



Letter to the Editor

Association between the AUDIT score and IgE in Korean adults: Results from the Korea National Health and Nutrition Examination Survey

Dear Editor,

Alcohol consumption is linked to various health problems, including allergic diseases. Indeed, chronic/high alcohol consumption is related with elevated serum levels of total IgE.^{1,2} Furthermore, habitual alcohol consumers have elevated *Dermatophagoides pteronyssinus*-specific IgE levels.³ Thus, alcohol use and allergic sensitization may be positively associated.

The Alcohol Use Disorders Identification Test (AUDIT) is a widely used and reliable test for assessing alcohol-related issues.^{4,5} The AUDIT includes questionnaires about alcohol consumption and frequency (Supplementary Table 1). The AUDIT inquires fell into three main categories: alcohol consumption pattern, dependence symptoms, and harmful alcohol use.⁵

Although alcohol consumption pattern is linked to allergic sensitization in a frequency-related manner, the relationship between allergic sensitization and the AUDIT score is unclear. Therefore, we investigated the relationship between the AUDIT score and the serum levels of total, cockroach-specific, dog-specific, and house dust mite-specific IgE levels in Korean adult participants in the Korea National Health and Nutrition Examination Survey (KNHANES).

The study was analyzed based on a nationwide study between January 2010 to December 2012 which was conducted by the

Division of Chronic Disease Surveillance under the Korean Ministry of Health and Welfare.⁶ The sampling units were based on the population and housing consensus from the 2005 National Census Registry in Korea, which includes age, sex, and geographic area.⁷

The subjects were participants in the fifth National Health and Nutrition Examination Survey (n = 8958) in 2010, and 1723 adults (918 males and 805 females) with available serum levels of total and allergen-specific IgE were enrolled in this study. Institutional Review Board of the Catholic University of Korea (No. KC16E-ISE0676) approved this study. The quantity of alcohol consumption per day was divided into three groups: non-drinker, mild to moderate drinker (1–30 g/day), and heavy drinker (>30 g/day). In addition, the subjects were divided into four levels according to the AUDIT score: level 1 (0–7), level 2 (8–14), level 3 (15–19), and level 4 (≥20).⁵ High-risk drinking refers to men who consume >60 g pure alcohol/day or women who consume >40 g pure alcohol/day on at least twice a week. As for smoking, there are two groups of ever-smokers and non-smokers. It was defined as a regular exercise group if physical activity was intense at least three times a week for more than 20 min.

Subjects received tests for three allergen, including dust mite (*Dermatophagoides farinae* [Der f]), dog, and cockroach using ImmunoCAP 100 (Phadia, Uppsala, Sweden). We classified participants into four groups based on serum levels of total, dust mite-,

Table 1

Pearson's correlation coefficients for serum levels of IgE and alcohol consumption, allergic sensitization, and metabolic parameters.

	Drinking days per year		AUDIT score		Total IgE		Sensitization to <i>Der f</i>		Sensitization to cockroach		Sensitization to dog	
	r	p	r	p	r	p	r	p	r	p	r	p
Waist circumference (cm)	0.163	<0.0001	0.166	<0.0001	0.192	<0.0001	0.066	0.0128	0.184	<0.0001	0.097	0.003
Body mass index (kg/m ²)	0.107	0.0087	0.096	0.0115	0.146	<0.0001	0.064	0.0258	0.150	<0.0001	0.074	0.0372
Systolic blood pressure, mmHg	0.176	<0.0001	0.119	0.0001	0.140	<0.0001	0.023	0.4206	0.148	<0.0001	0.074	0.0065
Diastolic blood pressure, mmHg	0.229	<0.0001	0.212	<0.0001	0.113	<0.0001	0.061	0.0214	0.155	<0.0001	0.087	0.0018
Glucose, mg/dL	0.075	0.0511	0.080	0.002	0.142	<0.0001	0.067	0.0304	0.173	0.0002	0.106	0.013
High density lipoprotein, mg/dL	0.050	0.1014	0.056	0.0644	−0.110	<0.0001	−0.040	0.1901	−0.135	<0.0001	−0.045	0.1088
Triglyceride, mg/dL	0.250	<0.0001	0.239	<0.0001	0.158	<0.0001	0.080	0.0025	0.146	<0.0001	0.066	0.0159

AUDIT, Alcohol Use Disorders Identification Test.

We divided the subjects into quartiles of total and specific IgE levels. Positivity was defined as being in the highest quartile.

Three or more of the following five are diagnosed with metabolic syndrome: (i) high weight circumference (WC) (≥90 cm for men and ≥85 cm for women), ii) elevated triglyceride (TG) level (≥150 mg/dl or taking medications for hypertriglyceridemia); (iii) reduced high-density lipoprotein (HDL) (<40 mg/dl in men and <50 mg/dl in women); (iv) elevated blood pressure (systolic blood pressure ≥130 mmHg or diastolic blood pressure ≥85 mmHg, or receiving antihypertensive treatment); and (v) elevated fasting glucose (>100 mg/dl or taking medications for increased glucose).

