Effect of Allergic Rhinitis and Asthma on Oral Health

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Background: This study aimed to investigate allergic rhinitis and the relationship between allergic diseases, such as asthma and allergic rhinitis, and dental caries and periodontal disease using the raw data from third year of the 6th Korean National Health and Nutrition Examination Survey.

Methods: A total of 3,729 subjects aged over 30 years who underwent examination for allergic diseases and an oral health checkup were selected. The data were analyzed using SPSS IBM SPSS ver. 25.0 (IBM Corp., USA). Composite sample cross correlation and composite sample logistic regression analyses were performed using the composite sample general linear model.

Results: On examining the socioeconomic characteristics of the subjects suffering from allergic disease and the relationship between allergic disease and oral health, allergic rhinitis was more frequently found in younger subjects with a higher level of education. Periodontal disease and dental caries were more frequent among female, older age groups, lower income earners, and subjects with a lower level of education ($p<0.05$). On examining the relationship between the oral health characteristics of the subject and allergic diseases and oral health, allergic rhinitis was more common in subjects with a good oral health status perception than those who answered "bad" to the oral health status question. The community periodontal index of treatment needs (CPITN) score was higher in subjects who answered "poor" to the oral health status question, lower frequency of brushing, and higher in subjects using secondary oral hygiene products; the decayed, missing and filled teeth (DMFT) index was higher in subjects with a perception of poor oral health status ($p<0.05$). The DMFT index was high in the asthma group, and the CPITN score was high in the group who answered "no" to allergic rhinitis.

Conclusion: There is a relationship between asthma and allergic rhinitis and the DFMT index and CPITN score. Corresponding oral programs for allergic patients need to be developed.

Key Words: Allergic rhinitis, Asthma, Oral health, Oral hygiene

Introduction

Allergic rhinitis and asthma are typical allergic diseases[1], and their prevalence is increasing every year worldwide[2]. According to the International Study of Asthma and Allergy in Childhood, the prevalence of the diagnosis of allergic rhinitis has increased to 20.4% in 2000, 28.5% in 2006, and 29.9% in 2010[3]. Allergic rhinitis is associated with bronchial asthma, which is a lower airway inflammatory disease, and develops with a time lag or at the same time[4]. 70~90% of asthma patients have allergic rhinitis, 20~50% of allergic rhinitis patients have

asthma[5]. Allergic diseases are not only caused by genetic factors, but also environmental factors such as change of diet, change in lifestyle and living environment, and increase in air pollution.

Previous studies have shown that beta-2 agonists (β2-agonists), which are used as therapeutic agents in asthmatic patients, affect salivary glands and decrease the salivary secretion and change the salivary components to increase dental caries activity[6]. It induces oral dryness, which causes malocclusion, and results in an oral environment that is susceptible to various oral diseases[7]. In patients with allergic rhinitis, the typical symptom of

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nasal obstruction increases the total airway resistance and induces oral respiration[8], causing oral dryness. These two diseases have commonalities in causing oral and respiratory dryness and have been linked to oral health disorders. In studies using allergic rhinitis as a dependent variable[3,8,9] there are no studies on the relevance of oral health.

This study aimed to classify allergic rhinitis, which is the most prevalent among the allergic diseases, and asthma, which is a comorbid disease, as allergic diseases, and to confirm the relationship between periodontal disease and dental caries.

Materials and Methods

1. Study population

This study used raw data from the third year (2015) of the 6th Korean National Health and Nutrition Examination Survey (KNHANES) as research data, and the analysis data were provided after deliberation according to the procedure of using raw data. The subjects were 5,189 adults aged 30 years or older out of the 7,390 who answered a health questionnaire and underwent oral examination. Among these, 3,729 people who did not have any missing values to be included in the analysis were selected as the final study subjects. The health questionnaire of the KNHANES was conducted by the interview method, and the oral examination was conducted by a dentist, based on the World Health Organization criteria.

