Archives of Gerontology and Geriatrics 83 (2019) 101–105

Contents lists available at ScienceDirect

Archives of Gerontology and Geriatrics

journal homepage: www.elsevier.com/locate/archger

Association between self-reported hearing impairment, use of a hearing aid and performance of instrumental activities of daily living☆

Miguel Germán Borda[a,b,c], Carlos A. Reyes-Ortiz[e], Rodrigo Alberto Heredia[c,d], Nicolás Castellanos-Perilla[c], Ana Maria Ayala Copete[c], Hogne Soennesyn[a], Carlos Alberto Cano-Gutierrez[c,d], Mario Ulises Perez-Zepeda[c,f,g,*]

[a] Centre for Age-Related Medicine (SESAM), Stavanger University Hospital, Stavanger, Norway
[b] Faculty of Health Sciences, University of Stavanger, Stavanger, Norway
[c] Semillero de Neurociencias y Envejecimiento, Ageing Institute, Medical School, Pontificia Universidad Javeriana, Bogotá, Colombia
[d] Geriatrics Unit, Hospital Universitario San Ignacio, Bogotá, Colombia
[e] Department of Internal Medicine, Division of Geriatric and Palliative Medicine, University of Texas Health Science Center at Houston, Houston, USA
[f] Geriatric Epidemiology Research Department, Instituto Nacional De Geriatría, México City, Mexico
[g] Geriatric Medicine Research Unit, Department of Medicine, Dalhousie University, Halifax, Nova Scotia, Canada

ARTICLE INFO

Keywords:
Aged
Hearing loss
Hearing aid
Functionality
Older adult care
Disability

ABSTRACT

Background and purpose: Age-related hearing loss is a prevalent condition among the growing elderly population, which has been associated with both cognitive decline and decreased daily functioning. Decreased functioning is linked to lower performance, predominantly regarding instrumental activities of daily living (IADLs). The present study aims to explore the association between hearing loss and impairment in IADLs.

Methods: This is a secondary analysis of The Health, Well-Being, and Aging Colombia study, performed in 2015. Participants were classified into three groups: 1) without hearing loss, 2) hearing loss corrected through the use of a hearing aid, and 3) hearing loss without a hearing aid. Bivariate and adjusted multivariate analyses were performed. The measured outcome was IADLs.

Results and discussion: Information from a total of 23,694 community-dwelling Colombian older adults (age ≥ 60 years) was used. The prevalence of hearing impairment was 23.4%, 1.8% out of those reported the use of hearing aids. Independent associations were found for having impaired IADLs when comparing participants with hearing loss without a hearing aid and those with normal hearing. However, there was no statistical significance with respect to IADLs when comparing hearing loss corrected by hearing aids versus participants with normal hearing. Participants using hearing aids have better functioning evaluated by IADLs when compared with participants with hearing impairment and no hearing aids.

Conclusion: This study evidences a positive association between hearing impairment and performance in the IADLs. This association is not significant in older adults using hearing aids

1. Introduction

Demographic transition has created a challenge for current healthcare providers regarding the specific needs of the aged population, due to a higher prevalence of chronic diseases and geriatric syndromes (Cano, Borda, Arciniegas, & Parra, 2014; Lee, 2003). Impairment in sense organs, such as hearing loss is an issue with great impact, which affects nearly 360 million people worldwide (Díaz, Goycoolea, & Cardemil, 2016; Who.int, 2018). Of these, approximately 164 million are people above the age of 65. Hearing loss is a prevalent condition in the older adults. It affects about one-third of the population and is associated to both cognitive and functional decline (Lin, Metter et al., 2011; Lin, Thorpe, Gordon-Salant, & Ferrucci, 2011). Thus, its assessment and therapeutic approach become relevant matters (Who.int,

☆ The manuscript reflects work has not been previously presented at any scientific meeting.

