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An Update on the Prevalence of Allergic Rhinitis in Korea, and Correlation with Hypertension, Obesity and Smoking

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－ ABSTRACT －

Background and Objectives：We aimed to provide an updated data on the prevalence of allergic rhinitis (AR) in the Korean population and to evaluate the correlation between AR and hypertension, obesity, and smoking. **Materials and Methods**：Analysis of data from 31,822 people in Korean National Health and Nutrition Examination Survey during a 5-year period (from 2010 to 2014). The diagnosis of AR was done by questionnaire. **Results**：The overall prevalence of AR was 15.2% and 16.4% in Korean males and females, respectively. The prevalence tended to decrease with age. Subjects with AR were younger than those without ($p<0.001$) in both males and females. Living in urban area, history of atopic dermatitis, and asthma were all significantly correlated with higher prevalence ($p<0.01$). Risk for AR conferred to maternal hypertension history was 1.31 (95% CI=1.06−1.62 ; $p<0.05$) in the male population. However, systolic and diastolic blood pressures (DBP), medication history, and paternal hypertension history did not differ between the AR and normal groups ($p>0.05$). The odds ratio of obesity (BMI ≥25, compared to normal) for AR was 0.82 (95% CI=0.68−0.98 ; $p<0.05$) in the male population. Finally, the adjusted odds ratio of ex-smoker (compared to non-smoker) for AR was 1.41 (95% CI=1.05−1.89 ; $p<0.05$) in males. However, current smoking and pack-year did not differ between AR and normal groups ($p>0.05$). **Conclusions**：There was no significant correlation between hypertension and AR. In Korean adult males, obesity was associated with a low prevalence of allergic rhinitis. Although there was no significant correlation between current smoking and AR, there was a notable correlation between ex-smoking and AR in male adults. **(J Clinical Otolaryngol 2018;29:42-52)**

KEY WORDS：Allergic rhinitis · Prevalence · Hypertension · Obesity · Smoking.

Introduction

With its steadily-increasing prevalence and its significant socio-economic effects, allergic rhinitis (AR) has recently become a significant health concern.[1-3] For effective management of AR, it is essential that we analyze the correct and updated data about its prevalence. However, to the best of our knowledge, there has only been a limited number of studies regarding the prevalence of AR in Korea. Recently, Ahn and colleagues reported the prevalence of AR between the years 2008 and 2012.[4] However, there has not been a recently updated data.

Along with AR, the prevalence of several chronic disorders, such as hypertension and obesity, is also on the rise as the overall Korean population is getting more Westernized. Therefore, we could assume that there is a relationship between AR and these aforementioned chronic disorders. However, there are still so many controversies without definite conclusion. Furthermore, the quality of evidences is still very low with respect to the correlation bewteen smoking and AR.[5]

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Therefore, we aimed to : (a) Provide recent, updated data about the prevalence of AR in the Korean population (31,822 people) based on a large, nationwide survey in the past 5 years (between 2010 and 2014) and (b) evaluate the correlation between AR and hypertension, obesity, and smoking.

Materials and Methods

Study population

This study was performed using data obtained from the Korean National Health and Nutrition Examination Survey (KNHANES), V (2010 to 2012) and VI study (2013 and 2014), a cross-sectional and nationally representative survey conducted on non-institutionalized individuals by the Division of Chronic Disease Surveillance, Korea Centers for Disease Control and Prevention. The KNHANES data was obtained from 20 households and 10,000 individuals who were randomly chosen from the 192 regions in Korea, on an annual basis using a stratified, multistage sampling procedure. The KNHANES data was obtained using health interviews, health examinations, and a nutrition survey.

AR diagnosis was done through questionnaires. In other words, we classified the person as AR patient who answered 'Yes' to the question 'Have you been diagnosed with allergic rhinitis?'. People who were indefinable for AR (due to missing data) were excluded from the study of prevalence rates, which was performed on 13,635 men-including 1,978 AR subjects, and 18,187 women which included 2,776 AR subjects in the Korean population. Moreover, this study included only adults, who are aged ≥19 years of age, to investigate the risk factors for AR on hypertension (8,687 males including 975 allergic rhinitis subjects and 13,222 females including 1,911 allergic rhinitis subjects), obesity (9,946 males including 1,097 allergic rhinitis subjects and 14,853 females including 2,099 allergic rhinitis subjects), and smoking status (6,180 males including 726 allergic rhinitis subjects and 9,269 females including 1,322 allergic rhinitis subjects).

