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Brief Original Report

Tinnitus preceded depressive symptoms in community-dwelling older Japanese: A prospective cohort study

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ABSTRACT

Objective. Most studies of the association between tinnitus and depression have been cross-sectional, making it difficult to draw any conclusions about the directionality of the association. This study aimed to clarify whether tinnitus precedes the development of depressive symptoms in a general older population.

Methods. Residents of Kurabuchi Town, Gunma Prefecture, Japan (239 men, 296 women: ≥65 years) without depressive symptoms were given health examinations in 2005–2006. Information on tinnitus was obtained via a questionnaire. Depressive symptoms were then assessed in a face-to-face home visit interviews carried out once in 2007 and once in 2008 according to the Geriatric Depression Scale 15-item version (GDS15).

Results. Among the men, the 2.5-year incidence of depressive symptoms (GDS15≥6) was higher in those with tinnitus than in those without (20.5% vs. 9.5%). In the multi-adjusted model, tinnitus was significantly associated with an increased risk of depressive symptoms (relative risk = 2.07; 95% confidence interval = 1.01–4.25). Among the women, no associations were found.

Conclusion. In the present study, tinnitus was independently associated with the risk of depressive symptoms developing in men, but not in women. We believe primary care providers and public health staff should recognize tinnitus as a risk factor for depressive symptoms.

Introduction

Tinnitus, defined as the perception of sound without external auditory stimulus (Lockwood et al., 2002), is closely associated with depression (Langguth et al., 2011), but the cross-sectional design of earlier studies has limited the conclusions that can be drawn about the temporality of the association, i.e. whether tinnitus precedes depression. In older adults, tinnitus is a relatively common complaint, with prevalence estimated to be more than 10% (Ahmad and Seidman, 2004). Depression has a strong negative impact on well-being (Reynolds et al., 2012), so primary prevention of depression is desirable from a public health point of view. Given the association of tinnitus with depression (Langguth et al., 2011; Michikawa et al., 2010) and many treatment modalities to improve symptoms of tinnitus (Seidman et al., 2010), it is important to establish whether the association is a causal one, i.e. whether tinnitus is a risk factor of depression. Therefore, we attempted to establish a causal link between tinnitus and depressive symptoms in a community-based study of older Japanese.

Methods

Study population

Between 2005 and 2006, all residents aged 65 years or older of Kurabuchi Town, Gunma Prefecture, Japan, excluding those hospitalized or institutionalized, were enrolled in a cohort study (The Kurabuchi Study); 834 of them (64.5%) participated in the baseline health examinations (Michikawa et al., 2012, 2013; Saito et al., 2010). Of these, the 549 participants (244 men, 305 women) with no depressive symptoms (Geriatric Depression Scale [GDS] 5-item version ≤1) at baseline were questioned about whether they had tinnitus. The protocol was approved by the Keio University Ethics Review Board, and written informed consent was obtained from all participants.

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Measures

Because tinnitus is a subjective experience, the subjects were classified as having tinnitus or not on the basis of their response ("Yes" or "No") to the following single question (Michikawa et al., 2010): "Have you experienced any ringing, buzzing or other sounds (tinnitus) in your ears within the past year?"

Face-to-face home-visit interviews were performed once in 2007 and once in 2008. Trained public health nurses and local welfare commissioners collected information on depressive symptoms according to the GDS15-item version (score: 0–15), one of the most useful and well-validated questionnaire for older populations (Sheikh and Yesabage, 1986). Subjects choose yes or no answers to questions asking how they felt over the past week. In the present study, participants with scores of 6 or more in either 2007 or 2008 were considered depressed (Michikawa et al., 2012; Saito et al., 2010).

Statistical analysis

Of the 549 participants, outcome information was obtained on 535 (239 men, 296 women); 9 of the other 14 had died, 4 had been admitted to nursing homes or hospitals, and 1 (0.2%) was lost to follow-up. Thus, we analyzed 535 participants to determine the association between tinnitus and depressive symptoms. Stata version 11 (StataCorp) was used to perform the statistical analysis.

We found moderate evidence of interaction between tinnitus and sex (p for interaction = 0.10), so all analyses were performed after stratification by sex. Poisson regression with robust error variance (Zou, 2004) was used to estimate the relative risks (RRs) with 95% confidence intervals (CIs) of depressive symptoms associated with tinnitus. In Model 1, we adjusted for age (continuous), hearing impairment, and hearing handicap, which are the factors strongly associated with tinnitus (Gopinath et al., 2010; Michikawa et al., 2010). For hearing impairment, subjects were categorized into 2 groups according to their ability to hear a 30 dB HL signal at 1 kHz in the better ear (Saito et al., 2010), because daily conversation in Japanese relies more on low-frequency signals than on high-frequency signals (Okamoto et al., 2004). We defined hearing handicap as a score of ≥10 in the Hearing Handicap Inventory for Elderly: Screening version (Lichtenstein et al., 1988). In Model 2, self-reported history of coronary heart disease, knee joint pain, vision impairment, and serum levels of dehydroepiandrosterone-sulfate were adjusted for. These covariates were previously found to be associated with tinnitus or depressive symptoms (Harada et al., 2008; Michikawa et al., 2012; Saito et al., 2010).

