

## Is the prevalence of atopic dermatitis in Korean children decreasing? : National Database 2009-2014

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### Abstract

**Background:** The prevalence of atopic dermatitis (AD) in children is increasing in many developing countries.

**Objective:** This study aimed to explore trends in the prevalence of AD in Korean children.

**Method:** We analyzed data from the Korean National Health Insurance Service (NHIS) from 2009 to 2014. Data for the estimated populations were collected from the Statistics Korea. The annual prevalence of AD was obtained by dividing the number of patients by the estimated population each year. We analyzed the prevalence of AD in 2014 and evaluated the change in the annual prevalence of AD from 2009 through 2014.

**Results:** The estimated population of children aged 18 years or younger was 9,992,581 in 2014, and the number of children with AD was 578,678 with the prevalence of 5.8%. The prevalence was 17.2% in infants aged 12–23 months, which decreased substantially to 7.3%, 3.2% and 2.4% at 5, 12 and 18 years of age, respectively. In the pediatric age group, the prevalence of AD slightly decreased from 6.5% to 5.8% from 2009 through 2014. Notably, in infants aged less than 24 months, the prevalence decreased from 20.8% to 15.4%.

**Conclusions:** Based on the Korean NHIS database, the prevalence of AD in Korean children aged 18 years or younger appears to be decreasing, especially in infants. Although the reason is not clear, an increase in breast milk feeding, vaginal delivery or consumption of probiotics might be involved. Further studies are needed to confirm this trend and to explain the possible mechanisms.

**Keywords:** Atopic dermatitis, children, eczema, Korea, prevalence

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### Introduction

Atopic dermatitis (AD) is a common skin disease that is characterized by chronic inflammation and pruritus.<sup>1</sup> AD mostly manifests during infancy and childhood before the age of 5 years.<sup>2</sup> Although the pathogenesis of AD is not clearly understood, skin barrier dysfunction, immune dysregulation or both are known to contribute to the development of AD.<sup>3</sup> The prevalence of AD is reportedly 10–20% in children and 1–3% in adults.<sup>2</sup> In Asia, prevalence of childhood AD is 12–13% in mainland Japan, 12.94% in China, and 10.7% in Taipei.<sup>4–6</sup> In an effort to evaluate the worldwide prevalence change over time, the data from 55 countries who participated in the International

Study of Asthma and Allergies in Childhood (ISAAC), Phase One and Phase Three, were compared.<sup>7</sup> Although the AD prevalence was decreasing in some developed countries such as New Zealand and the United Kingdom, an increasing trend is still observed in many developing countries in Asia and Africa where the prevalence had been very low in the past. It might be due to economic growth and rapid urbanization, which increases air pollution and can affect the prevalence of allergic diseases.<sup>8</sup>

In Korea, the first nationwide, population-based investigation on AD prevalence was conducted in 1995,<sup>9</sup> and successive

surveys were carried out in 2000 and 2010.<sup>10,11</sup> The study participants were children aged 6–15 years who were randomly selected from elementary and middle schools and then given the Korean versions of the ISAAC questionnaires. The prevalence of “itchy eczema in the last 12 months” increased from 13.4% in 2000 to 20.6% in 2010 in 6–7 year old children and from 6.7% in 2000 to 13.1% in 2010 in 12–13 year old children.<sup>12</sup> However, although the ISAAC questionnaires are validated and standardized instruments, the surveys had the limitations of recall bias and sampling error. In addition, all age groups were not included due to the high cost and great amount of effort involved.

Alternatively, we estimated the AD prevalence by analyzing data from the National Health Insurance Corporation (NHIC).<sup>13</sup> The studies using a national claim data have the benefits of low cost and no selection bias because the Korean National Health Insurance Service (NHIS) covers the entire population living in the country. Although there are several private medical insurances in Korea, the NHIS for the total Korean population is the only mandatory insurance system regulated by the law. We could obtain objective and reliable NHIS data based on patients’ medical records from 2003 through 2008. We found that the prevalence of physician-diagnosed AD in children aged 18 years or younger slightly decreased from 7.2% in 2003 to 6.9% in 2008. This report contradicted the results from the previous questionnaire surveys that reported the AD prevalence is still increasing in Korea.<sup>9–11</sup>

Evaluation of the AD prevalence and its trend over time is important because it will provide basic information regarding the necessity and directions of planning a prevention program. In the present study, we analyzed national statistical data from 2009 through 2014 by repeating the same method we used in our previous study<sup>13</sup> and aimed to explore trends in the prevalence of AD in Korean children.

