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Association of Dietary Factors with Presence and Severity of Tinnitus in Korean Adults with Normal Hearing

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Abstract Tinnitus is the perception of sound regardless of the external sound stimulus and have been focused about various risk factors in recent researches. The aim of this cross-sectional study was to investigate the nutritional risk factors for tinnitus with normal hearing in the general population by examining data from the Fifth Korea National Health and Nutrition Examination Survey (KNHANES). A total of 12,658 people were enrolled in Fifth KNHANES 2010-2012. We divided the subjects into two groups: tinnitus group and no tinnitus group, with a normal hearing threshold (< 25 dB). We analyzed the survey questionnaires for data on tinnitus, quality of life (QoL), and nutritional intake. The group with tinnitus and normal hearing accounted for 17.8% (n=2,249) of the total population. The QoL scores, including those for depression, pain, anxiety, and daily activity were significantly worse in the group with tinnitus than those in the normal group. The nutritional intake in the tinnitus group was generally low. A regression analysis revealed that a low salt intake was an important risk factor for the development of tinnitus in adults with normal hearing (OR=1.19, p=0.008). Mineral intake may affect the occurrence of tinnitus. In particular, lifestyle associated with low salt intake may be a risk factor for the development of tinnitus.

Keywords: *tinnitus, normal, hearing, nutrition, Korean*

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1. Introduction

Tinnitus is one of the most common auditory symptoms [1]. It occurs in 30 to 40% of the adult population, and 0.5 to 2.5% of the patients with tinnitus have serious discomfort that can reduce their quality of life. Tinnitus has exerted a burden on the growing medical system in the recent years [2]. The pathogenesis of tinnitus is not fully understood. It is therefore important to find the risk factors for tinnitus. Knowing the risk factors for tinnitus in adults with normal hearing may help in its prevention.

About 90% of the patients with tinnitus have associated hearing loss due to various conditions, such as noise exposure, presbycusis, ototoxic medications, middle ear infections, and inner ear disease; however, about 10% of patients with tinnitus have normal hearing [3]. The prevalence of tinnitus among individuals with normal audiometric threshold has not been well studied. Quaranta et al. found an 8% prevalence of tinnitus among normal hearing subjects in an Italian sample [4]; however, the sample size was small (~200).

Park et al. [5] studied the relationship between tinnitus and quality of life in the Korean National Health and Nutrition Examination Surveys. Hearing loss with tinnitus was shown to have a considerable impact on quality of life in the Korean population. However, the authors did not evaluate nutrition as a risk factor for tinnitus. A few studies have explored the potential relationships between tinnitus and nutritional deficiency. A study by McCormack et al. [6] was the first population-based study to examine the association between diet and tinnitus. The authors reported lower odds of persistent tinnitus with eating fish, avoiding eggs, and drinking more caffeinated coffee. Increased odds of reported tinnitus were associated with greater intake of vegetables/fruit, avoidance of dairy products, and greater intake of bread. Reduced odds of bothersome and persistent tinnitus were found when whole-meal/whole-grain bread was consumed rather than white or brown bread.

Here, we aimed to identify the nutritional risk factors for tinnitus in adults with normal hearing in the general population by examining data from the Fifth Korea National Health and Nutrition Examination Survey (KNHANES). Our analysis of the KNHANES database specifically assessed the potential association between

nutrition and reported tinnitus in subjects with normal hearing after controlling for other potentially confounding and mediating variables.

2. Subjects and Methods

2.1. Study Population

The data were collected from The Fifth Korea National Health and Nutrition Examination survey (KNHANES V) 2010-2012. KNHANES has been conducted by the Korean Centers for Disease Control since 1998 to study the healthcare and nutritional status of Koreans. KNHANES comprises a health screening survey, health examination survey, and nutritional examination survey. The survey was carried out in all household members aged over 1 year in over 3,800 households. A total of 23,621 adults aged more than 19 years who had normal hearing (less than 25 dB when divided by the six-quarter method by the pure tone hearing test) and had answered whether they have tinnitus were enrolled. Subjects with hearing loss, past history of otitis media, or abnormal tympanic endoscopic findings (tympanic membrane perforation, pearl type, exudative otitis media, and chronic otitis media) were excluded. Finally, 12,658 subjects were enrolled.

