

LETTER TO THE EDITOR  
RESEARCH STUDIES

# Relationship between age-related hearing loss and consumption of coffee and tea

Dear Editor,

Age-related hearing loss (ARHL) is a common problem in older individuals, characterized by deterioration of speech understanding, and leading to communication difficulties that might contribute to social isolation, depression and dementia.<sup>1,2</sup> Previous studies have suggested various controversial risk factors for ARHL, including noise exposure, smoking, diabetes, dyslipidemia, cardiovascular disease and dietary patterns.<sup>3,4</sup> Here, we investigated lifestyle factors associated with ARHL, focusing on beverage consumption, such as coffee and tea, as a source of anti-oxidants in daily diets.

The data for the present cross-sectional study were obtained from the 18 K TMM CommCohort Study carried out by Tohoku University Tohoku Medical Megabank Organization.<sup>5</sup> Overall, 17 123 individuals were included between April 2013 and April 2016. Those excluded were: aged >80 years, aged <60 years and with a history of chronic otitis media. We evaluated whether participants heard a 30-dB HL signal at 1000 Hz and a 40-dB HL signal at 4000 Hz using an audiometer (AA-H1; RION) and a soundproof booth (AT-66; RION), which are levels designated by the Japanese Industrial Safety and Health Law for workers' health examinations. We also excluded participants with hearing laterality and those that could hear a 4000 Hz signal rather than a 1000 Hz signal. The normal group comprised those that heard both 1000 and 4000 Hz signals in both ears, and the hearing loss group comprised those that did not hear 4000 Hz signals in both ears.

The Ethical Research Committee of the Tohoku University Graduate School of Medicine approved this study (2022-1-010).

The differences between the normal hearing and hearing loss groups in the univariate analyses were evaluated using  $\chi^2$ -tests (Table S1). Subsequently, we carried out a multivariate logistic regression analysis using participants without missing data. Explanatory variables were selected based on clinically essential factors from previous studies, factors showed significant differences in the univariate analysis, and factors associated with beverage consumption.<sup>2,3</sup> We confirmed these covariates were not correlated with each other (Table S2). All statistical analyses were carried out using R Statistical Software version 4.2.1 (The R Foundation for Statistical Computing, Vienna, Austria), and a two-tailed  $P < 0.05$  was considered statistically significant.

Overall, 5413 participants (1746 men and 3667 women) were included in the multivariate analyses (Table 1). Significant associations were found for the following factors: the male hearing loss group was older, had more family history for hearing loss, more occupations with noise exposure, higher Center for Epidemiologic Studies Depression Scale scores, fewer remaining teeth, a lower percentage of drinkers, less coffee consumption and more black

tea consumption; the female hearing loss group was older, had a family history of hearing loss and fewer remaining teeth.

The proportion of participants with high coffee consumption was significantly lower in the male hearing loss group, which is consistent with those of previous reports.<sup>6,7</sup> Considering that coffee is a major source of anti-oxidant compounds in diets, anti-oxidants from coffee might reduce oxidative stress and preserve hearing.<sup>7</sup> However, the exact amount of coffee, mode of coffee intake (such as instant, brewed) and accompanying factors (such as sugar and sugar substitutes) were not analyzed. Further detailed studies are required to elucidate the association between coffee consumption and ARHL.

Green, oolong and black teas are obtained from tea leaves collected from *Camellia sinensis*. These teas have anti-oxidant properties, due to the presence of polyphenols. A large prospective cohort study reported an inverse association between green tea consumption and total mortality.<sup>8</sup> We evaluated the association between green tea consumption and ARHL for the first time, and found no significant association in the multivariable analysis. As the present study did not analyze the precise amount of tea consumed and accompanying factors, including the addition of sugar and foods served with tea, prospective studies are needed to determine the causal relationship between tea consumption and ARHL.

Oral health has been the focus of significant attention, because many studies have shown the relationship between the number of healthy teeth and longevity.<sup>9</sup> A recent study emphasized that a higher degree of tooth loss was associated with an increased prevalence of hearing loss, which is consistent with the present results.<sup>10</sup> Although the underlying mechanisms have not been elucidated, the peripheral deafferentation of the stomatognathic system caused by tooth loss might reorganize the sensory and motor cortex, resulting in the triggering and aggravation of neurodegeneration.<sup>11</sup> Considering that the number of teeth is affected by oral health, general condition, and individual concepts of health and hygiene, multifaceted studies are required to clarify the causal relationship between ARHL and the number of remaining teeth.

The present study had several limitations. First, as the study design was cross-sectional, causal relationships could not be discussed. Second, we could not evaluate the hearing loss severity, because threshold determination was not carried out. Finally, because we recruited volunteers, we cannot deny the possibility that well-concerned participants were selected. Prospective studies with threshold determination are required for more detailed and accurate evaluations.

