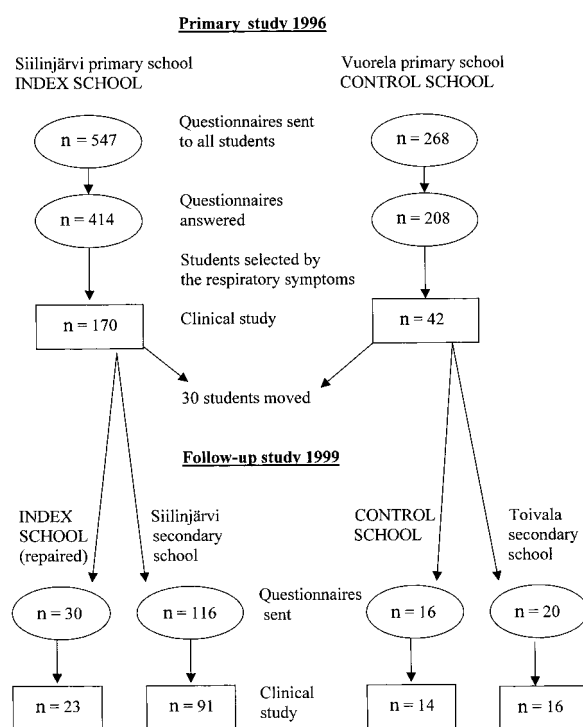


Fig. 1. Study design.

and atopic eczema. The questionnaires were completed by 162 (89%) of the students or parents.

Atopic manifestations were classified as doctor-diagnosed allergic rhinitis, allergic conjunctivitis, and atopic eczema ever in life, as discussed previously (5). Clinical atopy was defined as the presence of at least one doctor-diagnosed atopic manifestation, that is rhinitis, conjunctivitis or eczema. Atopy was defined as either clinical atopy or skin test positivity. Asthma cases were classified as atopic, if the child had clinical atopy.

Clinical examination and SPTs

In 1996 and 1999 an identical protocol was used for the clinical examination. It consisted of heart and lung auscultation, checking of infection focuses, SPTs, and lung function measurements (including exercise challenge) (5).

SPTs were performed in all 144 children; these children had also all been tested 3 years previously. The tests were performed on the volar aspect of the forearm by the same qualified nurse, using the ALK (Allergologisk Laboratorium, Copenhagen, Denmark) panel of 23 allergens.

The allergens tested were classified as 'indoor' and 'outdoor' allergens. Indoor allergens consisted of cat, dog, cow and horse epithelial danders, and two house dust mites (*Dermatophagoides farinae* and *Dermatophagoides pteronyssinus*). Outdoor allergens were pollens of birch, common alder, timothy grass, mugwort, and

meadow fescue. The moulds were tested by using 12 antigens; all antigens were the same as used 3 years previously. The only exception was *Rhizopus nigricans*, which was not available. Four fungi were considered as indicative of a moisture problem: *Aspergillus fumigatus*, *Fusarium roseum*, *Phoma herbarum*, and *Rhodotorula rubra* (10).

Histamine hydrochloride (10 mg/ml) and glycerol (50%) were used as positive and negative controls, respectively. The reactions were measured 15 min after testing. The size of the skin reactivity was recorded as the sum of the longest and the mid-point orthogonal diameters divided by two ($(D+d)/2$). The SPT reaction was regarded as positive if the reaction was 3 mm or more in diameter (4). In addition, weak responses of 1–2 mm to moulds were recorded. SPT positivity was considered to exist if at least one indoor and one outdoor allergen gave a positive response.

Ethics

The protocol for the follow-up study was accepted by the Ethics Committee of the National Public Health Institute, Finland. Written consent was obtained from the parents of all of the children.

Statistical analysis

The data were analyzed using the epicalc 2000 statistical package. The chi-square test and Fisher's exact test were used to analyze the significance of the differences between the groups.