2. Research method

The socioeconomic characteristics of the subjects composed of six items including sex, age, income, educational level, and diagnosis of asthma or allergic rhinitis. The items related to health behavior consisted of smoking, drinking, aerobic exercises, and walking practice. The items related to oral health behavior included lower frequency of brushing, use of auxiliary oral hygiene products, and decayed, missing and filled teeth (DMFT) and community periodontal index of treatment needs (CPITN) indices for oral health. The group with CPITN score of "0" was defined as not having ("No") periodontal disease, and the group with scores "1~3" as having periodontal disease ("Yes").

3. Analysis method

The sample design of the KNHANES was extracted using a two-stage stratified cluster sampling design, and a composite sample planning file was generated to estimate the mean and ratio. The composite sample cross correlation and composite sample logistic regression analyses were performed using the composite sample general linear model. Data analysis was performed using IBM SPSS ver. 25.0 (IBM Corp., Armonk, NY, USA).

Results

1. Relationship between socioeconomic characteristics of all subjects, allergic diseases, and oral health

As a result of examining the socioeconomic character-istics of the subjects and the relationship between allergic disease and oral health, asthma was found to be more frequent in female, older subjects, and those with a lower level of education; allergic rhinitis was more frequent in younger subjects, those with above middle class income, and higher level of education. In the CPITN group, periodontal disease was more frequent in males, older subjects, and those with lower income and lower level of education, while in the DMFT group, dental caries was more frequent in women, older subjects, and those with lower income level and lower level of education (Table 1).

2. Relevance of allergic disease and oral health according to the health behavior of the subject

As a result of examining the relationship between the health behavior of the subjects and allergic diseases and oral health, asthma was found more commonly in the in the walking practice group, the group that "does not-practice" group, and allergic rhinitis was more common in the "non-alcoholic" group and in the groups that practiced aerobic exercise. The CPITN score was high in the group that subjectively answered "bad" to subjective general health awareness and in the group that currently smoked, drink, and did not practicing exercise, aerobics, nor

Table 1. Relationship between Socioeconomic Characteristics of All Subjects and Allergic Diseases and Oral Health

Category	Total	Asthma			Allergic rhinitis			CPITN			DMFT	p-value
		No	Yes	p-value	No	Yes	p-value	No	Yes	p-value		
Sex												
Male	1,574 (48.4)	1,536 (97.9)	38 (2.1)	0.028	1,394 (86.7)	180 (13.3)	0.056	862 (59.3)	712 (40.7)	<0.001	6.45±0.17	<0.001
Female	2,155 (51.6)	2,075 (96.5)	80 (3.5)		1,849 (83.9)	306 (16.1)		1,455 (69.6)	700 (30.4)		7.90±0.14	
Total	3,729 (100.0)	3,611 (97.2)	118 (2.8)		3,243 (85.3)	486 (14.7)		2,317 (62.1)	1,412 (37.9)			
Age												
30~39	604 (23.3)	586 (97.2)	18 (2.8)	0.011	475 (77.0)	129 (23.0)	<0.001	506 (83.9)	98 (16.1)	<0.001	6.88±0.19	<0.001
40~49	785 (26.2)	771 (98.2)	14 (1.8)		646 (82.7)	139 (17.3)		558 (69.7)	227 (30.3)		6.07±0.18	
50~59	918 (25.0)	898 (97.6)	20 (2.4)		816 (88.9)	102 (11.1)		500 (54.0)	418 (46.0)		6.74±0.20	
60~69	808 (14.8)	781 (96.9)	27 (3.1)		738 (91.0)	70 (9.0)		426 (52.1)	382 (47.9)		8.05±0.28	
70≤	614 (10.8)	575 (94.3)	39 (5.7)		568 (93.2)	46 (6.8)		327 (52.2)	287 (47.8)		10.58±0.37	
Household income												
Low	702 (15.3)	668 (96.2)	34 (3.8)	0.399	636 (90.9)	66 (9.1)	0.004	350 (48.3)	352 (51.7)	<0.001	8.89±0.36	<0.001
Lower than middle	916 (23.0)	892 (97.8)	24 (2.2)		811 (86.3)	105 (13.7)		524 (59.7)	392 (40.3)		7.01±0.22	
Above middle	1,004 (29.5)	974 (97.0)	30 (3.0)		849 (82.0)	155 (18.0)		666 (68.6)	338 (31.4)		6.88±0.19	
High	1,107 (32.2)	1,077 (97.4)	30 (2.6)		947 (85.0)	160 (15.0)		777 (72.2)	330 (27.8)		6.85±0.16	
Educational level												
Finished elementary school	906 (18.2)	855 (95.3)	51 (4.7)	0.025	833 (92.0)	73 (8.0)	<0.001	477 (52.6)	429 (47.4)	<0.001	9.05±0.32	<0.001
Finished middle school	464 (10.4)	454 (96.8)	10 (3.2)		416 (89.2)	48 (10.8)		238 (50.6)	226 (49.4)		7.13±0.27	
Finished high school	1,137 (32.5)	1,106 (97.5)	31 (2.5)		1,000 (86.3)	137 (13.7)		701 (62.8)	436 (37.2)		6.76±0.18	
Finished university	1,222 (39.0)	1,196 (98.0)	26 (2.0)		994 (80.2)	228 (19.8)		901 (75.5)	321 (24.5)		6.74±0.16	

