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INVESTIGATIVE REPORT

Prevalence and Risk Factors for Atopic Dermatitis: A Cross-sectional Study of 6,453 Korean Preschool Children

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The aims of this study were to evaluate the prevalence, severity and risk factors for atopic dermatitis in Korean preschool children as determined by dermatological examination vs questionnaire survey. A total of 6,453 preschool children from 59 kindergartens and 14 day-care centres were evaluated. Parents responded to an International Study of Asthma and Allergies in Childhood (ISAAC)-based questionnaire containing questions concerning 23 risk factors, as well as the prevalence, and severity of atopic dermatitis. Fourteen dermatologists then examined the participants according to the Korean diagnostic criteria for atopic dermatitis, and the Eczema Area and Severity Index (EASI) score. Atopic dermatitis prevalence determined by dermatological examination was lower than the questionnaire-based prevalence (9.2% vs 19.1%). Most patients (96.2%) had mild atopic dermatitis according to the EASI score (mean ± SD 3.91 ± 4.73; median 1.5; range 0.2–38.0). However, 17.4% had sleep disturbance, and 56.7% had not obtained complete remission of their rash over the previous 12 months. Among the 12 risk factors, "changing the patient's house to a newly built house during the first year of life" had significant odds ratio. In conclusion, the prevalence of atopic dermatitis in Korea in the ISAAC-based survey conducted by paediatricians was similar to that in several European countries, and lower than the 2006 Korean figure (28.9%). In addition, the prevalence of atopic dermatitis was lower when assessed by dermatological examination than by questionnaire. ***Key words: atopic dermatitis; children; dermatological examination; prevalence; questionnaire; risk factors.***

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Atopic dermatitis (AD) can have a considerable impact on the quality of life of patients and their families (1), and the direct and indirect costs of AD are increasing annually worldwide (1–3). To formulate a societal solution to these problems, an epidemiological study of the prevalence and risk factors of AD is needed. The prevalence of AD has increased worldwide in the past decades (4); it was reported to be 28.9% in Korea in 2006, compared with 16.6% in 1995 according to an International Study of Asthma and Allergies in Childhood (ISAAC)-based questionnaire survey conducted by paediatricians (5, 6). However, this figure was high compared with other countries (7–14) and even to a recent Korean study by dermatologists (15).

The present study used a dermatological examination and a questionnaire to gather information on preschool children and the prevalence, severity, and risk factors of AD in Seoul, the capital of the Republic of Korea. We also compared estimates of prevalence and severity of AD based on physical examination by dermatologists and on the questionnaire.

MATERIALS AND METHODS

Study population

The target population consisted of preschool children (age range 0–6 years) in kindergartens and day-care centres in Seoul. In order to assess AD prevalence in the entire city of Seoul, we divided the city into 5 regions: downtown, northeast, northwest, southeast, and southwest. In each region, we selected 2 to 4 districts and obtained a list of kindergartens and day-care centres from the Seoul municipal government. These were selected in the order of enrolment in each district.

Data collection

The study was conducted from April to October 2008, using a questionnaire based on the ISAAC study format and under the direct supervision of 14 participating dermatologists and the Seoul municipal government. The study was carried out after obtaining written consent from the subjects' parents. Questionnaires were distributed prior to visiting kindergartens and day-care centres, and one week later 3 to 5 dermatologists visited the aforementioned places to examine the children (Fig. 1).

Diagnostic criteria for atopic dermatitis

AD was diagnosed during the dermatological examination, yielding point prevalence, when a patient had two major and

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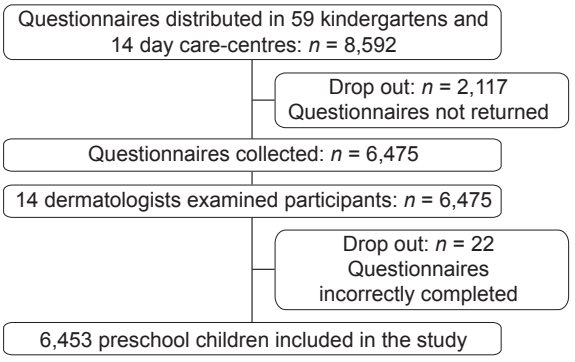

Fig. 1. Study flow-chart.