## Methods

We performed an observational study by using data from the Korean NHIS, because the Korean government requires citizens to subscribe compulsory health insurance by law and thus NHIS covers all Korean people living in the country. Under the Korean NHIS, all medical doctors in the nation make insurance claims to the NHIS with diagnostic codes after providing health care service to the patients, and then receive health care service cost from NHIS. It means that we could estimate the prevalence of AD in the whole population of Korea from NHIS data without randomly selecting samples to represent the total population. Indeed the NHIS covers 97.9% of the total population.<sup>14</sup> We collected data about AD (code L20 of the International Classification of Diseases-10<sup>th</sup> Revision) on the “Disclosure of Data” section of the homepage of the NHIS (<http://www.nhis.or.kr>). The data were based on insurance claims made by doctors after examining patients from 2009 to 2014. The doctors were pediatricians, dermatologists, internists, and family doctors. We estimated the number of affected patients in each year by counting those who visited hospitals for the management of AD at least once a year. Information on their ages and genders was also obtained. Data regarding the estimated population of all age groups from 2009

to 2014 were collected from the homepage of the Statistics Korea (<http://www.kostat.go.kr>).

The annual prevalence of AD was calculated by dividing the number of patients by the estimated population in each year. We analyzed the prevalence of AD in 2014 according to age and gender. After classifying children and adolescents aged 18 years or younger into 3 age groups (i.e., 0–1 years, 2–5 years and 6–18 years), we compared the annual prevalence of AD in each age group from 2009 to 2014. We also explored the prevalence change from 2003 through 2014 by adding our previous data.<sup>13</sup> In this study, we did not provide statistical values such as *P* value or confidence intervals because the study subjects accounted for the total population of Korea, not a randomly selected sample.

## Results

The total number of AD patients in Korea in 2014 was 948,968, with 449,172 males (47.3%) and 499,796 females (52.7%). There were 578,678 patients aged 18 years or younger, and they accounted for 61.0% of the total number of patients with AD. The highest number of patients among all age groups was found in the 1-year-old group ( $n=79,676$ ). Thereafter, the number of patients in each age group was 33,321 for 5-year-olds, 17,007 in 12-year-olds and 16,956 in 18-year-olds, showing that the number of patients with AD decreased with age (**Table 1**).

The overall prevalence of AD in the Korean population in 2014 was 1.9% (males: 1.8%, females: 2.0%). The prevalence of children aged 18 years or younger was 5.8%, and there was a higher prevalence in girls (5.9%) than in boys (5.6%). Among all age groups, the highest prevalence of AD (17.2%) was found in infants aged 12–23 months. Thereafter, the prevalence decreased substantially to 7.3%, 3.2% and 2.4% at the ages of 5 years, 12 years and 18 years, respectively (**Figure 1**).