2.2. Survey for Tinnitus

"Within the last year a sound was heard from the ear, and whether it is an alias or not was answered to the questionnaire item that answered yes or no to the question that it is? When answering, concretely answer "Not discomfort / Discomfort / hard to sleep" to the item "How sounds are uncomfortable in life?" to distinguish severity.

2.3. Auditory Evaluation

The tympanic membrane was examined by an otorhinolaryngologist using a 0-degree endoscope. Subjects with abnormal findings in one or both ears, with undetermined status, or who were not studied were excluded.

Audiometry was performed by using SA 203 audiometer (Entomed; Malmö, Sweden). Air conduction audiometry was measured at 500, 1000, 2000, 3000, 4000, and 6000 Hz in both ears. Hearing at less than 25 dB in pure tone audiometry (PTA) was regarded as normal, and the subject was allowed to participate in the study.

2.4. Nutritional Intake Data

Nutritional intake data were collected from a 24 h recall survey. A nutritional investigation team visited and surveyed the households. Factors such as fasting and this week could be present on the screening day, a check-up and a health check were completed, and after about a week, a food intake survey was conducted. The nutritional examination survey was conducted 7 days after the health screening survey. The average nutrient value contained in each food item, nutrient intake amount per day, investigated type, amount, frequency, etc. of food taken during the day of the survey were converted. Types of converted nutrients were energy, moisture, protein, fat, carbohydrates, dietary fiber, ash, calcium, phosphorus, iron, sodium, potassium, vitamin A, carotene, retinol, thiamine, riboflavin, niacin, and vitamin C.

2.5. Survey for Health-related Quality of Life

The quality of life was evaluated using EuroQol five-dimensional (EQ - 5 D) questionnaire, and EQ visual analogue scale (VAS). EQ - 5D was measured in patient subjective questionnaire based on 5 items (athletic ability, self-management, daily activities, pain/discomfort, anxiety/ depression). Each item was evaluated based on a single question with three response levels (no problem, some problems, and severe problems). We also included a visual analog assessment from 0 (the lowest imaginable health condition) to 100 (the best imaginable health condition) using the EQ-VAS, and the participant's subjective health was also surveyed.

2.6. Statistical Analysis

Data are expressed according to the properties of the variable. Continuous variables are presented as means and standard deviations. Categorical variables are presented as frequencies and percentages. In order to compare groups, we performed the two-sample t-test or chi-square test as appropriate. Logistic regression analysis was used to identify the factors associated with tinnitus, and the results are expressed as odds ratios with 95% confidence intervals. A p-value of less than 0.05 was considered statistically significant, and all statistical analyses were conducted using SAS 9.4 version (SAS Inc., Cary, NC, USA).

3. Results

From among 23,621 adults aged 19 years and above, a total of 12,658 participants who responded with respect to tinnitus with normal hearing were enrolled in this study. Of the 12,658 participants, 2,249 had tinnitus (17.8%), and 10,409 (82.2%) had no tinnitus. Their general characteristics are shown in Table 1. There was no statistically significant difference between the groups with respect to age ($p = 0.4659$). The proportion of women with tinnitus was significantly higher (43.4% vs. 36.3%, $p < 0.0001$), and the proportion of women with lower income was higher (40.23% vs. 35.88%, $p = 0.0001$). The proportion of dyslipidemia was higher in the tinnitus group (11.3% vs. 9.0%, $p = 0.0013$), and it was associated with low HDL levels. BMI was lower (23.09 ± 3.57 vs. 23.29 ± 3.59, $p = 0.0133$) and noise exposure rate higher (11.2% vs. 9.35%, $p = 0.0071$) in the tinnitus group than they were in the normal group.

