



7. Liu T, Kanaoka Y, Barrett NA, et al. Aspirin-exacerbated respiratory disease involves a cysteinyl leukotriene-driven IL-33-mediated mast cell activation pathway. *J Immunol.* 2015;195:3537-3545.
8. Shaw JL, Fakhri S, Citardi MJ, et al. IL-33-responsive innate lymphoid cells are an important source of IL-13 in chronic rhinosinusitis with nasal polyps. *Am J Respir Crit Care Med.* 2013;188:432-439.
9. Teufelberger AR, Nordengrun M, Braun H, et al. The IL-33/ST2 axis is crucial in type 2 airway responses induced by *Staphylococcus aureus*-

derived serine protease-like protein D. *J Allergy Clin Immunol.* 2018;141:549-559.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

DOI: 10.1111/all.13554

Dietary assessment and the development of asthma in Korean adolescents and adults

To the Editor,

Changes in dietary habits, such as decreased intake of fresh fruits and vegetables and increased intake of processed foods, had been linked with the increasing prevalence of asthma in the past half-century.¹⁻³ However, dietary habits in different parts of the globe vary considerably according to cultural background, religious beliefs and socioeconomic background. For example, the traditional Korean diet is characterised by a relatively high consumption level of vegetables, moderate to high consumption of legumes and fish and low consumption of red meat.⁴ The dietary pattern may also differ among ages, particularly in a rapidly changing society such as Korea. Therefore, the role of a specific diet in the development of specific diseases can vary according to the dietary pattern of the population of interest.

To examine the relationship between diet and the development of asthma in different age groups in Korea, we used two nationwide survey data: Korea Youth Risk Behavior Web-based Survey 2012 (KYRBWS) and Korean National Health and Nutrition Survey 2011 (KNHANES). The development of asthma, described as recent asthma, was assessed through the response to the following question: "During the last 12 months, have you been diagnosed with asthma by a physician?" Consumption of specific foods was assessed using a qualitative food frequency questionnaire for the past 7 days. Subjects were categorised into high intake (defined as ≥ 5 per week) and low intake (< 5 per week) groups except for vegetable intake in adults. High intake of vegetables among adults was defined as twice per day or more, and low intake was defined as less than twice per day. Foods included in the analyses were vegetables (excluding kimchi, which is a traditional Korean pickled vegetable dish), fruits (excluding fruit juice), milk, fast food and instant noodles. Intake of processed meat was also included in the analysis of KNHANES. Univariate and multivariate logistic regression analyses were used to investigate the influence of each variable on the development of asthma. Covariates were age, sex, body mass index, exercise, region of residence, smoking status, income and education. Model 1 was adjusted for age and sex. Model 2 was adjusted for all covariates

that were significantly related to recent asthma in univariate analyses. All statistical tests were two-sided with a significance level of 0.05. The detailed methods and results can be found in the Appendix.

A total of 76 980 subjects representing 3 832 799 Korean middle and high school students were enrolled in KYRBWS 2012. The prevalence of recent asthma was 2.4%, and among the subjects with recent asthma, 5.8% and 3.7% consumed a large amount of fast food and instant noodle, respectively (Table S1). The consumption frequencies of these foods in subjects with recent asthma were significantly higher (odds ratio [OR] 2.62, 95% confidence interval [CI] 2.11-3.27 for fast foods; OR 1.63, 95% CI 1.34-1.98 for instant noodle) than those in subjects without recent asthma. After adjusting for covariates, high intake of fast food was consistently related to recent asthma in all regression models (OR 2.18, 95% CI 1.72-2.76 in model 1; OR 2.05, 95% CI 1.54-2.75 in model 2), whereas instant noodle intake was not associated with recent asthma. No associations were observed between the consumption of fruits, vegetables or milk and recent asthma, and no significant interactions were observed among the different food items (Figure 1A; Table 1).

