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RESEARCH ARTICLE

Risk of dementia with hearing impairment and social isolation

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Abstract

INTRODUCTION: This study aimed to determine whether the concomitance of hearing impairment and isolation with lack of conversation, which is considered self-evident but has not been investigated extensively, is associated with the occurrence of dementia.

METHODS: A total of 2745 participants were divided into four groups according to the presence/absence of hearing impairment and isolation with lack of conversation. The association of dementia with hearing impairment and isolation with lack of conversation was analyzed using Cox proportional hazards regression.

RESULTS: The combined hearing impairment and isolation with lack of conversation (hazard ratio: 1.69, 95% confidence interval: 1.09-2.61) and non-hearing impairment and isolation with lack of conversation (hazard ratio: 1.60, 95% confidence: 1.07-2.39) were associated with the development of dementia.

DISCUSSION: These findings emphasize the importance of promoting high-quality social relationships throughout life by adopting preventive measures against isolation with lack of conversation from the early stage of awareness of hearing impairment.

KEYWORDS
conversation, dementia, disability, hearing impairment, social isolation

Highlights

- Dementia affects 12.9% of those with hearing impairment and isolation.
- Hearing impairment and isolation are associated with increased risk of dementia.
- Addressing these risk factors may help reduce the risk of developing dementia.
- Preventing isolation and promoting quality social relationships is important.

1 | BACKGROUND

The incidence of dementia is estimated to exceed 150 million people worldwide, resulting in economic damage of up to USD 50 billion by 2030.[1] Recently, hearing impairment has been demonstrated to be a modifiable risk factor for dementia, contributing to an 8% risk reduction.[2] This age-related hearing impairment is the most common sensory impairment in older adults and has reached an estimated 1.57 billion people by 2019.[3] Dementia is the leading cause of disability in Japan,[4] and addressing hearing impairment, which increases the risk of dementia, is paramount now.[5]

Studies have reported that limited communication with others due to hearing loss is a risk factor for depression and other psychiatric symptoms, which may result in cognitive decline.[6] Thus, the association

between hearing impairment and cognitive decline is often explained by the cascade hypothesis, as several factors are derivatively linked to each other.[7] Preliminary qualitative studies have shown that older adults with hearing impairment experience difficulty in communication, leading to stress. It has been suggested that stress may lead to withdrawal from social situations, resulting in social isolation.[6] As diminished communication ability is deemed self-evident in people with hearing impairment, relatively few epidemiological studies have investigated hearing impairment and social isolation caused by the lack of conversation in older adults. Therefore, there is a need to investigate the prevalence of hearing impairment and isolation due to lack of conversation, which has not been adequately examined, and to verify how these conditions are related to cognitive function and the development of dementia. Studies have also suggested that age-related sensory function decline, such as hearing impairment and vision loss, may limit various activities and[8] constrain life space mobility.[8,9] Furthermore, hearing impairment is associated with physical frailty, and is considered a risk factor for the development of disability.[10,11]

The results of the above-mentioned studies suggest that individuals with hearing impairment may experience a decrease in the frequency of conversation due to the reduction in the range of activities in their daily lives. Hearing impairment and isolation with lack of conversation may accelerate the decline in physical and mental functions, and increase the risk of dementia. Therefore, the purpose of this study was to examine whether hearing impairment and isolation with lack of conversation are associated with the potential onset of dementia.

RESEARCH IN CONTEXT

1. **Systematic review**: We conducted a literature review that included preprints and published articles. The results suggest that hearing impairment is the most relevant modifiable risk factor for dementia and that isolation with lack of conversation caused by hearing impairment may increase the risk of the onset of dementia.
2. **Interpretation**: The findings of this study clarify the previously unexplored and under-explored association between hearing impairment and isolation with lack of conversation, which increase the risk of new-onset dementia.
3. **Future directions**: It is important to implement measures to prevent age-related hearing impairment to avert isolation with lack of conversation at an early stage when people become aware of their hearing impairment to promote and maintain high-quality social relationships throughout life. Further detailed studies are needed to devise effective measures to arrest the progression of hearing impairment.