Values are presented as n (%) or mean±standard deviation.
CPITN: community periodontal index of treatment needs, DMFT: decayed, missing and filled teeth.

Table 2. Relevance of Allergy Disease and Oral Health according to Health Behavior of Subjects

Category	Total	Asthma		p-value	Allergic rhinitis		p-value	CPITN		p-value	DMFT	p-value
		No	Yes		No	Yes		No	Yes			
Subjective general health awareness												
Good	1,031	1,014 (98.3)	17 (1.7)	<0.001	919 (86.2)	112 (13.8)	0.394	683 (69.1)	348 (30.9)	<0.001	6.93±0.21	0.002
Normal	1,902	1,853 (97.9)	49 (2.1)		1,642 (85.5)	260 (14.5)		1,161 (64.0)	741 (36.0)		7.07±0.14	
Bad	796	744 (93.9)	52 (6.1)		682 (83.5)	114 (16.5)		473 (59.4)	323 (40.6)		7.99±0.27	
Smoking status												
Currently smoking	485	475 (98.4)	10 (1.6)	0.478	433 (87.6)	52 (12.4)	0.534	230 (52.4)	255 (47.6)	<0.001	6.63±0.24	0.582
Smoked before but quit	104	102 (98.9)	2 (1.1)		89 (83.1)	15 (16.9)		61 (59.5)	43 (40.5)		7.16±0.54	
Never smoked	863	839 (97.6)	24 (2.4)		753 (85.3)	110 (14.7)		492 (60.2)	371 (39.8)		6.56±0.22	
Drinking experience												
Drinking	467	447 (96.2)	20 (3.8)	0.221	427 (91.4)	40 (8.6)	<0.001	250 (53.2)	217 (46.8)	<0.001	8.63±0.33	<0.001
Never drink	3,262	3164 (97.3)	98 (2.7)		2,816 (84.6)	446 (15.4)		2,067 (65.9)	1,195 (34.1)		7.05±0.12	
Aerobic exercise practice[a]												
Not practicing	2,050	1,979 (97.1)	71 (2.9)	0.675	1,813 (87.7)	237 (12.3)	0.001	1,238 (62.3)	812 (37.7)	<0.001	7.39±0.16	0.051
Practicing	1,679	1,632 (97.3)	47 (2.7)		1,430 (82.7)	249 (17.3)		1,079 (67.0)	600 (33.0)		7.01±0.16	
Walking practice[b]												
Not practicing	2,984	2,881 (96.9)	103 (3.1)	0.008	2,602 (85.7)	382 (14.3)	0.217	1,856 (64.4)	1,128 (35.6)	<0.001	7.24±0.14	0.469
Practicing	745	730 (98.6)	15 (1.4)		641 (83.5)	104 (16.5)		461 (65.4)	284 (34.6)		7.08±0.20	

