Title
Association of Hearing Impairment and Emotional Vitality in Older Adults

Journal
The Journals of Gerontology Series B, 71(3)

ISSN
1079-5014

Authors
Contrera, Kevin J
Betz, Josh
Deal, Jennifer A
et al.

Publication Date
2016-05-01

DOI
10.1093/geronb/gbw005

Peer reviewed

THE GERONTOLOGICAL SOCIETY OF AMERICA®

Journals of Gerontology: Psychological Sciences
cite as: *J Gerontol B Psychol Sci Soc Sci*, 2016, Vol. 71, No. 3, 400–404
doi:10.1093/geronb/gbw005
Advance Access publication February 16, 2016

OXFORD

Brief Report

Association of Hearing Impairment and Emotional Vitality in Older Adults

Kevin J. Contrera,[1] Josh Betz,[2] Jennifer A. Deal,[3] Janet S. Choi,[1] Hilsa N. Ayonayon,[4] Tamara Harris,[5] Elizabeth Helzner,[6] Kathryn R. Martin,[7] Kala Mehta,[8] Sheila Pratt,[1,9] Susan M. Rubin,[4] Suzanne Satterfield,[10] Kristine Yaffe,[11,12] Melissa Garcia,[13] Eleanor M. Simonsick,[13] and Frank R. Lin[2,14]; for the Health ABC Study

[1]School of Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland. [2]Center on Aging and Health, Johns Hopkins Medical Institutions, Baltimore, Maryland. [3]Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland. [4]Department of Epidemiology and Biostatistics, University of California, San Francisco. [5]Laboratory of Epidemiology and Population Sciences, National Institute on Aging, Baltimore, Maryland. [6]Department of Epidemiology and Biostatistics, State University of New York Downstate Medical Center, Brooklyn. [7]Institute of Applied Health Sciences School of Medicine and Dentistry, University of Aberdeen, Scotland. [8]Division of Geriatrics, Department of Medicine University of California, San Francisco. [9]Geriatric Research Education and Clinical Center, VA Pittsburgh Healthcare System, Pennsylvania. [10]Department of Preventive Medicine, University of Tennessee Health Science Center, Memphis. [11]Department of Psychiatry and [12]Department of Neurology, University of California, San Francisco. [13]Intramural Research Program, National Institute on Aging, Baltimore, Maryland. [14]Department of Otolaryngology-Head and Neck Surgery, Johns Hopkins University, Baltimore, Maryland.

Correspondence should be addressed to Frank R. Lin, Department of Otolaryngology-Head and Neck Surgery, Johns Hopkins University, 2024 East Monument Street, Suite 2-700, Baltimore, MD 21205. E-mail: flin1@jhmi.edu.

Received October 5, 2015; Accepted January 11, 2016

Decision Editor: Bob G. Knight, PhD

Abstract

Objectives: To better understand the potential impact of hearing impairment (HI) and hearing aid use on emotional vitality and mental health in older adults.

Method: We investigated the cross-sectional association of HI with emotional vitality in 1,903 adults aged 76–85 years in the Health ABC study adjusted for demographic and cardiovascular risk factors. Hearing was defined by the speech frequency pure tone average (no impairment < 25 dB, mild impairment 25–40 dB, and moderate or greater impairment > 40 dB). Emotional vitality was defined as having a high sense of personal mastery, happiness, low depressive symptomatology, and low anxiety.

Results: Compared with individuals with no HI, participants with moderate or greater HI had a 23% lower odds of emotional vitality (odds ratio [OR] = 0.77; 95% confidence interval [CI]: 0.59–0.99). Hearing aid use was not associated with better emotional vitality (OR = 0.98; 95% CI: 0.81–1.20).

Discussion: HI is associated with lower odds of emotional vitality in older adults. Further studies are needed to examine the longitudinal impact of HI on mental health and well-being.

Key Words: Anxiety—Depression—Emotional vitality—Hearing—Mental health—Sensory impairment

The prevalence of hearing loss doubles with every decade of life. By the age of 70, two thirds of adults are hearing impaired (Lin, Niparko, & Ferrucci, 2011). Older adults with hearing loss have been shown to have poorer medical outcomes, including cognitive decline (Lin et al., 2013) and physical disability (Chen, Genther, Betz, & Lin, 2014);

however, limited research has examined the impact of hearing impairment (HI) on mental health and well-being.

