

—Original—

Risk Factors and Prevalence of Asthma or Atopic Dermatitis in Young Children by a Questionnaire Survey

Tomoyuki Kawada

Department of Hygiene and Public Health, Nippon Medical School

Abstract

Little is known about the relation between atopic disorders and altitude of residence. The author investigated the prevalence of asthma and atopic dermatitis, and their relationship with altitude of residence.

A total of 24,631 children aged four years and under in Gunma Prefecture, Japan, were surveyed. The ATS-DLD questionnaire for asthma was distributed together with an item on atopic dermatitis. Some confounding variables were also asked. The author judged subjects as having asthma when positive answers were given to all 6 items in the ATS/DLD questionnaire.

The prevalence of asthma in subjects with atopic dermatitis was higher than in those without (5.1% vs. 1.8%). Logistic regression analyses for asthma and atopic dermatitis were conducted, and male sex, increasing age, family history of target disease, and living at higher altitude commonly and significantly contributed to an increase in the risk of each allergic disorder. For asthma, not being the eldest child, and past or present history of atopic dermatitis were also selected as risk factors.

There was an increase in the prevalence of atopic disorders in groups living at a higher altitude was observed in this area.

(J Nippon Med Sch 2004; 71: 167–171)

Key words: asthma in young children, atopic dermatitis, prevalence, altitude

Introduction

Although large population studies on the prevalence of asthma or atopic dermatitis have been conducted in many countries^{1–3}, there are relatively fewer studies looking at asthma and atopic dermatitis in children aged four years and under. The author planned to conduct a survey not only to elucidate the prevalence of asthma and atopic dermatitis, but also the risk factors for these allergic

disorders with special emphasis on altitude of residence.

The association between these two disorders and altitude of residence was evaluated by adjusting some confounding risk factors. This large-scale survey should contribute to knowledge of the contributing factors in atopic disorders in addition to the prevalence of asthma and atopic dermatitis in children aged four years and under.

Correspondence to Tomoyuki Kawada, MD, Ph D, Department of Hygiene and Public Health, Nippon Medical School, 1-1-5 Sendagi, Bunkyo-ku, Tokyo 113-8602, Japan
E-mail: kawada@nms.ac.jp
Journal Website (<http://www.nms.ac.jp/jnms/>)

Table 1 A positive answer to all 6 questions of the ATS-DLD questionnaire classed the subject as having asthma

Q1.	Has your child ever had an attack of wheezing or whistling that has caused him/her to be short of breath?
Q2.	Has he/she ever had 2 or more such episodes?
Q3.	Has a doctor ever said that he/she had asthma, asthmatic bronchitis or child asthma?
Q4.	On that occasion, was his/her chest sounding wheezy or whistling?
Q5.	At that time, did he/she have difficulty in breathing accompanied by wheezing or whistling?
Q6.	In the past, has he/she ever had an attack of wheezing or received treatment for asthma?

Methods

Study Population

A total of 24,631 children aged four years and under in 70 towns in Gunma Prefecture, Japan, were surveyed.

The parents of the target population completed two-page written questionnaires about the symptoms of asthma and the medical diagnosis of atopic dermatitis. The author recruited collaborating staff in prefectural health centers. Each local government agreed to adhere to the study protocol. Three coordinators, members of the prefectural health department, were responsible for gathering the questionnaires.

To provide sufficient precision for estimating the prevalence of diseases, the survey was conducted intensively⁴. The collection of the questionnaire and checking processes were conducted precisely to ensure the completeness of the response. Data are presented for each local government in the prefecture. The Committee on Human Health Survey in Gunma Prefecture approved this study. Informed consent was obtained from all the families of the subjects.

Assessment of Asthma and Atopic Dermatitis

The ATS-DLD (American Thoracic Society–Division of Lung Disease) questionnaire⁵ has been used as a simple tool to evaluate the prevalence of asthma in children, and is supported by local governments to ensure high response rates.