Data collection and laboratory measurements

Information on age, living area, cigarette smoking, disease history, and medication status was collected using a self-administration or a face-to-face interview by trained interviewers during the health interview process. Information regarding height, weight, and blood pressure were collected during health examination. According to the standardized protocols, all health examination procedures are performed by trained medical personnel.

After obtaining informed consent, blood samples were obtained from the antecubital vein and collected in BD vacutainer tubes containing EDTA for trace element determinations.

Statistical analysis

The prevalence and 95% confidence intervals (CI) were estimated using the SAS surveyfreq procedures. The weighted results were estimated using the survey sample weight variables for associations between health interview, health examination, and nutrition survey. Associations stratified by gender between AR and epidemiological factors (such as age and living area), clinical factors (such as history of atopic dermatitis and asthma), and year were identified using chi-square test considering survey sample weights (SAS surveyfreq procedure). Multiple logistic regression analyses for AR were performed to investigate significant factors on blood pressure, obesity, and smoking status using the SAS survey logistic procedure.

All statistical analyses were performed using SAS version 9.3 (SAS Institute, Cary, NC). Statistical significance was accepted for P of < 0.05 (two-tailed).

Ethics statement

The KNHANES V and VI surveys were approved by the institutional review board of Centers for Disease Control and Prevention in Korea (IRB No. 2010-02CON-21-C, 2011-02CON-06-C, 2012-01EXP-01-2C, 2013-07CON-03-4C and 2013-12EXP-03-5C). All individuals that participated in the KNHANES V and VI surveys provided written informed consent.

Table 1. Prevalence of allergic rhinitis in the Korean male population

Year		N (total N)	% prevalence rate (95% CI)	N (total N)	% prevalence rate (95% CI)	N (total N)	% prevalence rate (95% CI)	N (total N)	% prevalence rate (95% CI)	N (total N)	% prevalence rate (95% CI)	N (total N)	% prevalence rate (95% CI)
		2010		2011		2012		2013		2014		2010–2014	
All		499 (3,080)	17.7 (15.4–20.0)	368 (2,884)	13.5 (11.5–15.4)	408 (2,667)	16.5 (14.3–18.7)	386 (2,655)	14.1 (12.5–15.6)	320 (2,382)	13.9 (12.2–15.6)	1,981 (13,668)	15.2 (14.3–16.0)
Age group (years)	4–12	134 (585)	22.7 (19.0–26.5)	109 (472)	24.9 (18.9–30.8)	97 (425)	20.7 (15.8–25.5)	130 (477)	26.7 (21.7–31.8)	96 (378)	25.0 (19.9–30.0)	566 (2,337)	24.0 (21.8–26.2)
	13–18	77 (272)	26.7 (20.4–33.0)	47 (237)	17.7 (11.5–23.9)	68 (244)	29.6 (22.8–36.4)	64 (245)	23.9 (18.2–29.5)	50 (200)	24.6 (17.2–31.9)	306 (1,198)	24.5 (21.6–27.4)
	19–29	57 (225)	28.0 (20.4–35.5)	47 (227)	20.7 (14.5–27.0)	48 (192)	24.2 (17.4–30.9)	43 (247)	18.6 (13.4–23.8)	39 (195)	19.1 (13.8–24.4)	234 (1,086)	22.1 (19.3–24.9)
	30–39	76 (384)	18.9 (13.6–24.2)	47 (343)	12.1 (8.2–16.0)	59 (304)	19.2 (14.0–24.5)	51 (314)	15.5 (11.7–19.3)	37 (294)	12.1 (8.3–15.9)	270 (1,639)	15.6 (13.6–17.7)
	40–49	54 (411)	12.3 (8.7–16.0)	41 (364)	10.9 (7.1–14.6)	33 (305)	10.5 (6.4–14.5)	38 (371)	9.7 (6.8–12.6)	30 (289)	10.7 (7.1–14.4)	196 (1,740)	10.8 (9.2–12.5)
	50–59	51 (402)	12.3 (8.3–16.2)	41 (432)	9.3 (6.1–12.4)	42 (367)	11.5 (7.6–15.4)	29 (344)	8.3 (5.1–11.4)	26 (320)	8.2 (5.2–11.2)	189 (1,865)	9.9 (8.3–11.4)
	60–69	32 (430)	7.8 (5.0–10.5)	21 (417)	4.5 (2.5–6.5)	34 (413)	8.1 (4.5–11.7)	14 (352)	4.0 (1.9–6.0)	25 (352)	8.9 (4.8–13.0)	126 (1,964)	6.6 (5.3–7.9)
	≥70	18 (371)	5.1 (2.5–7.6)	15 (392)	2.9 (1.0–4.7)	27 (417)	5.3 (2.8–7.8)	17 (305)	4.7 (2.3–7.1)	17 (354)	4.7 (2.2–7.1)	94 (1,839)	4.5 (3.5–5.6)