The mean threshold measured by PTA in each group was in the normal hearing range (<25 dB). There was no significant difference between the two groups with respect to all frequency ranges (Figure 1). The mean thresholds of PTA were 8.89 ± 6.16 in the tinnitus group and 8.64 ± 5.83 ($p = 0.08$) in the non-tinnitus group. We showed hearing patterns with hearing loss at high frequencies in both groups. Both groups had a pattern of reduced hearing at high frequencies. Therefore, we conducted the analysis by dividing participants (adults with normal hearing) into a group with tinnitus and a group without tinnitus.

Table 1. Epidemiologic and clinical characteristics of the participants

		Tinnitus (+) *n* = 2,249 (17.8%)	Tinnitus (-) *n* = 10,409 (82.2%)	p-value
Age (years)		40.0 ± 17.1	40.3 ± 16.0	0.4659
Sex (Male)		36.3%	43.4%	**<.0001***
Residential area (urban)		82.9%	83.4%	0.5623
Income	Top	59.77%	64.12%	**0.0001***
	Bottom	40.23%	35.88%	
Hypertension		15.3%	14.9%	0.6261
Dyslipidemia		11.3%	9.0%	**0.0013***
Hypercholesterolemia		13.2%	12.5%	0.4257
Hypertriglyceridemia		11.5%	12.2%	0.3995
Low HDL		17.2%	19.8%	**0.0054***
Stroke		1.1%	0.8%	0.1514
Myocardial infarction		2.6%	1.6%	**0.0022***
Diabetes		5.9%	5.2%	0.2049
Drinking		82.6%	83.1%	0.5665
Smoking	Current	19.74%	21.80%	0.0623
	Ex-smoker	16.84%	17.55%	
	Non	63.42%	60.65%	
BMI		23.09 ± 3.57	23.29 ± 3.59	**0.0133***
Noise exposure		11.2%	9.35%	**0.0071***

HDL, high-density lipoprotein; BMI, body mass index.

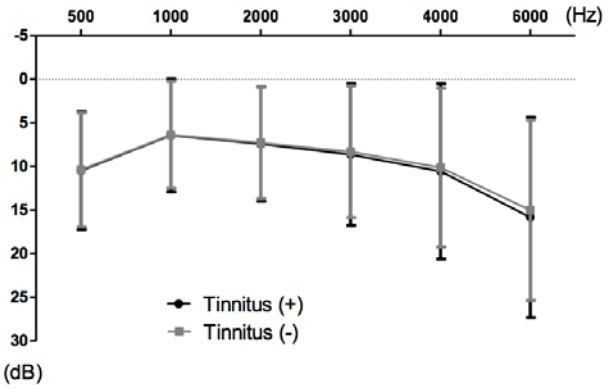

Figure 1. Comparison of the hearing between tinnitus and non-tinnitus group. The mean hearing threshold of the tinnitus group was 8.89 ± 6.16, and the non-tinnitus group was 8.64 ± 5.83. In both groups, the threshold of the high frequencies was increased than that of the low and mid-frequencies.

Table 2. Analysis of factors of quality of life potentially associated with tinnitus

		Tinnitus (+)	Tinnitus (-)	p-value
Depression		21.2%	12.4%	**<.0001***
Illness (in 1 month)		10.3%	6.9%	**<.0001***
Absence (in 1 month)		7.3%	4.8%	**<.0001***
Motor ability	Normal	86.88%	91.90%	**<.0001***
	Difficulty	12.86%	7.89%	
	Bed ridden	0.26%	0.21%	
Self-management	Possibility	97.42%	98.18%	0.0866
(cleansing, dressing)	Difficulty	2.42%	1.73%	
	Impossibility	0.16%	0.09%	
Daily activity	Normal	92.20%	95.22%	**<.0001***
	Difficulty	7.33%	4.42%	
	Impossibility	0.47%	0.37%	
Pain, Discomfort	None	71.81%	82.62%	**<.0001***
	Mild	25.87%	16.28%	
	Severe	2.32%	1.10%	
Anxiety, Depression	None	83.14%	91.85%	**<.0001***
	Mild	15.91%	7.80%	
	Severe	0.95%	0.34%	
EQ-VAS		72.5 ± 16.8	76.0 ± 15.5	**<.0001***
EQ5D		0.94 ± 0.1	0.96 ± 0.1	**<.0001***