In conclusion, various factors, including lower coffee consumption and fewer remaining teeth, were associated with ARHL. We found no significant association between green tea consumption and ARHL.

**Table 1** Factors associated with age-related hearing loss

	Male						Female					
	Univariate			Multivariate			Univariate			Multivariate		
	No. normal cases (%)	No. hearing loss cases (%)	Odds ratio (95% CI)	P-value	Odds ratio (95% CI)	P-value	No. normal cases (%)	No. hearing loss cases (%)	Odds ratio (95% CI)	P-value	Odds ratio (95% CI)	P-value
<b>Age (years)</b>												
60-64	402 (80.4%)	98 (19.6%)	1.00	-	1.000	-	1422 (97.5%)	36 (2.5%)	1.00	-	1.000	-
65-69	500 (74.7%)	169 (25.3%)	1.39 (1.04-1.86)	0.027*	1.44 (1.07-1.92)	0.014*	1268 (94.4%)	75 (5.6%)	2.34 (1.54)	<0.01**	2.23 (1.48-3.37)	<0.01**
70-74	238 (58.5%)	169 (41.5%)	2.91 (2.14-3.96)	<0.01**	2.84 (2.08-3.88)	<0.01**	579 (87.7%)	81 (12.3%)	5.52 (3.64-8.52)	<0.01**	5.23 (3.45-7.94)	<0.01**
75-79	76 (44.7%)	94 (55.3%)	5.06 (3.43-7.50)	<0.01**	4.51 (3.04-6.70)	<0.01**	162 (78.6%)	44 (21.4%)	10.7 (6.52-17.7)	<0.01**	9.54 (5.83-15.61)	<0.01**
<b>History of cardiovascular disease</b>												
No	1041 (70.7%)	431 (29.3%)	1.00	-	1.000	-	3208 (93.9%)	208 (6.1%)	1.00	-	1.000	-
Yes	175 (63.9%)	99 (36.1%)	1.37 (1.03-1.80)	0.026*	1.21 (0.90-1.62)	0.2	223 (88.8%)	28 (11.2%)	1.94 (1.23-2.96)	<0.01**	1.52 (0.98-2.35)	0.06
<b>Family history</b>												
No	1164 (70.2%)	493 (29.8%)	1.00	-	1.000	-	3257 (93.9%)	212 (6.1%)	1.00	-	1.000	-
Yes	52 (58.4%)	37 (41.6%)	1.68 (1.06-2.65)	0.025*	2.09 (1.32-3.31)	<0.01**	174 (87.9%)	24 (12.1%)	2.12 (1.29-3.34)	<0.01**	2.66 (1.65-4.27)	<0.01**
<b>Occupations with noise exposure</b>												
No	1101 (70.7%)	457 (29.3%)	1.00	-	1.000	-	3275 (93.6%)	224 (6.4%)	1.00	-	1.000	-
Yes	115 (61.2%)	73 (38.8%)	1.53 (1.10-2.11)	<0.01**	1.74 (1.25-2.43)	<0.01**	156 (92.9%)	12 (7.1%)	1.12 (0.56-2.06)	0.825	1.35 (0.72-2.53)	0.35
<b>METs</b>												
Q1	302 (69.6%)	132 (30.4%)	1.00	-	1.000	-	791 (93.6%)	54 (6.4%)	1.00	-	1.000	-
Q2	326 (73.4%)	118 (26.6%)	0.83 (0.61-1.12)	0.236	0.84 (0.62-1.15)	0.28	878 (94.4%)	52 (5.6%)	0.87 (0.57-1.31)	0.542	0.91 (0.60-1.36)	0.63
Q3	316 (71.7%)	125 (28.3%)	0.91 (0.67-1.22)	0.55	0.92 (0.68-1.26)	0.62	880 (92.9%)	67 (7.1%)	1.15 (0.76-1.65)	0.630	1.20 (0.82-1.76)	0.36
Q4	272 (63.7%)	155 (36.3%)	1.30 (0.97-1.75)	0.079	1.24 (0.91-1.68)	0.17	882 (93.3%)	63 (6.7%)	1.05 (0.71-1.55)	0.889	1.12 (0.76-1.66)	0.57
<b>CES-D</b>												
<16	1079 (71.0%)	440 (29.0%)	1.00	-	1.000	-	2683 (93.6%)	184 (6.4%)	1.00	-	1.000	-
≥16	137 (60.4%)	90 (39.6%)	1.61 (1.19-2.17)	<0.01**	1.54 (1.13-2.09)	<0.01**	748 (93.5%)	52 (6.5%)	1.01 (0.72-1.40)	0.998	0.94 (0.68-1.32)	0.74
<b>No. teeth</b>												
≥20	876 (72.2%)	337 (27.8%)	1.00	-	1.000	-	2381 (94.8%)	131 (5.2%)	1.00	-	1.000	-
10-19	226 (70.4%)	95 (29.6%)	1.09 (0.82-1.44)	0.567	0.96 (0.72-1.27)	0.77	687 (92.3%)	57 (7.7%)	1.51 (1.07-2.10)	0.015*	1.31 (0.94-1.84)	0.11
<9	114 (53.8%)	98 (46.2%)	2.23 (1.64-3.04)	<0.01**	1.72 (1.25-2.37)	<0.01**	363 (88.3%)	48 (11.7%)	2.40 (1.66-3.44)	<0.01	1.73 (1.20-2.50)	<0.01**
<b>Alcohol consumption</b>												
No	217 (60.8%)	140 (39.2%)	1.00	-	1.000	-	2022 (92.8%)	157 (7.2%)	1.00	-	1.000	-
Yes	999 (71.9%)	390 (28.1%)	0.61 (0.47-0.78)	<0.01**	0.74 (0.57-0.96)	0.022*	1409 (94.7%)	79 (5.3%)	0.72 (0.54-0.96)	0.026*	0.77 (0.57-1.02)	0.068
<b>Coffee</b>												
≤2 times a week	252 (64.1%)	141 (35.9%)	1.00	-	1.000	-	630 (93.5%)	44 (6.5%)	1.00	-	1.000	-
3-7 times a week	457 (68.5%)	210 (31.5%)	0.82 (0.63-1.08)	0.16	0.89 (0.67-1.18)	0.41	1250 (92.8%)	97 (7.2%)	1.11 (0.76-1.65)	0.64	1.15 (0.78-1.69)	0.47
≥2 times a day	507 (73.9%)	179 (26.1%)	0.63 (0.48-0.83)	<0.01**	0.74 (0.55-0.98)	0.034*	1551 (94.2%)	95 (5.8%)	0.88 (0.60-1.30)	0.55	1.13 (0.77-1.67)	0.52
<b>Green tea</b>												
≤2 times a week	351 (73.4%)	127 (26.6%)	1.00	-	1.000	-	653 (94.9%)	35 (5.1%)	1.00	-	1.000	-
3-7 times a week	381 (70.3%)	161 (29.7%)	1.16 (0.88-1.55)	0.298	1.09 (0.81-1.45)	0.57	888 (94.5%)	52 (5.5%)	1.09 (0.69-1.75)	0.778	0.99 (0.63-1.57)	0.98
≥2 times a day	484 (66.7%)	242 (33.3%)	1.38 (1.06-1.80)	0.015*	1.18 (0.90-1.55)	0.23	2890 (95.1%)	149 (4.9%)	0.85 (0.65-1.14)	0.917	1.13 (0.76-1.67)	0.56