* Corresponding author at: Geriatric Epidemiology Research Department, Instituto Nacional De Geriatría, Bulevar Adolfo López Mateo 2767, Jardines del Pedregal, Magdalena Contreras, 10200, Ciudad de México, D.F., Mexico.

E-mail addresses: Carlos.A.ReyesOrtiz@uth.tmc.edu (C.A. Reyes-Ortiz), herediar@javeriana.edu.co (R.A. Heredia), nicolascastellanos@javeriana.edu.co (N. Castellanos-Perilla), anaayala@javeriana.edu.com (A.M. Ayala Copete), hogne.sonnesyn@sus.no (H. Soennesyn), ccano@javeriana.edu.co (C.A. Cano-Gutierrez), mperez@inger.gob.mx, ulises.perez@salud.gob.mx (M.U. Perez-Zepeda).

https://doi.org/10.1016/j.archger.2019.04.001
Received 22 February 2019; Received in revised form 1 April 2019; Accepted 5 April 2019
Available online 06 April 2019

2018).

Hearing loss has been related to poor scores regarding instrumental activities of daily living (IADLs), which tend to be affected before basic activities of daily living (ADLs) since the former are more complex to perform and are thus more vulnerable to impairment. Hearing loss has also been associated to cognitive decline, falls, social isolation, poor quality of life and mortality (Dalton et al., 2003; Heine & Browning, 2002; Lin, Metter et al., 2011; Lin, Thorpe et al., 2011; Skrzypek, Sekula, Derylo, Kuśmierczyk, & Talar, 2014; Viljanen et al., 2009). Nonetheless, the impairment of IADLs related to hearing loss might potentially be reduced (Cardemil, Aguayo, & Fuente, 2014; Lin, Thorpe et al., 2011). However, we face the problem that hearing loss is often seen as normal in the elderly, and interventions are not widely available, patient education and strict follow up for their correct use are still lacking (Guerra-Zuniga, Cardemil-Morales, Albertz-Arevalo, & Rahal-Espejo, 2014).

This paper aims to explore the association between hearing loss and the usage of hearing aids with impairment in IADLs.

2. Methods

2.1. Setting and participants

This is a secondary analysis of The Health, Well-Being, and Aging (SABE) Colombia study, performed in 2015 with a representative sample of community-dwelling Colombian older adults (age ≥ 60 years), which aims to determine the factors that characterize aging in this country (Albala et al., 2005). As of 2018, this was the largest database available for Latin American older adults. A set of questionnaires from different topics (socio-demographic characteristics, health-related issues, access to health services, cognitive performance, functional status, and financial resources) was applied to all the participants by interviewers at the older adult's household. 23,694 older adults were surveyed for an effective national response rate of 66%. Complete methodology, processes and objectives are available elsewhere (Sindhusake et al., 2001).

The population was divided into three groups:

Group 1: Participants without hearing loss

Group 2: Participants with hearing loss corrected by the use of a hearing aid

Group 3: Participants with hearing loss and not using a hearing aid.

2.2. Variables

2.2.1. Dependent variable

Hearing loss was assessed through self-report. Participants were asked ´´*Do you have hearing problems?* ´´ (Dichotomous answer: Yes, or No). This question has been validated in previous studies as a surrogate for audiometry with adequate specificity and sensitivity (Gomez, Corchuelo, Curcio, Calzada, & Mendez, 2016).

2.2.2. Independent variables

IADLs were assessed through the question: "*Can you perform the following activities without help from anyone*?" Answer options were binary: *capable to perform the tasks alone (It included those which perform the activities alone without no difficulties or those who perform the activities alone with difficulty); and Not able to do it alone (It included those which perform the activities with any kind of help or those who cannot perform the activity)*. The following IADLs were included:

1) Able to manage own finances
2) Capable of making daily purchases (especially food)
3) Able to prepare food
4) Able to manage own medications
5) Use of public transportation or taxi
6) Telephone use