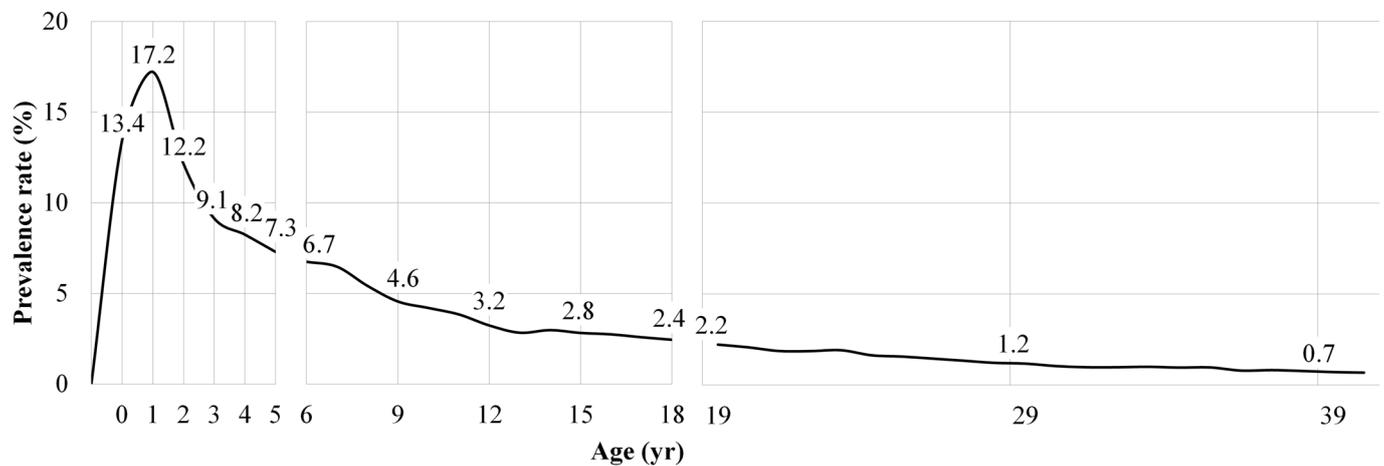
In children with 2 years of age or less, the prevalence of AD in females (13.5%) was lower than in males (14.9%), while a higher prevalence was found in girls (4.7%) than in boys (4.2%) among children older than 2 years of age. The difference in the prevalence between genders became more significant with age. The prevalence rates of males and females at 18 years of age were 2.0% and 3.0%, respectively (**Table 1**).

The annual prevalence of AD in Korean children was calculated from 2009 to 2014 (**Table 2**). The prevalence of AD in Korean children and adolescents under the age of 18 slightly decreased from 6.5% in 2009 to 5.8% in 2014. In particular, the AD prevalence in children less than 24 months of age decreased substantially from 20.8% in 2009 to 15.4% in 2014. During the same period, the prevalence in children aged 2–5 years was also reduced from 11.6% to 9.2%, whereas no remarkable change was found in children and adolescents aged 6–18 years.

We tried to observe the prevalence change between 2003 through 2014 by combining the current data with our previous data.<sup>13</sup> The prevalence of AD in children with the age of 18 years or younger declined from 7.2% in 2003 to 5.8% in 2014 (**Figure 2**). In children less than 24 months of age, the AD prevalence was 19.8% in 2003, peaked at 23.8% in 2008 and then substantially decreased to 15.4% in 2014. In preschool children aged 2–5 years, the prevalence slightly decreased from 12.3% in 2003 to 9.2% in 2014. However, the decreasing trend of AD

**Table 1. The prevalence of AD in children and adolescents according to age and gender in 2014**

Age (yr)	Number of patients (person)			Estimated population (person)			Prevalence (%)		
	Total	Boy	Girl	Total	Boy	Girl	Total	Boy	Girl
0	56,517	30,847	25,670	420,635	215,720	204,915	13.4	14.3	12.5
1	79,676	43,459	36,217	462,658	237,425	225,234	17.2	18.3	16.1
2	58,443	30,342	28,101	480,953	246,913	234,041	12.2	12.3	12.0
3	43,224	22,071	21,153	473,310	243,527	229,783	9.1	9.1	9.2
4	37,880	19,186	18,694	459,688	236,892	222,796	8.2	8.1	8.4
5	33,321	16,852	16,469	457,521	235,554	221,967	7.3	7.2	7.4
6	32,481	16,429	16,052	481,536	247,758	233,778	6.7	6.6	6.9
7	30,567	15,252	15,315	472,115	243,462	228,653	6.5	6.3	6.7
8	23,965	12,077	11,888	442,394	228,972	213,422	5.4	5.3	5.6
9	20,696	10,482	10,214	454,665	235,645	219,021	4.6	4.4	4.7
10	20,280	10,345	9,935	483,349	250,884	232,466	4.2	4.1	4.3
11	18,956	9,469	9,487	493,761	257,234	236,528	3.8	3.7	4.0
12	17,007	8,594	8,413	526,714	274,714	252,000	3.2	3.1	3.3
13	16,936	8,229	8,707	598,793	312,558	286,235	2.8	2.6	3.0
14	18,684	8,562	10,122	628,827	328,574	300,253	3.0	2.6	3.4
15	17,714	7,826	9,888	629,002	328,780	300,222	2.8	2.4	3.3
16	17,921	8,048	9,873	654,632	341,126	313,506	2.7	2.4	3.1
17	17,454	7,505	9,949	677,054	353,933	323,121	2.6	2.1	3.1
18	16,956	7,272	9,684	694,978	367,081	327,898	2.4	2.0	3.0
> 18	370,290	156,325	213,965	40,770,578	20,187,740	20,582,838	0.9	0.8	1.0
Total	948,968	449,172	499,796	50,763,159	25,374,487	25,388,672	1.9	1.8	2.0

