Published in final edited form as:
Arch Intern Med. 2012 February 27; 172(4): 369–371. doi:10.1001/archinternmed.2011.728.

Hearing Loss and Falls Among Older Adults in the United States

Frank R. Lin, M.D., Ph.D.[1,2] and **Luigi Ferrucci, M.D., Ph.D.**[3]

[1]Department of Otolaryngology-Head & Neck Surgery, Johns Hopkins School of Medicine, Baltimore, Maryland [2]Center on Aging and Health, Johns Hopkins Medical Institutions, Baltimore, Maryland [3]Longititudinal Studies Section, National Institute on Aging, Baltimore, Maryland

To the Editor

Identifying modifiable risk factors for falls in older adults is of significant public health importance. While hearing is not typically considered a risk factor for falls, a recent report in a cohort of older Finnish female twins has demonstrated a strong association between audiometric hearing loss and incident falls [1]. Possible pathways that could explain this observed association include shared cochlear and vestibular pathology, poor awareness of the auditory and spatial environment, or mediation through the effects of hearing loss on cognitive load and shared attention. These latter two pathways that suggest a possible causal pathway between hearing loss and falling are intriguing because hearing loss is highly prevalent but remains vastly undertreated in older adults [2, 3]. The objective of this current study was to investigate the cross-sectional association of audiometric hearing loss with self-reported falls in a representative sample of the United States population ages 40–69 years participating in the National Health and Nutritional Examination Survey (NHANES).

Methods

Study subjects

Subjects were participants (age 40–69 years) in the 2001–2004 cycles of NHANES who had assessment of audiometric hearing loss and fall history. During this period, audiometry was administered to a half sample of all adults 20–69 years, and an interviewer-administered questionnaire on fall history was administered to all adults 40 years and older. The NHANES is an ongoing program of studies that assesses the health and functioning of representative cross-sectional samples of the civilian, non-institutionalized U.S. population[4].

Pure tone audiometry was performed by a trained examiner according to established NHANES protocols (see eAppendix). Hearing loss was defined by a speech-frequency pure tone average (PTA) of thresholds at 0.5, 1, 2, and 4 kHz in the better hearing ear per the definition of hearing loss adjudicated by the World Health Organization [5]. Fall history was ascertained in an interviewer-administered questionnaire (“Have you had difficulty with falling during the past 12 months”). Data on demographic variables and medical history were obtained from interviews. Objective vestibular balance testing consisted of test condition 4 of the Modified Romberg Test of Standing Balance on Firm and Compliant Support Surfaces (eAppendix).

Address correspondence, reprint requests, and proofs to: Frank R. Lin, Johns Hopkins Center on Aging & Health, Suite 2-700 2024 E. Monument St. Baltimore, MD 21205, Telephone: (443) 287-6509, Fax: (410) 614-9444, flin1@jhmi.edu.

Financial disclosures: This work was supported by NIH K23DC011279 (F.L.). All authors report no conflicts of interest.

Logistic regression was used to analyze the association between hearing loss and self-reported falling while adjusting for age and other covariates. We accounted for the complex sampling design in all analyses by using sample weights according to National Center for Health Statistics (NCHS) guidelines. All analyses were conducted using STATA 11.1 (StataCorp, College Station, TX), and 2-sided p-values <.05 were considered statistically significant.

Results

From 2001–2004, 2017 participants age 40–69 years had concurrent assessment of hearing loss and fall history in NHANES (eTable). Hearing loss >25dB was prevalent in 14.3% of these participants, and 4.9% of the participants reported falling over the preceding 12 months. We examined the association of hearing loss with having self-reported falls in stepwise logistic regression models. In an unadjusted model, hearing loss was significantly associated with the odds of reported falls. For every 10 dB increase in hearing loss, there was a 1.4 fold (95% CI: 1.3–1.5) increased odds of an individual reporting falling over the preceding 12 months. Adjustment for demographic factors (age, sex, race, education), cardiovascular factors (smoking, diabetes, hypertension, stroke), and vestibular balance function did not substantially change the magnitude or significance of this association (Table). Restricting the analytical cohort to only those participants with hearing loss ≤ 40 dB (thereby excluding those with a moderate or severe hearing loss) did not affect the magnitude of our results (c.f. Table).

Comment

In this nationally-representative study of 40–69 year-old adults, greater hearing loss was independently associated with self-reported falls over the preceding 12 months. These results were robust to analyses accounting for multiple confounders, excluding participants with moderate or severe hearing loss, and after adjustment for vestibular balance function. The magnitude of the association of hearing loss with falls is clinically-significant with a 25 dB hearing loss (equivalent from going from normal to mild hearing loss) being associated with a nearly three-fold increased odds of reporting falling over the preceding year.