4 minor features consistent with the 2005 Korean diagnostic criteria for AD (Table SI; available from http: //www.medicaljournals.se/acta/content/?doi=10.2340/00015555-1252) (16). In regard to the questionnaire, yielding one-year prevalence, if a subject met the 3 ISAAC criteria, a diagnosis of AD was established (Table SII; available from http: //www.medicaljournals.se/acta/content/?doi=10.2340/00015555-1252) (17, 18). The three ISAAC criteria were as follows: intermittent itchy rash for at least 6 months; itchy rash at any time in the last 12 months; and itchy rash at any time affecting the folds of the elbows, behind the knees, in front of the ankles, under the buttocks, or around the neck, ears or eyes.

Assessment of severity

During the dermatological examination, the severity of eczema was measured by 14 dermatologists working in the various institutions using the Eczema Area and Severity Index (EASI) score. Eczema was scored in each patient as mild (< 15), moderate (16–26) or severe (> 27), as defined in previous studies (19). In the questionnaire, if a patient experienced any form of sleep disturbance due to AD at least once a week, or if the symptoms had not disappeared in the last 12 months, the diagnosis was severe AD (Table SII) (20).

Risk factors

The risk factors for AD that were evaluated in the study were: present passive smoking (at least once a week), receiving vaccines according to the Korean immunization schedule, parental educational background, breastfeeding or formula-milk feeding, type of house (apartment, multiplex house, detached house, or others), age of house (> 10 years, 6–10 years, 2–6 years, < 2 years, or unknown), moving to a newly-built or renovated house during the first year of life, air pollution (living in a residential area or others), type of house heating system (central heating system, separate heating, portable heating, or others), keeping pets in the present or past, or never having kept pets, and keeping pets during pregnancy or the first year of children's life (Table SII).

Statistical analysis

Demographic characteristics and AD risk factors between AD and non-AD groups from the dermatological examination and questionnaire survey were analysed using the χ^2 test. Then, the odds ratio (OR) and 95% confidence interval (CI) was calculated by logistic regression analysis by the stepwise selection method. A p-value lower than 0.05 was considered statistically significant.

RESULTS

Demographic characteristics

The epidemiological study was performed in 59 kindergartens and 14 day-care centres in 14 districts of Seoul. In total, 8,592 questionnaires were distributed, and 75.4% of them ($n = 6,475$) were returned (Table SIII; available from: http://www.medicaljournals.se/acta/content/?doi=10.2340/00015555-1252). Of the 6,475 questionnaires, 22 were incorrectly completed, thus a final total of 6,453 preschool children were examined by dermatologists. Table I shows the demographic characteristics of the children. There were no significant differences in these characteristics between the patient and non-AD groups.

Prevalence of atopic dermatitis

Fig. S1 (available from: http://www.medicaljournals.se/acta/content/?doi=10.2340/00015555-1252) summarizes the prevalence of AD assessed by dermatological examination and by questionnaire. The prevalences of AD in Seoul according to the dermatological examination and questionnaire were 9.2% and 19.1%, respectively. The differences in AD prevalence between regions were statistically significant for both research methods (dermatological examinations, $p = 0.0008$; questionnaire survey, $p = 0.0001$). The prevalence was higher in the downtown, southeast, and northwest regions than in the other regions.

Severity of atopic dermatitis

The mean ± SD EASI score in the dermatological examination was 3.91 ± 4.73, and the median, 1.5 (range 0.2–38.0) (Table II). The numbers of mild, moderate, and severe AD cases were 571 (96.2%), 18 (3.0%) and 5 (0.8%), respectively. In the questionnaire, 17.4% of respondents reported that they had experienced sleep disturbance due to AD at least once a week in the last 12 months. In addition, 56.7% of respondents reported their symptoms had not completely cleared up in the last 12 months (Table II).

Table I. *Demographic characteristics*

	Seoul ($n = 6,453$)
Gender, *n*	
Male	3,254
Female	3,199
Age, years, mean ± SD	4.56 ± 1.16
Body weight, kg, mean ± SD	18.73 ± 3.75
Height, cm, mean ± SD	108.87 ± 8.66
Birth weight, kg, mean ± SD	3.32 ± 1.77

SD: standard deviation.