EQ-VAS, EuroQol visual analogue scale; EQ5D, EuroQol five-dimensional.

We also assessed the relationship between quality of life and tinnitus (Table 2). Many items for evaluating the quality of life showed a higher score in the group with tinnitus. Depression, illness, absence, pain, and anxiety scores were higher in the tinnitus group, and motor ability and daily activity were significantly decreased. Both EQ-VAS (72.5 ± 16.8 vs. 76.0 ± 15.5, $p < 0.0001$) and EQ5D (0.94 ± 0.1 vs. 0.96 ± 0.1, $p < 0.0001$) were statistically significantly lower in the group with tinnitus.

Table 3 shows a comparison of the dietary factors between the two groups. In the tinnitus group, food intake (protein and carbohydrate), energy, and water intake were lower than in the non-tinnitus group. Individually, the intake of ashes, phosphorus, sodium, potassium, thiamine riboflavin, and niacin in the tinnitus group was less than that in the group without tinnitus. We divided the participants into 4 groups based on the intake of each nutrient, and we assessed the association between their intake and tinnitus (Table 4). Tinnitus tended to increase as the intake of energy, water, protein, dietary fiber, ashes, calcium, phosphorus, iron, sodium, potassium, vitamin A, thiamine, and riboflavin decreased.

After correcting double for sex and age, only ashes, potassium, and sodium remained significant (Table 5). After further calibration and analysis of significant factors in Table 1, only the sodium intake remained significant, and other nutrients were no longer significant.

Table 3. Comparison of the dietary factors between the tinnitus and non-tinnitus groups

Intake	Tinnitus (+)	Tinnitus (-)	P-value
Food intake (g)	1479.5 ± 758.1	1536.1 ± 819.3	**0.0030***
Energy (kcal)	2006.7 ± 865.8	2077.6 ± 892.6	**0.0013***
Water (g)	1009.8 ± 619.3	1051.8 ± 679.2	**0.0073***
Protein (g)	72.55 ± 40.63	76.48 ± 41.95	**0.0001***
Fat (g)	44.83 ± 33.47	46.39 ± 34.56	0.0665
Carbohydrate (g)	318.4 ± 129.5	325.9 ± 127.8	**0.0181***
Dietary fiber (g)	7.29 ± 5.24	7.55 ± 5.60	0.0514
Ashes (g)	19.75 ± 12.01	20.70 ± 11.18	**0.0013***
Calcium (mg)	517.0 ± 356.3	530.9 ± 343.8	0.1138
Phosphorus (mg)	1174.6 ± 522.1	1233.2 ± 550.3	**<.0001***
Iron (mg)	14.95 ± 10.65	15.37 ± 10.73	0.1149
Sodium (mg)	4745.7 ± 3428.9	4964.4 ± 3156.4	**0.0091***
Potassium (mg)	3012.5 ± 1660.0	3156.4 ± 1616.0	**0.0004***
Vitamin A (μgRE)	871.2 ± 1180.2	893.4 ± 1332.9	0.4585
Carotene (μg)	4386.8 ± 6310.5	4537.6 ± 7725.8	0.3560
Retinol (μg)	132.7 ± 454.4	125.1 ± 329.3	0.4836
Thiamine (mg)	0.42 ± 0.85	1.36 ± 0.79	**0.0025***
Riboflavin (mg)	1.28 ± 0.75	1.32 ± 0.75	**0.0248***
Niacin (mg)	17.01 ± 9.58	17.96 ± 9.99	**<.0001***
Vitamin C (mg)	112.0 ± 99.1	115.6 ± 106.5	0.1482