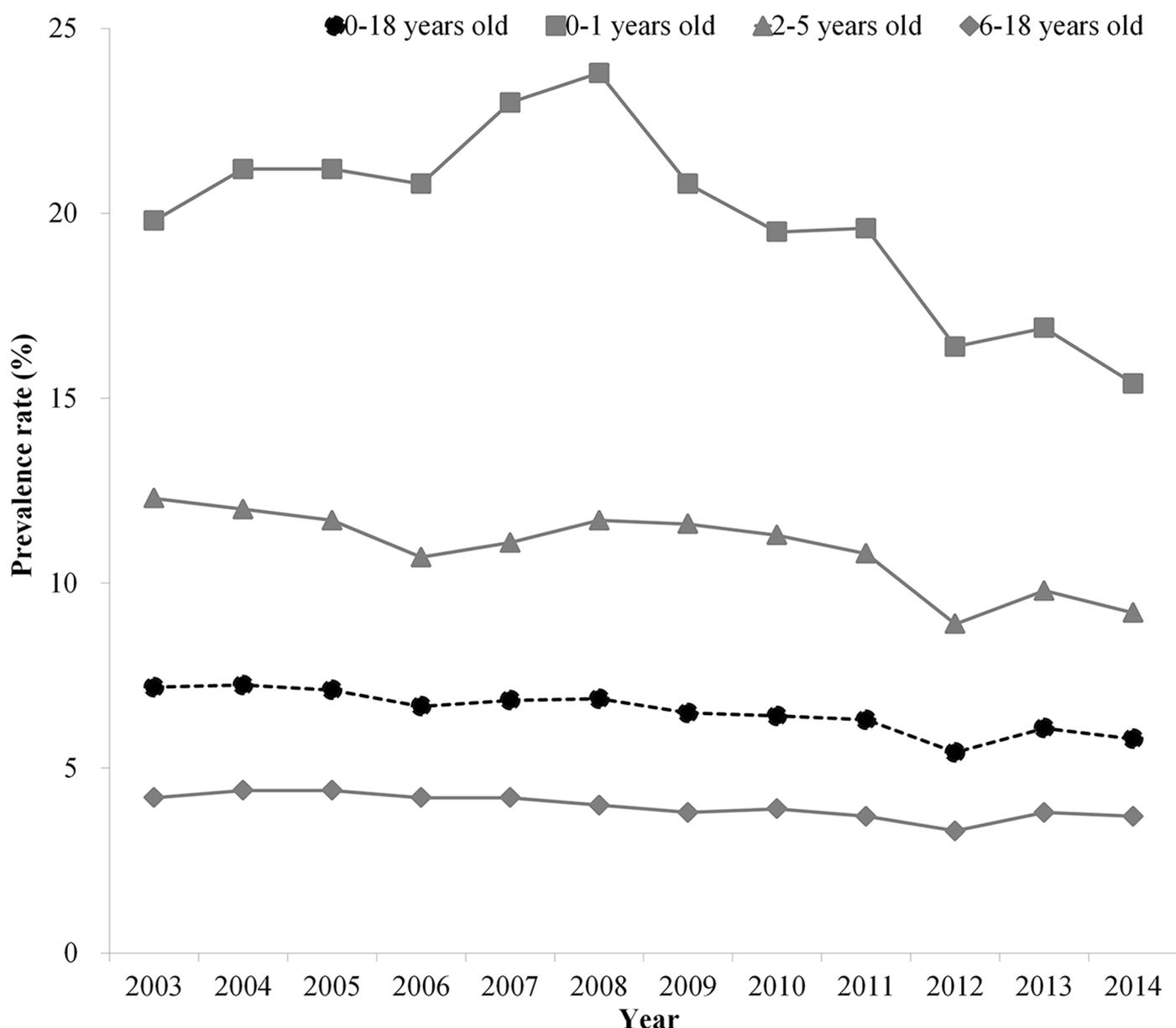


**Figure 1. The prevalence rate of atopic dermatitis by age in Korea in 2014.**

**Table 2. The prevalence of atopic dermatitis in children aged 18 years or younger from 2009 to 2014**

	0-1 years		2-5 years		6-18 years		0-18 years	
2009	20.8%	(189,468/912,365)	11.6%	(214,562/1,847,390)	3.8%	(323,136/8,435,660)	6.5%	(727,166/11,195,415)
2010	19.5%	(173,528/890,570)	11.3%	(208,297/1,844,689)	3.9%	(322,229/8,244,678)	6.4%	(704,054/10,979,937)
2011	19.6%	(177,591/907,018)	10.8%	(200,233/1,848,212)	3.7%	(299,329/7,983,608)	6.3%	(677,153/10,738,838)
2012	16.4%	(152,738/929,127)	8.9%	(166,319/1,866,772)	3.3%	(250,793/7,706,739)	5.4%	(569,850/10,502,638)
2013	16.9%	(156,143/922,292)	9.8%	(183,932/1,869,587)	3.8%	(283,977/7,466,088)	6.1%	(624,052/10,257,967)
2014	15.4%	(136,193/883,293)	9.2%	(172,868/1,871,472)	3.7%	(269,617/7,237,820)	5.8%	(578,678/9,992,585)

Data are presented as prevalence (number of patients / number of estimated population)



**Figure 2.** The prevalence of atopic dermatitis (AD) in Korean children aged 0–18 years from 2003 to 2014. Children were classified into 3 age groups (0-1 years, 2-5 years, and 6-18 years), and change in AD prevalence in each age group from 2003 to 2014 was observed. Data from 2003 to 2008 were derived from reference 13.

prevalence over time was not noted in children with the age of 6–18 years.

## Discussion

So far many epidemiologic studies have been done to evaluate the prevalence of allergic diseases worldwide. In a nationwide survey, the best way for the prevalence study would be to examine the whole population by doctors who diagnose the disease of interest clinically. However, that method is not efficient due to high cost and time, and thus, questionnaires are commonly used in a randomly selected sample to represent the total population as was shown in ISAAC studies.<sup>7,9-11</sup> In ISAAC studies, the prevalence of AD is still increasing in most Asia-Pacific countries probably due to the environmental

