HHS Public Access

Author manuscript

JAMA Otolaryngol Head Neck Surg. Author manuscript; available in PMC 2016 October 01.

Published in final edited form as:

JAMA Otolaryngol Head Neck Surg. 2015 October ; 141(10): 944–946. doi:10.1001/jamaoto.2015.1762.

Association of Hearing Impairment and Mortality in the National Health and Nutrition Examination Survey

Kevin J. Contrera, MPH[1], **Josh Betz, MS**[2], **Dane J. Genther, MD**[2,3], and **Frank R. Lin, MD PhD**[2,3,4]

[1]Johns Hopkins University School of Medicine, Baltimore, Maryland, USA.

[2] Center on Aging and Health, Johns Hopkins Medical Institutions, Baltimore, Maryland, USA.

[3] Department of Otolaryngology-Head & Neck Surgery, Johns Hopkins University, Baltimore, Maryland, USA.

[4] Departments of Geriatric Medicine, Mental Health and Epidemiology, Johns Hopkins University, Baltimore, Maryland, USA.

Hearing impairment (HI) is common in older adults. Its prevalence doubles with every decade of life, affecting two-thirds of adults older than 70 years.[1] Hearing impairment has been shown to be associated with various negative health out-comes. The association of HI and mortality has been studied in select populations.[2,3] We investigated the association of HI and all-cause mortality in a nationally representative sample of adults in the United States.

Methods

Using combined data from the January 1, 2005, to December 31, 2006, and January 1, 2009, to December 31, 2010, cycles of the National Health and Nutrition Examination Sur-vey (NHANES), we studied 1666 adults 70 years or older who had undergone audiometric testing. The NHANES is an ongoing epidemiologic study designed to assess the health of the US population using representative samples.[4] The NHANES protocol was reviewed and approved by the National Center for Health Statistic's Institutional Review Board and in-formed written consent was obtained from all participants. Analysis was conducted from March 1 to May 1, 2015.

Address correspondence, reprint requests, and proofs to: Kevin J. Contrera, Johns Hopkins Center on Aging & Health, 2024 E. Monument St, Suite 2-700, Baltimore, MD 21205, Telephone: (410) 502-0150, Fax: (443) 683-8310, kcontre2@jhmi.edu.

Authors' Contributions: Kevin J. Contrera: (1) conception of the design, conduction of the analysis, (2) drafting the manuscript, (3) approval of the final manuscript, (4) agreement to be accountable for all aspects of the work
Josh Betz: (1) conduction of the analysis, (2) critical revision of the manuscript, approval of the final manuscript, (4) agreement to be accountable for all aspects of the work
Dane J. Genther: (1) conduction of the analysis, (2) critical revision of the manuscript, (3) approval of the final manuscript, (4) agreement to be accountable for all aspects of the work
Frank R. Lin: (1) conception of the design, (2) critical revision of the manuscript, (3) approval of the final manuscript, (4) agreement to be accountable for all aspects of the work
Kevin J. Contrera had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Disclosures: Dr. Frank Lin reports being a consultant to Cochlear, on the scientific advisory board for Autifony and Pfizer, and a speaker for Med El and Amplifon

Severity of HI was defined per the World Health Organization criteria, based on the pure-tone average of hearing thresholds (in decibels) at speech frequencies (0.5-4 kHz) in the ear with better hearing (no HI, <25 dB; mild HI, ≥25 dB but <40 dB; moderate or more severe HI, ≥40 dB).[5] Mortality was determined by probabilistic matching between NHANES data and death certificates from the National Death Index through December 31, 2011.[6]

Baseline characteristics of participants were compared using the χ^2 test. The association between HI and mortality was analyzed using Cox proportional hazards regression models sequentially adjusted for demographic characteristics and cardiovascular risk factors known to be epidemiologically associated with HI. All analyses were weighted and conducted using the Stata statistical software program, version 12 (StataCorp LP).

Results

Compared with individuals without HI (n = 527), individuals with HI (n = 1139) were more likely to be older, male, white, former smokers, less educated, and have a history of cardiovascular disease and stroke (Table 1). In the age-adjusted model, moderate or more severe HI was associated with a 54% increased risk of mortality (hazard ratio [HR], 1.54; 95% CI, 1.08-2.18) and mild HI with a 27% increased risk of mortality (HR, 1.27; 95% CI, 0.83-1.95), compared with individuals without HI (Table 2). After further adjustment for demo-graphic characteristics and cardiovascular risk factors, our results suggest that HI may be associated with a 39% (HR, 1.39;95% CI, 0.97-2.01) and 21% (HR, 1.21; 95% CI, 0.81-1.81) in-creased risk of mortality in individuals with moderate or more severe HI and mild HI, respectively, compared with individuals without HI. Analysis restricted to individuals 80 years or younger (in whom age could be adjusted for precisely) yielded results also suggestive of a positive association between HI and mortality.

Discussion

In this nationally representative sample of adults 70 years or older, moderate or more severe HI was significantly associated with a 54% increased risk of mortality after adjustment for age, although this association was attenuated after adjustment for demographics and cardiovascular factors. We observed a dose-response association, with greater HI being associated with a greater risk of mortality. To our knowledge, this report is the first to investigate the association between HI and mortality in a nationally representative US sample.