(Continues)

Table 1 Continued

	Male				Female			
	Univariate		Multivariate		Univariate		Multivariate	
	No. normal cases (%)	No. hearing loss cases (%)	Odds ratio (95% CI)	P-value	No. normal cases (%)	No. hearing loss cases (%)	Odds ratio (95% CI)	P-value
Black tea								
≤2 times a week	1085 (70.5%)	455 (29.5%)	1.00	-	2820 (93.5%)	196 (6.5%)	1.00	-
3-7 times a week	115 (66.5%)	58 (33.5%)	1.20 (0.85-1.70)	0.32	486 (93.8%)	32 (6.2%)	0.95 (0.62-1.40)	0.859
≥2 times a day	16 (48.5%)	17 (51.5%)	2.53 (1.19-5.41)	0.011*	125 (94.0%)	8 (6.0%)	0.92 (0.38-1.91)	0.967

Note: History of cardiovascular diseases included cerebral hemorrhage, cerebral infarction, subarachnoid hemorrhage, myocardial infarction/angina, aneurysm/aortic dissection, heart failure, atrial fibrillation, pacemaker implantation and ventricular fibrillation. Occupations with noise exposure were defined as working in forestry, mining, construction and manufacturing industries. Metabolic equivalent task units (METs) were calculated from the results of the questionnaires regarding exercise, summed, and divided into four groups by quantile range: [Q1] 0 to <25%, [Q2] 25 to <50%, [Q3] 50 to <75% and [Q4] 75 to 100%. Regarding alcohol consumption, a group that responded to the survey that "do not drink" or "rarely drink" alcoholic beverages was categorized as the "no drinking group."

Abbreviations: CI, confidence interval; BMI, body mass index; CES-D, Center for Epidemiologic Studies Depression Scale.

\* $P < 0.05$ .

\*\* $P < 0.01$ .

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## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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## Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

**Table S1.** Characteristics of the study population and results of univariate analyses.

**Table S2.** Correlation matrix among variables.

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