2 | METHODS

2.1 | Participants

This population-based cross-sectional study included community-dwelling older Japanese adults recruited from a sub-cohort of the National Center for Geriatrics and Gerontology-Study of Geriatric Syndromes (NCGG-SGS).[12] The NCGG-SGS is a large cohort study that aims to identify the risks of and effective ways to manage geriatric syndromes that occur due to aging. The inclusion criteria were residence in Takahama City, Aichi Prefecture, Japan, and age ≥ 65 years at baseline. The assessment involved face-to-face interviews to gather demographic information and medical history, lifestyle and home environment questionnaires, and physical and cognitive performance tests. All assessments were conducted by trained nurses and study assistants at community centers. The exclusion criteria were as follows: (1) history of dementia, Parkinson's disease, or stroke ($n = 240$); (2) impairment in basic activities of daily living ($n = 16$); (3) individuals requiring long-term care insurance (LTCI) at baseline ($n = 45$); and (4) missing values on assessment data ($n = 344$). Finally, 2745 participants were included in the baseline survey for this study. The follow-up study of dementia onset and disability incidence comprised 2225 persons, excluding 520 persons with missing follow-up data (Figure 1). The baseline data collection for this study was conducted from September 2015 to June 2016. A 5-year follow-up was conducted thereafter.

2.2 | Measures

2.2.1 | Measurement of self-reported hearing impairment

Hearing impairment at baseline was defined based on participant answer to a single question asked by the nurse: "Do you have hearing problems when something is whispered to you (possible with hearing aids or cochlear implants)?" Participants who answered "no" to this question were defined as having no hearing impairment, and those who answered "sometimes" or "yes" were defined as having hearing impairment. During the baseline survey, the participants were also asked if they used hearing aids or cochlear implants. Although pure tone audiometry is the gold standard for determining hearing impairment, previous studies have shown that questionnaire-based assessment of hearing impairment in large populations is somewhat reliable.[13] A validation study of self-reported hearing impairment in older women reported a sensitivity of 79% for a single-question hearing impairment assessment.[13] In recent years, it has been reported that self-reported hearing impairment assessment is often also associated with psychosomatic function[14,15] and cognitive decline,[16,17] and self-reported hearing impairment assessment may be widely used as a screening assessment for these conditions.

2.2.2 | Measurement of isolation with lack of conversation

Isolation with lack of conversation was assessed based on previous studies that examined the relationship between social interaction and health[18,19] using the three questions:

