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**Self-Reported Hearing Is Associated with Time Spent Out-of-Home and Withdrawal from
Leisure Activities in Older Community-Dwelling Adults**

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ABSTRACT

Background

Hearing difficulties are prevalent among older people and can lead to difficulties in social interaction. These difficulties may increase the tendency to remain at home and withdraw from leisure activities.

Aims To investigate whether self-reported hearing problems are associated with time spent out-of-home and withdrawal from a leisure activity among older persons.

Methods Cross-sectional and longitudinal data on 75- to 90-year-old community-dwelling men and women (n=767) was used. Self-reports of hearing, diseases, and difficulty walking 2 km were obtained via home interviews at baseline, and withdrawal from a leisure activity via 1- and 2-year follow-up telephone interviews. Time spent out-of-home was obtained from a subsample (n=532) via seven-day diaries at baseline.

Results

Hearing problems were associated with time spent out-of-home ($p=.025$) and withdrawal from a leisure activity ($p=.025$) among persons reporting no walking difficulty, but not among those reporting walking difficulty ($p=.269$ and $.396$, respectively). Among the former, persons with major hearing problems spent significantly less time out-of-home (estimated marginal mean 161 minutes, 95%CI 122-212) than those with good hearing (242, 95%CI 218-270). Persons with major hearing problems also had 3.0 times higher odds (95%CI 1.3-7.1) for withdrawal from a leisure activity than persons with good hearing during the two-year follow-up.

Discussion and conclusions

Among older adults without walking difficulty, hearing problems may reduce time spent out-of-home and increase the likelihood for withdrawal from a leisure activity. Decreased

leisure and out-of-home activity may have negative effects on older persons' social, mental and physical functioning.

Key words: *Aging, hearing, homebound, time out-of-home, mobility*

INTRODUCTION

Hearing impairment affects the majority of older adults. In persons aged 70 and older more than half have hearing impairment [1-3] yet only a minority receive treatment for the problem [3, 4]. Hearing difficulties hamper communication with other people and may make it hard to participate in activities that require following speech, such as theatre-going. Consequently, persons with hearing difficulty may begin to avoid other people, withdraw from various activities [5, 6], as has been indicated by cross-sectional studies, and spend more time at home. Previous longitudinal studies have shown that being homebound may negatively affect older adults' mental health [7] and physical functioning [7-9], and increase the risk for death [7] independent of baseline health status.

We are aware of only one study that has investigated the association between hearing problems and home confinement [10]. No significant association was found in that study. Furthermore, no longitudinal studies seem to have investigated whether hearing predicts changes in leisure activities. In the present study, we investigated cross-sectionally whether self-reported hearing problems are associated with time spent out-of-home. In addition, using longitudinal data, we examined whether self-reported hearing problems predict withdrawal from a leisure activity among community-dwelling older adults.

METHODS

Material

The present analysis utilized cross-sectional and longitudinal data gathered for the Life-Space Mobility in Old Age (LISPE) project, which is a study of community-dwelling older adults [11]. Briefly, a sample of 2 550 older persons between 75 and 90 years of age was drawn from the population register. A telephone interview was used to screen eligible participants. The inclusion criteria were: living independently, residing in the recruitment area, being able to communicate, and willingness to participate in the study. Finally, 848 individuals participated in structured computer-assisted interviews in their homes at baseline. Follow-ups at one (n= 806) and two years (n=761) were conducted via telephone interviews. Of the participants, 41 dropped out during the study due to decease and 18 were excluded (12 were unable to communicate and 6 moved outside the study area). The remaining non-participation in the follow-ups was due to moving to institutional care, poor health, unwillingness to participate, and inability to reach the participant. The LISPE project was approved by the ethical committee of the University of Jyväskylä. The subjects signed an informed consent at the start of the home interview.

Assessments

Hearing was assessed at baseline by the following question: “Do you have difficulty hearing when conversing with another person in a noisy environment?”[6] The response categories were 1) No difficulty, 2) Sometimes, some difficulty, and 3) Yes, major difficulty. The

participants were asked to estimate their level of difficulty when using a hearing aid if they had one. Data on hearing were lacking for one participant.