Our results are generally comparable with those of previous studies.[2,3] Potential mechanisms for these findings include causal (or plausibly bidirectional) connections of HI with cognitive, mental, and physical function. A limitation of this study is that the size of our analytic cohort and duration of follow-up may have limited the power to detect significant associations in our fully adjusted models compared with those of previous studies.[2,3] In addition, age was treated as a categorical covariate instead of as the time scale in the Cox analysis, which was necessary because NHANES truncates age at 80 years for confidentiality purposes. This parameterization of age may result in residual confounding owing to the inability to precisely adjust for differences in age.

Future studies are required to explore the basis of the association of HI with mortality and to determine whether therapies to rehabilitate hearing can reduce mortality.

Acknowledgments

Funding: This manuscript was supported in part by the Johns Hopkins Institute for Clinical and Translational Research, NIH TL1 TR001078, NIH K23DC011279, the Eleanor Schwartz Charitable Foundation, and a Triological Society/American College of Surgeons Clinician Scientist Award. Funding sources had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication. Its contents are solely the responsibility of the authors.

References

1. Lin FR, Niparko JK, Ferrucci L. Hearing loss prevalence in the United States. Arch Intern Med. 2011; 171(20):1851–1852. [PubMed: 22083573]
2. Genther DJ, Betz J, Pratt S, et al. Association of Hearing Impairment and Mortality in Older Adults. J Gerontol A Biol Sci Med Sci. 2015; 70(1):85–90. [PubMed: 25024235]
3. Fisher D, Li CM, Chiu MS, et al. Impairments in hearing and vision impact on mortality in older people: the AGES-Reykjavik Study. Age Ageing. 2014; 43(1):69–76. [PubMed: 23996030]
4. Centers for Disease Control and Prevention. [March 24, 2015] The National Health and Nutrition Examination Survey Questionnaire and Exam Protocol. http://www.cdc.gov/nchs/nhanes.htm.
5. World Health Organization. [October 26, 2014] Grades of hearing impairment. Prevention of blindness and deafness. http://www.who.int/pbd/deafness/hearing_impairment_grades/en/. 2014
6. National Center for Health Statistics. [March 1, 2015] Data Linked to Mortality Files. http://www.cdc.gov/nchs/data_access/data_linkage/mortality.htm.

Table 1

Characteristics of Participants by Category of Hearing Category[a]

Characteristics	Hearing Impairment, No. (%)			
	None (n =527)	Mild (n = 589)	Moderate or More Severe (n = 550)	*P* Value
Age, y				
70-74	288 (54.6)	212 (36.0)	107 (19.5)	<.001
75-79	137 (26.0)	155 (26.3)	127 (23.1)	
≥80	102 (19.4)	222 (37.7)	316 (57.5)	
Sex				
Male	217 (41.2)	286 (48.6)	344 (62.5)	<.001
Female	310 (58.8)	303 (51.4)	206 (37.5)	
Race				
White	327 (62.1)	427 (72.5)	432 (78.6)	<.001
Black	117 (22.2)	77 (13.1)	40 (7.3)	
Hispanic	67 (12.7)	69 (11.7)	62 (11.3)	
Other	16 (3.0)	16 (2.7)	16 (2.9)	
Education				
Less than high school	160 (30.4)	201 (34.1)	226 (41.1)	<.001
High school graduate	128 (24.3)	175 (29.7)	125 (22.7)	
Some College	238 (45.2)	213 (36.2)	197 (35.8)	
Refused or not known	1 (0.2)	0	2 (0.4)	
Smoking status				
Never	257 (48.8)	287 (48.7)	246 (44.7)	0.039
Former	225 (42.7)	254 (43.1)	275 (50.0)	
Current	45 (8.5)	48 (8.1)	29 (5.3)	
Cardiovascular disease[b]	103 (19.5)	153 (26.0)	154 (28.0)	0.004
Hypertension	351 (66.6)	372 (63.2)	330 (60.0)	0.080
Diabetes mellitus	112 (21.3)	141 (23.9)	105 (19.1)	0.136
Stroke history	38 (7.2)	62 (10.5)	68 (12.4)	0.018
All-cause mortality	55 (10.4)	85 (14.4)	112 (20.4)	<.001

[a]Hearing impairment is defined by the speech frequency pure-tone average of thresholds at 0.5, 1, 2, and 4 kHz in the better hearing ear (no impairment <25 dB, mild 25 to <40 dB, moderate or severe impairment ≥ 40dB).

[b]Includes history of myocardial infarction, history of angina, diagnosis of coronary artery disease, diagnosis of congestive heart failure.

Table 2

Adjusted Risk of Mortality by Category of Hearing Impairment[a]

Cox Proportional Hazards Regression Model	Hazard Ratio (95% CI)		
	No Hearing Impairment	Mild Hearing Impairment	Moderate or More Severe Hearing Impairment
Base	ref	1.54 (1.06, 2.25)	2.3 (1.64, 3.27)
Base + age	ref	1.27 (0.83, 1.95)	1.54 (1.08, 2.18)
Base + age, sex, race, education	ref	1.27 (0.87, 1.87)	1.41 (0.99, 2.02)
Base + Demographic + Cardiovascular Factors (stroke, smoking, diabetes, hypertension, cardiovascular disease[b])	ref	1.21 (0.81, 1.81)	1.39 (0.97, 2.01)

[a] Hearing impairment is defined by the speech frequency pure-tone average of thresholds at 0.5, 1, 2, and 4 kHz in the better hearing ear (no impairment <25 dB, mild 25 to <40 dB, moderate or severe impairment ≥ 40dB).

[b] Includes history of myocardial infarction, history of angina, diagnosis of coronary artery disease, diagnosis of congestive heart failure.