There were 5811 subjects (2521 men and 3290 women) representing 33 629 698 Korean people aged 30 years and older in the KNHANES 2011. The prevalence of recent asthma was 0.5%. Among the subjects with recent asthma, 14.6% and 21.1% consumed a large amount of processed meat and instant noodle, respectively (Table S3). In univariate analyses, the amount of processed meat consumed was significantly higher in subjects who developed asthma recently than in those who did not (OR 21.45, 95% CI 2.54-180.8). After adjusting for covariates, processed meat intake was significantly associated with recent asthma in all regression models (OR 12.86, 95% CI 2.6-63.67 in model 1; OR 13.85, 95% CI 3.3-58.09 in model 2). In addition, instant noodle consumption was significantly related to recent asthma (OR 12.33, 95% CI 2.55-59.56) in univariate analyses and in all regression models (OR 11.74, 95% CI 3.81-36.22 in model 1; OR 9.49, 95% CI 3.32-27.13 in model 2). No associations

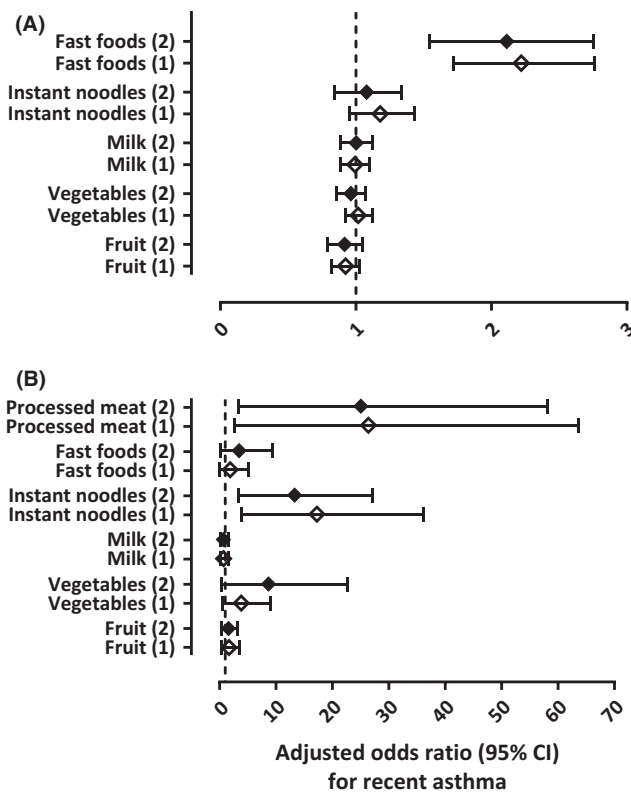


FIGURE 1 Adjusted odds ratios (aORs) for dietary impact and the development of asthma in Korean adolescents (A) and adults (B). Data from two models are presented as follows: Model 1 (white diamonds) was adjusted for sex and age, and Model 2 (black diamonds) was adjusted for significant covariates in univariate analyses. CI, confidence interval

were observed between the consumption of fruits, vegetables or milk and recent asthma, and no significant interactions were observed among the different food items (Figure 1B; Table 1).

The influence of dietary factors on recent asthma was different between adolescents and adults in our study. High fast food consumption was significantly related to the development of asthma in adolescents but not in adults. The ISAAC Phase II study reported that fast food consumption is associated with childhood asthma.⁵ However, the incidence of adult onset asthma and fast food consumption was less evident in few reports.¹ On the other hand, instant noodle consumption, which were high in calories, refined carbohydrates, saturated fat and sodium,⁶ was associated with the development of asthma in adults but not in adolescents. Our findings indicate that there might be different roles of food in asthma development according to age, and factors that could explain the differences in the associations warrant additional research. We did not find a protective role of fruits and vegetables in the development of asthma. The percentages of daily fruits and vegetables consumed in Korea is highest among developed countries.⁷ Hence, the beneficial effects could not be recognised because virtually the entire population eats high levels of these foods.