Table 2. Prevalence of allergic rhinitis in the Korean female population

Year		N (total N)	% prevalence rate (95% CI)	N (total N)	% prevalence rate (95% CI)	N (total N)	% prevalence rate (95% CI)	N (total N)	% prevalence rate (95% CI)	N (total N)	% prevalence rate (95% CI)	N (Total N)	% prevalence rate (95% CI)
		2010		2011		2012		2013		2014		2010–2014	
All		610 (3,989)	15.3 (13.6–17.0)	543 (3,851)	15.7 (13.6–17.8)	606 (3,680)	17.4 (15.6–19.2)	527 (3,517)	16.4 (14.8–17.9)	501 (3,220)	17.5 (15.7–19.3)	2,787 (18,257)	16.4 (15.6–17.2)
Age group (years)	4–12	104 (507)	18.8 (14.2–23.4)	88 (424)	20.0 (15.0–25.0)	79 (384)	16.3 (12.5–20.2)	91 (415)	22.1 (17.2–26.9)	77 (337)	23.2 (17.7–28.7)	439 (2,067)	20.0 (17.9–22.1)
	13–18	49 (252)	15.3 (9.5–21.0)	44 (219)	20.7 (14.3–27.1)	47 (197)	18.5 (12.2–24.8)	45 (243)	19.5 (14.0–24.9)	41 (176)	22.7 (16.0–29.5)	226 (1,087)	19.3 (16.5–22.1)
	19–29	89 (378)	24.2 (19.2–29.4)	78 (333)	26.2 (20.1–32.4)	91 (329)	27.5 (21.8–33.3)	74 (332)	23.2 (18.1–28.3)	73 (286)	26.1 (20.5–31.6)	405 (1,658)	25.5 (23.0–28.0)
	30–39	155 (661)	22.9 (19.2–26.5)	126 (604)	18.8 (15.3–22.4)	141 (533)	25.8 (20.8–30.8)	117 (511)	23.5 (19.0–28.0)	103 (469)	23.2 (19.4–27.0)	642 (2,778)	22.8 (21.0–24.6)
	40–49	91 (574)	14.1 (10.7–17.6)	93 (560)	17.2 (13.7–20.8)	103 (518)	18.2 (14.6–21.8)	90 (566)	16.4 (13.0–19.7)	89 (463)	19.7 (15.2–24.2)	466 (2,681)	17.1 (15.4–18.7)
	50–59	72 (633)	10.7 (7.7–13.7)	57 (629)	9.3 (6.2–12.3)	80 (575)	13.4 (9.9–16.9)	57 (545)	10.9 (7.8–14.1)	60 (529)	11.0 (8.3–13.7)	326 (2,911)	11.1 (9.7–12.4)
	60–69	32 (522)	5.0 (2.9–7.2)	34 (513)	5.6 (2.8–8.4)	42 (551)	6.6 (4.2–9.0)	30 (445)	7.0 (4.3–9.8)	46 (473)	8.9 (6.2–11.6)	184 (2,504)	6.7 (5.5–7.8)
	≥70	18 (462)	2.7 (1.1–4.3)	23 (569)	3.0 (1.4–4.7)	23 (593)	3.7 (1.9–5.4)	23 (460)	4.8 (2.7–6.9)	12 (487)	1.9 (0.8–3.0)	99 (2,571)	3.2 (2.5–4.0)