Table 4. Comparison of the dietary factors between the tinnitus and non-tinnitus groups

Intake	Quartile 1	Quartile 2	Quartile 3	Quartile 4	P-value
Food intake (g)	539 (19.5%)	470 (17.0%)	499 (18.1%)	474 (17.1%)	0.0580
Energy (kcal)	553 (20%)	480 (17.4%)	509 (18.4%)	440 (15.9%)	**0.0008***
Water (g)	533 (19.3%)	464 (16.8%)	517 (18.7%)	468 (16.9%)	**0.0317***
Protein (g)	545 (19.7%)	531 (19.2%)	451 (16.3%)	455 (16.5%)	**0.0004***
Fat (g)	520 (18.8%)	1092 (17.7%)	215 (18.0%)	155 (16.8%)	0.4755
Carbohydrate (g)	538 (19.5%)	488 (17.6%)	488 (17.6%)	468 (16.9%)	0.0852
Dietary fiber (g)	542 (19.6%)	477 (17.3%)	470 (17.0%)	493 (17.8%)	**0.0496***
Ashes (g)	555 (20.1%)	531 (19.2%)	460 (16.6%)	436 (15.8%)	**<.0001***
Calcium (mg)	556 (20.1%)	483 (17.5%)	467 (16.9%)	476 (17.2%)	**0.0064***
Phosphorus (mg)	542 (19.6%)	514 (18.6%)	481 (17.4%)	445 (16.1%)	**0.0047***
Iron (mg)	545 (19.7%)	502 (18.2%)	459 (16.6%)	476 (17.2%)	**0.0161***
Sodium (mg)	585 (21.2%)	492 (17.8%)	451 (16.3%)	454 (16.4%)	**<.0001***
Potassium (mg)	559 (20.2%)	508 (18.4%)	472 (17.1%)	443 (16.2%)	**0.0004***
Vitamin A (μgRE)	538 (19.5%)	508 (18.4%)	466 (16.9%)	470 (17.0%)	**0.0357***
Carotene (μg)	536 (19.4%)	492 (17.8%)	482 (17.4%)	472 (17.1%)	0.1163
Retinol (μg)	510 (18.4%)	492 (17.8%)	481 (17.4%)	499 (18.1%)	0.7739
Thiamine (mg)	540 (19.5%)	505 (18.3%)	476 (17.2%)	461 (16.7%)	**0.0298***
Riboflavin (mg)	541 (19.6%)	499 (18.1%)	459 (16.6%)	483 (17.5%)	**0.0323***
Niacin (mg)	549 (19.9%)	508 (18.4%)	494 (17.9%)	431 (15.6%)	**0.0005***
Vitamin C (mg)	537 (19.4%)	486 (17.6%)	493 (17.8%)	466 (16.9%)	0.0857

Table 5. Odds ratio (95% confidence interval) according to the quartiles of nutrition