Emotional vitality is a complex mental health construct indicating a high level of emotional functioning and well-being (Barbic, Bartlett, & Mayo, 2013). It has been evaluated using a composite assessment of an individuals' anxiety, depression, personal mastery, and happiness (Ble, Volpato, Pacetti, & Zuliani, 2003; Penninx et al., 2000; Pitkala, Laakkonen, Strandberg, & Tilvis, 2004). To our knowledge, the association between HI and emotional vitality has not been studied, although lower emotional vitality has been associated with other deficits, including impaired vision and cognition (Penninx et al., 1998).

In this study, we investigated whether HI, objectively measured with audiometry, was associated with emotional vitality in a population of U.S. community-dwelling older adults followed in the Health, Aging and Body Composition (Health ABC) study. Emotional vitality was assessed using an established research definition based on self-reported measures. We hypothesized that greater HI is associated with lower emotional vitality, independent of demographic and cardiovascular risk factors.

Method

Study Design and Population

We conducted a cross-sectional analysis of data from the Health ABC study, a prospective observational study that enrolled 3,075 well-functioning, community-dwelling older adults aged 70–79 years (76–85 years in Year 6) living in Pittsburgh or Memphis from 1997 to 1998 (previously described) (Simonsick et al., 2001). Our analytic cohort was comprised of individuals who completed audiometric testing administered in Year 5 and emotional vitality assessments measured in Year 6 (n = 1,903). Of those enrolled in the Health ABC study, 1,172 participants were excluded from our analytic cohort for various causes (inability to complete hearing testing [n = 500], death prior to Year 6 [n =378], withdrawal from study prior to Year 6 [n = 12], missed study visit in Year 6 [n = 249], or missing covariates [n = 33]). Compared with the individuals excluded, the analytic cohort was more likely to be younger, white, higher educated, and former smokers. All participants provided informed consent, and the institutional review boards approved this study.

Audiometry

Air conduction thresholds were obtained in each ear from 0.25 to 8 kHz using an audiometer in a soundproof booth. We calculated a speech frequency pure tone average (PTA) using audiometric thresholds at 0.5, 1, 2, and 4 kHz in the better-hearing ear in accordance with the World Health Organization established cutoffs for clinically significant hearing loss (i.e., none < 25 dB, mild 25–40 dB, and moderate or greater > 40 dB) (WHO, 2014).

Emotional Vitality

Based on prior studies of emotional vitality (Barbic et al., 2013; Penninx et al., 1998, 2000), we classified participants as being emotionally vital if they fulfilled the criteria for high personal mastery, happiness, low depressive symptomatology, and low anxiety. Criteria for emotional vitality were measured at Year 6, except happiness (Year 1). Personal mastery was defined using two questions, "Do you often feel helpless?" and "Do you feel you can do anything you set your mind to (Pearlin & Schooler, 1978)?" Answers were provided on a four-level ordinal scale: "strongly disagree," "disagree," "agree," or "strongly agree." Participants were considered to have high personal mastery beliefs if they disagreed or strongly disagreed with feeling helpless and agreed or strongly agreed with feeling they could do anything they set their mind to. Happiness was defined as a self-rating of more than 7 on a scale of 0–10. Low depressive symptomatology was defined as a score ≤ 16 on the validated 20-item Center for Epidemiologic Studies Depression Scale (Radloff, 1977). Low anxiety was based on three questions from the validated Hopkins Symptom Checklist (Parloff, Kelman, & Frank, 1954): "During the past week: 1) have you felt fearful; 2) have you felt nervous/shaky inside; and 3) have you felt tense/keyed up?" These questions were answered on a four-level ordinal scale: "no," "a little," "quite a bit," or "a lot." Low anxiety was defined as having less than two anxiety symptoms rated as "a little" and no symptoms rated as "quite a bit" or "a lot."

Covariates

At enrollment, participants reported their age, sex, race, and educational history. Prespecified algorithms based on self-reported and physician diagnoses, recorded medications, and laboratory data were used to define the presence of hypertension and diabetes mellitus (Lin et al., 2013). Stroke history and smoking status were based on interviewer-administered questionnaires. Hearing aid use was based on interviewer-administered questionnaires.

Statistical Analysis

Baseline characteristics of participants were compared using the Kruskal–Wallis test and Fisher's exact test. The relationship between HI and emotional vitality was analyzed using logistic regression. Models were sequentially adjusted for demographic characteristics (age, sex, race, and education) and cardiovascular risk factors (smoking status, hypertension, diabetes, and stroke). Sensitivity analyses included treating HI as a continuous variable. A two-sided p value less than .05 was considered significant for our statistical question. All analyses were conducted in Stata 12 (StataCorp, College Station, TX).

