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Financial Disclosure: None reported.
Funding/Support: Dr Manson and colleagues at Brigham and Women's Hospital, Harvard Medical School, are recipients of funding from the National Institutes of Health to conduct the VITamin D and OmegA-3 TriaL (VITAL), a large-scale randomized trial of vitamin D and omega-3s in the prevention of cancer and cardiovascular disease.

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RESEARCH LETTERS

Hearing Loss and Falls Among Older Adults in the United States

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 of a cohort of older Finnish female twins demonstrated a strong association between audiometric hearing loss and incident falls.[1] Possible pathways that could explain this observed association include comcomitant cochlear and vestibular dysfunction, poor awareness of the auditory and spatial environment, or mediation through the effects of hearing loss on cognitive load and shared attention. The latter 2 pathways, which 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 aged 40 to 69 years who participated in the National Health and Nutritional Examination Survey (NHANES).

Methods. The study included participants (age range, 40-69 years) in NHANES (2001-2004) who underwent assessment of audiometric hearing loss and fall history. During this period, a half sample of all adults aged 20 to 69 years underwent audiometric testing, 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, noninstitutionalized US population.[4]

Pure tone audiometry was performed by a trained examiner according to established NHANES protocols (eAppendix [http://www.archinternmed.com]). Hearing loss was defined by a speech-frequency pure tone average of thresholds at 0.5, 1, 2, and 4 kHz in the better-hearing ear according to the definition of hearing loss established 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).

Logistic regression was used to analyze the association between hearing loss and self-reported falling after adjustment 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 guidelines. All analyses were conducted using Stata version 11.1 (StataCorp), and 2-sided *P* values of less than .05 were considered statistically significant.

Results. From 2001 to 2004, a total of 2017 participants aged 40 to 69 years underwent concurrent assessment of hearing loss and fall history in NHANES (eTable). A hearing loss of greater than 25 dB 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 a fall 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 only to those participants with a hearing loss of 40 dB or less (thereby excluding those with a moderate or severe hearing loss) did not affect the magnitude of our results (cf Table).

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Table. Stepwise Logistic Regression Models of the Odds of Self-Reported Falls per 10 dB of Hearing Loss, National Health and Nutritional Examination Survey, 2001-2004

Variable[a]	N	Odds of Falling per 10 dB of Hearing Loss (95% CI)[b]
Base model (hearing loss only)	2017	1.4 (1.3-1.5)
Base + demographic factors	2016	1.5 (1.3-1.8)
Base + demographic factors + cardiovascular risk factors	1999	1.4 (1.2-1.7)
Base + demographic factors + cardiovascular risk factors + vestibular balance function	1674	1.6 (1.2-1.9)

[a] Demographic factors include age, sex, race/ethnicity, and education; cardiovascular risk factors include smoking status, diabetes mellitus, hypertension, and stroke; and vestibular balance function was assessed by condition 4 of the Modified Romberg Test of Standing Balance on Firm and Compliant Support Surfaces and was administered only to the 1684 study participants who passed the 3 prior easier test conditions.

[b] $P < .001$.

Comment. In this nationally representative study of adults aged 40 to 69 years, 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 adjusting 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 3-fold increased odds of reporting a fall 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 used both self-reported[6] and audiometric[1,7] measures of hearing and have demonstrated that hearing loss is associated with balance function[7] and incident falls.[1] In contrast, another longitudinal study did not find similar associations.[8] Potential factors that may limit the consistency of reported results across studies are variability in how hearing loss is measured, variability in cohort characteristics, and variability in how balance and falls are assessed. For example, in studies in which a hearing screening instrument rather than pure tone audiometry is used,[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 a concomitant dysfunction of both the cochlear and the 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 measurement 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 underused.

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Author Contributions: *Study concept and design:* Lin and Ferrucci. *Analysis and interpretation of data:* Lin. *Drafting of the manuscript:* Lin. *Critical revision of the manuscript for important intellectual content:* Ferrucci. *Statistical analysis:* Lin. *Obtained funding:* Lin. *Study supervision:* Ferrucci.

Financial Disclosure: None reported.

Funding/Support: This work was supported by the National Institute on Deafness and Other Communication Disorders (K23DC011279) and by a National Institute on Aging Pepper Older Americans Independence Center Research Career Development Award (Dr Lin).

Online-Only Material: The eAppendix and eTable are available at http://www.archinternmed.com.