change.<sup>7,8,11,15</sup> In the present study, we used data from NHIS in which all Koreans are covered and insurance claims are made by medical doctors with diagnostic codes. It indicates that we could evaluate the annual prevalence of AD in Korea without random sampling and without using questionnaires for the diagnosis of AD. As a result, the strengths of our study are a large study population size, coverage of all age groups, diagnostic accuracy, and the avoidance of selection bias.

Our study showed that the highest prevalence of AD in 2014 among all age group was 17.2% in infants aged 12–23 months. Our data is similar to previous studies. Kay et al.<sup>16</sup> demonstrated that 60% of all cases of AD begin during the first year of life and 85% before age 5 years. In Taiwan National Health Insurance analysis form 2000 to 2007, the peak age group

was less than one year old (22.4%).<sup>17</sup> We also found that the AD prevalence in Korean children with the age of 18 years or younger decreased during the period from 2009 through 2014. In particular, a declining trend was prominent in children with the age of 0-5 years. The prevalence of AD in infants aged less than 24 months increased from 19.8% to 23.8% during 2003–2008 and then went down to 15.4% in 2014. In 2–5 year-old children, the AD prevalence in 2014 was 9.2%, decreasing from 12.3% in 2003. In contrast, the prevalence of AD in children 6–18 years old was not changed as substantially as in the other age groups. Taken together, we found that decreasing prevalence of AD in Korean children since 2009 is mainly explained by reduction in the prevalence of AD in young children, especially in infants aged less than 24 months. Other studies from Korea and Taiwan also used National Health Insurance data to evaluate the annual prevalence of allergic diseases,<sup>17,18</sup> but they did not analyze the prevalence change over time according to each age group like ours.