We could not prove a causal or temporal relationship between diet and asthma because of the cross-sectional design of the study. In addition, we restricted the analyses to data on self-reported physician-diagnosed asthma and dietary intake, which may have led to selective underreporting or misreporting. Despite these potential limitations, we could suggest that the influence of specific food on the development of asthma should be interpreted considering the dietary habits of target population.

TABLE 1 Association between dietary intake and asthma development in Korean adolescents and adults

	Unadjusted		Model 1 ^a		Model 2 ^b	
	OR (95% CI)	P-value	aOR (95% CI)	P-value	aOR (95% CI)	P-value
Adolescents (12-18 y old) ^c						
Fruit	0.98 (0.87-1.09)	0.68	0.92 (0.82-1.03)	0.15	0.91 (0.79-1.05)	0.2
Vegetables	1 (0.91-1.09)	0.92	1.01 (0.92-1.12)	0.78	0.96 (0.86-1.07)	0.42
Milk	1.09 (0.98-1.2)	0.1	0.99 (0.89-1.1)	0.75	1 (0.89-1.12)	0.96
Fast food	2.62 (2.11-3.27)	<0.001	2.18 (1.72-2.76)	<0.001	2.05 (1.54-2.75)	<0.001
Instant noodle	1.63 (1.34-1.98)	<0.001	1.16 (0.95-1.43)	0.15	1.06 (0.84-1.34)	0.62
Adults (≥30 y old) ^d						
Fruit	1.11 (0.34-3.61)	0.87	1.14 (0.37-3.49)	0.82	1.15 (0.41-3.23)	0.79
Vegetables	1.92 (0.44-8.42)	0.38	2.1 (0.49-9)	0.31	2.95 (0.38-22.7)	0.3
Milk	0.47 (0.12-1.85)	0.28	0.41 (0.1-1.66)	0.21	0.42 (0.12-1.52)	0.18
Processed meat	21.45 (2.54-180.8)	0.005	12.86 (2.6-63.67)	0.002	13.85 (3.3-58.09)	<0.001
Fast food	0.82 (0.1-6.45)	0.85	0.43 (0.04-5.24)	0.51	0.93 (0.09-9.44)	0.96
Instant noodle	12.33 (2.55-59.56)	0.002	11.74 (3.81-36.22)	<0.001	9.49 (3.32-27.13)	<0.001

aOR, adjusted OR; CI, confidence interval; OR, odds ratio; Ref, reference.

Values are presented as mean ± standard deviation.

^aModel 1 involved demographic factors (sex and age).

^bModel 2 involved all variables included in the analysis.

^{c,d}Our analyses resulted in a selection of higher food intake as follows: consumption of vegetable, twice a day or more; other food items, five times a week or more.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

FUNDING INFORMATION

This research was supported by a grant of the Korea Health Technology R&D Project through the Korea Health Industry Development Institute (KHIDI) and funded by the Ministry of Health & Welfare, Republic of Korea (Grant Number: HC15C1335).

ORCID

Sung-Yoon Kang  <http://orcid.org/0000-0001-5505-3028>

Woo-Jung Song  <http://orcid.org/0000-0002-4630-9922>

Min-Hye Kim  <http://orcid.org/0000-0002-1775-3733>

Sae-Hoon Kim  <http://orcid.org/0000-0002-2572-5302>

Sang-Heon Cho  <http://orcid.org/0000-0002-7644-6469>

Yoon-Seok Chang  <http://orcid.org/0000-0003-3157-0447>

Min-Suk Yang  <http://orcid.org/0000-0002-9861-0530>

Sung-Yoon Kang¹ 

Woo-Jung Song² 

Min-Hye Kim³ 

Sae-Hoon Kim^{4,5,6} 

Sang-Heon Cho^{5,6} 

Yoon-Seok Chang^{4,5,6} 

Min-Suk Yang^{5,6,7} 

¹Department of Internal Medicine, Gachon University Gil Medical Center, Incheon, Korea

²Department of Allergy and Clinical Immunology, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea

³Department of Internal Medicine, Ewha Womans University School of Medicine, Seoul, Korea