Answers were further codified as 0 if the individual was able to perform the task alone (either with or without difficulty) and 1 if he/she was not able to perform the task by her/himself. A summary score was also created ranging between 0 and 6; a higher score reflected a greater impairment in IADL´s; meaning that the older adult could not perform alone any of the 6 IADL´s

2.3. Confounding variables

We included sociodemographic factors (age in years, gender and years of schooling), visual deficit (assessed by self-report with the question "*How would you describe your vision?)*, and chronic diseases (hypertension, diabetes, COPD, stroke, myocardial infarction, arthritis, and cancer). In order to further capture the burden of chronic disease, a summary score was created, summing up each individual disease, categorizing the subjects into three categories: no chronic disease, only one disease and multimorbid (≥2-chronic diseases). Evidence suggest that multimorbidity accounts more efficiently for the impact in global health in older adults, than individual entities. Finally, cognitive impairment was measured through the modified Mini Mental State Examination (scores < 13 were the cut-off value for defining cognitive impairment) (Icaza & Albala, 1999).

2.4. Statistical analysis

A descriptive analysis was performed with the previously listed variables, by estimating relative and absolute frequencies for nominal variables; and means ± standard deviations (SD) for continuous variables. Afterwards, a bivariate analysis was performed; the Chi-square test was used for categorical variables, and t-tests were used for continuous variables. Finally, in the multivariate analysis, logistic regression models were fitted in order to obtain odds ratios (OR) with 95% confidence intervals (CIs) comparing the groups according to their performance in IADLs, this was done by using group 1 (no hearing impairment) as the reference group and later on group 2 when compared with group 3. An additional linear regression model was built to obtain adjusted means (with 95% CI) for the total IADLs score stratified by the above hearing category groups. The statistical level of significance was set at $p < 0.050$. Data was analyzed using STATA 14® software.

2.5. Ethical issues

The Institutional Review Boards of Ethics Committees of Pontificia Universidad Javeriana approved this study. The rights of human participants were protected.

3. Results

Of a total of 23,694 older adults, 21.6% reported having hearing problems, from which only 8.1% reported using hearing aids (1.8% of the total sample). 54.9% of the participants were between the ages of 60 and 70 years, and 57% were women. About a quarter of the sample had no formal schooling, 52.6% had visual decline, and 19.8% had cognitive impairment (Table 1). Bivariate analyses showed significant differences in IADLs when classified by hearing loss categories, were Group 3 had a greater impairment for IADLs than the other groups. The presence of impaired IADLs was also associated with older age, female gender (except for phone use and medication management), lower schooling (0 years of education), high comorbidity, cognitive and visual decline (Table 1).

Logistic regression analysis displayed no statistically significant differences after adjustment for confounding variables when comparing Group 1 against Group 2 (Table 2).

On the other hand, there was an overall statistically significant difference between Group 3 and Group 1 for each of the IADLs. ORs

Table 1
Bivariate analysis.