The questions regarding asthma are listed in **Table 1**. The author judged those subjects who gave positive answers to all 6 items in the ATS/DLD questionnaire as having asthma. For atopic dermatitis, the question, “Has your child been

diagnosed as having atopic dermatitis?” was applied to 24,631 children to select patients. Information on the patient’s sex, age, order among siblings, smoking in the patient’s home environment, living with a pet, and family history of disease was also elicited.

Data Analysis

The author analyzed the prevalence of asthma and atopic dermatitis by the age of the patient, and then the percentage was calculated with stratification by geographical altitude using the Cochran-Armitage test for trends. The prevalence of asthma was calculated as follows: the number of positive responses to all six questions divided by all the respondents. The author also calculated the prevalence of atopic dermatitis. Logistic regression analysis was adopted to adjust for the other risk factors for asthma and atopic dermatitis, respectively. Statistical analysis was performed using the SPSS 11.5J software package for Windows (SPSS Japan Inc., Tokyo).

Results

A total of 24,631 children aged four years and under living under 70 local governments in Gunma Prefecture participated in this study. Members of prefectural health centers distributed the self-administered questionnaire with the support of public health nurses in each local government area. The response rate was 70.7% (17,402/24,631).

Prevalence of asthma increased linearly and significantly with the increasing age of the patient. In contrast, the prevalence of atopic dermatitis did not increase linearly with age (**Table 2**). The prevalence of asthma in the cities was 2.9% among boys and 1.2% among girls. The prevalence in towns or villages was 2.3% among boys and 1.4% among

Table 2 Change in the Prevalence of Asthma and Atopic Dermatitis by Increasing Age

I) Asthma	Boys		Girls	
	Year of age	Case/Population	Prevalence	Case/Population
0	18/3,201	0.6	14/3,214	0.4
1	52/2,445	2.1	29/2,412	1.2
2	20/ 717	2.8	13/ 759	1.7
3	134/2,231	6.0	53/2,142	2.5
Total	224/8,594	2.6	109/8,527	1.3
Cochran-Armitage trend test		<0.01		<0.01
II) Atopic Dermatitis	Boys		Girls	
	Year of age	Case/Population	Prevalence	Case/Population
0	145/2,902	5.0	78/2,933	2.7
1	133/2,206	6.0	105/2,159	4.9
2	52/ 641	8.1	21/ 675	3.1
3	119/2,002	5.9	95/1,966	4.8
Total	449/7,751	5.8	299/7,733	3.9
Cochran-Armitage trend test		not significant		not significant

Table 3 Prevalence of Asthma and Atopic Dermatitis Stratified by Altitude

I) Asthma	Boys		Girls	
	Altitude	Case/Population	Prevalence	Case/Population
0 ~ 100m	85/ 3,737	2.3	41/ 3,682	1.1
100 ~ 200m	82/ 3,369	2.4	42/ 3,364	1.2
200 ~ 1,200m	60/ 1,604	3.7	28/ 1,589	1.8
Total	227/ 8,710	2.6	111/ 8,635	1.3
Cochran-Armitage trend test		<0.01	not significant (=0.054)	
II) Atopic dermatitis	Boys		Girls	
	Altitude	Case/Population	Prevalence	Case/Population
0 ~ 100m	145/ 3,407	4.3	113/ 3,370	3.4
100 ~ 200m	203/ 3,006	6.8	123/ 3,011	4.1
200 ~ 1,200m	106/ 1,442	7.4	70/ 1,449	4.8
Total	454/ 7,855	5.8	306/ 7,830	3.9
Cochran-Armitage trend test		not significant		<0.05

girls. The prevalence of asthma among subjects who had atopic dermatitis was 5.1%, whereas the prevalence of asthma among subjects who had no atopic dermatitis was 1.8%.

The author stratified the altitude into three categories and the prevalence of asthma among boys and atopic dermatitis among girls significantly increased concomitantly with the altitude (**Table 3**).

A multiple logistic regression analysis to predict asthma was conducted, and male sex, increasing age, not being the eldest child, family history of asthma,

history of atopic dermatitis, and living at higher altitudes (200 m or higher) significantly contributed to an increase in the risk of asthma (**Table 4**). In the case of atopic dermatitis, male sex, increasing age, family history of atopic dermatitis, and living at higher altitudes (100 m or higher) significantly contributed to an increase in the risk of the disease.