⁴Department of Internal Medicine, Seoul National University Bundang Hospital, Seongnam, Korea

⁵Department of Internal Medicine, Seoul National University College of Medicine, Seoul, Korea

⁶Seoul National University Medical Research Center, Seoul National University College of Medicine, Seoul, Korea

⁷Department of Internal Medicine, SMG-SNU Boramae Medical Center, Seoul, Korea

Correspondence: Min-Suk Yang, MD, PhD, Department of Internal medicine, SMG-SNU Boramae Medical Center, 20 Boramae-ro 5-gil, Dongjak-gu, Seoul 07061, Korea (iatus13@hanmail.net).

REFERENCES

- Brigham EP, Kolahdooz F, Hansel N, et al. Association between Western diet pattern and adult asthma: a focused review. *Ann Allergy Asthma Immunol* 2015;114:273-280.
- Li N, Xiao L, Ma J. Dietary pattern and asthma: a systematic review and meta-analysis. *J Asthma Allergy*. 2014;7:105-121.
- Garcia-Larsen V, Del Giacco SR, Moreira A, et al. Asthma and dietary intake: an overview of systematic reviews. *Allergy* 2016;71:433-442.
- Kim SH, Kim MS, Lee MS, et al. Korean diet: characteristics and historical background. *J Ethn Food*. 2016;3:26-31.
- Nagel G, Weinmayr G, Kleiner A, Garcia-Marcos L, Strachan DP, Group IPTS. Effect of diet on asthma and allergic sensitisation in the International Study on Allergies and Asthma in Childhood (ISAAC) Phase Two. *Thorax* 2010;65:516-522.
- Huh IS, Kim H, Jo HK, et al. Instant noodle consumption is associated with cardiometabolic risk factors among college students in Seoul. *Nutr Res Pract*. 2017;11:232-239.
- Indicators O. *Health at a Glance 2011. OECD Indicators*. Paris, France: OECD Publishing; 2015;15:2016.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

DOI: 10.1111/all.13555

Neuromedin U directly induces degranulation of skin mast cells, presumably via MRGPRX2

To the Editor,

Mast cells (MCs) play critical roles in immune responses through either the high affinity IgE receptor (FcεRI) or FcεRI independent

pathways, which involve cytokines, pathogens, and/or neuropeptides. Neuromedin U (NMU), a neuropeptide, originally isolated from porcine spinal cord and has various functions, such as regulation of stress responses and modification of ion transport in the gastrointestinal tract.¹ Recently, several groups have reported that NMU stimulates group 2 innate lymphoid cells (ILC2s) and induces type 2 inflammation in mouse gastrointestinal tract and lung.² Moriyama et al³ reported that in mouse skin, NMU released from keratinocytes induces MC degranulation with an early phase of inflammation.

Abbreviations: BMMCs, bone marrow-derived mouse mast cells; c48/80, compound 48/80; CTMCs, connective tissue-type mouse mast cells differentiated from BMMCs; FcεRI, the high affinity IgE receptor; GPCRs, G protein-coupled receptors; hSMCs, human skin-derived mast cells; ILC2s, group 2 innate lymphoid cells; MCs, mast cells; MRGPR, Mas-related G protein-coupled receptor; NMU, neuromedin U; PTx, pertussis toxin; SP, substance P; TRPV3, the transient receptor potential vanilloid 3.