Values are presented as number only, n (%), or mean±standard deviation.
CPITN: community periodontal index of treatment needs, DMFT: decayed, missing and filled teeth.
[a]Number of people who take 2 hours 30 minutes or more of mid-level physical activity on weekdays or 1 hour 15 minutes or more of high-intensity physical activity (2 minutes of middle intensity equals to 1 minutes of high intensity). [b]Number of people who walk more than 10 minutes at once, more than 30 minutes a day for more than 5 days a week.

Table 3. Relationship between Oral Health Characteristics and Allergy Diseases and Oral Health of Subjects

Category	Total	Asthma		p-value	Allergic rhinitis		p-value	CPITN		p-value	DMFT	p-value
		No	Yes		No	Yes		No	Yes			
Oral health status awareness												
Good	540	532 (98.4)	8 (1.6)	0.290	479 (88.7)	61 (11.3)	0.008	381 (73.9)	159 (26.1)	<0.001	5.48±0.29	<0.001
Normal	1,449	1,403 (97.2)	46 (2.8)		1,227 (83.0)	222 (17.0)		1,000 (72.8)	449 (27.2)		6.69±0.15	
Bad	1,740	1,676 (96.8)	64 (3.2)		1,537 (86.2)	203 (13.8)		936 (54.7)	804 (45.3)		8.19±0.19	
Number of brushing												
Less than 1 time	358	344 (97.1)	14 (2.9)	0.542	323 (88.5)	35 (11.5)	0.314	181 (53.4)	177 (46.6)	<0.001	7.65±0.43	0.089
Less than twice	1,452	1,404 (96.8)	48 (3.2)		1,277 (85.8)	175 (14.2)		864 (61.8)	588 (38.2)		7.41±0.18	
More than 3 times	1,919	1,863 (97.5)	56 (2.5)		1,643 (84.4)	276 (15.6)		1,272 (68.4)	647 (31.6)		6.99±0.14	
Use of extra oral hygiene products												
Yes	1,738	1,676 (96.9)	62 (3.1)	0.344	1,583 (88.9)	155 (11.1)	<0.001	958 (57.9)	780 (42.1)	<0.001	7.09±0.18	0.277
No	1,991	1,935 (97.5)	56 (2.5)		1,660 (82.4)	331 (17.6)		1,359 (69.9)	632 (30.1)		7.30±0.14	
Unmet medical treatment status												
Yes	1,176	1,130 (96.4)	46 (3.6)	0.069	1,028 (85.7)	148 (14.3)	0.654	693 (61.7)	483 (38.3)	0.037	7.61±0.19	0.003
No	2,552	2,480 (97.6)	72 (2.4)		2,214 (85.1)	338 (14.9)		1,624 (66.0)	928 (34.0)		7.02±0.14	
1 year oral examination status												
Yes	2,490	2,412 (97.2)	78 (2.8)	0.831	2,200 (86.3)	290 (13.7)	0.050	1,508 (63.3)	982 (36.7)	0.055	7.14±0.14	0.320
No	1,239	1,199 (97.3)	40 (2.7)		1,043 (83.3)	196 (16.7)		809 (67.1)	430 (32.9)		7.33±0.17	

Values are presented as number only, n (%), or mean±standard deviation.
CPITN: community periodontal index of treatment needs, DMFT: decayed, missing and filled teeth.

walking. The DMFT index was significantly higher in the group who answered "bad" to subjective general health awareness, and in the group with the habit of alcohol consumption (Table 2).

3. Relationship between oral health characteristics and allergic diseases and oral health of subjects

As a result of examining the relationship between the oral health characteristics of the subjects and allergic diseases and oral health, allergic rhinitis was more common in the subjects who answered "bad" to subjective oral health status perception, and in many of the respondents who used oral hygiene products and did not receive a yearly oral examination. The CPITN score was higher in subjects who answered "poor" to subjective oral health status perception, lower frequency of brushing, higher in subjects using secondary oral hygiene products, and the DMFT index was higher in those who considered their oral health status to be poor (Table 3).