Table 1. Moisture damage classifications (based on technical survey) and microbiological findings of the four school buildings

	Siilinjärvi primary (index)		Siilinjärvi secondary	Vuorela primary (control)		Toivala secondary
	1995	1999	1999	1995	1999	1999
Class of moisture damage*	2	1	2	1	1	2
Concentrations of viable total fungi						
GM† (CFU/m ³)‡	23	10	9	6	7	4
Range (CFU/m ³)	0–129	0–140	0–120	0–254	0–39	0–28
Presence of fungi indicative of moisture§						
<i>Alternaria</i>		x				
<i>Aureobasidium</i>	xo		x	x	x	
<i>Aspergillus fumigatus</i>	xo			x		
<i>Aspergillus versicolor</i>	xo	x		x		xo
<i>Eurotium</i>	xxo	xx		x	x	x
<i>Exophiala</i>	xxo					
<i>Fusarium</i>	o					o
<i>Mucor</i>	xo				x	o
<i>Phialophora</i>	o					
<i>Scopulariopsis</i>	xo					
<i>Stachybotrys</i>	o	x	x			
<i>Trichoderma</i>	xo	x	x	x	x	x
<i>Wallemia</i>	xxo		x	x	x	o

*1, a building with no or minimal visible moisture damage and no mould growth; 2, a building with visible moisture damage or mould growth.

†Geometric mean.

‡CFU, colony-forming units.

§x, fungi detected in less than five air samples (sporadically found); xx, fungi detected in five or more air samples (frequently found); o, fungi detected in material samples obtained from visibly damaged material.

Results

Assessment of the microbial quality of the indoor environment

The classification of moisture damage observed in the school buildings, the viable fungal concentrations in indoor air samples, and the findings of moisture-indicative moulds in air or material samples, are presented in Table 1.

The repair of moisture-damaged structures in the index school had been completed in December 1998 and no visible signs of damage could be observed. Therefore, on technical criteria, the building was now assessed as non-damaged. However, although the geometric mean of the fungal concentrations had been reduced, the difference between 1995 and 1999 was not significant. In the qualitative assessment of the airborne microbial flora, six genera originally found in 1995 were not present in 1999. However, *Aspergillus versicolor*, *Stachybotrys*, *Trichoderma* and *Alternaria* were found sporadically and *Eurotium* in frequent colonies in the 1999 samples. The original control school had remained a healthy building with no significant moisture or mould problems. The airborne concentrations of fungi were low. Sporadic colonies of fungal species, regarded as indicators of moisture, were found, as shown in Table 1. In Toivala and Siilinjärvi secondary schools, moisture damage was observed in different parts of the buildings, mainly in the uppermost and in base floor structures, and the school buildings were assessed as being damaged. Microbial findings supported classification of the buildings in the damaged category.

Clinical atopic manifestations

In 1999, atopic manifestations were present in 66 (46%) children. Of these, 50 (76%) had allergic rhinitis, 22 (33%) had allergic conjunctivitis, and 41 (62%) had atopic eczema (Table 2). The highest figure (69%) was seen in Toivala secondary school and the lowest (29%) in Vuorela primary school (the control school); the differences between the schools were not significant. The prevalence of asthma varied from 12 to 29% in the four groups ($p=NS$); 35% of the 23 children with asthma were on continuous maintenance medication.

SPT findings

Positive SPTs to indoor allergens were present in 57 (40%) students and to outdoor allergens in 58 (40%) students: the highest figure was 75% in Toivala secondary school and the lowest was 36% in Vuorela primary school (the control school). Thirty per cent of children were positive for both indoor and outdoor allergens, and these 43 children formed the SPT-positive group of the present study. Dog epithelial dander was the most common positive indoor allergen, followed by cat and horse epithelial dander. The most common outdoor allergens were meadow fescue pollen, timothy grass pollen, and birch pollen, respectively. Only 12% of the children had positive reactions to house dust mites.

There were only six (4%) children who had positive ≥ 3 mm reactions to moulds; five reacted to at least one moisture-indicative mould. Weak mould reactions (1–2 mm) were seen in an

Table 2. Atopic manifestations among the 144 children in the four schools

	Siilinjärvi primary	Siilinjärvi secondary	Vuorela primary	Toivala secondary
Number of children	23	91	14	16
Class of moisture damage*	1	2	1	2
Clinical atopy†	12 (52%)	39 (43%)	4 (29%)	11 (69%)
Allergic rhinitis	10	29	3	8
Allergic conjunctivitis	3	12	2	5
Atopic eczema	6	25	3	7
SPT positivity‡	5 (22%)	28 (31%)	2 (14%)	8 (50%)
SPT to moulds				
Positive	1 (4%)	2 (2%)	0 (0%)	3 (19%)
Weak	2 (9%)	7 (8%)	1 (7%)	1 (6%)
Total atopy§	16 (70%)	57 (63%)	6 (43%)	13 (81%)
Bronchial asthma	4 (17%)	11 (12%)	4 (29%)	4 (25%)
Atopic¶	4	11	1	4
Non-atopic**	0	0	3	0

The diagnoses were parent-reported in the questionnaires; only doctor-diagnosed cases were included. There were no statistically significant differences between the schools.