Appendix

Supplementary methods

The KYRBWS is a nationwide self-administered online survey that assesses health-risk behaviours among middle and high school students aged 13–18 years. A total of 76,980 students representing 3,832,799 Korean students from 400 middle and 400 high schools were enrolled in 2012 with a response rate of 96.4%. The development of asthma, described as recent asthma, was assessed through the response to the following question: “During the last 12 months, have you been diagnosed with asthma by a physician?” Dietary assessments in the KYRBWS consisted of a qualitative food frequency questionnaire (FFQ) for the past 7 days. Foods included in the analyses were vegetables (excluding kimchi, which is a traditional Korean pickled vegetable dish), fruits (excluding fruit juice), milk, fast food, and instant noodles. Fast foods included pizza, hamburgers, fried chicken, and other fried foods. Instant noodles were steamed and deep-fried noodles with a flavoured powder or seasoned oil. Subjects were categorised into high intake (defined as ≥ 5 times per week) and low intake (less than five times per week) groups for each food. Sociodemographic and health-related factors included age, sex, body mass index (BMI), residency region, regular exercise, smoking status, maternal education, and parental socioeconomic status. The KNHANES is a national program designed to assess the health and nutritional status of children and adults in Korea using direct personal interviews and laboratory tests. The KNHANES uses a stratified, multistage, probability cluster sampling design to select a representative sample of civilians aged ≥ 1 year. Of the 8,518 subjects participating in the KNHANES 2011, we excluded subjects < 30 years old ($n = 2,707$), and a total of 5,811 subjects (2,521 males and 3,290 females) were included in the analyses. This sample was representative of all 33,629,698 Korean adults ≥ 30 years. Adult asthma was defined as asthma diagnosed by a doctor when the subject was ≥ 30 years old. Dietary assessments in the KNHANES consisted of a qualitative FFQ for the past year. The FFQ consisted of 63 commonly consumed food items in Korea. To compare the results with those from the KYRBWS, some items of FFQ were selected and classified into six categories: fruits, vegetables, milk, processed meat, fast food, and instant noodles. Subjects were categorised into high intake (defined as ≥ 5 per week) and low intake

(<5 per week) groups except for vegetables. High intake of vegetables was defined as twice per day or more, and low intake was defined as less than twice per day. Processed meats such as ham and sausage were included in the KNHANES analysis. Sociodemographic and health-related factors, including age, sex, BMI, residency region, regular exercise, smoking status, income level, educational attainment, and occupation were analysed.

Table S1. Baseline characteristics of the study population in Korean adolescents (KYRBWS-VIII)

Variables	Categories	Unweighted, n	Weighted, % (SE)	Recent asthma, % (SE)*
Age, years	12	7,282	9.2 (0.16)	3.2 (0.23)
	13	12,168	16 (0.27)	2.8 (0.16)
	14	12,596	16.9 (0.27)	2.2 (0.13)
	15	12,581	17.4 (0.16)	2.3 (0.13)
	16	12,448	17.3 (0.26)	2 (0.13)
	17	12,219	16.9 (0.27)	2 (0.12)
	18	4,556	6.4 (0.13)	2 (0.26)
Sex	Male	38,221	52.5 (1.29)	2.6 (0.09)
	Female	35,965	47.5 (1.29)	2.1 (0.07)
Residence	Urban	49,226	69.0 (0.75)	2.4 (0.07)
	Rural	24,960	31 (0.75)	2.4 (0.1)
Regular exercise†	< 3 times/week	51,629	69.5 (0.37)	2.1 (0.07)
	≥ 3 times/week	22,557	30.5 (0.37)	2.9 (0.11)
Smoking	Never	55,888	75.4 (0.39)	2.1 (0.06)
	Ever	18,298	24.6 (0.39)	3.1 (0.14)
2 nd hand smoking‡	Never	49,228	67.1 (0.26)	2.1 (0.07)
	Ever	24,958	32.9 (0.26)	2.9 (0.11)
BMI, percentile§	Underweight/Normal	62,610	86.9 (0.16)	2.2 (0.06)
	Overweight/Obese	9,619	13.1 (0.16)	2.8 (0.17)
Maternal education	High school	35,850	57.2 (0.56)	2.3 (0.08)
	College or above	25,507	42.8 (0.56)	2.4 (0.1)
Socio-economic status (SES)	High	22,282	30.7 (0.36)	2.5 (0.11)
	Middle	34,884	46.7 (0.25)	2.1 (0.08)
	Low	17,020	22.6 (0.27)	2.8 (0.13)
Foods (≥ 5 times/week)	Fruit	17,020	29.1 (0.31)	2.3 (0.11)
	Vegetables	42,339	57.1 (0.24)	2.4 (0.08)
	Milk	33,787	44.7 (0.50)	2.5 (0.09)