	Use of public transportation or taxi	Manage their own money	Able to prepare food	Capable of doing daily purchases (especially food)	Manage their own medications	Use of the telephone	Total
	n (%) p-value						
Female	3078 (73.1) < .001	1107 (69.1) < .001	1227 (39.7) < .001	1897 (68.4) < .001	1700 (58.6) 0.137	2481 (58.0) 0.289	13852 (57.3)
High comorbidity	2315 (55.0) < .001	839 (52.4) < .001	1504 (48.7) < .001	1533 (55.3) < .001	1485 (51.2) < .001	1754 (41.0) < .001	8962 (37.8)
Group 1	3170 (64.9) < .001	1100 (61.1) < .001	2070 (62.6) < .001	1811 (61.5) < .001	1954 (61.0) < .001	3060 (65.4) < .001	18157 (76.6)
Group 2	115 (2.4)	30 (1.7)	79 (2.4)	69 (2.4)	55 (1.7)	73 (1.6)	416 (1.8)
Group 3	1598 (32.7)	671 (37.2)	1157 (35.0)	1063 (36.1)	1194 (37.3)	1544 (33.0)	5121 (21.6)
Age							
60-70	1187 (24.3) < .001	431 (23.9) < .001	807 (24.4) < .001	583 (19.8) < .001	833 (26.0) < .001	1390 (29.7) < .001	13011 (54.9)
71-80	1762 (36.1)	560 (31.1)	1092 (33.0)	955 (32.5)	1040 (32.5)	1688 (36.1)	7346 (31.0)
> 80	1934 (39.6)	810 (45.0)	1407 (42.6)	1405 (47.7)	1330 (41.5)	1599 (34.2)	3337 (14.1)
MMSE < 13	2546 (52.1) < .001	1247 (69.2) < .001	1829 (55.3) < .001	1866 (63.4) < .001	2086 (65.1) < .001	2564 (54.8) < .001	4690 (19.8)
Visual decline	1711 (35.0) < .001	411 (22.8) < .001	1043 (31.5) < .001	826 (28.1) < .001	852 (26.6) < .001	1506 (32.2) < .001	12472 (52.6)
Schooling							
0 years	1748 (35.8) < .001	781 (39.9) < .001	1129 (34.1) < .001	1034 (35.1) < .001	1357 (42.4) < .001	2097 (44.8) < .001	6228 (26.3)
1-5 years	2596 (53.2)	888 (49.3)	1724 (52.2)	1558 (52.9)	1555 (48.5)	2268 (48.5)	13.011 (54.9)
6-12 years	385 (7.9)	124 (6.9)	312 (9.4)	247 (8.4)	189 (5.9)	215 (4.6)	3312 (14.0)
> 12 years	154 (3.1)	71 (3.9)	141 (4.3)	104 (3.6)	102 (3.2)	97 (2.1)	1143 (4.8)

Activities for which help is required, or the person is not able to perform *Group 1: Participants without hearing loss, Group 2: Participants with hearing loss corrected by the use of a hearing aid, Group 3: Participants with hearing loss not using a hearing aid.

Table 2
Multivariate analysis.

Activities	Managing transportation	Managing own finances	Able to prepare food	Making daily purchases (especially food)	Managing their own medications	Telephone usage
	OR (95% CI) p-value					
Unadjusted						
Group 2 vs group 1	1.81 (1.45 - 2.25) < .001	1.20 (0.83 - 1.76) 0.33	1.82 (1.42 - 2.34) < 0.001	1.79 (1.38 - 2.33) < 0.001	1.26 (0.95 - 1.69) 0.111	1.05 (0.81 - 1.35) 0.708
Group 3 vs group 1	2.14 (2.00 - 2.30) < .001	2.34 (2.11 - 2.59) < 0.001	2.27 (2.09 - 2.46) < 0.001	2.36 (2.17 - 2.57) < 0.001	2.52 (2.33 - 2.73) < 0.001	2.13 (1.98 - 2.29) < 0.001
Group 3 vs group 2	1.19 (0.95 - 1.48) 0.131	1.94 (1.33 - 2.83) < 0.001	1.24 (0.97 - 1.60) < 0.090	1.32 (1.01 - 1.72) 0.043	1.99 (1.49 - 2.67) < 0.001	2.03 (1.56 - 2.62) < 0.001
Adjusted						
Group 2 vs group 1	1.27 (0.98 - 1.64) 0.073	0.86 (0.57 - 1.30) 0.470	1.03 (0.77 - 1.37) 0.87	1.12 (0.81 - 1.52) 0.5	0.91 (0.66 – 1.26) 0.581	0.87 (0.65 - 1.16) 0.348
Group 3 vs group 1	1.39 (1.27 - 1.51) < .001	1.47 (1.31 - 1.65) < 0.001	1.29 (1.17 - 1.42) < 0.001	1.39 (1.25 - 1.54) < .0001	1.64 (1.49 - 1.80) < 0.001	1.52 (1.40 - 1.66) < 0.001
Group 3 vs group 2	1.10 (0.84 - 1.43) 0.489	1.72 (1.13 - 2.60) 0.011	1.26 (0.94 - 1.69) 0.12	1.25 (0.91 - 1.71) 0.172	1.80 (1.29 - 2.50) < 0.001	1.75 (1.31 - 2.33) < 0.001

*Multivariate analyses before and after adjustment for: age, years of schooling, sex, cognitive and visual decline and comorbidities.
*Group 1: Participants without hearing loss, Group 2: Participants with hearing loss corrected by the use of a hearing aid, Group 3: Participants with hearing loss not using a hearing aid.