Intake	Model	Quartile 1	Quartile 2	Quartile 3	Quartile 4	P-value
Energy (kcal)	Crude	1.32 (1.15~1.52)	1.11 (0.96~1.28)	1.19 (1.04~1.37)	1	**0.0008***
	Model 1	1.14 (0.98~1.32)	0.98 (0.85~1.14)	1.11 (0.96~1.28)	1	0.1093
Water (g)	Crude	1.17 (1.02~1.34)	0.99 (0.86~1.14)	1.13 (0.98~1.30)	1	**0.0319***
	Model 1	1.07 (0.93~1.24)	0.93 (0.80~1.07)	1.08 (0.94~1.24)	1	0.1060
Protein (g)	Crude	1.25 (1.09~1.43)	1.21 (1.05~1.39)	0.99 (0.86~1.14)	1	**0.0004***
	Model 1	1.10 (0.95~1.28)	1.10 (0.96~1.27)	0.93 (0.81~1.08)	1	0.0602
Phosphorus (mg)	Crude	1.27 (1.11~1.46)	1.19 (1.04~1.37)	1.10 (0.95~1.26)	1	**0.0048***
	Model 1	1.12 (0.97~1.30)	1.08 (0.93~1.25)	1.04 (0.90~1.20)	1	0.4590
Thiamine (mg)	Crude	1.21 (1.06~1.39)	1.12 (0.97~1.28)	1.04 (0.90~1.20)	1	**0.0300***
	Model 1	1.08 (0.93~1.25)	1.03 (0.89~1.18)	0.99 (0.86~1.14)	1	0.6283
Riboflavin (mg)	Crude	1.15 (1.00~1.32)	1.04 (0.91~1.20)	0.94 (0.82~1.08)	1	**0.0325***
	Model 1	1.04 (0.91~1.20)	0.97 (0.84~1.12)	0.90 (0.78~1.04)	1	0.2222
Niacin (mg)	Crude	1.34 (1.17~1.54)	1.22 (1.06~1.40)	1.18 (1.02~1.36)	1	**0.0005***
	Model 1	1.20 (1.04~1.39)	1.12 (0.97~1.30)	1.12 (0.97~1.29)	1	0.1023
Ashes (g)	Crude	1.34 (1.17~1.54)	1.27 (1.10~1.46)	1.07 (0.92~1.23)	1	**<.0001***
	Model 1	1.21 (1.05~1.39)	1.18 (1.03~1.36)	1.02 (0.88~1.18)	1	**0.0120***
	Model 2	1.17 (1.00~1.38)	1.18 (1.01~1.38)	1.02 (0.87~1.20)	1	0.0753
Potassium (mg)	Crude	1.33 (1.16~1.52)	1.18 (1.03~1.36)	1.08 (0.94~1.24)	1	**0.0004***
	Model 1	1.22 (1.06~1.40)	1.11 (0.97~1.28)	1.04 (0.91~1.20)	1	**0.0385***
	Model 2	1.10 (0.94~1.29)	1.09 (0.93~1.27)	0.96 (0.82~1.13)	1	0.2808
Sodium (mg)	Crude	1.37 (1.19~1.57)	1.10 (0.96~1.27)	0.99 (0.86~1.14)	1	**<.0001***
	Model 1	1.24 (1.07~1.42)	1.03 (0.89~1.19)	0.96 (0.83~1.10)	1	**0.0014***
	Model 2	1.19 (1.02~1.39)	1.02 (0.87~1.20)	0.91 (0.77~1.06)	1	**0.0080***

Model 1: Adjusted Age and Sex
Model 2: Model 1 + Adjusted Dyslipidemia, Low HDL, Myocardial infarction, BMI and Noise exposure
HDL, high-density lipoprotein; BMI, body mass index.

4. Discussion

Tinnitus is more than four times common in people with hearing loss than in people without hearing loss [7]. There is a clearly high correlation between hearing impairment and tinnitus [8,9]. The prevalence of any type of tinnitus is 17-20 %, and that of persistent tinnitus is 8-10 %, in normal hearing populations [10]. Furthermore, even in people with normal hearing, an initial hearing loss limited to a high frequency may be considered an early stage of moderate hearing loss with tinnitus [11,12]. Therefore, it depends on how hearing loss is defined; even if a person has normal hearing at less than 25 dB, it does not mean that he or she has normal physiological hearing [13] Therefore, the occurrence of tinnitus in normal hearing may be a symptom that can distinguish early hearing loss from hearing loss. We studied the nutritional risk factors for tinnitus in adults with normal hearing (<25 dB), and we thought that we could identify early risk factors for tinnitus in their lifestyle. In our study, despite the absence of hearing loss, we found that patients with tinnitus had a poor quality of life that could interfere with their daily lives [14-16]. Based on the findings, we found that there are differences in nutrient intake among these people. We think that the difference in nutrient intake may be an important factor in the development of tinnitus. After correcting for the other factors and nutrients, the odds ratio for sodium intake was 1.19, indicating a statistically significant increase in the risk of tinnitus.