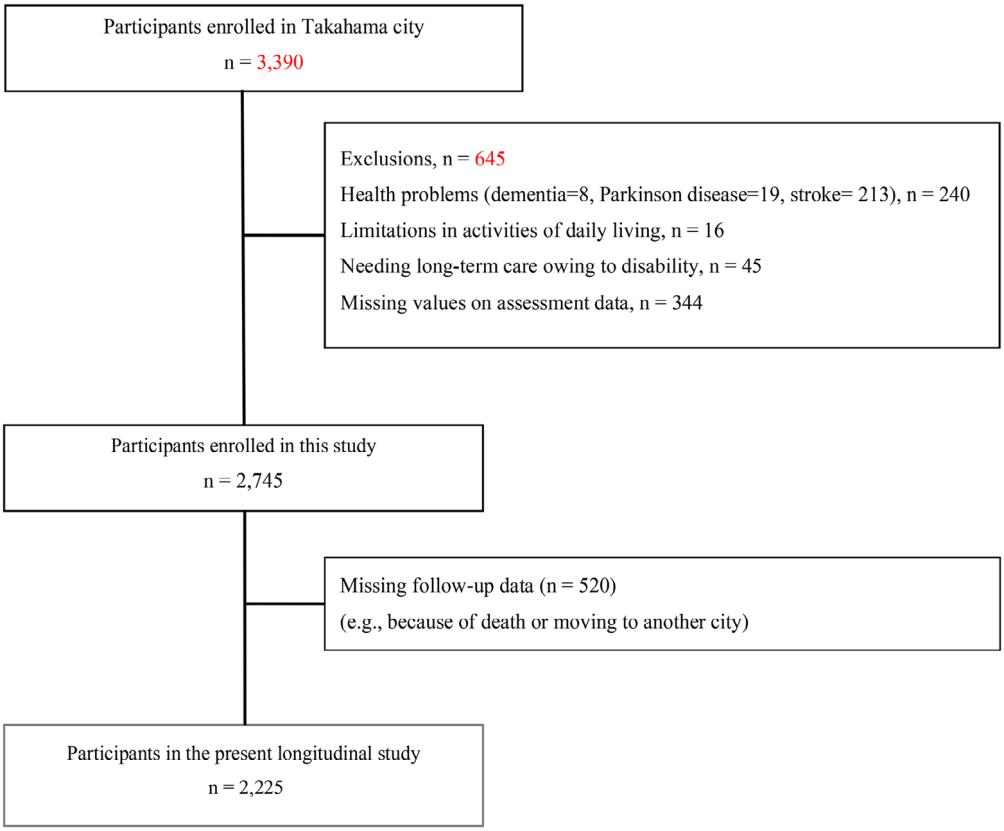

FIGURE 1 Flow diagram of the sample selection process.

1. How often do you have conversations with family members or relatives who live with you?
2. How often do you talk with family members or relatives who live separately?
3. How often do you talk with your friends and acquaintances?

The frequency of each conversation was measured in six categories: (1) almost every day, (2) several times a week, (3) once a week, (4) two to three times a month, (5) less than once a month, (6) never.

A composite score of 0 to 3 was calculated as the degree of "isolation with lack of conversation," with 1 point awarded for the presence of isolation in each item. Participants who scored 1 point or more on this assessment were allocated to the "isolation with lack of conversation" group depending on the cutoff for the onset of dementia. For question (1), answers ≤ 2 are isolated. For questions (2) and (3), answers ≤ 4 are isolated.

2.2.3 | Measurement of the incidence of dementia

We identified the incidence of dementia from the NCGG-SGS data when the participant was diagnosed with dementia using the corresponding code of the International Classification of Diseases 10th Revision (ICD-10) or Dementia Rating Scale of the LTCI system used in Japan.[20–22] New dementia was defined as the absence of dementia at baseline and new onset of dementia during the 60-month follow-up period.[23] The details of the dementia follow-up based on ICD-10 codes and the LTCI system are given below.

2.2.4 | Follow-up of dementia according to ICD-10

In Japan, all adults aged ≥ 65 years have public health insurance, which includes one of the following: health insurance for employed individuals (Employees' Health Insurance), national health insurance for unemployed and self-employed individuals aged < 75 years (Japanese National Health Insurance), or health care for individuals aged ≥ 75 years (Later-Stage Medical Care [LSMC]). In this study, the participants were followed up monthly for new-onset dementia (Alzheimer's disease [AD], vascular dementia, frontotemporal dementia, and other dementia subtypes), as recorded by the National Health Insurance and the LSMC system. The participants were considered to have dementia based on a diagnosis made by a physician according to the ICD-10. We identified dementia, including AD, vascular dementia, and other dementia subtypes from the NCGG-SGS data according to the corresponding ICD-10 codes. The diagnosis of dementia from the UK Biobank inpatient data, whose criteria are similar to those of the NCGG-SGS, had a positive predictive value of 87.3% for dementia compared to clinical expert adjudication using full-text medical records (Table S1 in supporting information).[24]

2.2.5 | Dementia follow-up through the LTCI system

The LTCI is a mandatory form of social insurance to support the daily lives of older adults with disabilities.[25–28] In Japan, all individuals aged ≥ 65 years are eligible for institutional or community-based services, depending on their disability level. The disability certification process consists of two parts: (1) determining the degree of disability based on a questionnaire developed by the Ministry of Health, Labor and Welfare of Japan, and (2) a written opinion prepared by the attending physician.[29] We identified dementia using the Dementia Rating Scale (level of independence in daily living for older adults with dementia) in the disability certification process.[30] The dementia scale is classified into six ranks (0, I–IV, M), with patients with mild or moderate dementia being allocated to rank II. In this study, we defined dementia onset as rank II or higher.[31,32] A previous validation study showed good correlation between the Dementia Rating Scale and Mini-Mental State Examination (MMSE; $r = -0.736$),[33] while another study reported an association between dementia classified by Dementia Rating Scale and Clinical Dementia Rating.[34]