*1, a building with no or minimal visible moisture damage and no mould growth; 2, a building with visible moisture damage or mould growth.

†Parent-reported doctor-diagnosed allergic rhinitis, allergic conjunctivitis or atopic eczema.

‡At least one positive reaction to an indoor allergen and an outdoor allergen in skin-prick tests (SPTs).

§Either clinical atopy or SPT positivity.

¶Bronchial asthma and total atopy.

**Bronchial asthma and no atopy.

Table 3. Skin prick test (SPT) responses to 12 moulds in the 144 students

	Number of responses in SPTs	
	Positive*	Weak†
Fungal species	n=16	n=20
<i>Aspergillus fumigatus</i> ‡	2	3
<i>Fusarium culmorum</i> ‡	3	4
<i>Rhodotorula species</i> ‡	0	2
<i>Phoma herbarum</i> ‡	2	1
<i>Alternaria alternata</i>	2	0
<i>Aureobasidium pullulans</i>	3	1
<i>Botrytis cinerea</i>	2	2
<i>Cladosporium herbarum</i>	2	2
<i>Mucor racemosus</i>	0	1
<i>Mucor spinosus</i>	0	1
<i>Penicillium brevicompactum</i>	0	2
<i>Penicillium expansum</i>	0	1

*The diameter of the weal was ≥ 3 mm.†The diameter of the weal was 1–2 mm.

‡Moisture-indicative moulds.

additional 11 (8%) children, six of whom reacted to the dampness-indicative moulds. Altogether, 17 (12%) children reacted to moulds and 11 (8%) to moisture-indicative moulds, to some degree. The total number of individual mould responses was 36; 16 were positive and 20 weak responses (Table 3). Seven positive and 10 weak reactions were to moisture-indicative moulds. There were no differences between boys and girls, among the three age groups or among different schools or school years, relative to mould reactions (data not shown). Likewise, no association was observed with house dust mite allergy.

Altogether, 92 (64%) children had either clinical atopy or SPT positivity, or both. Fourteen (15%) of the 92 atopic children reacted to at least one mould; there were five (5%) positive reactions and eight (9%) reactions to moisture-indicative moulds (Table 4). The respective figures were 6%, 2%, and 6% for the 52 non-atopic children; the differences between atopic and non-atopic

children were not significant. There were 23 children with asthma: eight (35%) reacted to moulds and five (22%) reacted to moisture-indicative moulds (Table 4). The figures were significantly higher than the respective figures of 7%, 3%, and 5% for the 121 non-asthmatic children.

Eleven (26%) of the 43 SPT-positive children had at least one reaction to moulds: five (12%) had positive and six (14%) had weak reactions (Table 4). In the 101 children classified as SPT negative, there was only one positive reaction and five weak reactions to moulds ($p < 0.01$ vs. SPT-positive cases). If there were no SPT responses to common allergens, the respective figures were one positive and one weak reaction ($p < 0.01$ vs. SPT-positive cases). Thus, 15 (88%) of the 17 children with positive or weak reactions to moulds also had reactions to other allergens.

The number of children with positive or weak reactions to moulds was three (13%) in the index

Table 4. Skin test reactivity to moulds in relation to skin test positivity, clinical atopy, and asthma

	Atopy			Asthma
	Clinical atopy*	SPT positivity	Total	
n	66	43	92	23†
Skin test reactions to moulds (n=17)	12 (18%)§	11 (26%)¶	14 (15%)	8 (35%)††
Positive reaction	5	5	5	2
Weak reaction	7	6	9	6
Skin test reactions to moisture-indicative moulds (n=11)‡	6 (9%)	7 (16%)**	8 (9%)	5 (22%)††
Positive reaction	3	3	3	1
Weak reaction	3	4	5	4

*Parent-reported doctor-diagnosed allergic rhinitis, allergic conjunctivitis or atopic eczema.

†Twenty children had atopic asthma.

‡Moisture-indicative moulds: *Aspergillus fumigatus*, *Fusarium culmorum*, *Rhodotorula species*, and *Phoma herbarum*.

§ $p < 0.05$ vs. children with no clinical atopy.