Results

The overall prevalence of AR was 15.2% and 16.4% during the 5-year study period (from 2010 to 2014) in Korean male and female population, respectively, which is also presented in Table 1, 2. The prevalence of AR for males tended to decrease with age, and was greatest among adolescents aged 13−18 years (24.5%), which was followed by children aged 4−12 years (24.0%). The prevalence of AR in the adult population was as follows ; 22.1% in 19−29 year olds, 15.6% in 30−39 year olds, 10.8% in 40−49 years old, 9.9% in 50−59 year olds, 6.6% in 60−69 year olds, and 4.5% in over 70 year olds (Table 1). However, in case of the female population (Table 2), the prevalence in 19−29 year olds was the greatest (25.5%) and that in 30-39 year olds was the 2nd greatest (22.8%). The prevalence of AR for 4−12, 13−18, 40−49, 50−59, 60−69, and >70 year olds were 20.0%, 19.3%, 17.1%, 11.1%, 6.7%, and 3.2%, respectively.

For males aged 19−29 years, the prevalence of AR decreased in 2014 as compared with 2010 to 2012. Moreover, for females aged 4−12 and 13−18 years, the prevalence of AR tended to increase in 2014 as compared with 2010 to 2013 (Fig. 1). Although the prevalence rates of AR showed slight changes as determined by surveys conducted for 5 years, there was no statistical significance ($p>0.05$ by chi-square test considering survey sample weights and Bonferroni procedure for multiple testing adjustments).

Table 3 shows the distributions of epidemiological and clinical confounding factors stratified by AR and gender. Subjects with AR group were younger than those without ($p<0.001$) in both males and females. The distribution of living area (rural/ urban) in study subjects was different in the allergic rhinitis and normal groups in both males ($p=0.002$) and females ($p<0.001$). Furthermore, the history of atopic dermatitis and asthma differed in the AR and normal groups regardless of gender ($p<0.001$). However, the year in which these measurements were taken was not different between these groups at the $\alpha=0.05$ level in females.

The association between AR and hypertension-related factors is shown in Table 4. After adjusting for confounding factors, such as age, living area, history of atopic dermatitis and asthma, and year when measurement were taken, the risk for AR conferred to maternal hypertension history was 1.3 with significance (95% CI=1.06−1.62 ; $p=0.0126$) in the male population, but not in the female population. However, systolic blood pressure (SBP), diastolic blood pressure

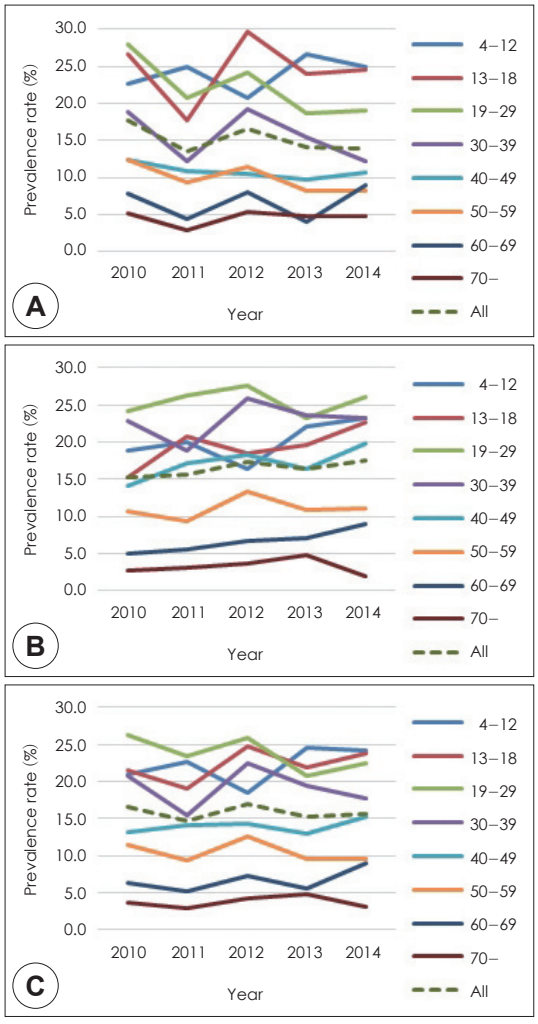

Fig. 1. The prevalence of allergic rhinitis, classified according to gender and age group. A : Male prevalence. B : Female prevalence. C : Overall prevalence.