2.3 | Potential confounding factors

We included age, sex, body mass index (BMI), duration of education, positive medical history (heart disease, diabetes, hypertension, hyperlipidemia, eye disease), number of medications, and smoking habit (current/previous vs. never) as potential confounding variables for dementia and hearing impairment.[2] The BMI was calculated using height and body weight, which was measured through a bioelectrical impedance analyzer (Tanita MC780A; Tanita Corp.).[35] We also included depression, which was assessed using the 15-item Geriatric Depression Scale (GDS)[36]; the cut-off score of ≥ 6 has 82% sensitivity and 75% specificity for the related structured clinical interview.[37] Depressive symptoms were considered present if participants scored ≥6 on the GDS-15.[36,38] Cognitive function was assessed using the MMSE.[39,40] Walking speed was measured in seconds over a 2.4-m distance with a comfortable walking speed. The participants walked for an additional 2-m distance before and after measurement to ensure consistent speed. A digital stopwatch was used to automatically determine when participants walked past infrared sensors at the start and end of the measurement area.

2.4 | Statistical analysis

The participants were classified according to the self-reported questionnaire described above into the following four groups: (1) non-hearing impairment without isolation with lack of conversation, (2) non-hearing impairment with isolation with lack of conversation, (3) hearing impairment without isolation with lack of conversation, and (4) hearing impairment with isolation with lack of conversation. For the potential confounders, we used the multivariate analysis of variance and the χ^2 test for categorical variables to compare the baseline characteristics between participants. Survival analyses were performed using Kaplan–Meier curves to estimate the cumulative survival rate for the onset of dementia with respect to hearing impairment and social isolation at baseline, and inter-group differences were examined using the log-rank test. Finally, Cox proportional hazards regression was performed to calculate the hazard ratios (HRs) for new dementia occurrence with respect to hearing impairment and isolation due to lack of conversation, along with the 95% confidence intervals (CIs). The Kaplan–Meier analysis and Cox proportional hazards regression focused on the time interval between the baseline survey to the occurrence of new dementia. The Cox regression model was adjusted for the following potential confounders: age, sex, BMI, duration of education, living alone, heart disease, diabetes mellitus, hypertension, hyperlipidemia, eye disease, medication, smoking status, depression, MMSE, walking speed, and hearing aid. Statistical analysis was performed using IBM SPSS, version 27.0 (SPSS Corp.). Statistical significance was set at $P < 0.05$.

3 | RESULTS

3.1 | Comparison of baseline participant characteristics by presence of hearing impairment and isolation with lack of conversation

The current study enrolled 2745 participants (mean age: 73.1 ± 5.9 years; women: 55.9%), who were classified, according to the self-reported presence or absence of hearing impairment or isolation with lack of conversation at baseline, into four groups as follows: non-hearing impairment without isolation with lack of conversation, $n = 881$ (32.1%); non-hearing impairment with isolation with lack of conversation, $n = 963$ (35.1%); hearing impairment without isolation with lack of conversation, $n = 385$ (14.0%); and hearing impairment with isolation with lack of conversation, $n = 516$ (18.8%). Table 1 compares the characteristics of the participants, grouped according to hearing impairment and isolation with lack of conversation. Significant differences were found in baseline characteristics such as age, sex, duration of education, living alone, hypertension, eye disease, smoking status, number of medications, depressive tendencies, cognitive function, walking speed, hearing aid use, and degree of lack of conversation. In particular, those with hearing impairment with isolation with lack of conversation showed significant differences compared to the other groups in living alone, eye disease, smoking status, depressive tendencies, walking speed decline, and index of conversation deficits.

3.2 | Comparison of the incidence of dementia after 5 years in participants with and without hearing impairment and participants with and without isolation with lack of conversation

Table 2 depicts the comparison of the incidence of dementia after 5 years according to stratification by hearing impairment and isolation

TABLE 1 Baseline survey-acquired demographic characteristics of the study participants stratified by hearing impairment and isolation with lack of conversation status.