¶ $p < 0.01$ vs. children with no skin-prick test (SPT) positivity.

** $p < 0.05$ vs. children with no SPT positivity.

†† $p < 0.01$ vs. non-asthmatic children.

Table 5. Comparison of skin-prick test (SPT) responses to moulds between 1996 and 1999

	1996 n=144	1999 n=144	p-value
Number of responses to moulds	12 (4)* 8%	36 (17) 25%	<0.001
Positive reaction	5 (3)	16 (7)	<0.05
Weak reaction	7 (1)	20 (10)	
Number of children with responses to moulds	7 (4) 5%	17 (11) 12%	<0.05
Positive reaction	3 (3)	6 (4)	NS
Weak reaction	4 (1)	11 (7)	

*Responses to the moisture-indicative moulds *Aspergillus fumigatus*, *Fusarium culmorum*, *Rhodotorula* species, and *Phoma herbarum* are given in parenthesis.

school and one (7%) in the control school ($p=NS$). The respective figures were nine (10%) and four (25%) in the two secondary schools ($p=NS$). These three mould-positive students had moved from the control school to Toivala secondary school; two reacted to moisture-indicative moulds. With the exception of one student, all subjects with positive, ≥ 3 mm reactions to mould were 14 years or older. Only one had reacted to moulds 3 years previously.

All the 144 children had been tested 3 years previously; responses to moulds were significantly more common in 1999 than in 1996 (Table 5). In 1996, three children had positive and four had weak reactions to moulds. In 1999, only one child remained positive, and weak reactions had not changed to positive in any student. All the three mould-positive children had moved from the index school to Siilinjärvi secondary school. Thus, 83% of the six children who were now positive had developed mould allergy during the preceding 3-year period.

The SPT reactions to moulds and the microbial findings from the buildings did not correspond with other (Table 6). *Aspergillus*, *Cladosporium*, and *Penicillium* were found in every school, but SPT reactions to these moulds remained negative in 92% of the students. On the other hand, there were positive reactions to *Fusarium*, *Rhodotorula*, *Phoma*, *Alternaria*, *Aureobasidium*, and *Botrytis* with no known exposure.

Among the children with asthma, there were 15 old cases diagnosed before or at the 1996 study and eight new cases diagnosed after that study. Asthma improved in only two children during the 3-year time-period between the studies. Skin test responses to moulds, when positive and weak reactions were combined, were seen in five (33%) and three (38%) subjects of these two asthma groups and in only 7% of the 119 children with no asthma ($p<0.05$). Positive ≥ 3 mm reactions were present in 13% of old asthma cases, in none of the new asthma cases and in 3% of the subjects with no asthma ($p=NS$).

Discussion

Three main results were obtained in the present study. First, mould allergy (diagnosed by SPTs to moulds) is rare in schoolchildren. The prevalence of positive responses was 4%, being rather similar to the figures of 2.4–5% reported in previous studies (4,5). The responses were rare despite documented moisture damage and mould growth in school buildings. Second, most reactions to moulds were in children with multiple skin test reactions to common allergens, as also suggested previously (5). Third, no tendency of a shift from mild to positive reactions was seen during the 3-year follow-up period. This may, of course, be caused by the diminished exposure in the index school as a result of the renovation carried out between 1996 and 1999. The number of reactive children increased with age, although not significantly, and no association with exposure data was seen.

The classification of the school buildings into 'damaged' and 'non-damaged' was based on the frequency and seriousness of the signs of moisture and mould growth, as assessed by experienced civil engineers. The microbial results did not show any evident trends. Although the median concentration of total viable fungi decreased after repairs to the original index school, there were still occasional spores of moisture-indicative moulds. This may have been caused by contamination from the dismantling and repair process. A more complete profile of the microbial flora of the moisture-damaged materials can be achieved where samples of materials can be removed for laboratory analysis. This is, however, not always possible, for example when the repair process has not yet been started. The fungal concentration in the indoor air of the schools was generally low, an order of magnitude lower than in the home. Although widely used, sampling for viable fungi may not be a method sufficiently sensitive to detect differences between a damaged and a non-damaged school building (11).