At baseline, 533 participants agreed to fill in a diary registering time spent out-of-home over a seven-day period. They were instructed to record time spent out-of-home for seven consecutive days in a structured diary at baseline [11]. Diaries that contained data on time spent out-of-home for at least three days were considered valid. One person's diary data were excluded from the analysis, owing to hospitalization for five days during the diary week. Subjects who had valid diary data and who had answered the hearing question, were included in the analyses (n=524). The numbers of participants who lacked diary data for 0, 1, 2, 3, and 4 days were 419, 71, 21, 8, and 5, respectively. Average time out-of-home in minutes per day was calculated (sum of time spent out-of-home during the diary week divided by number of valid days).

In the follow-up telephone interviews, the participants were asked whether they had withdrawn from any leisure activity during the past year (yes/no). The answers in the one- and two-year follow-ups were combined into a single variable. Where answers were missing in either follow-up, the variable was coded as missing. However, if the participant had died between the first and second follow-up, answer at one-year was included in the analysis. Information on withdrawal from a leisure activity was available for 767 participants.

Potential confounders, obtained at baseline, included self-reported difficulty in walking 2 km, sufficient financial resources relative to one's needs, completed education in years (missing for 7 participants) and cognition (Mini-Mental State Examination score). Age and sex were obtained from the population register. Self-reported diseases were obtained from a list of 22 physician-diagnosed chronic diseases and an open question. Potential confounding diseases included diabetes, cancer, and cardiac, circulatory, locomotor/rheumatic and neurological diseases.

Data analysis

The associations between hearing and time spent out-of-home were analyzed using generalized linear models with linear gamma log-link for the response variable owing to its non-normal distribution. Binary logistic regression analysis was used to assess the association between hearing and withdrawal from a leisure activity. The analyses on time spent out-of-home and withdrawal from a leisure activity were stratified according to walking difficulty categories owing to the interactions observed between hearing and walking difficulty (interaction $p=.013$ for time spent out-of-home and $p=.054$ for withdrawal from a leisure activity). The inclusion criterion for possible confounders was an association ($p\leq 0.20$) with both the predictor and the response variable.

Due to missing data in the follow-up (8%), the analyses on withdrawal from a leisure activity were confirmed using multiple imputed datasets. The potential confounders listed earlier were used as the predictors in the imputation regression model and twenty datasets

created that were pooled in the final analysis. The multiple imputation method has the advantage of accounting for the uncertainty of the imputed values [12]. The data were analyzed using IBM SPSS Statistics for Windows software version 20.0 (IBM Corp., Armonk, NY, USA). Statistical significance was set at $p < 0.05$.

RESULTS

Of the participants, 339 (44%) reported no hearing difficulty, 349 (46%) reported some hearing difficulty and 78 (10%) reported major hearing difficulty. Participants' characteristics are given in Table 1. The characteristics of the subsample with diary data did not materially deviate from the characteristics of the whole sample. Compared to those who did not consent to filling in the diary, among those who did the proportions of those reporting good hearing (42% vs. 46%) and major hearing difficulty (9% vs. 13%) were smaller and the proportion reporting some hearing difficulty was greater (49% vs. 42%) (Chi square $p=0.055$).

The median time spent out-of-home per day was 156 minutes. Hearing was significantly associated with time spent out-of-home among persons who reported no difficulty walking 2 km (crude model $p=.017$, adjusted model $p=.025$), but not among persons who reported difficulty walking 2 km (crude model $p=.220$, adjusted model $p=.269$). According to the crude model (Table 2), among those reporting no difficulty walking 2 km, those with major hearing problems spent significantly less time out-of-home than those with good hearing. However, compared to having good hearing, having only some hearing problems did not reduce the time spent out-of-home. Adjusting the models for age, and for cardiac and locomotor diseases did not materially change the results (Table 3).