Variables	Non-hearing impairment without isolation with lack of conversation (*n* = 881, 32.1%)	Non-hearing impairment with isolation with lack of conversation (*n* = 963, 35.1%)	Hearing impairment without isolation with lack of conversation (*n* = 385, 14.0%)	Hearing impairment with isolation with lack of conversation (*n* = 516, 18.8%)	*P* value
Age, years	72.7 ± 5.6	72.2 ± 5.8	74.4 ± 6.2	74.6 ± 5.9	< 0.001[a]
Sex, female, *n* (%)	533 (60.5)[c]	521 (54.1)	218 (56.6)	263 (51.0)[d]	0.003[b]
BMI, point	23.6 ± 3.3	23.6 ± 3.4	23.4 ± 3.2	23.3 ± 3.1	0.320[a]
Duration of education, years	11.1 ± 2.3	11.2 ± 2.4	10.8 ± 2.3	10.7 ± 2.3	< 0.001[a]
Living alone, yes, *n* (%)	27 (3.1)[d]	178 (18.5)[c]	16 (4.2)[d]	104 (20.2)[c]	< 0.001[b]
Heart disease, yes, *n* (%)	125 (14.2)	154 (16.0)	67 (17.4)	93 (18.0)	0.232[b]
Diabetes mellitus, yes, *n* (%)	124 (14.1)	134 (13.9)	55 (14.3)	76 (14.7)	0.978[b]
Hypertension, yes, *n* (%)	425 (48.2)	455 (46.2)[d]	213 (55.3)[c]	262 (50.8)	0.018[b]
Hyperlipidemia, yes, *n* (%)	285 (32.3)	278 (28.9)	112 (29.1)	167 (32.4)	0.285[b]
Eye disease, yes, *n* (%)	393 (44.6)[d]	462 (48.0)	204 (53.0)	294 (57.0)[c]	< 0.001[b]
Smoking status, yes	296 (33.7)[d]	401 (41.7)	144 (37.4)	217 (42.1)[c]	0.001[b]
Medication, number	2.7 ± 2.5	2.8 ± 2.6	3.1 ± 2.4	3.3 ± 2.8	< 0.001[a]
Depression (GDS-15 > 6), yes, *n* (%)	77 (8.7)[d]	157 (16.3)	50 (13.0)	121 (23.4)[c]	< 0.001[b]
MMSE, score	27.1 ± 2.6	27.1 ± 2.6	26.8 ± 2.7	26.8 ± 2.7	0.055[a]
Walking speed < 1 m**/sec, yes,** *n* (%)	211 (24.0)	226 (23.5)	108 (28.1)	157 (30.4)[c]	0.011[b]
Hearing aid, yes, *n* (%)	9 (1.0)[d]	4 (0.4)[d]	40 (10.4)[c]	57 (11.0)[c]	< 0.001[b]
Conversation-deficient score, point	0.00 ± 0.00	1.27 ± 0.50	0.00 ± 0.00	1.32 ± 0.54	< 0.001[a]

Note: Data are expressed as mean ± standard deviation or number (%).
Abbreviations: BMI, body mass index; GDS-15, Geriatric Depression Scale 15; MMSE, Mini-Mental State Examination.
[a]*P* values obtained by multivariate analysis of variance (MANOVA).
[b]*P* values obtained by Pearson's chi-squared test.
[c]Statistically significant association by the adjusted standardized residual > 1.96 [$P < 0.05$].
[d]Statistically significant association by the adjusted standardized residual < −1.96 [$P < 0.05$].

TABLE 2 Comparison of dementia incidence among participants stratified by hearing impairment and isolation with lack of conversation.

Variables	Participants with dementia *n* (%)	Participants without dementia *n* (%)	*P* value
Hearing impairment			0.003
No	106 (7.9)	1,237 (92.1)	0.003[†]
Yes	80 (12.0)	586 (88.0)	0.003[††]
Isolation with lack of conversation			0.034
No	71 (7.8)	844 (92.2)	0.034[†]
Yes	115 (10.5)	979 (89.5)	0.034[††]
Hearing impairment and isolation with lack of conversation			0.005
Non-hearing impairment without isolation with lack of conversation	42 (6.5)	601 (93.5)	0.005[†]
Non-hearing impairment with isolation with lack of conversation	64 (9.1)	636 (90.9)	0.005
Hearing impairment without isolation with lack of conversation	29 (10.7)	243 (89.3)	0.005
Hearing impairment with isolation with lack of conversation	51 (12.9)	343 (87.1)	0.005[††]

