A Study of Atopic Dermatitis in Elementary School Children in Hirosaki City, Aomori Prefecture, Japan

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Abstract

The purpose of this study was to investigate the relationship between residential environments and atopic dermatitis (AD). Subjects were 1378 elementary school children from 4 elementary schools in Hirosaki City, Aomori Prefecture located in the northeastern of Japan. Physical examinations, which adhered to the diagnostic criteria set by the Japanese Dermatological Association, were given by dermatological specialists in October 1994 (first series) and April 1995 (second series). Half of the children with AD showed symptoms in only one of two seasons, either the autumn or spring, so the drifting of symptoms of AD occurred largely by seasons. The data on residential environments was gathered by questionnaire. Multiple logistic regression analysis showed that more children who were diagnosed positive as AD twice (AD(+,+)), lived in damp and moldy homes than did children who were diagnosed negative as AD twice (AD(-,-)). Moreover AD(+,+) were more likely to live in homes built between 1984 and 1989 than did AD(-,-). In addition, most AD(+,+) children frequently lived in homes in which the bedrooms were vacuumed 3-5 times or more in a week. Then damp and moldy houses or houses built between 1984 and 1989 may be risk factors for the outbreak of AD.

Key words: atopic dermatitis, school children, physical examination, residential environments, multiple logistic regression analysis

Introduction

The frequency of atopic dermatitis (AD) in children has been increasing not only in Japan but also in other countries. Schultz et al. reported the results of an epidemiological study of AD in first-grade students in Denmark.¹⁾ Before 1960, about 2-3% of children surveyed suffered from AD in Denmark. By the 1960s, this frequency had risen to 4-8% in a number of studies, while for all children born after 1970, the likelihood of developing AD in childhood has been 9-12%.

The factors associated with the pathogenesis of AD are heredity and the environment,²⁾ and in particular, the presence of house dust mite allergens has been greatly emphasized.³⁾ "Tight" houses, while constructed to be energy-efficient and therefore airtight, foster a favorable environment for mite growth.⁴⁾

The purpose of this study was to investigate the relationship between residential environments and AD. Physical examinations, which adhered to the diagnostic criteria set by the Japanese Dermatological Association,⁵⁾ were given to 1378 elementary school children by dermatological specialists. The parents provided the data on home environments via questionnaire.

Subjects and Methods

1 Survey subjects

Subjects were 1378 children from 4 elementary schools in Hirosaki City in Aomori Prefecture. Hirosaki City, with a population of 170,000, is located in the northeastern of Japan.

2 Survey and analysis methods

-1- Physical examination and questionnaire

Dermatological specialists conducted two separate series of physical examinations, one in October 1994 (first series), and one in April 1995 (second series), to investigate the frequency of AD. The examinations adhered to the guidelines established by the

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Japanese Dermatological Association for the diagnosis of AD (Table 1).⁹⁾

In addition, a questionnaire was distributed to the children's parents in October 1994. It consisted of questions concerning the home environment, such as the year in which the building was built, the presence of dampness or mold in the house, how frequently the bedroom was vacuumed, and so forth (Figure 1).

-2- Methods of analysis

Based on the results of the two physical examinations, the children diagnosed AD positive only once were removed. The remaining children were classed into 2 groups: an AD(+,+) group,

comprising children who were positive for AD twice; and an AD(-,-) group, made up of children who were negative for AD twice.

The home environment survey results were analyzed by calculating the odds ratio of AD(+,+) for AD(-,-) and the chi-square test for official approval. In addition, multiple logistic regression was used to calculate the standardized coefficient of regression and the adjustment odds ratio.⁶⁾ All statistical analyses were performed using the program STAT FLEX (View Flex company, Tokyo, Japan).

Table 1 The diagnostic criteria for atopic dermatitis by the Japanese Dermatological Association.⁹⁾

1. Pruritus
2. Typical morphology and distribution:
 - (1) Eczematous dermatitis
 - Acute lesions:
 - erythema, exudation, papules, vesiculopules, scales and crusts
 - Chronic lesions:
 - infiltrated erythema, lichenification, prurigo scales and crusts
 - (2) Distribution
 - Symmetrical
 - Predilection sites:
 - forehead, periorbital area, perioral area, preauricular area, neck, joint areas of limbs, trunk
 - Age-related characteristics
 - Infantile phase : starts on the scalp and face, often spreads to the trunk and extremities
 - Childhood phase ; neck, the flexural surface, of the arms and legs
 - Adolescent and adult phase:
 - tendency to be severe on the upper half of body (face, neck, anterior chest, and back)
3. Chronic or chronically relapsing course (usually coexistence of old and new lesions):
 - More than 2 months in infancy
 - More than 6 months in childhood, adolescence, and adulthood

Definite diagnosis of atopic dermatitis requires the presence of all three features without any consideration severity. Other cases should be evaluated on the basis of the clinical course with the tentative diagnosis of acute or chronic non-specific eczema.