Fast foods	1,775	2.5 (0.07)	5.8 (0.6)
Instant noodle	3,806	5 (0.1)	3.7 (0.35)

*Recent asthma is defined as previous physician-diagnosed asthma within the past 12 months. SE, standard error. [†]Regular exercise was defined as engaging in vigorous physical activity for more than 20 min per session and at least 3 times per week. [‡]Secondhand smoke exposure was defined as exposure to the cigarette smoke from other people in the subject's home once or more per week. [§]Weight status were classified using age- and sex-specific BMI (calculated as self-reported weight in kilograms divided by the square of self-reported height in meters) percentiles based on the 2007 Korea National Growth Chart for Children and Adolescents. Age- and sex-specific BMI was divided into two categories: normal weight or less (5th-84th percentile), and overweight or obese ($\geq$ 85th percentile).

Table S2. Association between dietary intake and asthma development in Korean adolescents

	Unadjusted		Model 1*		Model 2†	
	OR (95% CI)	P-value	aOR (95% CI)	P-value	aOR (95% CI)	P-value
Age	0.92 (0.89 – 0.94)	<0.001	0.91 (0.88 – 0.94)	<0.001	0.89 (0.86 – 0.92)	<0.001
Sex						
Male	Ref		Ref		Ref	
Female	0.77 (0.7 – 0.86)	<0.001	0.77 (0.69 – 0.85)	<0.001	0.79 (0.7 – 0.89)	<0.001
Residence						
Rural	Ref				Ref	
Urban	1 (0.9 – 1.12)	0.96			1.03 (0.91 – 1.16)	0.65
Regular exercise						
< 3times/week	Ref				Ref	
≥3times/week	1.35 (1.22 – 1.49)	<0.001			1.18 (1.05 – 1.33)	0.006
Smoking						
Never	Ref				Ref	
Ever	1.45 (1.29 – 1.62)	<0.001			1.24 (1.1 – 1.41)	0.001
2nd hand smoking						
Never	Ref				Ref	
Ever	1.36 (1.22 – 1.51)	<0.001			1.17 (1.04 – 1.31)	0.007
BMI, percentile						
Underweight/Normal	Ref				Ref	
Overweight/Obese	1.31 (1.15 – 1.49)	<0.001			1.27 (1.09 – 1.47)	0.002
Maternal education						
High school	Ref				Ref	
College or above	0.96 (0.85 – 1.07)	0.43			0.94 (0.84 – 1.06)	0.33
Socio-economic status						
High	Ref				Ref	
Middle	0.83 (0.75 – 0.93)	0.001			0.93 (0.82 – 1.05)	0.25
Low	1.15 (1.01 – 1.3)	0.03			1.18 (1.01 – 1.38)	0.03
Foods‡						
Fruit	0.98 (0.87 – 1.09)	0.68	0.92 (0.82 – 1.03)	0.15	0.91 (0.79 – 1.05)	0.2
Vegetables	1 (0.91 – 1.09)	0.92	1.01 (0.92 – 1.12)	0.78	0.96 (0.86 – 1.07)	0.42
Milk	1.09 (0.98 – 1.2)	0.1	0.99 (0.89 – 1.1)	0.75	1 (0.89 – 1.12)	0.96
Fast food	2.62 (2.11 – 3.27)	<0.001	2.18 (1.72 – 2.76)	<0.001	2.05 (1.54 – 2.75)	<0.001
Instant noodle	1.63 (1.34 – 1.98)	<0.001	1.16 (0.95 – 1.43)	0.15	1.06 (0.84 – 1.34)	0.62

Values are presented as mean ± standard deviation. *Model 1 involved demographic factors (sex and age). †Model 2 involved all variables included in the analysis. ‡Our analyses resulted in a selection of higher food intake consuming 5 times a week or more. Ref, reference; OR, odds ratio; aOR, adjusted OR; CI, confidence interval.