Note: Number (percentage).
[†]Significantly lower prevalence of incidence of dementia compared to the other groups.
[††]Significantly higher prevalence of incidence of dementia compared to the other groups.

with lack of conversation. The incidence rates (per 1000 person-years) of dementia at 5 years were as follows: 12.7 (95% CI: 9.4–17.1) for non-hearing impairment without isolation with lack of conversation, 17.9 (95% CI: 14.0–22.9) for non-hearing impairment with isolation with lack of conversation, 20.9 (95% CI: 14.5–30.0) for hearing impairment without isolation with lack of conversation, and 25.7 (95% CI: 19.6–33.8) for hearing impairment with isolation with lack of conversation.

The incidence of dementia was significantly higher in the hearing impairment with isolation with lack of conversation group and significantly lower in the non-hearing impairment without isolation with lack of conversation group.

3.3 | Association of hearing impairment and isolation with lack of conversation with the incidence of dementia after 5 years

Analysis of survival using the Kaplan–Meier curve stratified by hearing impairment and isolation with lack of conversation showed a significant difference in the log-rank test. Table 3 shows the HR and 95% CIs for the Cox proportional hazards regression model examining the association with the development of dementia in the four groups. The risk of new onset of dementia at 5 years was significantly higher among the hearing impairment with isolation with lack of conversation (HR: 1.69, 95% CI: 1.09–2.61) group and among the non-hearing impairment with isolation with lack of conversation (HR: 1.60, 95% CI: 1.07–2.39) group. However, no significant associations were found in the other groups. Significant differences were also found in the adjusted variables of age, sex (female), depressive tendency (yes), cognitive function, and walking speed (decline). Figure 2 shows the cumulative survival curves of the Cox proportional hazards regression model for the variables for which significant differences were found.

TABLE 3 HRs for dementia incidence.

Variables	HR (95% CI)	*P* value
Four groups divided according to hearing impairment and isolation with lack of conversation		
Non-hearing impairment without isolation with lack of conversation	1	
Non-hearing impairment with isolation with lack of conversation	1.60 (1.07, 2.39)	0.021
Hearing impairment without isolation with lack of conversation	1.39 (0.86, 2.26)	0.182
Hearing impairment with isolation with lack of conversation	1.69 (1.09, 2.61)	0.018
Age year	1.15 (1.12, 1.19)	<0.001
Sex, female	1.96 (1.19, 3.24)	0.009
BMI	0.98 (0.94, 1.03)	0.433
Duration of education, year	1.07 (1.00, 1.15)	0.065
Living alone, yes	0.90 (0.60, 1.37)	0.631
Heart disease, yes	0.70 (0.46, 1.06)	0.094
Diabetes mellitus, yes	1.18 (0.80, 1.75)	0.403
Hypertension, yes	0.79 (0.58, 1.08)	0.142
Hyperlipidemia, yes	0.90 (0.64, 1.29)	0.577
Eye disease, yes	1.01 (0.73, 1.40)	0.968
Medication, number	1.06 (1.00, 1.12)	0.074
Smoking status, yes	1.47 (0.90, 2.39)	0.124
Depression (GDS-15 > 6), yes	1.40 (1.01, 1.96)	0.046
MMSE, score	0.86 (0.81, 0.90)	<0.001
Walking speed < 1 m/s, yes	3.16 (2.25, 4.44)	<0.001
Hearing aid, yes	0.93 (0.54, 1.60)	0.853

Note: This model was adjusted for age, sex, BMI, duration of education, living alone, heart disease, diabetes mellitus, hypertension, hyperlipidemia, eye disease, medication, smoking status, depression, MMSE, walking speed, and hearing aid use.

Abbreviations: BMI, body mass index; CI, confidence interval; GDS, Geriatric Depression Scale; HR, hazard ratio; MMSE, Mini-Mental State Examination.