Discussion

The standard simple ATS-DLD questionnaire was

Table 4 Odds Ratio and 95% Confidence Interval (CI) on Asthma and Atopic Dermatitis by Several Factors Using a Multiple Logistic Regression Analysis

Variables	asthma	Atopic Dermatitis
	OR (95%CI)	OR (95%CI)
Girls	0.45 (0.35, 0.57)	0.64 (0.55, 0.75)
Age (one year)	1.90 (1.71, 2.10)	1.12 (1.05, 1.19)
Not eldest	1.92 (1.49, 2.47)	1.05 (0.90, 1.22)
No passive smoking	0.97 (0.76, 1.23)	1.01 (0.86, 1.18)
Not living with pet	0.81 (0.63, 1.04)	1.11 (0.93, 1.32)
Family history of target disease	3.79 (2.99, 4.81)	6.68 (5.73, 7.79)
Atopic dermatitis		
Past history	2.02 (1.46, 2.81)	
Present history	2.34 (1.62, 3.38)	
Altitude (0 ~ 100 m)		
100 ~ 200 m	1.04 (0.79, 1.36)	1.38 (1.16, 1.64)
200 ~ 1,200 m	1.38 (1.02, 1.87)	1.47 (1.19, 1.81)

OR; odds ratio

used to calculate the prevalence of asthma in the children in this study. As the questionnaires had been validated before the study⁶⁻⁸, no validation study using sensitivity and specificity against clinical diagnosis was conducted in this article. However, showing a video depicting signs and symptoms of asthma to the parents, rather than a self-administered written questionnaire, would provide a more accurate recognition of asthma. Validation studies on questionnaire surveys should be continued to get a precise epidemiological outcome⁹.

The author conducted this survey in one prefecture broadly and intensively. Although any sampling method has a potential source of bias, the response rate in this survey was 70.7%, which seems satisfactory considering the test situation in a health examination.

Because of the problems concerning the parents' perception of atopic dermatitis symptoms, adding a question to the questionnaire regarding a medical doctor's positive diagnosis of their child as having atopic dermatitis seemed to be appropriate to predict the prevalence. Kimura et al. reported that the prevalence of atopic dermatitis by questionnaire and the medical diagnosis by a doctor were similar, though there was some dissociation on each individual judgment¹⁰. Further studies on validation are needed for this questionnaire to be used widely.

The author evaluated the relationship of the prevalence between the two allergic disorders. These two disorders are strongly related, in that the prevalence of asthma among subjects who had atopic dermatitis was about three times higher than the prevalence of asthma among subjects who had no atopic dermatitis. This finding was also verified by the multiple logistic regression analysis. The odds ratio of asthma in subjects who had a present history of atopic dermatitis was 2.34 (95%CI; 1.62, 3.38).

There are some reports that air pollution is not a major risk factor for the development of asthma in populations, although it may exacerbate asthma in individuals¹¹⁻¹³. In the past, there have been reports that the prevalence of asthma had an inverse relationship with geographical altitude^{14,15}. In Gunma Prefecture, a southeastern wind blows in the summer, and air pollution from acidic fog in places of higher altitude around Mt. Akagi has been reported¹⁶. This fact may partly explain the increase in the prevalence of asthma in children who were living at higher altitudes. The author has a plan to explore quantitatively the relationship between air pollution including nitrogen dioxide (NO₂) and suspended particulate matter (SPM), and respiratory symptoms, which was the subject of a similar study in Indonesia by the author and a colleague¹⁷.

Acknowledgments: The author would like to thank to the participants in this study. This research was supported partly by a grant from "Koken Kyokai", in 2002.

