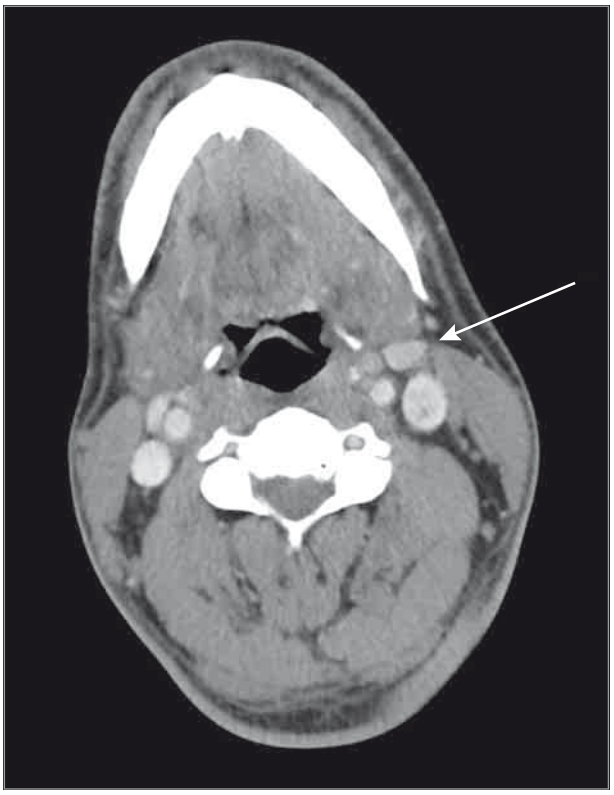
Figure 2. Case 1: Computed Tomographic (CT) Scan



An axial cut from a CT study obtained after the patient's initial surgery and second sestamibi single photon emission computed tomographic (SPECT) series confirmed a mass in the left submandibular gland (arrow).

Discussion | As illustrated by these cases, undescended parathyroid adenomas are challenging to identify with sestamibi studies. When sestamibi studies do not demonstrate uptake in the thyroid bed or mediastinum, careful scrutiny for asymmetry of the submandibular regions is warranted to rule out these lesions. Alternatively, 4-dimensional CT imaging is a useful adjunct for localizing undescended adenomas.[3]

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RESEARCH LETTER

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

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 outcomes. 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 Survey (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 informed written consent was obtained from all participants. Analysis was conducted from March 1 to May 1, 2015.

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;

Table 1. Characteristics of Participants by Category of Hearing Impairment[a]

Characteristic	Hearing Impairment, No. (%)			P Value
	None (n = 527)	Mild (n = 589)	Moderate or More Severe (n = 550)	
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 (62.0)	427 (72.5)	432 (78.5)	<.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)	
Educational level				
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)	.04
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)	.004
Hypertension	351 (66.6)	372 (63.2)	330 (60.0)	.08
Diabetes mellitus	112 (21.3)	141 (23.9)	105 (19.1)	.14
Stroke history	38 (7.2)	62 (10.5)	68 (12.4)	.02
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 ear with better hearing (no impairment, <25 dB; mild impairment, 25 to <40 dB; moderate or more severe impairment, ≥40 dB).

[b] Includes history of myocardial infarction, history of angina, diagnosis of coronary artery disease, or 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	[Reference]	1.54 (1.06-2.25)	2.30 (1.64-3.27)
Base + age	[Reference]	1.27 (0.83-1.95)	1.54 (1.08-2.18)
Base + age, sex, race, education	[Reference]	1.27 (0.87-1.87)	1.41 (0.99-2.02)
Base + demographics + cardiovascular factors (stroke, smoking status, diabetes mellitus, hypertension, cardiovascular disease[b])	[Reference]	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 ear with better hearing (no impairment, <25 dB; mild impairment, 25 to <40 dB; moderate or more severe impairment, ≥40 dB).

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

95% CI, 0.83-1.95), compared with individuals without HI (**Table 2**). After further adjustment for demographic 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) increased 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 cat-

egorical 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.

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Author Contributions: Mr Contrera had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Contrera, Betz, Lin.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Contrera, Betz.
Critical revision of the manuscript for important intellectual content: Contrera, Genther, Lin.
Statistical analysis: All authors.
Obtained funding: Lin.
Study supervision: Lin.

Conflict of Interest Disclosures: Dr Lin reported being a consultant to Cochlear, serving on the scientific advisory board for Autifony and Pfizer, and being a speaker for Med El and Amplifon.

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COMMENT & RESPONSE

Unusual Lacrimal Gland Tumor Epidemiology Explained

To the Editor Mallen-St Clair and colleagues[1] provided a wealth of data in their recent article on the epidemiology and treatment of lacrimal gland tumors. The authors have unfortunately overlooked a flaw in the methods that significantly limits the utility of the data. In the Surveillance, Epidemiology, and End Results Program (SEER) database, tumors of both the lacrimal gland and lacrimal sac are coded C69.5.

This explains the vastly different distribution of malignant lacrimal gland tumors seen in clinical practice and prior series. The authors comment on their surprise to find that squamous cell carcinoma represented almost 30% of the tumors in their series. Indeed, squamous cell carcinoma is the most common (nonlymphoma) malignant tumor of the lacrimal sac.[2] Melanoma, transitional carcinoma, mucoepidermoid carcinoma, and adenocarcinoma follow in frequency.[2] All of these are included in Table 2 as lacrimal gland tumor types. Mucoepidermoid carcinoma and adenocarcinoma do occur both in the lacrimal gland and lacrimal sac. Melanoma is an exceedingly rare primary lacrimal gland tumor, with a single case report in the literature.[3] Transitional epithelium can be seen in the lacrimal sac as elsewhere in the sinonasal tract, but it is not seen in the lacrimal gland.[4] There is a single report[5] of transitional carcinoma of the "lacrimal gland"—a review of the images shows that in fact it was a lacrimal sac tumor.

The amalgamated data are problematic because these are 2 distinct anatomic regions that are treated differently surgically (excision of lacrimal gland or exenteration vs dacryocystectomy and lateral rhinotomy) and with respect to radiation therapy. I hope that the authors are able to apportion the cases anatomically and mend their otherwise excellent study.

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In Reply In our recent study,[1] we surveyed the Surveillance, Epidemiology, and End Results Program (SEER) database to determine the prevalence and determinants of survival of ma-