In a study conducted to compare data between ISAAC Phase One and Phase Three, the prevalence of an itchy flexural rash in the last 12 months reached a maximum prevalence of around 20% and then decreased in some countries that once had a high prevalence of AD, such as the United Kingdom, Ireland and New Zealand.<sup>7</sup> A questionnaire survey involving 4 million Japanese school children aged 7–12 years revealed that the prevalence of lifetime AD increased from 15.0% in 1985 to 24.1% in 1993, stayed at a plateau thereafter, and then decreased to 16.5% in 2006.<sup>19,20</sup> The fact that the AD prevalence did not seem to increase indefinitely suggests there might be a finite number of susceptible hosts in any population.<sup>7</sup> In the present study, a substantial decrease in AD prevalence in infants aged less than 24 months suggests that unknown environmental change during the perinatal period occurred as environmental factors play an important role in the development or persistence of AD.<sup>21,22</sup> In Korea, an increased rate of breast milk feeding, a rising rate of vaginal delivery and an elevated consumption of probiotics might contribute to a decrease in AD prevalence, especially within the first 2 years of life, although the pathogenesis of AD is not clearly understood as yet.<sup>22-24</sup> Indeed, the rates of vaginal delivery and breastfeeding were 65.7% and 28.2% during 2003–2008, but these rates increased to 71.9% and 34.3%, respectively, during 2009–2014.<sup>25,26</sup> In addition, the consumption of fermented milk was 449,850 tons in 2008 and rose to 567,069 tons in 2014.<sup>27</sup> Another reason for a decreasing trend of AD in Korean children might be due to the public healthcare policies, i.e., establishment of environmental health center and operation of asthma allergy education information center that local and central governments have initiated to ensure better treatment of AD. An increased awareness of the disease, education programs for better treatment and information about the importance of environmental control could be effective in preventing the development or progression of AD. Either a decreasing development of AD or better control of pre-existing AD symptoms could reduce the number of hospital visits. Besides, other factors such as the cost of medical care or the accessibility to over-the-counter oral medicine and moisturizers should be considered when interpreting our results.

However, our study had some limitations. The validity of the

diagnosis of AD remains a problem because of interobserver variability. It means that discrepancy between the real disease and the claim codes may cause problems with internal validity.<sup>18</sup> Unfortunately, there have been no studies on the diagnostic accuracy of allergic diseases in the NHIS data. Furthermore NHIC data are entirely dependent on accessibility to medical services. In other words, AD patients are not counted if healthcare services are not available in their geographic area or if they do not visit a doctor for some reason. It is possible that some patients stop visiting hospitals for care due to the associated economic burden or frustration produced by unresponsiveness to conventional treatment.<sup>28,29</sup> In order to investigate the true prevalence of AD, an improved study design, more accurate diagnostic criteria and more efficient sampling are required.

Although the present study has demonstrated a decrease in the prevalence of AD, it must be noted that infants less than 24 months of age and children under 6 years of age still manifested AD at rates of 15.4% and 9.2%, respectively. More importantly, some AD patients in these age groups show disease persistence and even progress to respiratory allergies, such as asthma and allergic rhinitis.<sup>2,30</sup> Our results suggest that we still need to cope with pediatric AD at a public health level.

In conclusion, based on the Korean NHIS database, the prevalence of AD in Korean children aged 18 years and younger seems to be decreasing, especially in young children. Further well-designed cohort-based studies to confirm the trend and to identify factors affecting the nature of AD epidemiology is warranted.

### Conflict of interest

The authors declare that there are no potential conflicts of interests with respect to the authorship and/or publication of this article.

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