(DBP), medication taking for blood pressure, and paternal hypertension history did not differ between the AR and normal groups for both males and females ($p>0.05$).

Table 5 presents the association of obesity related factors for AR. After adjusting for confounding factors such as age, living area, history of atopic dermatitis and asthma, and year when measurement were taken, the odds ratio (OR) of obesity (BMI ≥25, compared to normal) for allergic rhinitis was 0.82 (95% CI=0.68−0.98 ; $p<0.05$) in the male population. This protective effect for allergic rhinitis was not significantly detected in the female population. GOT and GPT were not different between the AR and normal groups for both males and females ($p>0.05$).

The association between AR and smoking-related factors is shown in Table 6. The smoking in the past (ex-smoker) conferred a risk of AR in males, but not in females. The adjusted OR (for age, living area, history of atopic dermatitis and asthma, and year) of ex-smoker (compared to non-smoker) for AR was 1.41 (95% CI=1.05−1.89 ; $p<0.05$) in males. However, current smoking and pack-year did not differ between the AR and normal groups for both males and females ($p>0.05$).

Discussion

As the prevalence of allergic disorders is steadily increasing, serial analysis of their prevalence based

Table 3. Distribution of factors stratified by allergic rhinitis and gender in the Korean population

Factors	Male		p-value*	Female		p-value*
	N (%)			N (%)		
	Allergic rhinitis	Normal		Allergic rhinitis	Normal	
Age (years)			<.0001			<.0001
19−29	234 (34.22)	852 (18.04)		403 (28.98)	1,251 (15.89)	
30−39	269 (25.15)	1,364 (20.17)		638 (28.10)	2,133 (17.91)	
40−49	196 (18.29)	1,538 (22.41)		465 (22.68)	2,200 (20.44)	
50−59	188 (14.28)	1,670 (19.48)		324 (12.94)	2,582 (19.62)	
60−69	126 (5.25)	1,830 (11.04)		183 (4.90)	2,311 (12.79)	
≥70	94 (2.82)	1,740 (8.86)		98 (2.40)	2,445 (13.35)	
Living area			0.0021			<.0001
Rural (eup/myun)	169 (15.48)	2,077 (20.18)		271 (12.55)	2,776 (19.10)	
Urban (dong)	938 (84.52)	6,917 (79.82)		1,840 (87.45)	10,146 (80.90)	
History of atopic dermatitis			0.0003			<.0001
No	1,036 (92.66)	8,706 (97.53)		1,988 (94.10)	12,554 (97.81)	
Yes	62 (7.34)	162 (2.47)		115 (5.90)	228 (2.19)	
History of asthma			<.0001			<.0001
No	1,033 (93.86)	8,643 (97.74)		1,975 (94.27)	12,391 (97.11)	
Yes	65 (6.14)	225 (2.26)		128 (5.73)	391 (2.89)	
Year			0.0016			0.2249
2010	288 (24.54)	1,931 (19.36)		454 (18.75)	2,769 (20.10)	
2011	212 (18.12)	1,954 (20.70)		408 (18.84)	2,784 (20.45)	
2012	241 (22.77)	1,738 (19.85)		475 (22.40)	2,577 (19.80)	
2013	192 (17.51)	1,741 (20.32)		391 (19.60)	2,468 (20.15)	
2014	174 (17.06)	1,630 (19.76)		383 (20.41)	2,324 (19.50)	

* : p-values were obtained by surveyfreq procedure

Table 4. Odds ratios for allergic rhinitis by hypertension and gender in the Korean population