Results

Our analytic cohort comprised of 1,903 adults characterized in Table 1. Participants with mild HI (n = 710) and moderate

Table 1. Baseline Characteristics of Analytic Cohort

Characteristics	No hearing impairment	Mild hearing impairment	Moderate or greater hearing impairment	*p* Value
	n = 802	*n* = 710	*n* = 391	
Age, mean (*SD*)	73.3 (2.7)	74.0 (2.7)	74.7 (2.9)	<.001
Gender, *n* (%)				<.001
Male	315 (39.3)	348 (49.0)	257 (65.7)	
Female	487 (60.7)	362 (51.0)	134 (34.3)	
Race, *n* (%)				<.001
White	442 (55.1)	465 (71.7)	279 (79.3)	
Black	306 (41.9)	184 (28.4)	73 (20.7)	
Education, *n* (%)				.012
Less than high school	157 (19.6)	143 (20.1)	111 (28.4)	
High school graduate	259 (32.3)	230(32.4)	112 (28.6)	
Some college	386 (48.1)	337 (47.5)	168 (43.0)	
Smoking status, *n* (%)				<.001
Never	406 (50.6)	328 (46.3)	149 (38.1)	
Former	333 (41.5)	338 (47.7)	206 (52.7)	
Current	63 (7.9)	42 (5.9)	36 (9.2)	
Study site, *n* (%)				.002
Memphis, TN	356 (44.4)	361 (50.9)	212 (54.2)	
Pittsburgh, PA	446 (55.6)	349 (49.2)	179 (45.8)	
Hypertension, *n* (%)	503 (62.9)	425 (60.0)	236 (60.5)	.492
Diabetes mellitus, *n* (%)	119 (14.8)	119 (16.8)	73 (18.7)	.222
Stroke history, *n* (%)	11 (1.4)	13 (1.8)	5 (1.3)	.760
Hearing aid use, *n* (%)	6 (0.7)	63 (8.9)	175 (44.8)	<.001
Pure tone average, mean (*SD*)	18.2 (5.0)	32.4 (4.3)	50.4 (9.0)	<.001
Emotional vitality, *n* (%)	436 (54.4)	379 (53.4)	188 (48.1)	.113

Note. 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 impairment 25–40 dB, and moderate or greater impairment ≥ 40 dB).

or greater HI (*n* = 391) were more likely to be older, male, white, less educated, enrolled at the Memphis site, and have a history of smoking than participants with no HI (*n* = 802).

The association between HI and emotional vitality was investigated through logistic regression models adjusted for demographic and cardiovascular risk factors (Table 2). Compared with individuals with no HI, we observed a statistically significant lower odds of emotional vitality in participants with moderate or greater HI (odds ratio [OR]: 0.77; 95% confidence interval [CI]: 0.59–0.99). Sensitivity analysis treating HI as a continuous variable suggested that each 10-dB increase in PTA was associated with a 6% lower odds of emotional vitality (OR = 0.94; 95% CI: 0.88–1.01).

To explore whether hearing aid use was associated with greater emotional vitality, we included hearing aid use as a variable in our final model. Hearing aid use was not associated with emotional vitality (OR = 0.98; 95% CI: 0.81–1.20), and the association between HI and emotional vitality was essentially unchanged (OR = 0.78; 95% CI: 0.59–1.02).

Discussion

Our results demonstrate that moderate or greater HI is associated with emotional vitality in older adults in the United States. Individuals with moderate or greater HI had a 23% lower odds of emotional vitality after adjustment for multiple potential confounders. To our knowledge, this study is the first to examine the relationship between HI and emotional vitality.

Although the relationship of HI to emotional vitality has not been explored, several studies have investigated some of the components of mental health status, especially depression and anxiety from which emotional vitality is derived. Mener and colleagues found no statistically significant association with depression (Mener, Betz, Genther, Chen, & Lin, 2013), whereas Li and colleagues found an association only among older women with moderate or greater HI (Li et al., 2014). A large survey in a Norwegian population identified an association between HI and anxiety only in adults 20–64 years of age (Tambs, 2004). The significant findings observed in this study may suggest that emotional vitality may better capture the cumulative impact of HI on mental health in older adults, versus the individual dimensions of depression or anxiety.