There have been a few studies on the relationship between tinnitus and food intake. Not only the total intake of food, but also the type of food, is important in the occurrence of tinnitus [1]. McCormak et al. showed the associations between different food types and tinnitus using a large representative cohort of adults aged 40 to 69 years [2]. They reported that transient tinnitus was increased with avoidance of dairy products (OR=1.18) and decreased with consumption of caffeinated coffee (OR=0.98 per cup/day) and brown bread (OR=0.94). In our study, when dietary intake of energy, water, protein, dietary fiber, ashes, calcium, phosphorus, iron, sodium, potassium, vitamin A, thiamine, and riboflavin through dietary supplements was lower, the number of patients with tinnitus increased. After correction for sex and age variables, ashes, potassium, and sodium were associated with tinnitus, and sodium was the most closely associated factor. After we corrected for many risk factors (adjusting for dyslipidemia, low HDL, myocardial infarction, BMI, and noise exposure) associated with tinnitus, low sodium intake was finally a statistically significant risk factor. The lower amount of salt intake in Koreans, the greater the incidence of tinnitus in people who are not hearing-impaired. Previous studies have reported that the type of food consumed is related to tinnitus, and some studies have shown that dietary control is related to the degree of tinnitus in patients with metabolic syndrome. Zinc deficiency is well known to increase the risk for tinnitus. The prevalence rates of zinc deficiency in individuals with tinnitus varies from 2 to 69%; it affects elderly individuals more frequently [3,4]. Studies have also shown that zinc can help in the treatment of tinnitus. Thus, it is important to investigate which minerals and ions in the body can affect the development of tinnitus. Based on several studies, it seems clear that tinnitus is related to food intake.

In this study, tinnitus was associated with a reduction in overall nutrient intake, and it was closely related to the deficiency of the nutrients mentioned above.

The depression, illness, absence, and anxiety and pain scores were significantly higher in the tinnitus group. The motor ability, daily activity, EQ-5D and EQ-VAS scores were significantly lower in the tinnitus group. Although QoL has declined from this, it agrees with the previous report. In addition, tinnitus with normal hearing may indicate a future risk of reduction in hearing, and as hearing decreases, the quality of life is expected to decline. Therefore, in order to preserve the quality of life, it is important to investigate the causes of tinnitus and treat them. Rocha et al. reported that tinnitus interferes with the quality of life of individuals who had preserved or altered auditory thresholds [17] It was concluded that tinnitus interferes with the general quality of life independent of age or presence of associated hearing loss. Therefore, despite the absence of hearing impairment, patients with tinnitus may become targets of treatment, and it is important to prevent tinnitus by an early change in the lifestyle.

There are a few limitations in the present study. First, because this study is a cross-sectional study at a single point in time, it can explain the correlation of each factors associated with tinnitus. However, it cannot conclude that these factors are responsible for tinnitus. Also, there may be a risk of recall bias when participant responds to the questionnaire or interviews with the researcher. Second, we did not get objective information such as intensity, severity and more detailed history of tinnitus from participants.

In summary, the prevalence of tinnitus among adult Koreans without hearing impairment was 17.8%, and it was associated with mental discomfort, anxiety, limitation of daily activities, and significantly decreased quality of life. Nutrient intake in people with tinnitus was significantly different from subjects with normal hearing without tinnitus. In particular, the low intake of sodium was found to be an important risk factor for the development of tinnitus. Therefore, it is necessary to demonstrate whether the correction of dietary habits could prevent the occurrence of tinnitus in the following research.

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