Results

Table 1 summarizes the baseline characteristics of the participants with or without tinnitus by sex. In both men and women, those with tinnitus were more likely to have hearing impairment and hearing handicap; the men with tinnitus were also more likely to use hearing aids than those without. No differences in the distribution of the other variables were found in relation to tinnitus.

During the average follow-up period of 2.5 years, the cumulative incidence of depressive symptoms was 20.5% among men with tinnitus, and 9.5% among those without (Table 2). The men with tinnitus had a statistically significant increased risk of depressive symptoms (Model 2: RR = 2.07; 95% CI = 1.01–4.25), which persisted after further adjustments and restricted analyses. Conversely, no association between tinnitus and depressive symptoms was observed in women.

Discussion

As far as we know, only one study of older community-based subjects has longitudinally examined the association between tinnitus and depressive symptoms (Gopinath et al., 2010). However, that study did not consider depressive symptoms at baseline, so ours is the first to present data on the temporal association between tinnitus and depressive symptoms in a general older population.

We observed a sex-specific association between tinnitus and depressive symptoms. A recent physiological study showed a different response to tinnitus between men and women in the orbitofrontal cortex, an important region for the emotional processing of sounds (Vanneste et al., 2012), so a sex-specific association is perhaps not surprising. However, it is still not entirely clear why we observed an association between tinnitus and depressive symptoms only in men.

Table 1
Baseline characteristics (2005–2006) of participants in the Kurabuchi Study.

Variables	Tinnitus	Men (n = 239)		*P*-value[a]	Women (n = 296)		*P*-value[a]
		No (n = 200) number (%)	Yes (n = 39) number (%)		No (n = 248) number (%)	Yes (n = 48) number (%)	
Age (years)	65–69	46 (23.0)	10 (25.6)	.73	61 (24.6)	11 (22.9)	.97
	70–79	111 (55.5)	19 (48.7)		130 (52.4)	26 (54.2)	
	80–	43 (21.5)	10 (25.6)		57 (23.0)	11 (22.9)	
Educational level	Elementary or junior high school	135 (69.6)	27 (69.2)	.97	180 (73.5)	38 (80.9)	.29
Living circumstances	Alone	13 (6.6)	2 (5.1)	.73	34 (14.1)	6 (12.8)	.82
Social activities	None/occasional	80 (41.0)	17 (43.6)	.77	135 (55.3)	26 (56.5)	.88
Current smoker	Yes	52 (26.5)	8 (20.5)	.43	7 (2.9)	1 (2.1)	.78
Current alcohol drinker	Yes	110 (56.4)	25 (64.1)	.38	30 (12.3)	5 (10.9)	.79
Vision impairment[b]	Yes	31 (15.5)	10 (25.6)	.12	73 (29.4)	9 (18.8)	.13
Hearing impairment[c]	Yes	28 (14.0)	10 (25.6)	.07	49 (19.8)	14 (29.8)	.12
Hearing handicap[d]	Yes	41 (20.8)	18 (44.7)	<.01	33 (13.4)	15 (31.3)	<.01
Hearing aid usage	Yes	5 (2.5)	3 (7.7)	.10	7 (2.8)	1 (2.1)	.79
Functional activities[e]	Reduced	13 (6.7)	4 (10.3)	.43	24 (9.9)	3 (6.4)	.45
Cognitive function[f]	Impaired	23 (11.5)	8 (20.5)	.13	45 (18.2)	8 (16.7)	.80
Serum levels of dehydroepiandrosterone-sulfate (μmol/L)[g]		2.22 (1.78)	2.36 (1.63)	.56	1.35 (1.94)	1.23 (2.67)	.35
History of diabetes[h]	Yes	46 (24.0)	11 (28.1)	.58	35 (14.5)	7 (14.9)	.95
Self-reported history of stroke	Yes	16 (8.4)	3 (7.9)	.92	14 (5.8)	1 (2.1)	.30
Self-reported history of coronary heart disease	Yes	19 (10.0)	7 (18.4)	.14	20 (8.3)	4 (8.5)	.97
Self-reported history of cancer	Yes	8 (4.2)	2 (5.3)	.76	7 (2.9)	1 (2.1)	.76
Knee joint pain in the last year	No pain	124 (63.9)	21 (53.9)	.36	139 (56.5)	22 (46.8)	.24

[a] The chi-square test or Student *t*-test.
[b] Vision impairment was defined as a corrected visual acuity of worse than 0.5 in the better eye.
[c] Subjects were classified as belonging to the hearing impairment group if they failed to hear the 30 dB HL signal at 1 kHz in the better ear.
[d] Hearing handicap was defined as a score of ≥10 in the 10-item screening version of Hearing Handicap Inventory for Elderly.
[e] Reduced functional activities were defined as a score of ≤10 in the Tokyo Metropolitan Institute of Gerontology Index of Competence.
[f] Cognitive impairment was defined as a score of ≤3 in the Clock-Drawing Test.
[g] Geometric mean (geometric standard deviation).
[h] Diabetes was defined as self-reported and/or hemoglobin of A_{1c} ≥ 5.8%.