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Table 2

Adjusted ORs and 95% CIs of allergic sensitization (highest quartile) obtained from a multivariate logistic regression model of alcohol consumption.

			HR (95%CI)							
			Male				Female			
			Model 1	<i>p</i>	Model 2	<i>p</i>	Model 1	<i>p</i>	Model 2	<i>p</i>
Increased serum total IgE (>150 IU/mL)	Drinker level	heavy drinker	2.103 (0.963, 4.594)	0.0092	2.044 (0.89, 4.691)	0.3332	1.468 (0.466, 4.622)	0.0063	0.661 (0.186, 2.341)	0.5544
		mild to moderate drinker	1.133 (0.558, 2.301)		1.294 (0.591, 2.833)		0.497 (0.3, 0.823)		0.411 (0.243, 0.694)	
	High-risk drinker	non-drinker	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
		yes	1.411 (0.978, 2.036)	0.066	1.384 (0.915, 2.093)	0.1553	1.991 (0.922, 4.3)	0.0794	1.276 (0.54, 3.013)	0.4848
		no	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
Sensitization to <i>Der f</i>	Drinker level	AUDIT level 4	2.833 (1.573, 5.102)	0.0007	2.906 (1.583, 5.334)	0.0065	2.678 (0.81, 8.849)	0.017	1.628 (0.535, 4.956)	0.8728
		Score 20–								
	3	15–19	2.006 (1.189, 3.386)		1.958 (1.159, 3.307)		3.263 (1.303, 8.169)		1.754 (0.62, 4.966)	
	2	8–14	1.387 (0.921, 2.088)		1.465 (0.962, 2.231)		1.393 (0.799, 2.428)		1.129 (0.626, 2.035)	
	1	0–7	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
Sensitization to cockroach	Drinker level	heavy drinker	1.775 (0.822, 3.83)	0.0809	1.822 (0.779, 4.257)	0.5366	1.944 (0.64, 5.904)	0.0031	1.433 (0.4354, 7.21)	0.6894
		mild to moderate drinker	1.321 (0.631, 2.765)		1.435 (0.642, 3.211)		0.585 (0.373, 0.918)		0.531 (0.328, 0.862)	
	High-risk drinker	non-drinker	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
		yes	1.168 (0.822, 1.66)	0.1232	1.158 (0.779, 1.723)	0.1117	2.012 (0.974, 4.155)	0.5785	1.435 (0.612, 3.365)	0.1238
		no	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
Sensitization to dog	Drinker level	AUDIT level 4	1.837 (1.04, 3.246)	0.0013	1.806 (1, 3.26)	0.0054	1.287 (0.363, 4.568)	0.6318	0.918 (0.262, 3.208)	0.7236
		Score 20–								
	3	15–19	1.684 (0.974, 2.912)		1.681 (0.968, 2.918)		2.199 (0.937, 5.159)		1.332 (0.519, 3.422)	
	2	8–14	1.165 (0.788, 1.723)		1.236 (0.816, 1.872)		1.319 (0.749, 2.32)		1.099 (0.603, 2.003)	
	1	0–7	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
Sensitization to dog	Drinker level	heavy drinker	1.139 (0.518, 2.507)	0.2299	1.123 (0.479, 2.63)	0.0229	1.234 (0.236, 6.44)	0.0092	0.854 (0.193, 3.768)	0.9067
		mild to moderate drinker	0.845 (0.408, 1.747)		0.875 (0.383, 1.996)		0.72 (0.353, 1.47)		0.697 (0.304, 1.6)	
	High-risk drinker	non-drinker	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
		yes	1.317 (0.901, 1.925)	0.3852	1.392 (0.926, 2.093)	0.7676	0.632 (0.174, 2.293)	0.0589	0.357 (0.096, 1.326)	0.0011
		no	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
Sensitization to dog	Drinker level	AUDIT level 4	1.523 (0.927, 2.503)	0.1087	1.556 (0.922, 2.626)	0.0798	1.005 (0.118, 8.535)	0.2492	0.546 (0.089, 3.333)	<0.0001
		Score 20–								
	3	15–19	1.844 (1.133, 3.001)		2.116 (1.261, 3.551)		0.519 (0.105, 2.563)		0.42 (0.068, 2.579)	
	2	8–14	0.808 (0.536, 1.22)		0.88 (0.563, 1.374)		0.878 (0.363, 2.122)		0.803 (0.329, 1.961)	
	1	0–7	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
Sensitization to dog	Drinker level	heavy drinker	8.528 (1.809, 40.191)	0.3299	5.84 (1.11, 30.736)	0.1139	1.576 (0.147, 16.927)	0.0098	2.393 (0.166, 34.454)	0.7307
		mild to moderate drinker	5.015 (1.18, 21.311)		4.366 (0.945, 20.166)		1.254 (0.378, 4.166)		1.701 (0.407, 7.102)	
	High-risk drinker	non-drinker	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
		yes	1.103 (0.575, 2.117)	0.4679	1.07 (0.541, 2.114)	0.8467	6.722 (2.142, 21.096)	0.4068	7.496 (2.144, 26.203)	0.0016
		no	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)	
Sensitization to dog	Drinker level	AUDIT level 4	1.342 (0.549, 3.278)	0.1444	1.288 (0.548, 3.026)	0.1712		0.9375		<0.0001
		Score 20–								
	3	15–19	2.451 (1.126, 5.333)		2.226 (0.976, 5.077)		10.657 (2.468, 46.013)		13.278 (2.841, 62.061)	
	2	8–14	1.097 (0.516, 2.333)		1.018 (0.47, 2.205)		2.149 (0.573, 8.062)		2.622 (0.662, 10.383)	
1	0–7	1 (ref.)		1 (ref.)		1 (ref.)		1 (ref.)		