Table II. *Severity of atopic dermatitis (AD) investigated by dermatologists and by written questionnaire*

	EASI score	Sleep disturbance due to AD in the last 12 months			Complete remission of itchy rash during the last 12 months	
Area	Mean±SD	Nothing (%)	<1/week (%)	≥1/week (%)	Yes (%)	No (%)
Seoul	3.91±4.73	47.7	34.9	17.4	43.3	56.7
Downtown	3.63±4.28	50.5	37.8	11.7	39.1	60.9
Northeast	3.69±4.30	45.6	35.5	18.9	48.0	52.0
Northwest	3.23±3.74	43.2	36.6	20.2	46.3	53.7
Southeast	5.85±6.58	51.4	32.1	16.5	38.0	62.0
Southwest	2.81±2.88	49.0	34.2	16.8	43.1	56.9

Risk factors for atopic dermatitis

For the AD group diagnosed by dermatologists, "moving to a newly built or renovated house during the first year of life" (OR = 1.392, 95% CI 1.067–1.654) was significantly associated with the occurrence of AD. In the analysis of the AD group defined by questionnaire, the same factor was also significant: "moving to a newly built or renovated house during the first year of life" (OR = 1.603, 95% CI 1.368–1.878) (Table III).

DISCUSSION

Many epidemiological studies of AD have been performed worldwide, and it is generally accepted that AD is increasingly prevalent. The most recent estimate of its prevalence in Korea was close to 30% based on the 2006 ISAAC-based questionnaire survey. However, this prevalence appears rather high compared with the prevalence in other countries, which have rates of up to 20% (18). Furthermore, some countries, such as Switzerland, Denmark, Hungary, Norway, and Japan, have recently documented a decline in or levelling off of prevalence (Table IV) (7–14).

In the present study, the prevalence of AD by questionnaire survey was 19.1%, which is lower than the 2006 Korean data (6). A major reason could be a difference in the definition of AD. In the 2006 study, emphasis was placed on a positive response to "diagnosis of atopic dermatitis, ever" among the prevalence-related questions. On the other hand, in this study, a diagnosis of AD was made only if the patient satisfied the aforementioned 3 conditions of the previous epidemiological study using the ISAAC questionnaire (17, 18). Moreover, the societal culture in Korea may influence the estimates of AD prevalence. For instance, because of Korea's strong information-technology industry and high internet access rate, AD may be overemphasized via the Internet and mass media. Indeed, Korean patients with dermatoses are often misdiagnosed and treated for AD by physicians other than dermatologists, herbal doctors, or even pharmacologists. As a result, non-atopic Korean patients often think their dermatosis is AD. Thus, the prevalence of AD, as given by the response to the question "diagnosis of atopic dermatitis, ever", might be higher than by using the 3 ISAAC criteria.

Furthermore, the prevalence of AD based on dermatological examination was lower than the questionnaire-

Table III. *Results of χ^2 test (*p*-value) and logistic regression analysis (odds ratio (OR)) to identify risk factors associated with atopic dermatitis (AD) diagnosed by dermatologists and questionnaire. Two risk factors were selected by the stepwise selection method in each AD group. Significant results are in bold type*

	Dermatological examination				Questionnaire			
Risk factors	Non-AD *n* (%)	AD *n* (%)	*p*-value	OR (95% CI)	Non-AD *n* (%)	AD *n* (%)	*p*-value	OR (95% CI)
Type of house								
Apartment					3,419 (82.1)	748 (17.9)	**0.0031**	1
Multiplex house					1,219 (77.9)	346 (22.1)		1.170 (0.710–1.930)
Detached house					401 (78.9)	107 (21.1)		0.835 (0.502–1.389)
Others					91 (80.5)	22 (19.5)		0.869 (0.505–1.497)
Age of house, years								
>10	2,599 (89.7)	297 (10.3)	**0.0075**	0.676 (0.268–1.706)				
6–10	1,367 (92.4)	112 (7.6)		0.916 (0.357–2.351)				
2–6	1,293 (89.6)	150 (10.4)		0.686 (0.269–1.751)				
<2	374 (93.3)	27 (6.7)		1.010 (0.371–2.750)				
Unknown	69 (93.2)	5 (6.8)						
Changing the patient's house to a newly built house during the first year of life								
No	4,835 (91.2)	469 (8.8)	**0.0030**	1	4,346 (82.3)	933 (17.7)	**<0.0001**	1
Yes	1,007 (88.3)	133 (11.7)		1.329 (1.067–1.654)	847 (74.5)	290 (25.5)		1.603 (1.368–1.878)

CI: confidence interval.