References

1. Burr ML, Limb ES, Andrae S, Barry BMJ, Nagel F: Childhood asthma in four countries: a comparative study. *Int J Epidemiol* 1994; 23: 341-347.
2. Larsen FS, Diepgen T, Svensson A: The occurrence of atopic dermatitis in North Europe: an international questionnaire study. *J Am Acad Dermatol* 1996; 34: 760-764.
3. Pearce NE, Weiland S, Keil U, Langridge P, Anderson HR, Strachan D, Bauman A, Young L, Gluyas P, Ruffin D, Crane J, Beasley R: Self-reported prevalence of asthma symptoms in children in Australia, England, Germany and New Zealand: an international comparison using the ISAAC written and video questionnaires. *Eur Respir J* 1993; 6: 1455-1461.
4. Asher MI, Keil U, Anderson HR, Beasley R, Crane J, Martinez F, Mitchell EA, Pearce N, Sibbald B, Stewart AW, Strachan D, Weiland SK, Williams HC: International study of asthma and allergies in childhood (ISAAC): rationale and methods. *Eur Respir J* 1995; 8: 483-491.
5. Ferris BG: Epidemiology Standardization Project (American Thoracic Society). II. Recommended respiratory disease questionnaires for use with adults and children in epidemiological research. *Am Rev Respir Dis* 1978; 118 (6 Pt 2): 7-53.
6. Shaw R, Woodman K, Ayson M, Dibdin S, Winkelmann R, Crane J, Beasley R, Pearce N: Measuring the prevalence of bronchial hyper-responsiveness in children. *Int J Epidemiol* 1995; 24: 597-602.
7. Lai CK, Chan JK, Chan A, Wong G, Ho A, Choy D, Lau J, Leung R: Comparison of the ISAAC video questionnaire (AVQ 3.0) with the ISAAC written questionnaire for estimating asthma associated with bronchial hyper-reactivity. *Clin Exp Allergy* 1997; 27: 540-545.
8. Williams HC, Burney PGJ, Pembroke AC, Hay RJ: Validation of the UK diagnostic criteria for atopic dermatitis in a population setting. *Br J Dermatol* 1996; 135: 12-17.
9. Adachi M, Kobayashi M, Iwasaki A, Nitta Y, Yoshida R: A new children's respiratory disease questionnaire (1) Comparison of interview and self-completion method. *Nippon Koshu Eisei Zasshi* 1982; 29: 557-565. in Japanese
10. Kimura Y, Guang S, Kanazawa Y, Kida K, Mita R, Nishizawa Y, Hashimoto I: Relationship of atopic dermatitis to residential environment. A study of the comparison between diagnosis by medical examination and assessment by questionnaire. *Nippon Koshu Eisei Zasshi* 1996; 43: 1033-1044. in Japanese
11. Committee of the Environmental and Occupational Health Assembly of the American Thoracic Society: Health effects of outdoor air pollution. part I. *Am J Respir Crit Care Med* 1996; 153: 3-50.
12. Committee of the Environmental and Occupational Health Assembly of the American Thoracic Society: Health effects of outdoor air pollution. part II. *Am J Respir Crit Care Med* 1996; 153: 477-498.
13. Venn A, Lewis S, Cooper M, Hubbard R, Hill I, Boddie R, Bell M, Britton J: Local road traffic activity and the prevalence, severity, and persistence of wheeze in school children: combined cross sectional and longitudinal study. *Occup Environ Med* 2000; 57: 152-158.
14. Charpin D, Kleisbauer JP, Lanteaume A, Razzouk H, Vervloet D, Toumi M, Faraj F, Charpin J: Asthma and allergy to house-dust mites in populations living in high altitudes. *Chest* 1988; 93: 758-761.
15. Vargas MH, Sienna-Monge JJ, Diaz-Mejia G, DeLeon-Gonzalez M: Asthma and geographical altitude: An inverse relationship in Mexico. *J Asthma* 1999; 36: 511-517.
16. Ikeda Y, Yasuda R, Higashino H, Watanabe R, Hatakeyama S, Murano K: An analysis of acid fog and air pollution at Mt. Akagi—Focusing on transportation of polluted air mass—. *Taiki Osen Gakkai Shi* 1995; 30: 113-125. in Japanese
17. Duki Z, Sudarmadi S, Suzuki S, Kawada T, Tri-Tugaswati A: Effect of air pollution on respiratory health in Indonesia and its economic cost. *Arch Environ Health* 2003; 58: 135-143.

(Received, November 5, 2003)

(Accepted, December 24, 2003)