Table S3. Baseline characteristics of the study population in Korean adults (KNHANES-V)

Variables	Categories	Unweighted, n	Weighted, % (SE)	Recent asthma, % (SE)*
Age, years		54.3 (14.67)	50.5 (0.40)	
Sex	Male	2,521	48.8 (0.59)	0.3 (0.08)
	Female	3,290	51.2 (0.59)	0.7 (0.18)
Residence	Rural	1,950	30.9 (1.9)	0.4 (0.15)
	Urban	3,861	69.1 (1.9)	0.5 (0.13)
Regular exercise	< 3 times/week	2,993	55.6 (0.87)	0.4 (0.14)
	≥ 3 times/week	2,333	44.4 (0.87)	0.5 (0.14)
Smoking	Never	3,208	54.8 (0.72)	0.6 (0.16)
	Ever	2,140	45.2 (0.72)	0.3 (0.10)
Household income (quartile)	1st	1,482	17.8 (0.94)	0.8 (0.25)
	2nd	2,315	28.7 (1.08)	0.2 (0.13)
	3rd	2,433	28.2 (0.99)	0.5 (0.25)
	4th	2,184	25.3 (1.27)	0.5 (0.24)
BMI, percentile†	Underweight	205	3.3 (0.31)	0.5 (0.29)
	Normal	3,455	62.5 (0.85)	0.4 (0.10)
	Overweight/Obese	1,821	34.2 (0.88)	0.4 (0.20)
Education	Elementary school	1,565	23.2 (1.07)	0.7 (0.18)
	Middle school	655	12.5 (0.6)	0.3 (0.20)
	High school	1,627	33.7 (1.08)	0.6 (0.20)
	College or above	1,499	30.5 (1.26)	0.3 (0.13)
Occupation‡	Group 1	620	13.1 (0.65)	0.5 (0.36)
	Group 2	372	8.3 (0.52)	0.2 (0.22)
	Group 3	615	13.4 (0.68)	1.2 (0.40)
	Group 4	493	6.2 (0.85)	0.3 (0.17)
	Group 5	534	11.4 (0.58)	0.2 (0.21)
	Group 6	504	8.4 (0.44)	0.1 (0.06)
	Group 7	2,208	39.2 (0.92)	0.4 (0.11)
Foods§	Fruit	4,093	81.2 (0.97)	82.8 (8.4)
	Vegetables	4,489	90.2 (0.6)	94.6 (3.84)
	Milk	1,219	24 (0.97)	13 (7.74)
	Processed meat	31	0.8 (0.21)	14.6 (12.9)
	Fast foods	244	6.2 (0.54)	5.3 (5.17)
	Instant noodle	89	2.2 (0.29)	21.1 (13.4)

*Recent asthma, first diagnosed after 30 years or more, is defined as previous physician-diagnosed asthma within the past 12 months. SE, standard error. †Participants were classified into three BMI groups: normal or underweight (< 23.0 kg/m²), overweight (23.0–24.9 kg/m²) and obese (≥ 25.0 kg/m²). ‡Occupational classification uses the Korean Standard Classification of Occupation: group 1 (managers, professionals, and related workers); group 2 (clerks); group 3 (service and sales workers); group 4 (skilled agricultural, forestry, and fishery workers); group 5 (craft, equipment, and machine operating and assembling workers); group 6 (elementary workers); and group 7 (housewives, students, and the unemployed). §Our analyses resulted in a selection of higher food intake as follows; consumption of vegetable, twice a day or more; other food items, 5 times a week or more. Other variables were categorized in the same way as the variables in the KYRBWS.