Table IV. *Prevalence of atopic dermatitis (AD) reported in countries showing a decline or levelling off of prevalence*

Country	Author	Study year (*n*)	Study method	Prevalence, %
Switzerland	Grize et al. (7)	1992 (988)	Questionnaire	18.4
		2001 (1,274)	Questionnaire	15.2
Denmark	Olesen (8)	1993 (1,060)	Questionnaire	18.9
		1998 (9,744)	Questionnaire	19.6
	Schultz et al. (9)	2000 (622)	Questionnaire	14.0
Japan	Saeki et al. (10)	2001 (12,292)	Dermatological examination	12.7
	Saeki et al. (11)	2007 (7,362)	Questionnaire	12.1
Hungary	Harangi et al. (12)	2002 (1,454)	Questionnaire	15.1
		2005 (1,454)	Questionnaire	16.1
Norway	Selnes et al. (13)	1995 (1,432)	Questionnaire	21.1
		2000 (3,853)	Questionnaire	20.8
	Smidesang et al. (14)	2005 (4,784)	Questionnaire	16.5
Korea	Lee et al. (6)	2006 (37,365)	Questionnaire	28.9
	This study	2008 (6,453)	Dermatological examination	9.2
			Questionnaire	19.1

based prevalence. In a review of previous studies, ISAAC questionnaire responses were found to reveal a higher prevalence of AD than dermatological examination for several reasons (18). First, the prevalence rate by the dermatological examination is point prevalence, whereas the questionnaire-based prevalence is period prevalence. In general, symptoms of AD are known to be influenced by seasonality. Therefore, point prevalence might give a lower incidence than period prevalence, since AD patients may improve during the study period, especially if it is summer (21). However, in the questionnaire survey the seasonal effect is negligible because the questionnaire contains "Itchy rash at any time in the last 12 months" as a diagnostic criterion. Another issue may be the accuracy of the Korean version of the ISAAC questionnaire. In many European countries, the validity of the ISAAC questionnaire has been confirmed by much research, and the questionnaire has undergone many modifications (18, 21), but the questionnaire is not validated in the Korean setting.

There was a greater prevalence in the southeast, downtown, and northwest regions of Seoul according to both research methods (Fig. S1). Although we did not focus on the cause of the high prevalence of AD in these regions, it is possible that air pollution (downtown, northwest) and high education and economic levels (southeast) increase the incidence of AD.

In terms of severity, the results of the questionnaire survey pointed to more severe AD than did the dermatological examination. One possible cause for the low EASI score was that the dermatological examination took place during the summer, when patients' symptoms generally improve. Secondly, the severity data from the questionnaire may suffer from recall bias, leading to inaccurate severity results. Thirdly, some answers to the questionnaire may be inaccurate; for instance, the reason for patients' sleep disturbance may not always have been itchy rash, since there are many other possible causes, such as nightmares or hunger, especially in very young children aged 0–2 years with limited vocabularies of 8–10 words.

In the analysis of the risk factors for AD, we found that "changing the patient's house to a newly-built house during the first year of life" was a risk factor. According to some reports, sick-building syndrome is a contributory cause of AD (22–24). Gustafsson et al. (23) reported that moving into a newly built house increases the occurrence of AD, and Wen et al. (24) reported that renovating and redecorating a home also increases AD.

There were several limitations to this study. Because it was conducted from April to October rather than throughout the year, the prevalence of AD was not perfectly represented. In addition, the data may also be affected by the fact that the 14 dermatologists allocated to the different regions judged the symptoms subjectively. The return rate of the questionnaire is another issue. The return rate was initially expected to be over 95%, but the actual rate was 75.4%. This lower return rate means that the questionnaire subjects are not quite the same as those that underwent dermatological examination and this could affect the results of the study. Selection bias might also exist, as some kindergartens and day-care centres declined to cooperate with the study. Furthermore, our analyses are based on cross-sectional data, which may be subject to recall bias.

In conclusion, the prevalence of AD in this study was lower than the Korean estimates from 2006. In addition, the prevalence of AD based on dermatological examination was lower than the questionnaire-based prevalence. We hope that our Korean data will be of use in understanding worldwide AD epidemiology. More refined studies with larger numbers of subjects are warranted.

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