4. Relevance of oral health in allergic disease

Asthma is associated with the DMFT index ($p < 0.05$). That is, asthma patients had a high DMFT of 8.23.

Allergic rhinitis and CPITN scores were significantly related ($p < 0.001$). That is, 26.5% of the patients with allergic rhinitis presented with periodontal disease, and 36.9% of the patients who answered "no" to allergic rhinitis presented with periodontal disease (Table 4).

5. Logistic regression analysis of factors affecting periodontal disease

In order to analyze the factors affecting periodontal disease, composite sample logistic regression analysis was performed with statistically significant items as independent variables and periodontal disease as the dependent variable. As a result, it was found that the variables affecting periodontal disease were related to the groups that were older in age, lower in income level, with current smoking habits, and with allergic rhinitis (Table 5).

6. General linear regression analysis of factors affecting dental caries

In order to analyze the factors affecting asthma, composite sample general linear regression analysis was performed with statistically significant items as independent variables and asthma as the dependent variable. As a result, it was found that the variables affecting asthma were related to the group that was higher in age and the group that subjectively opined that their oral health is bad (Table 6).

Discussion

The purpose of this study was to evaluate the relationship between allergic rhinitis and asthma, and periodontal disease and dental caries using the 2015 KNHANES.

Results of the study showed that allergic rhinitis and asthma were more prevalent in female, and allergic rhinitis was more prevalent in the younger subjects, while asthma in the older subjects. The results were in line with the research reported by Chala et al.[10]. On the contrary, Song and Cho[11] found a higher number of male in a study on

Table 4. Relevance of Oral Health to Allergic Disease

Category	Total	CPITN		p-value	DMFT	p-value
		No	Yes			
Asthma						
No	3,611	2,242 (64.6)	1,369 (35.4)	0.842	7.18±0.12	0.028
Yes	118	75 (65.7)	43 (34.3)		8.23±0.60	
Allergic rhinitis						
No	3,243	1,967 (63.1)	1,276 (36.9)	<0.001	7.26±0.13	0.138
Yes	486	350 (73.5)	136 (26.5)		6.88±0.26	

Values are presented as number only, n (%), or mean±standard deviation.
CPITN: community periodontal index of treatment needs, DMFT: decayed, missing and filled teeth.

Table 5. Logistic Regression Analysis of Factors Affecting Periodontal Disease

Category	B	SE	95% CI	t	p-value	Odds ratio
Sex (ref. female)						
Male	0.294	0.207	(−0.115〜0.702)	1.421	0.157	1.342
Age (ref. 30 years old)						
40〜49	0.869	0.241	(0.393〜1.344)	3.611	<0.001	2.383
50〜59	1.454	0.257	(0.946〜1.961)	5.656	<0.001	4.278
60〜69	1.484	0.254	(0.983〜1.985)	5.852	<0.001	4.410
≥70	1.353	0.281	(0.798〜1.908)	4.818	<0.001	3.869
Household income (ref. high)						
Low	0.701	0.237	(0.233〜1.170)	2.955	0.004	2.016
Lower than middle	0.479	0.224	(0.036〜0.922)	2.137	0.034	1.615
Above middle	0.149	0.207	(−0.260〜0.557)	0.720	0.472	1.161
Educational level (ref. university graduate or more)						
Finished elementary school	−0.073	0.251	(−0.569〜0.423)	−0.291	0.772	0.930
Finished middle school	0.426	0.217	(−0.003〜0.854)	1.963	0.051	1.531
Finished high school	0.164	0.177	(−0.186〜0.514)	0.925	0.356	1.178
Smoking status (ref. non-smoking)						
Currently smoking	0.585	0.148	(0.292〜0.878)	3.943	<0.001	1.794
Smoked before but quit	0.412	0.259	(−0.100〜0.924)	1.588	0.114	1.510
Drinking status (ref. not drinking)						
Drinking currently	−0.218	0.360	(−0.930〜0.493)	−0.606	0.545	0.804
Number of brush (ref. more than 3 times)						
2 times	0.090	0.208	(−0.320〜0.500)	0.433	0.665	1.094
Less than 1 time	−0.050	0.141	(−0.329〜0.228)	−0.358	0.721	0.951
Use oral hygiene products (ref. do not use)						
Use	0.024	0.130	(−0.233〜0.281)	0.183	0.855	1.024
Allergic rhinitis (ref. yes)						
No	0.318	0.187	(−0.051〜0.686)	1.702	0.019	1.374
Constant term	−2.218	0.469	(−3.145〜−1.292)	−4.728	<0.001	