4 | DISCUSSION

This large cohort study of community-dwelling older adults found that self-reported hearing impairment concomitant with isolation with lack of conversation was associated with new onset of dementia using Cox proportional hazards regression analysis adjusted for potential confounding factors. A systematic review that investigated the association between hearing impairment and social isolation and loneliness reported that older adults with hearing impairment were more likely to experience social isolation.[6] Other studies have shown that older adults with hearing impairment experience communication difficulties and are more likely to feel discriminated against in their daily lives,[14] thereby leading them to limit social contact. In the present study, we devised an operational definition for isolation with lack of conversation based on the frequency of conversations with family and relatives living together, with family and relatives living separately, and with friends and acquaintances. The results indicated that the likelihood of isolation with lack of conversation was higher among persons with hearing impairment. Therefore, this research is relevant because it is a large epidemiological study that confirmed the association between hearing impairment and isolation with lack of conversation—a relationship that has not been adequately investigated because it was considered self-evident. This finding is important for preventive measures because the combination of hearing impairment and isolation with lack of conversation can lead to the development of new dementia and disability due to limitations in activities of daily living.

Hearing impairment has been reported to be the most relevant of the 12 modifiable factors for dementia prevention.[2] This association between hearing impairment and dementia is thought to be derived from several factors, including accelerated brain atrophy resulting from reduced activity in the auditory neural pathways, decreased auditory information, and depression and social isolation caused by communication difficulties.[7] Akin to previous studies, this study found that