Several mechanisms could explain the observed association between HI and emotional vitality. Demographic factors or microvascular disease could underlie the association (Helzner et al., 2005; Taylor, Aizenstein, & Alexopoulos, 2013).

Table 2. Odds of Emotional Vitality by Hearing Impairment Category

Regression model	No hearing impairment	Mild hearing impairment	Moderate or greater hearing impairment
		OR (95% CI)	OR (95% CI)
Base (age, sex)	Ref	0.95 (0.77, 1.16)	0.73 (0.56, 0.94)
Base + Demographic factors (race and education)	Ref	0.96 (0.78, 1.18)	0.76 (0.59, 0.98)
Base + Demographic factors + Cardiovascular factors (stroke, smoking, diabetes, and hypertension)	Ref	0.97 (0.78, 1.19)	0.77 (0.59, 0.99)

Notes. 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 impairment 25–40 dB, and moderate or greater impairment >40 dB)
CI = confidence interval; OR = odds ratio.

However, our results were adjusted for demographic characteristics and cardiovascular risk factors. Poor communication in individuals with HI (Pinto et al., 2014) could underlie the association with lower emotional vitality through factors such as social isolation (Mick, Kawachi, & Lin, 2014) and sensory deprivation (Gilmartin, Grota, & Sousa, 2013).

In the present study, we did not observe hearing aid use as protective of emotional vitality. However, this study may have been underpowered to detect a statistically significant association and did not include key variables that could influence the strength of association.

Our study has limitations. Although there is no universal definition of emotional vitality, this study used one of the first and most widely accepted criteria for emotional vitality in the literature (Barbic et al., 2013; Penninx et al., 1998, 2000). Still, use of more restrictive or clinically based criteria for emotional vitality could have yielded different results. Likewise, additional confounders could potentially mitigate the relationship between HI and emotional vitality. Data on happiness were only available in Year 1 but was considered to be an appropriate surrogate of happiness in Year 6 due to the stability of happiness over time (Ehrhardt, Saris, & Veenhoven, 2000).

In conclusion, our results demonstrate that moderate or greater HI is associated with lower emotional vitality. As greater attention is focused on the mental health of an aging population, future research is necessary to elucidate the mechanistic pathways between HI and mental health well-being and to determine whether outcomes are improved with hearing rehabilitative therapies.

Funding

This study was funded by the NIH grant K23DC011279; the Eleanor Schwartz Charitable Foundation; the Triological Society; the Johns Hopkins Institute for Clinical and Translational Research; the NIA contracts N01-AG-6-2101, N01-AG-6-2103, and N01-AG-6-2106; the NIA grant R01-AG028050; the NINR grant R01-NR012459; and the NIA Intramural Research Program.

Acknowledgments

F. R. Lin reports being a consultant to Cochlear, on the scientific advisory board for Autifony and Pfizer, and a speaker for Med El and Amplifon.

References

Barbic, S. P., Bartlett, S. J., & Mayo, N. E. (2013). Emotional vitality: concept of importance for rehabilitation. *Archives of Physical Medicine and Rehabilitation*, **94**, 1547–1554. doi:10.1016/j.apmr.2012.11.045

Ble, A., Volpato, S., Pacetti, M., & Zuliani, G. (2003). Emotional vitality and change in lower extremity function after acute medical illness and hospitalization. *Journal of the American Geriatrics Society*, **51**, 1814–1815. doi:10.1046/j.1532–5415.2003.51572_1.x

Chen, D. S., Genther, D. J., Betz, J., & Lin, F. R. (2014). Association between hearing impairment and self-reported difficulty in physical functioning. *Journal of the American Geriatrics Society*, **62**, 850–856. doi:10.1111/jgs.12800

Ehrhardt, J. J., Saris, W. E., & Veenhoven, R. (2000). Stability of life-satisfaction over time. *Journal of Happiness Studies*, **1**, 177–205. doi:10.1023/A:1010084410679

Gilmartin, H. M., Grota, P. G., & Sousa, K. (2013). Isolation: A concept analysis. *Nursing Forum*, **48**, 54–60. doi:10.1111/nuf.12001

Helzner, E. P., Cauley, J. A., Pratt, S. R., Wisniewski, S. R., Zmuda, J. M., Talbott, E. O., … Newman, A. B. (2005). Race and sex differences in age-related hearing loss: The Health, Aging and Body Composition Study. *Journal of the American Geriatrics Society*, **53**, 2119–2127. doi:10.1111/j.1532-5415.2005.00525.x