Adjusted for age (model 1) and age, BMI, smoking, exercise, education, income, metabolic syndrome, and vitamin D level (model 2). OR, odds ratio; CI, confidence interval; AUDIT, Alcohol Use Disorders Identification Test.

cockroach-, and dog-specific IgE. Total IgE level >150 IU/mL and an allergen-specific IgE level >0.35 kU/L were defined as being sensitized.

Continuous and categorical variables were analyzed using *t*-tests and chi-square tests. Logistic regression analyses were conducted to analyze the relationship between allergic sensitization and the pattern of alcohol use. Age, body mass index (BMI), smoking, exercise, education, income, metabolic syndrome, and vitamin D (Serum 25-hydroxyvitamin D), which are confounding factors, were adjusted, and then evaluated for odds ratios (ORs) and 95% confidence interval (CI). SAS version 9.4 (SAS Institute, Cary, NC, USA) were used. A *p*-value < 0.05 was considered to be a statistical significance.

A total of 1723 adults was included in the study. The characteristics of the subjects are listed in [Supplementary Table 2](#). Males had lower HDL levels and higher levels of BMI, WC, systolic blood pressure, diastolic blood pressure, glucose, and triglycerides (*p* < 0.05) than females. Males had a higher drinking frequency per year and a higher proportion of high-risk drinkers than females (*p* < 0.05). The alcohol-consumption pattern and AUDIT score were also significantly different between the sexes (*p* < 0.05). In addition, males had higher levels of total and specific IgE (*Der f*, cockroach, and dog) than females (*p* < 0.05).

WC, BMI, diastolic blood pressure, glucose level, and triglyceride level were weakly but significantly correlated with the number of drinking days per year, AUDIT score, total IgE level, and allergen-specific IgE levels (*p* < 0.05). All IgE levels were negatively correlated with HDL cholesterol levels (*r* = −0.067, *p* = 0.034) ([Table 1](#)).

The ORs and 95% CIs obtained by multiple logistic regression controlling for age in model 1, and for age, BMI, smoking, physical activity, education, income, metabolic syndrome, and blood vitamin D level in model 2, are listed in [Table 2](#). In model 2, the association between increased total IgE and level 3 of AUDIT (1.958, 95% CI 1.159–3.307)/level 4 of AUDIT (2.906, 95% CI 1.583–5.334) in male have significantly observed compared to level 1 of AUDIT. In addition, *Der f*-specific IgE levels (1.806, 95% CI 1.000–3.260) were significantly associated with AUDIT levels 4. Moreover, cockroach sensitization was associated with AUDIT level 3 (OR 2.116, 95% CI 1.261–3.551) compared to AUDIT level 1. Drinker levels significantly differed among males with sensitization to dog, where heavy-drinking subjects had an OR for dog-specific IgE of 5.840 (95% CI 1.110–30.736) compared to non-drinkers. In females, the AUDIT score was not significantly associated with total IgE levels or *Der f*-specific IgE levels.

The strength of the study was that it first studied the association between IgE level and AUDIT score. Because majority of the AUDIT questions are related to dependence symptoms and harmful alcohol use, the current findings can be interpreted as that alcohol dependence is positively associated with increased total IgE levels in males. In addition, we found that the AUDIT score is independently associated with allergic sensitization to *Der f* and total IgE levels in males. In addition, dog-specific IgE was associated with heavy drinker (>30 g pure alcohol per drinking day) in males. This might explain the male predominance in the association between both alcohol-consumption and alcohol-dependence patterns and allergic sensitization.

This study had several limitations. First, the total amount of alcohol consumed was not estimated. Second, allergic diseases or symptoms were not analyzed according to alcohol-consumption pattern. Third, since the average value of a partic-

ular IgE is not high, although the specific IgE > 0.35 kU/L is defined, the central data for the IgE analysis may be performed in the negative specific IgE range. However, this is the first report that alcohol dependence is a risk factor for allergic sensitization in males. In addition, binge drinking was related to increased levels of dog-specific IgE.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.alit.2019.10.010>.

Conflict of interest

The authors have no conflict of interest to declare.

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