Factors	Male					Female				
	N (%)		Multiple logistic regression			N (%)		Multiple logistic regression		
	Allergic rhinitis	Normal	OR*	95% CI	p-value	Allergic rhinitis	Normal	OR*	95% CI	p-value
Systolic blood pressure (mmHg)										
≤120	601 (61.64)	4,008 (51.97)	1	Reference		1.508 (78,91)	7,005 (61.93)	1	Reference	
121−139	298 (30.56)	2,697 (34.97)	0.81	0.66−1.01	0.0570	302 (15.80)	2,890 (25.55)	0.91	0.74−1.12	0.3705
≥140	76 (7.79)	1,007 (13.06)	0.79	0.55−1.14	0.2061	101 (5.29)	1,416 (12.52)	0.81	0.58−1.15	0.2482
Diastolic blood pressure (mmHg)										
≤ 80	602 (61.74)	4,753 (61.63)	1	Reference		1,586 (82.99)	8,770 (77.54)	1	Reference	
81−89	231 (23.69)	1,822 (23.63)	1.11	0.89−1.38	0.3707	236 (12.35)	1,739 (15.37)	0.96	0.78−1.19	0.7227
≥90	142 (14.56)	1,137 (14.74)	1.09	0.80−1.48	0.5953	89 (4.66)	802 (7.09)	0.93	0.67−1.31	0.6894
Medication taking for blood pressure										
No	859 (88.10)	6,108 (79.20)	1	Reference		1,724 (90.21)	8,893 (78.62)	1	Reference	
Yes	116 (11.90)	1,604 (20.80)	0.86	0.65−1.13	0.2705	187 (9.79)	2,418 (21.38)	1.10	0.86−1.40	0.4448
Paternal hypertension history										
No	773 (79.28)	6,467 (83.86)	1	Reference		1,521 (79.59)	9,525 (84.21)	1	Reference	
Yes	202 (20.72)	1,245 (16.14)	1.05	0.86−1.28	0.6451	390 (20.41)	1,786 (15.79)	1.08	0.92−1.26	0.3383
Maternal hypertension history										
No	771 (79.08)	6,443 (83.55)	1	Reference		1,434 (75.04)	8,983 (79.42)	1	Reference	
Yes	204 (20.92)	1,269 (16.45)	1.31	1.06−1.62	0.0126	477 (24.96)	2,328 (20.58)	1.14	0.99−1.31	0.0669

Table 5. Odds ratios for allergic rhinitis by obesity and gender in the Korean population

Factors	Male					Female				
	N (%)		Multiple logistic regression			N (%)		Multiple logistic regression		
	Allergic rhinitis	Normal	OR*	95% CI	p-value	Allergic rhinitis	Normal	OR*	95% CI	p-value
BMI										
<18.5	26 (2.37)	273 (3.09)	0.80	0.48−1.34	0.3939	160 (7.62)	652 (5.11)	1.11	0.88−1.40	0.3997
18.5−24.9	691 (62.99)	5,440 (61.48)	1	Reference		1,472 (70.13)	8,247 (64.66)	1	Reference	
≥25	380 (34.64)	3,136 (35.44)	0.82	0.68−0.98	0.0312	467 (22.25)	3,855 (30.23)	0.91	0.79−1.05	0.1804
GOT	23.31 (16.00)†	24.72 (13.73)	1.00	0.99−1.00	0.2638	19.17 (10.02)	17.98 (13.41)	1.00	0.99−1.01	0.9568
GPT	25.90 (18.14)†	25.58 (21.04)	1.00	1.00−1.01	0.5028	16.50 (13.61)	20.71 (8.99)	1.00	0.99−1.01	0.9544

* : Odds ratio after adjusting for confounding factors such as age, living area, history of atopic dermatitis and asthma, and year when measurement were taken, † : mean (SE)

Table 6. Odds ratios for allergic rhinitis by smoking status and gender in the Korean population (during 2010−2012)

Factors	Male					Female				
	N (%)		Multiple logistic regression			N (%)		Multiple logistic regression		
	Allergic rhinitis	Normal	OR*	95% CI	p-value	Allergic rhinitis	Normal	OR*	95% CI	p-value
Smoking status										
Non-smoker	166 (22.87)	989 (18.13)	1	Reference		1,153 (87.22)	7,180 (90.35)	1	Reference	
Ex-smoker	309 (42.56)	2336 (42.83)	1.41	1.05−1.89	0.0211	104 (7.87)	382 (4.81)	1.30	0.96−1.73	0.0860
Current smoker	251 (34.57)	2129 (39.04)	0.89	0.66−1.20	0.4365	65 (4.92)	385 (4.84)	0.77	0.53−1.10	0.1517
Pack-year	256.72 (314.63)†	367.71 (397.51)	1.00	1.00−1.00	0.2260	9.56 (52.68)	12.38 (72.95)	1.00	1.00−1.00	0.9189