Li, C. M., Zhang, X., Hoffman, H. J., Cotch, M. F., Themann, C. L., & Wilson, M. R. (2014). Hearing impairment associated with depression in US adults, National Health and Nutrition Examination Survey 2005–2010. *JAMA Otolaryngology—Head & Neck Surgery*, **140**, 293–302. doi:10.1001/jamaoto.2014.42

Lin, F. R., Niparko, J. K., & Ferrucci, L. (2011). Hearing loss prevalence in the United States. *Archives of Internal Medicine*, **171**, 1851–1852. doi:10.1001/archinternmed.2011.506

Lin, F. R., Yaffe, K., Xia, J., Xue, Q. L., Harris, T. B., Purchase-Helzner, E., … Simonsick, E. M. (2013). Hearing loss and

cognitive decline in older adults. *JAMA Internal Medicine*, **173**, 293–299. doi:10.1001/jamainternmed.2013.1868

Mener, D. J., Betz, J., Genther, D. J., Chen, D., & Lin, F. R. (2013). Hearing loss and depression in older adults. *Journal of the American Geriatrics Society*, **61**, 1627–1629. doi:10.1111/jgs.12429

Mick, P., Kawachi, I., & Lin, F. R. (2014). The association between hearing loss and social isolation in older adults. *Otolaryngology Head and Neck Surgery*, **150**, 378–384. doi:10.1177/0194599813518021

World Health Organization. (2014). Grades of hearing impairment. *Prevention of blindness and deafness*. Retrieved from http://www.who.int/pbd/deafness/hearing_impairment_grades/en/

Parloff, M. B., Kelman, H. C., & Frank, J. D. (1954). Comfort, effectiveness, and self-awareness as criteria of improvement in psychotherapy. *The American Journal of Psychiatry*, **111**, 343–352. doi:10.1176/ajp.111.5.343

Pearlin, L. I., & Schooler, C. (1978). The structure of coping. *Journal of Health and Social Behavior*, **19**, 2–21. Retrieved from http://www.jstor.org/stable/2136319

Penninx, B. W., Guralnik, J. M., Bandeen-Roche, K., Kasper, J. D., Simonsick, E. M., Ferrucci, L., & Fried, L. P. (2000). The protective effect of emotional vitality on adverse health outcomes in disabled older women. *Journal of the American Geriatrics Society*, **48**, 1359–1366. doi:10.1111/j.1532–5415.2000.tb02622.x

Penninx, B. W., Guralnik, J. M., Simonsick, E. M., Kasper, J. D., Ferrucci, L., & Fried, L. P. (1998). Emotional vitality among disabled older women: The Women's Health and Aging Study. *Journal of the American Geriatrics Society*, **46**, 807–815. doi:10.1111/j.1532–5415.1998.tb02712.x

Pinto, J. M., Kern, D. W., Wroblewski, K. E., Chen, R. C., Schumm, L. P., & McClintock, M. K. (2014). Sensory function: Insights from Wave 2 of the National Social Life, Health, and Aging Project. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, **69**(Suppl. 2), S144–S153. doi:10.1093/geronb/gbu102

Pitkala, K. H., Laakkonen, M. L., Strandberg, T. E., & Tilvis, R. S. (2004). Positive life orientation as a predictor of 10-year outcome in an aged population. *Journal of Clinical Epidemiology*, **57**, 409–414. doi:10.1016/j.jclinepi.2003.07.013

Radloff, L. S. (1977). The CES-D scale a self-report depression scale for research in the general population. *Applied Psychological Measurement*, **1**, 385–401. doi:10.1177/014662167700100306

Simonsick, E. M., Newman, A. B., Nevitt, M. C., Kritchevsky, S. B., Ferrucci, L., Guralnik, J. M., & Harris, T. (2001). Measuring higher level physical function in well-functioning older adults: Expanding familiar approaches in the Health ABC study. *The Journals of Gerontology, Series A: Biological Sciences*, **56**, M644–M649. doi:10.1093/gerona/56.10.M644

Tambs, K. (2004). Moderate effects of hearing loss on mental health and subjective well-being: Results from the Nord-Trøndelag Hearing Loss Study. *Psychosomatic Medicine*, **66**, 776–782. doi:10.1097/01.psy.0000133328.03596.fb

Taylor, W. D., Aizenstein, H. J., & Alexopoulos, G. S. (2013). The vascular depression hypothesis: Mechanisms linking vascular disease with depression. *Molecular Psychiatry*, **18**, 963–974. doi:10.1038/mp.2013.20