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Less Is More

Prescription Drug Use and Self-prescription Among Training Physicians

Although guidelines suggest physicians should not treat themselves, the self-prescription of medications is common.[1] Self-prescription among physicians in training is of particular concern, given their limited clinical experience and high levels of work stress.[2,3] In the only large multicenter study conducted to date, to our knowledge, Christie et al[4] found that self-prescribing is widespread, with 52% of residents self-prescribing medications during their training. Importantly, the most common sources of self-prescribed medications were sample cabinets (42%) and pharmaceutical representatives (11%). In the 13 years since the publication of this study there has been substantial change in the relationship between residency programs and pharmaceutical companies. Thus, it is important to reassess the rates of self-prescription among physicians in training.

Methods. Interns entering internal medicine, general surgery, pediatrics, obstetrics/gynecology, emergency medicine, and psychiatry residency programs during the 2009-2010 and 2010-2011 academic years at 16 US medical centers were invited to take part in the study before the start of the academic year. Interns completed online surveys at 3-month intervals throughout internship year assessing whether prescription medications were used, the class of medications used, and how they were obtained. To allow a direct comparison to previous results, we used the item language developed by Christie et al.[4] All surveys were conducted through a secure Web site designed to maintain confidentiality, with subjects identified only by numbers.

Results. Of 2660 subjects, 1555 (58.5%) agreed to take part in the study. Of these 1555 interns, 1267 (81.5%) completed at least 1 follow-up survey during internship year, 140 (11%) of whom reported using at least 1 prescription medication during internship year. Five interns received medications from multiple sources. Of 145 medications, 73 (50.3%) and 35 (24.1%) were obtained through a personal physician or colleague, respectively, and 11 (7.6%) were self-prescribed. Of the self-prescribed medications, only 2 (18%) were obtained from a sample cabinet. No intern reported obtaining a medication from a pharmaceutical representative. There were no significant differences in age, sex, marital status, specialty, or institution among interns who used prescription medications or self-prescribed medications compared with interns who did not use or self-prescribed medications. The **Table** reports self-prescription rates among the most common classes of medications.

Comment. Our findings suggest that a small proportion of interns use prescription medications during internship, and a small fraction of interns who used medications, self-prescribed them. Encouragingly, the majority of physicians in training are receiving medications through a personal physician or colleague. These findings are in stark contrast to the previously largest study of self-prescribing practices among medical trainees, conducted in 1998, that reported that a majority of medical residents self-prescribed medications.[4] Furthermore, while the earlier study found that sample closets and pharmaceutical representatives were common sources of medications, these sources were rarely used by the subjects in our study. These results suggest that the rate of self-medication has decreased substantially among residents over the past 13 years and that this decrease is largely explained by a decreased use of medications obtained directly from pharmaceutical companies. The increased awareness of industry influence on medical practice and the reduced interaction between medical trainees and pharmaceutical companies may have played a role in this shift. Other changes in graduate

Table. Prescription Drug Use by Class in Present Study and 1998 Study by Christie et al[4]

Medication Class	Self-Prescriptions Rates: Self-Prescriptions/Total Prescriptions (%)		Examples of Medications (Present Study)
	Present Study	Christie et al[4]	
Cardiovascular medications	1/13 (7.7)	4/17 (23.5)	Metoprolol succinate, hydrochlorothiazide, lisinopril
All psychotropic medications	4/72 (5.5)	7/25 (28)	
Antidepressants	4/57 (7.0)	NA	Citalopram hydrobromide, escitalopram oxalate, bupropion hydrochloride, duloxetine hydrochloride
Mood stabilizers	0/2	NA	Lamotrigine
Antipsychotics	0/1	NA	Not reported
Stimulants	0/12	NA	Lisdexamfetamine dimesylate
Allergy and asthma medications	1/47 (2.1)	84/150 (56)	Albuterol, fexofenadine hydrochloride
Antibiotics	0/53	128/232 (55.2)	Ciprofloxacin, doxycycline, rifampin, amoxicillin sodium/clavulanate potassium, metronidazole
Prescription analgesics	0/6	21/38 (55.3)	Not reported
Sedative hypnotics	0/22	NA	Zolpidem tartrate
Other	5/63 (7.9)	8/34 (23.5)	Pantoprazole, esomeprazole magnesium, levothyroxine sodium, clobetasol propionate, ketoconazole, oral contraceptive pills

Abbreviation: NA, data not available.

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