SE: standard error, CI: confidence inteval.

domestic elderly asthma patients. In a cohort study including elderly asthma patients. Suggested that about 90% of the patients developed the disease beyond the age of 40 years, and about 50% of the patients developed it beyond the age of 60 years. Hence, pediatric asthma symptoms were different from those of the older subjects. Greiner et al.[12] suggested that allergic rhinitis is a common disease affecting all age groups, which can be a source of many complications that could affect their quality of life. The prevalence of allergic rhinitis was higher with higher income and education levels, and that of asthma was higher with a lower level of education. Although allergic diseases are highly related to demographic sociological factors, most domestic studies related to allergic rhinitis are aimed at children. Existing studies on asthma also do not include overall age and demographic

factors. The increasing prevalence of asthma in Korea, the aging population, lifestyle changes, and the worsening of air pollution will increase the number of patients with allergic diseases. The CPITN scored and DMFT index were noted to be higher with age and lower household income and education level, which is consistent with the results of a study by Shin et al.[13]. As age increases, the prevalence of alveolar bone increases with an increase in plaque or calculus, which in turn increases the prevalence of periodontal disease and poor oral environment due to the lack of nutritional intake and systemic diseases. As a result of the lack of preventive consciousness for oral disease and the burden of treatment costs, the treatment time is thought to be missed, but further research is needed to provide more clarity of evidence.

As for health behavior, the prevalence of asthma was

Table 6. General Linear Regression Analysis of Factors Affecting Dental Caries

Category	B	SE	95% CI	t	p-value
Sex (ref. male)					
Female	−1.380	0.196	(−1.768~−0.992)	−7.023	<0.001
Age (ref. 30 years old)					
40~49	−0.726	0.257	(−1.233~−0.219)	−2.828	0.005
50~59	−0.129	0.296	(−0.713~0.455)	−0.435	0.664
60~69	1.147	0.367	(0.422~1.872)	3.125	0.002
≥70	3.380	0.457	(2.477~4.283)	7.392	<0.001
Household income (ref. high)					
Low	0.404	0.362	(−0.311~1.120)	1.117	0.266
Lower than middle	−0.324	0.244	(−0.805~0.158)	−1.328	0.186
Above middle	−0.165	0.223	(−0.605~0.275)	−0.742	0.459
Education level (ref. university graduate or more)					
Finished elementary school	−0.073	0.402	(−0.867~0.721)	−0.182	0.856
Finished middle school	−0.667	0.320	(−1.298~−0.036)	−2.087	0.038
Finished high school	−0.293	0.225	(−0.738~0.151)	−1.303	0.194
Drinking status (ref. not drinking)					
Drinking currently	0.072	0.310	(−0.540~0.684)	0.231	0.817
Subjective general health awareness (ref. good)					
Bad	−0.362	0.323	(−1.000~0.277)	−1.118	0.265
Normal	−0.428	0.230	(−0.882~0.027)	−1.859	0.065
Oral health status awareness (ref. good)					
Bad	2.818	0.309	(2.208~3.428)	9.121	<0.001
Normal	1.482	0.271	(0.946~2.018)	5.460	<0.001
Diagnosis of asthma (ref. yes)					
No	0.225	0.573	(−0.907~1.357)	0.392	0.695
Constant term	6.136	0.481	(5.186~7.086)	12.755	<0.001