* : Odds ratio after adjusting for confounding factors such as age, living area, history of atopic dermatitis and asthma, and year when measurement were taken, † : mean (SE)

on a nation-wide survey is very important. Accordingly, we analyzed the trend of allergic disorders. The most recent analysis about the prevalence of AR in Korea was performed by Ahn and colleagues.[4] They showed that the prevalence of AR was about 16.1% during the years 2008 through 2012, based on symptoms and allergic skin test. In our study, the prevalence was 15.2% (year 2010 to 2012) and 16.4% (year 2013 and 2014). Therefore, we suggest that the prevalence of AR remains stable during the past 7 years.

Ahn and colleagues also suggested that aging had protective effects for AR.[4] In line with their study, the prevalence was the highest among children, adolescent, and young adults in our study. As age increased, the prevalence decreased (Fig. 1). Also in our study, we confirmed the correlation between AR and several patient factors, such as living area (rural or urban), history of allergic asthma, and atopic dermatitis.

Controversies are still ongoing regarding the correlation between allergic respiratory disorders and hypertension. Kony and colleagues suggested that men with AR had higher SBP than those without, after controlling for other potential confounding factors.[6] Interestingly, this association was not so prominent in women.[6] The possible mechanism is the neuro-humoral response to chronic obstructive sleep apnea and hypoxemia due to chronic nasal obstruction.[7] Conversely, in a 2005−2006 United States National Health and Nutrition Examination Survey (NHANES), Li et al. argued that no significant association was discovered between the hay fever diagnosis and hypertension in men at any age group.[8] Heinrich and Döring also argued that there was no significant correlation between rhinitis and blood pressure (systolic or diastolic).[9] In our study, we could not find any significant correlation between the diagnosis of AR and SBP/DBP. However, we could find some significant correlation between the maternal familial history of hypertension and AR in males. Interestingly, this tendency was not observed the female population. We should study the possible mechanism that could explain this tendency, if any.

There have been several former studies suggesting the correlation between obesity and allergic asthma.[10-12] However, there is still lots of controversies regarding the correlation between obesity and AR. According to Lei and colleagues, obesity increased prevalence of AR in pediatric patients.[11,13] Conversely, 2005−2006 National Health and Nutrition Examination Survey in the United States revealed that in children, central obesity was significantly associated with reduced prevalence of AR.[14] To the best of our abilities with the literature review, our study is the first to prove reduced odds of AR in obese adults.

There is a lot of research on the relationship between obesity and allergic inflammation, and their conclusions are so different, making it difficult to generalize. Studies have shown that allergic sensitization is less in children with weight gain at their infant stage.[15] Perhaps this inverse relationship with obesity and allergic inflammation may be due to the fact that leptin secreted from adipose tissue activates the Th1 response and suppresses the secretion of Th2 cytokines.[16-18] To prove this hypothesis, we will have to do more research.

There are still lots of controversies surrounding the effect of smoking on the development and aggravation of AR. While some studies suggest harmful effects,[19,20] others argue that smoking has a protective effect for AR.[21-23] Still other researchers suggest that they could not find any association between smoking and AR.[24-26] According to recent systemic review and meta-analysis, there was no significant correlation between active smoking and AR.[27] Accordingly, we also could not find any significant correlation between current smoking status and prevalence of AR. On the other hand, ex-smoker (history of smoking in the past but stopped it now) had increased the odds for AR. It is possible that as patients with respiratory and nasal discomfort stop smoking, the odds for AR increases. Given that our study is a cross-sectional study, we could not differentiate between cause and effect. It would be quite meaningful if we could perform a cohort study to prove this hypothesis.

The main advantage of our study is that we per-

formed a large study-incorporating a study population of 31,822 patients during 5 consecutive years. However, as this is simply a cross-sectional study, we should perform further studies to prove this tendency and elucidate the pathophysiologic mechanism.

In conclusion, there was no significant correlation between high blood pressure and AR. In Korean adult males, obesity was associated with a low prevalence of allergic rhinitis. Finally, although there was no significant correlation between current smoking and AR, there was a notable correlation between ex-smoking and AR.

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