Table S4. Association between dietary intake and asthma development in Korean adults

	Unadjusted		Model 1*		Model 2†	
	OR (95% CI)	P-value	aOR (95% CI)	P-value	aOR (95% CI)	P-value
Age	1.00 (0.97 – 1.04)	1	1 (0.97 – 1.04)	0.91	1.01 (0.96 – 1.06)	0.92
Sex						
Male	Ref		Ref		Ref	
Female	2.58 (1.08 – 6.19)	0.03	2.73 (0.97 – 7.65)	0.06	2.69 (0.66 – 11)	0.17
Residence						
Rural	Ref				Ref	
Urban	0.93 (0.36–2.40)	0.88			0.93 (0.3 – 2.82)	0.89
Regular exercise						
< 3times/week	Ref				Ref	
≥3times/week	1.01 (0.41 – 2.49)	0.98			1.47 (0.56 – 3.81)	0.43
Smoking						
Never	Ref				Ref	
Ever	0.69 (0.29 – 1.67)	0.41			1.31 (0.41 – 4.13)	0.65
Household income						
1st quartile	Ref				Ref	
2nd quartile	0.25 (0.05 – 1.16)	0.08			0.2 (0.03 – 1.47)	0.11
3rd quartile	0.69 (0.22 – 2.13)	0.51			0.99 (0.35 – 2.83)	0.98
4th quartile	0.69 (0.23 – 2.08)	0.51			1.03 (0.41 – 2.62)	0.95
BMI, percentile						
Underweight	Ref				Ref	
Normal	0.39 (0.08 – 1.88)	0.24			0.48 (0.1 – 2.24)	0.35
Overweight/Obese	0.45 (0.08 – 2.62)	0.38			0.29 (0.04 – 2.15)	0.23
Education						
Elementary school	Ref				Ref	
Middle school	0.77 (0.17 – 3.58)	0.74			0.61 (0.07 – 5.35)	0.65
High school	1.23 (0.46 – 3.32)	0.68			0.96 (0.37 – 2.47)	0.93
College or above	0.25 (0.08 – 0.82)	0.02			0.21 (0.04 – 1.01)	0.05
Occupation						
Group 1	Ref				Ref	
Group 2	0.52 (0.04 – 6.78)	0.62			0.56 (0.06 – 5.5)	0.62
Group 3	1.85 (0.29 – 11.72)	0.51			1.24 (0.25 – 6.07)	0.79
Group 4	0.51 (0.07 – 3.91)	0.51			0.38 (0.07 – 2.04)	0.26
Group 5	0.41 (0.03 – 5.25)	0.49			0.43 (0.04 – 4.53)	0.48
Group 6	0.13 (0.01 – 1.61)	0.11			0.09 (0.01 – 0.89)	0.04 [§]
Group 7	0.95 (0.17 – 5.45)	0.96			0.5 (0.11 – 2.19)	0.35
Foods						
Fruit	1.11 (0.34 – 3.61)	0.87	1.14 (0.37 – 3.49)	0.82	1.15 (0.41 – 3.23)	0.79
Vegetables	1.92 (0.44 – 8.42)	0.38	2.1 (0.49 – 9)	0.31	2.95 (0.38 – 22.7)	0.3
Milk	0.47 (0.12 – 1.85)	0.28	0.41 (0.1 – 1.66)	0.21	0.42 (0.12 – 1.52)	0.18
Processed meat	21.45 (2.54 – 180.8)	0.005	12.86 (2.6 – 63.67)	0.002	13.85 (3.3 – 58.09)	<0.001
Fast food	0.82 (0.1 – 6.45)	0.85	0.43 (0.04 – 5.24)	0.51	0.93 (0.09 – 9.44)	0.96
Instant noodle	12.33 (2.55 – 59.56)	0.002	11.74 (3.81 – 36.22)	<0.001	9.49 (3.32 – 27.13)	<0.001

Values are presented as mean ± standard deviation. *Model 1 involved demographic factors (sex and age). †Model 2 involved all variables included in the analysis. ^{||} Our analyses resulted in a selection of higher food intake as follows; consumption of vegetable, twice a day or more; other food items, 5 times a week or more. Ref, reference; OR, odds ratio; aOR, adjusted OR; CI, confidence interval.