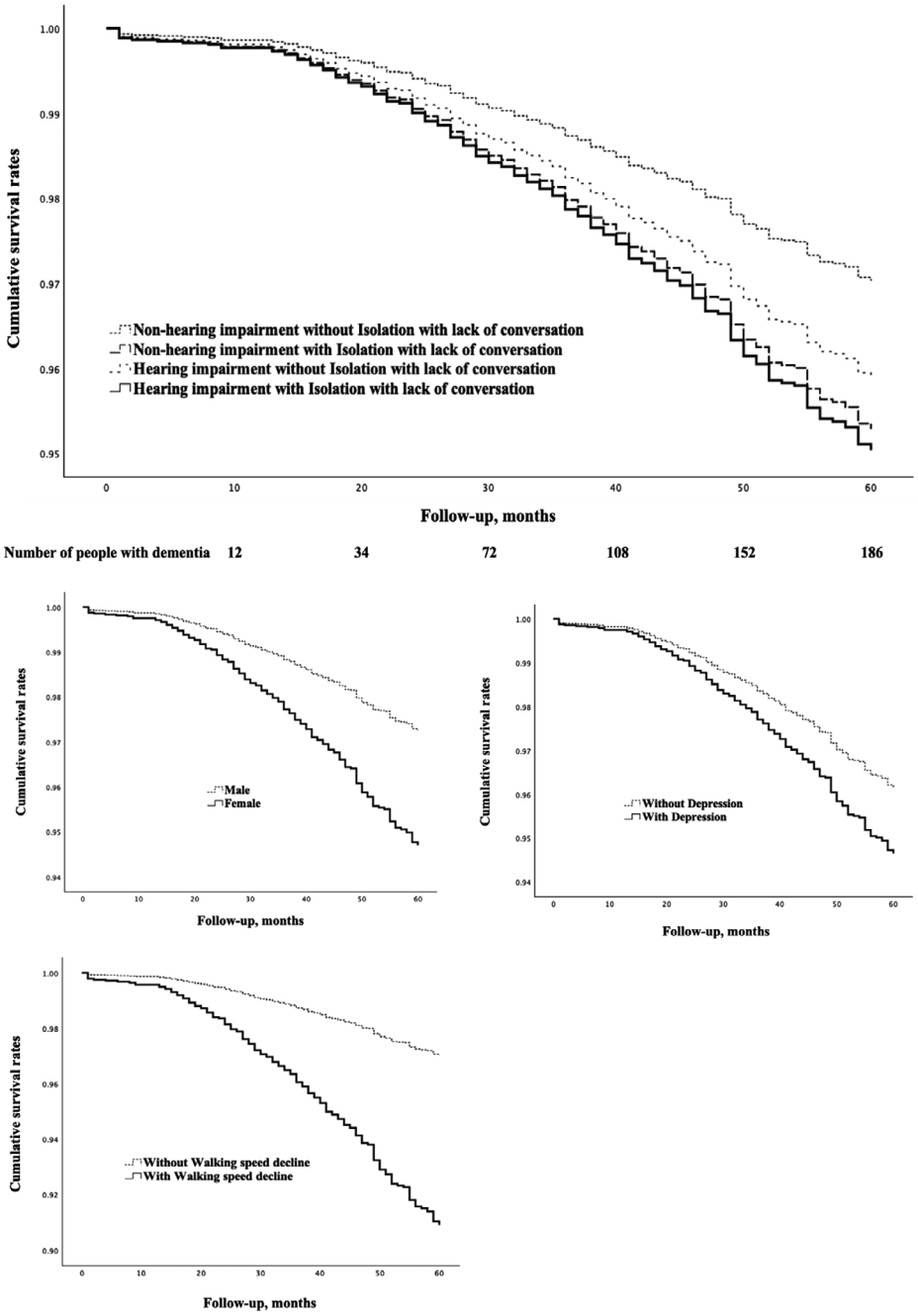

FIGURE 2 Cumulative survival rates of dementia.

older people with hearing impairment showed a tendency toward depression,[41] cognitive decline,[41,16] reduced walking speed,[42] and other physical and cognitive dysfunctions compared to people without hearing impairment (Table 1). Among these, mobility disability caused by inactivity has also been noted as a factor involved in social isolation, as it reduces the frequency of outings and decreases life space.[2] Previous studies have shown that social isolation is associated with loneliness and lower life satisfaction.[19] It has also been suggested that social isolation is also associated with reduced physical and mental functioning including physical frailty, decreased walking speed, and depressive symptoms.[19] Furthermore, loneliness in older adults is associated with decreased willingness to participate in society[43] and an increased risk of developing disability.[11] Additionally, decreased social activity has been shown to be a factor involved in increased risk of depression.[44]

Moreover, a higher proportion of participants with isolation with lack of conversation had depression compared to those who were able to maintain daily conversations (Table 1), supporting previous research suggesting that lack of social contact in older adults may negatively affect mental health.[45] Furthermore, a meta-analysis of longitudinal cohort studies showed that poor social relationships are associated with cognitive decline.[46] In contrast, older adults who are able to

maintain an active lifestyle have been reported to face a lower risk of developing dementia.[47] Consequently, maintaining daily conversation and engaging in social activities are considered important for preserving mental health and reducing the risk of dementia.[23]

The findings of this study may be limited by several factors. First, the participants were in relatively good health and all were able to voluntarily participate in the baseline survey, which might have led to underestimation of cognitive decline. Second, as shown in Table 3 and Figure 2, age, sex, depressive tendencies, cognitive function, and walking speed were also associated with the development of dementia. Each of these factors may contribute to cognitive function, and we did not fully examine these differences. The present study also showed an association between female sex and the development of dementia, similar to previous studies that have reported an association between AD and female sex.[48] However, the present study was not able to conduct data analysis differentiating among subtypes of dementia (e.g., AD, vascular dementia, Lewy body dementia, frontotemporal dementia), and the detailed relationship between hearing impairment and isolation with lack of conversation and the pathophysiology of dementia is a topic for future research. Third, we were not able to examine genetic factors. Furthermore, in this study, the measurement of hearing impairment and isolation with lack of conversation was based on subjective assessments, and the analysis on the incidence of dementia could not be adjusted for physical activity, which may be implicated in promoting isolation and loneliness. However, to the best of our knowledge, this study is the first to show combined association of hearing impairment and isolation with lack of conversation with the onset of dementia 5 years later. This is an important finding for the prevention of dementia and disability.

In conclusion, this study highlights the importance of addressing the concomitance of self-reported hearing impairment and isolation with lack of conversation in older adults for the prevention of dementia. Self-reported hearing impairment is reportedly associated with the reduction in communication skills,[49] life space,[8] and frailty.[42] Studies have also reported that isolation with lack of conversation enhances feelings of loneliness due to reduced interaction with others and is more likely to lead to depression.[50] It is important to implement measures to prevent isolation with lack of conversation from the early stages of awareness of hearing impairment to promote and maintain the quality of social relationships throughout life.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest to declare. Author disclosures are available in the supporting information.

CONSENT STATEMENT

This study was conducted in accordance with the principles of the Declaration of Helsinki. The study protocol was approved by the ethics committee of the National Center for Geriatrics and Gerontology (approval number: 1440-5). Written informed consent was obtained from all participants before participation.

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SUPPORTING INFORMATION

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

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