Grade	Class	Number	Name	(Male, Female)
(1) Have you ever been troubled with damp and mold ?				
	1. Yes	2. No	3. Not sure	
(2) What year was your house built?				
	1. _____	2. Not sure		
(3) What kind of heating do you use?				
	1. hot air	2. electric heater		
	3. foot warmer	4. heater with a stovepipe		
	5. heater without stovepipe	6. others ()		
(4) What kind of bed does your child use?				
	1. foreign style bed	2. Japanese style mattress		
	3. others ()			
(5) How frequently is the bedroom vacuumed?				
	1. almost every day	2. 3-5 times a week		
	3. 1-2 times a week	4. 1-2 times a month		
	5. seldom			
(6) Do you have a pet?				
	1. yes	2. No		
	↓			
What kind of pet do you have?				
	1. dog	2. cat	3. bird	4. others ()
(7) Does anyone smoke in your family ?				
	1. Yes	2. No		

Fig. 1 Questionnaire distributed to the parents of the children

Results

1 Participation rates

Out of the 1579 school children, 1514 (95.9%) received a physical examination during the first series, and 1521 (96.3%) during the second. Of these, 1465 (92.8%) attended both series.

The questionnaire was returned by 1473 children (93.3%). After excluding children who either missed an examination or failed to hand in the questionnaire, a total of 1378 children (87.3%) remained for consideration in the present study (Table 2). Table 2 gives the data for these children, including their year in school as of October 1994.

Table 2 Number of subjects by school year and by gender

Graders	Boys	Girls	Total
1	127	130	257
2	125	138	263
3	167	128	295
4	153	134	287
5	134	142	276
Total	706	672	1378

2 Frequency of AD and itemized statements of children with AD

A total of 1378 children were considered for this study. Of these, 103 children (7.5%) were diagnosed as AD positive in both examinations (AD(+,+) group), and 1091 (79.2%) were negative (AD(-,-) group). During the first and second series, 194 (14.1

%) and 196 (14.2%) of the children were diagnosed with AD, (6.6%); children with AD only in the second series totaled 93 (6.7%) (Table 3).

Table 3 Number of itemized statements of children with atopic dermatitis and without atopic dermatitis.

In April 1995 (second series)	In October 1994 (first series)		Total
	Children with AD	Children without AD	
Children with AD	103 (7.5%)	93 (6.7%)	196 (14.2%)
Children without AD	91 (6.6%)	1091 (79.2%)	1182 (85.8%)
Total	194 (14.1%)	1184 (85.9%)	1378 (100.0%)

(6.6%); children with AD only in the second series totaled 93 (6.7%) (Table 3).

(3) Frequency of Children with AD classified by school year and by gender

The frequency of children with AD classified by school year is shown in Figure 2. No significant difference in the frequency of AD between the first and second series was found in any of each grade. In the first series the rate of boys diagnosed positive for AD was 14.0%, and that of girls was 14.1% with., no significant gender difference shown. Similarly in the second series the rate of boys diagnosed positive for AD was 13.2%, and that of girls was 15.3% with no significant gender difference.

(4) Questionnaire results

-1- Comparison of residential environments of AD(+,+) and AD(-,-)

The odds ratio was calculated for the AD(+,+) subjects

compared with AD(-,-) subjects, and the chi-square test for official approval was performed (Table 4).

Table 4 Comparison of residential environments of AD(+,+) and AD(-,-).

Residential environments		AD(+,+) (number)	AD(-,-) (number)	odds ratio
the presence of dampness or mold in the house	Yes	50	385	1.70*
	No	47	617	
the year in which the building was built	Between 1984 and 1989	21	155	1.63
	Prior to 1984 or after 1989	67	807	
Non-exhaust style heating	Use	43	516	0.78
	Not use	60	562	
Type of bed	Japanese style mattress	62	574	1.37
	foreign style bed	39	496	
How frequently the bedroom was vacuumed	1-2 times or less a week	41	556	0.65*
	3-5 times or more a week	59	519	
Existence of pet with hair	Yes	30	310	1.05
	No	71	769	
Existence of smoker in the family	Yes	59	755	0.60*
	No	42	323	

*p<0.05

AD(+,+) : children diagnosed with atopic dermatitis in twice series

AD(-,-) : children diagnosed without atopic dermatitis in both series

-2- Analysis of multiple logistic regression

The objects of multiple logistic regression analysis were the items showing significance (p<0.1). However since it was thought that the families with AD children leave a tendency not to smoke and consequently there were fewer smokers in families of AD(+,+) children than in the families of AD(-,-), the items on smoking was excluded in the analysis.