Epidemiological data have suggested that moisture and mould exposure may increase

Table 6. Skin prick test (SPT) responses to moulds in relation to exposure (+or –) to the specific mould species in the schools

	Exposure+ n†/N‡	Exposure – n†/N§
<i>Aspergillus</i> *	5/144	0/0
<i>Fusarium</i> *	1/16	6/128
<i>Rhodotorula</i> *	0/0	2/144
<i>Phoma</i> *	0/0	3/144
<i>Alternaria</i>	1/23	1/121
<i>Aureobasidium</i>	1/105	3/39
<i>Botrytis</i>	2/91	2/53
<i>Cladosporium</i>	4/144	0/0
<i>Mucor</i>	2/144	0/0
<i>Penicillium</i>	3/144	0/0

*Moisture-indicative moulds.

†Number of positive or weak responses to moulds in SPTs.

‡Number of exposed children.

§Number of non-exposed children.

The statistical significance between the exposed and non-exposed children was not significant for any mould.

the risk for asthma, up to five-fold, in children of school age (4,9,12). In previous studies, preliminary evidence has been found which suggests that exposure to moisture and moulds in the home or at school seems to be associated with asthma or asthma-like symptoms (5). In the present study, 35% of asthmatic children as compared to only 7% of non-asthmatic children reacted to moulds. This means that 47% of the children reactive to moulds had asthma. However, nearly all children with asthma were atopic, having many other positive skin test results. Moreover, nearly all responses were weak and these weak reactions may be non-specific in nature. Two findings – the lack of a tendency for weak reactions to develop into positive reactions during the follow-up and the common occurrence of weak reactions in non-exposed children – suggest this non-specificity. The study design did not allow the evaluation of symptoms suggestive for asthma in children with no asthma diagnosis. Our results, based on doctor-diagnosed asthma, do not confirm the hypothesis that asthma in children is associated with the low level of mould exposure that occurs in public buildings with moisture problems, such as schools.

Previous studies have suggested that atopic illnesses and atopic symptoms, unlike respiratory infections and cough or wheezing symptoms, have no association with moisture or mould exposure in the home or at school (4). In contrast, skin test responses to moulds are, as seen also in the present study, clearly associated with atopic manifestations and skin test reactivity, especially with multiple reactivity to other common allergens (5). However, there was one student who was negative to common allergens but positive to one mould. Thus, allergy to indoor moulds is rare and

it seems to be present only in children with severe atopy or at least with atopy to many allergens.

We were not able to show any clear association between moisture and mould exposure at school and skin test reactivity to moulds. The result was similar when the findings of specific fungal species in the school buildings were compared with corresponding skin test responses. A large panel of 12 fungal allergens was used, which is larger than most panels used previously (4,5; T. Taskinen et al., submitted). In addition, the same children were tested using the same panel, twice, 3 years apart, at an age when responses to common inhalation allergens are likely to increase (13). It is clear that our panel, like all others, can incorporate only a small number of fungal species that are present in the environment and have potential health effects, even when the indoor environment is considered (1). On the other hand, children had responses to indoor moulds not present in the school buildings. Thus, exposure had taken place, and naturally often takes place, elsewhere than in the school. Despite this, the indoor air quality in public buildings like schools should be so good that exposure does not happen and that previously sensitized persons do not suffer from symptoms.

Studies examining moisture and mould problems in buildings, and exposure and health effects of the inhabitants, have thus far been cross-sectional and questionnaire-based (14,15). In these settings, the participants are often aware of the problem in their houses while answering the questions, leading easily to a reporting bias (16). On the other hand, some persons may have such an early stage of the disease that it is not possible to make a definite diagnosis; this is typical for pediatric asthma with a lack of objective tools for an early diagnosis. In the

present study, careful technical investigation supplemented by microbiological assays was combined with medical examination in a population-based setting. The same 144 children were investigated 3 years apart, and the participation rate was good: 79% of those who still lived in the community of Siilinjärvi. The questionnaires were identical and the SPTs were performed using the same 12 mould allergens at both phases of the study; this design guarantees comparability of the results (4). To our knowledge, follow-up studies among the same group of children, evaluating changes in SPT reactions to moulds and their association with changes in the environment, have not been performed previously. In particular, no data are available on the effects of building renovation procedures on the health of inhabitants.

In conclusion, mould allergy diagnosed by SPTs to moulds is rare in school children. Most reactions to moulds were in children with multiple skin test reactions to common allergens. No tendency for progression from mild to positive reactions was seen during the 3-year follow-up period. Asthma in children is not associated with a low level of mould exposure, as is present in public buildings such as schools, but children with severe or multiple atopy may be at risk for mould allergy and asthma.

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