The proportions of participants who withdrew from a leisure activity during the 2-year follow-up were 22%, 26% and 39% for persons reporting good hearing, some hearing

problems, and major hearing problems, respectively. In the binary logistic regression analyses, hearing problems were associated with withdrawal from leisure activities during the two-year follow-up among participants without walking difficulty (crude model $p=.005$, adjusted model $p=.025$) but not among those with walking difficulty (crude model $p=.378$, adjusted model $p=.396$) (Table 3). Among participants without walking difficulty, those reporting some hearing problems had higher likelihood for withdrawal from a leisure activity in the crude model (OR 1.7) than those with good hearing. However, this association became non-significant after adjustment (age, cognition, education, and cardiac, circulatory, and locomotor diseases). Persons reporting major hearing problems had higher likelihood for withdrawal from a leisure activity during the two-year follow-up in both the crude (OR=3.5) and the adjusted (OR=3.0) model. The results derived from the pooled imputed dataset did not deviate markedly from those for the original data. Using the pooled imputed dataset, the odds ratios and p-values did not markedly change.

DISCUSSION

The results of the present study suggest that among older people without walking difficulty, persons with major hearing problems spend less time outside the home. They are also more likely to withdraw from leisure activities than persons with good hearing.

To the best of our knowledge, this is the first study to investigate the association between hearing and time spent out-of-home. We believe that time spent out-of-home is an indicator of global activity in older people. This activity may include running errands, physical activity, leisure activities, and social activities. Hence, spending time out-of-home provides more opportunities than merely staying at home for engagement in a variety of activities that help to maintain physical functioning and mental health. This is supported by previous studies which have found that, among older adults, homebound status predicts poorer future physical functioning [7-9] and poorer mental health [7] independently of baseline health.

When analyzing changes in leisure activities, we found that persons reporting major hearing problems were more likely to withdraw from a leisure activity than persons reporting good hearing during the two-year follow-up. Unfortunately, we did not have information on the types of leisure activities. However, various types of leisure activities – e.g. productive [13], solitary [13, 14], social [15] and physical [14, 16] – have been found to predict older adults' wellbeing, health and survival. Hence, persons with hearing problems may be at higher risk

for adverse health outcomes following withdrawal from leisure activities. High leisure activity has also been shown to contribute to quality of life in longitudinal studies [17, 18]. Consequently, withdrawal from leisure activities may partly explain the poorer quality of life found in older persons with hearing impairment [19, 20].

Intuitively, the results of the present study may be explained by the possibility that people with hearing difficulties begin to spend more time at home and withdraw from leisure activities in order to avoid being in the presence of disturbing noise and also to avoid meeting other people and the discomfort entailed by their communication problems [21]. Going out-of-home and leisure activities are also likely to increase possibilities for social contacts in older persons, many of whom live alone. In fact, social engagement may be one of the most important reasons for going out-of-home for older people [22]. Previous cross-sectional studies have found associations between hearing and specific social activities [5, 6]. Persons with self-reported hearing loss go to church and the movies and visit friends less often than those without hearing loss [5]. Further, persons reporting major hearing problems less often participate in group activities and perceive their possibilities to live life the way they want outside the home as poorer than persons reporting good hearing [6]. However, it should be underlined that walking ability was also a strong determinant of time spent out-of-home and withdrawal from leisure activities: compared to persons without walking difficulty, persons with walking difficulty spent less time out-of-home and were more likely to withdraw from leisure activities. Among them, having hearing problems did not further reduce time spent out-of-home or increase the likelihood of withdrawal from leisure activity.

The strengths of this study include the use of a population-based sample and a diary-based data collection procedure on time spent out-of-home. The study is further strengthened by longitudinal data on changes in leisure activity. However, there are some limitations that should be taken into account when interpreting the results. The participants were well-functioning compared to non-participants [11] and therefore the results cannot be generalized to community-dwelling adults with poor functioning. We also lacked information on the types of leisure activities from which our participants withdrew. Further, we were not able to assess hearing using an audiometer but used self-reports. However, given the range of adaptive communication strategies [23, 24] and the diversity of individuals' physical and social environments, it is possible that self-reports of hearing may be more closely related to behavior in older people than hearing thresholds measured in a standardized setting.