Multiple logistic regression analysis showed that more AD(+,+) children lived in damp and moldy homes than did AD(-,-) children, and AD(+,+) were more likely to live in homes built between 1984 and 1989 than did AD(-,-) children (Table 5). In addition, most AD(+,+) children frequently lived in homes in which the bedrooms were vacuumed 3-5 times or more a week.

Fig. 2 Frequency of children with atopic dermatitis classified by school year

The standardized coefficient of regression in moldy and damp houses was 0.52, the highest of all related factors, and its adjustment rate was 1.69.

Table 5 The results of multiple logistic regression analysis.

Residential environments	Standardized coefficient of regression	Adjusted odds ratio
Damp and moldy houses	0.52*	1.69
Houses built between 1984 and 1989	0.52	1.68
Bedrooms vacuumed 3-5 times or more a week	-0.50*	0.60

*p<0.05

Discussion

To compare the frequency of AD occurring in different regions of the world, at least a minimal number of basic evaluation criteria are needed. Unfortunately, such diagnostic criteria have been standardized neither in Japan nor in other countries. Some researchers, such as Hanifin et al.⁷⁾ and Williams et al.⁸⁾ have reported the criteria they used, but in the case of Williams et al.⁸⁾ for example, those criteria are somewhat simplified⁹⁾ and best suited to epidemiological surveys. In Japan, the situation is further complicated by the release of two separate series of AD diagnostic criteria; one by the Ministry of Health and Welfare (1991)¹⁰⁾ and one by the Japanese Dermatological Association (1994).⁹⁾ This lack of standardization also makes it difficult to study the relationship between a particular environmental agent and the frequency of AD in a designated region. A unified protocol would greatly enhance future studies of AD.

In the present study, we followed the criteria set by the Japanese

Dermatological Association.⁹⁾ A frequency rate of 14.1% and 14.2% for AD was found in the spring and autumn, respectively, yet only 7.5% , that is, half of these children showed their symptoms in both of two seasons.

The drifting of symptoms was large. For future studies, we recommend that several examinations are carried out during different seasons.

In a previous study of AD,¹¹⁾ we reported results similar to the present ones. In that earlier study, a physical examination and home-environment questionnaire were given to 1725 elementary school children, and allergy tests for mite allergen were conducted. The rate of concordance between those diagnosed to have AD by medical examination and the group that responded as having AD in the questionnaire was found to be about 50%. Moreover there were differences in conclusions regarding risk factor of AD between the medical examination and the questionnaire. For increasing reliability, a medical examination would be preferred. And the results of allergy tests suggest that damp and moldy houses or those built since 1974 may be risk factors for the outbreak of AD. The children whose bedrooms vacuumed at least 3-5 times a week had high response rate on the allergy test. It was reported that the stirring of air in the room scatter mite allergens in the room¹³⁾, therefore it may be possible that vacuum cleaning stirred up mite allergens in the carpet and floor.

In the present study, most AD(+,+) children frequently lived

in homes in which the bedrooms were vacuumed 3-5 times or more a week. One reason for this result may be that families with AD children tend to clean their homes more often, although on the basis of our previous study, we recommend to open a window during vacuuming. Moreover in the present study, damp and moldy houses were again found to be a factor in the development of AD(+,+) similar to that reported in the previous study. We considered that one reason for this result may be that the damp and moldy houses can breed mites more easily.¹¹⁾

Yet this survey found that most children with AD(+,+) live in homes built between 1984 and 1989. As houses constructed since 1984 are more airtight than those built prior to 1984, their air ventilation is poor and thus their indoor air humidity is greater.¹⁴⁾ In other words, building ventilation and indoor air humidity are inversely related. A humid and damp environment is more hospitable to mites than a well-ventilated and dry environment. Therefore, the increase in AD in children might parallel the potential increase in mite populations in these more recently built homes.

Another factor which may contribute to the increase in AD cases is the change of types of mites found in different types of homes. It has been reported that, in Japan, the type and number of mites present in a household varies with the age of the house.¹⁵⁾ The Pyridicshidae, which are considered to be the cause of allergic disease, initially were rare at the construction sites of new homes, but gradually became more preponderant. In 5-10 years after the construction of these homes, the Pyridicshidae populations at their sites are believed to have stabilized.¹⁵⁾ The homes built between 1984 and 1990 have passed 5-10 years since construction, therefore in these homes the Pyridicshidae are considered to have been proliferated and become the potential cause of the increase of AD cases.

In conclusion, while airtight houses are energy-efficient and comfortable for people, they are comfortable for mites and molds as well. The ventilation of homes, through opening windows and other simple measures, can help inhibit the growth of mites. We need to make the effort to enjoy healthy lives in our comfortable homes.

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