Our results contribute to the literature examining the association between hearing loss and falls. Our findings are consistent with prior research studies that have utilized both self-reported[6] and audiometric [1, 7] measures of hearing and have demonstrated associations between hearing loss with balance function [7] and incident falls [1]. In contrast, another longitudinal study has not found similar associations [8]. Potential factors that may limit the consistency of reported results across studies are variability in how hearing loss was measured, variability in cohort characteristics, and how balance and falls were assessed. For example, in studies using a hearing screening instrument rather than pure tone audiometry [8], any misclassification of hearing loss status by the screening device may bias any observed results toward the null hypothesis

A number of mechanisms could explain the observed association between hearing loss and falls. There may be concomitant dysfunction of both the cochlear and vestibular sense organs given their shared location within the bony labyrinth of the inner ear. Decreased hearing sensitivity may also directly limit access to auditory cues that are needed for environmental awareness. Finally, the association of hearing loss with falls may be mediated through cognitive load and reduced attentional resources. Attentional resources are critical for maintaining postural control [9], and decrements in attentional and cognitive resources imposed by hearing loss [10] may impair the maintenance of postural balance in real-world situations and increase the risk of falling.

A key limitation of our study is that our results are based on cross-sectional data rather than on longitudinal trajectories of hearing loss and fall history over time. Our measure of fall history was also dependent on retrospective self-report. However, our results were generally consistent with other studies [1, 6, 7], and our results demonstrated a robust association between hearing loss and falls after adjustment for multiple confounders.

Further prospective research is needed to determine whether hearing loss is a modifiable risk factor for falls that may be amenable to hearing rehabilitative strategies that remain underutilized.

Acknowledgments

This work was supported by the National Institute on Deafness and Other Communication Disorders (K23DC011279) and a National Institute on Aging Pepper Older Americans Independence Center Research Career Development Award (F.L.).

References

1. Viljanen A, Kaprio J, Pyykko I, et al. Hearing as a predictor of falls and postural balance in older female twins. J Gerontol A Biol Sci Med Sci. Feb; 2009 64(2):312–317. [PubMed: 19182227]
2. Lin FR, Niparko JK, Ferrucci L. Hearing loss prevalence in the United States. Arch Intern Med. 2011 In press.
3. Lin FR, Thorpe R, Gordon-Salant S, Ferrucci L. Hearing Loss Prevalence and Risk Factors Among Older Adults in the United States. J Gerontol A Biol Sci Med Sci. Feb 27.2011
4. Centers for Disease Control and Prevention (CDC). National Center for Health Statistics (NCHS). National Health and Nutrition Examination Survey. Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2010. http://www.cdc.gov/nchs/nhanes.htm/
5. World Health Organization Prevention of Blindness and Deafness (PBD) Program. [Accessed 7/1/2011] Prevention of Deafness and Hearing Impaired Grades of Hearing Impairment. http://www.who.int/pbd/deafness/hearing_impairment_grades/en/index.html
6. Lopez D, McCaul KA, Hankey GJ, et al. Falls, injuries from falls, health related quality of life and mortality in older adults with vision and hearing impairment--is there a gender difference? Maturitas. Aug; 2011 69(4):359–364. [PubMed: 21664773]
7. Baloh RW, Ying SH, Jacobson KM. A longitudinal study of gait and balance dysfunction in normal older people. Arch Neurol. Jun; 2003 60(6):835–839. [PubMed: 12810488]
8. Purchase-Helzner EL, Cauley JA, Faulkner KA, et al. Hearing sensitivity and the risk of incident falls and fracture in older women: the study of osteoporotic fractures. Ann Epidemiol. May; 2004 14(5):311–318. [PubMed: 15177269]
9. Woollacott M, Shumway-Cook A. Attention and the control of posture and gait: a review of an emerging area of research. Gait Posture. Aug; 2002 16(1):1–14. [PubMed: 12127181]
10. Lin FR, Ferrucci L, Metter EJ, An Y, Zonderman AB, Resnick SM. Hearing loss and cognition in the Baltimore longitudinal study of aging. Neuropsychology. Jul 4.2011

Table

Stepwise Logistic Regression Models of the Odds of Self-Reported Falls per 10dB of Hearing Loss, NHANES 2001–4.

	N	Odds of Falling per 10dB of Hearing Loss[b] (95% CI)
Base model (hearing loss only)	2017	1.4*** (1.3–1.5)
Base + Demographic factors[b]	2016	1.5*** (1.3–1.8)
Base + Demographic Factors + Cardiovascular Risk Factors[c]	1999	1.4*** (1.2–1.7)
Base + Demographic Factors + Cardiovascular Risk Factors + Vestibular Balance Function[d]	1674[d]	1.6*** (1.2–1.9)

[a] *** p<0.001

[b] Demographic factors include age, sex, race/ethnicity, and education.

[c] Cardiovascular risk factors include smoking status, diabetes mellitus, hypertension, and stroke

[d] Vestibular balance function was assessed by condition 4 in the Modified Romberg Test of Standing Balance on Firm and Compliant Support Surfaces and was only administered to the 1,684 study participants who passed the 3 prior easier test conditions.