In conclusion, among older adults with good mobility, major hearing problems may reduce time spent out-of-home and increase the risk of withdrawal from leisure activities. Activities and services provided for older people should be hearing-friendly to promote participation of all older adults regardless of hearing status. Longitudinal studies are needed to determine whether hearing problems predict future home confinement and changes in different types of leisure activities in older persons.

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COMPLIANCE WITH ETHICAL STANDARDS

On behalf of all authors, the corresponding author states that there is no conflict of interest.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

This article does not contain any studies with animals performed by any of the authors.

Informed consent was obtained from all individual participants included in the study.

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Table 1. Background Characteristics of the Older Adults Reporting Good Hearing, Some Problems, and Major Problems in Hearing When Conversing in a Noisy Environment (N=766).

	Self-reported hearing categories						p ^a
	Good hearing (N=339)		Some problems (N=349)		Major problems (N=78)		
	N	%	N	%	N	%	
Female	212	63	217	63	51	65	.867
Hearing aid owner	12	3.6	50	14	38	49	<.001
Sufficient financial resources	162	48	159	46	32	41	.531
Walking difficulty	113	33	149	43	48	62	<.001
Cardiac disease	116	34	158	45	44	56	<.001
Circulatory disease	210	62	228	65	56	72	.237
Diabetes	60	18	64	18	14	18	.976
Locomotor/rheumatic disease	219	65	234	67	62	80	.041
Neurological disease	19	6	24	7	6	8	.702
Cancer	60	18	52	15	12	15	.596
	Median	IQR	Median	IQR	Median	IQR	p ^b
Age (years)	79.8	7.0	80.0	7.0	82.9	6.4	<.001

MMSE score	27	3.0	27	3.0	26	4.1	.006
Education (years)	9.0	5	9.0	5	8.0	5	.093

Note. MMSE, Mini-Mental State Examination

^aChi-square test

^bKruskal-Wallis H-test

Table 2. Mean Time Spent Out-Of-Home (in Minutes) across Three Hearing Categories in Older Community-Dwelling Adults (N=524). Generalized Linear Models Stratified by Walking Ability.

	Self-reported hearing categories								
	Good hearing			Some hearing problems			Major hearing problems		
	Mean	95% CI		Mean	95% CI	p ^a	Mean	95% CI	p ^a
No walking									
difficulty (n=342)									
Crude	241	218-267		222	200-246	.256	157	118-208	.005
Adjusted	242	218-270		229	206-253	.429	161	122-212	.007
Walking									
difficulty (n=182)									
Crude	130	108-157		160	139-186	.085	154	117-203	.320
Adjusted	132	109-160		156	133-184	.155	165	123-221	.186

Note. Analyses are adjusted for age, and cardiac and locomotor diseases.

^aCompared to the category Good hearing

Table 3. Odds for Withdrawal from Any Leisure Activity during a 2-Year Follow-Up Across Three Hearing Categories in Older Community-Dwelling Adults (N=760). Binary logistic Regression Models Stratified by Walking Ability.

	Self-reported hearing categories								
	Good hearing		Some hearing problems			Major hearing problems			
	OR	95% CI	OR	95% CI	p ^a	OR	95% CI	p ^a	
No walking									
difficulty (n=452)									
Crude	1	(ref.)	1.7	1.0-2.7	.038	3.5	1.6-7.9	.002	
Adjusted	1	(ref.)	1.6	1.0-2.6	.073	3.0	1.3-7.1	.012	
Walking									
difficulty (n=308)									
Crude	1	(ref.)	0.8	0.5-1.3	.360	1.2	0.6-2.5	.561	
Adjusted	1	(ref.)	0.8	0.5-1.4	.395	1.3	0.6-2.6	.521	

Note. Analyses are adjusted for age, education in years, cognition and cardiac, circulatory, and locomotor diseases.

^aCompared to the category Good hearing