SE: standard error, CI: confidence inteval.

higher in the group without the habit of exercise, and the prevalence of allergic rhinitis was higher in the group without any drinking experience. It is difficult to explain the causal relationship between "cannot practice walking" due to asthma and "asthma occurred due to absence of walking practice"; hence, further research is needed in this area. The CPITN score was higher in the group that perceived subjective systemic health awareness as "bad," and higher in the group who smoked, had a drinking habit, and did not exercise. The study by Kim and Choi[14] supports the results of this study because the practice of exercise and periodontal disease are related, and smoking and drinking have a direct effect on periodontal disease. The DMFT index was higher in the group that perceived their subjective overall health awareness as "bad" and in subjects with a drinking habit.

Regarding oral health behaviors, fewer the number of brush strokes, higher the prevalence of periodontal disease and dental caries. If frequency of brushing or the habit of practicing auxiliary oral hygiene is low, the oral environment deteriorates, and there is an increase in oral diseases as a natural result. According to the 2010 National Health Survey Report, the use of dental floss was limited to 14.65% of the population, indicating that the need for dental flossing and interdental toothbrush training is urgently needed. In addition, the DMFT index was high in the subjects who had not undergone oral examination for one year.

The association between asthma and dental caries was interpreted using average DMFT index. The score was 8.23 in asthmatic patients, and this was significantly higher than that of non-asthmatic subjects (7.18; p<0.05); these results were consistent with the findings of Choi[15] and Alavaikko et al.[16]. In Choi's study[15], the average DMFT index for asthma patients was 7.92, which is lower than the results of this study. However, the relationship

between the two diseases was thereby confirmed. Alavaikko et al.[16] reported of doubling of the risk of dental caries in asthma patients, and doctors and dentists emphasized the need to develop dental caries prevention programs for asthma patients. Bozejac et al.[17] reported that asthma patients had no oral health education, and Ryberg et al.[18] suggested that asthma patients have increased susceptibility to dental caries but poor oral hygiene management. In order to prevent poor oral health in asthma patients, it is necessary to educate them regarding the importance of oral health, aid them with appropriate oral health management, and develop programs to prevent oral diseases.

There was an inverse relationship between allergic rhinitis and periodontal disease ($p < 0.001$). Previous studies like those by Friedrich et al.[19] showed an inverse association of allergic disease with periodontitis, and these are consistent with the results of this study. These results were in contrast to the hypothesis at the beginning of the study, but many allergic diseases and otolaryngology-related studies are questioning the relationship between allergic rhinitis and periodontal disease. It is significant that no similar studies have been attempted in Korea until now. Biological mechanisms of hygiene hypotheses about how periodontal pathogens affect allergic rhinitis[20,21] or the oral breathing habit due to nasal congestion in the allergic rhinitis patients are thought to adversely affect oral disease. However, to provide more solid evidence, this study suggests the need for follow-up studies that add variables such as lifestyle and drug use in allergic rhinitis patients.

The limitation of the study is that it may be difficult to explain the causal relationship due to the limitations of cross-sectional examination. A prospective cohort study may be necessary because the CPITN test is limited to representative tooth use, and the prevalence of period-ontitis may be overestimated or underestimated. Nevertheless, by using the large-scale data from the KNHANES a representative data of the Korean population, the results were meaningful because domestic studies confirmed the relationship between allergic diseases and oral health. Allergic diseases include allergic rhinitis, asthma, and atopic dermatitis. All three diseases were analyzed in this study; as atopic dermatitis was not related to oral health, it was excluded from the final results.

In the future, the development of oral intervention programs reflecting the characteristics of oral health of allergy patients and the development of dental hygiene specialists who can be dedicated to the education and provision of oral health care in allergy patients will be necessary.

Notes

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