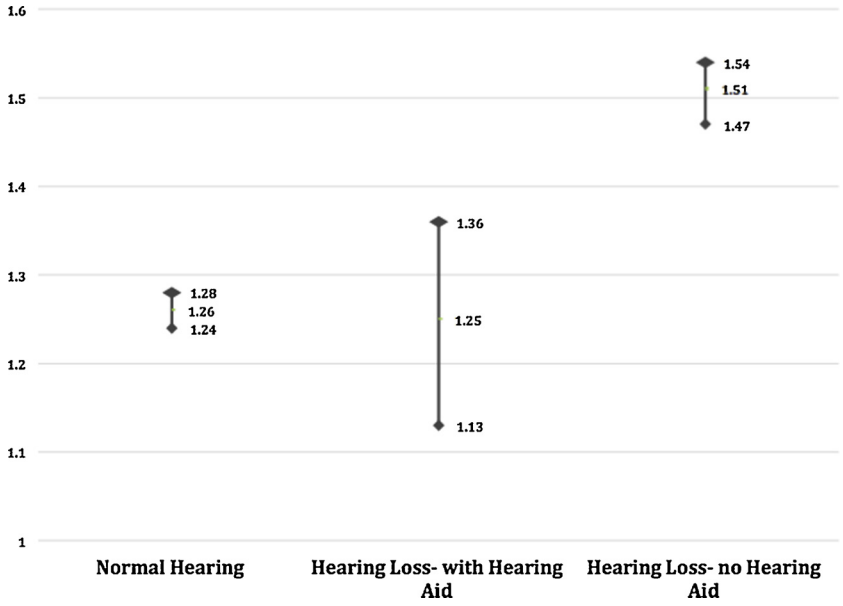

Fig. 1. Adjusted Mean IADLs Scores with 95% CI by Hearing Category.

ranged between 1.29 (95% CI 1.17–1.42, $p < 0.001$) and 1.64 (95% CI 1.49–1.80, $p < 0.001$), for being able to prepare food and managing their own medications, respectively. Finally, when comparing Group 3 against Group 2 there was a significant association with impaired IADLs regarding telephone usage (OR 1.75 95% CI 1.31–2.33, p-value < 0.001), taking medications (OR 1.80 95 CI 1.29–2.50, $p < 0.001$), and managing finances (OR 1.72 95% CI 1.13–2.60, $p = 0.011$).

Group 3, those with hearing loss and not using a hearing aid, had a significantly higher mean IADLs total score when compared with the other groups ($p < 0.001$) even after adjusting for age, gender, visual decline, cognitive impairment and high comorbidity (Fig. 1).

4. Discussion

In this study, we found a prevalence of 21.6% for hearing loss in Colombia, among which only 8.1% used hearing aids. A previous cross-sectional study carried out in Bogotá, Colombia, reported a lower prevalence of hearing loss (13.4%) with a higher proportional rate of hearing aid usage (15%) in comparison to the prevalence found in this country-wide cross-sectional study (Cano et al., 2014). We could argue that the higher use of hearing aids may be explained by better access to health in Bogotá, which is the city capital of Colombia, as seen in other Latin American countries with similar social conditions and access to healthcare.

Moreover, we found an independent association between hearing loss and impairment in IADLs such as telephone usage, managing finances and medications, the ability of taking public transportation, making purchases and preparing food. There was an overall statistically significant difference for all of the IADLs when comparing Group 3 (those with hearing loss not using a hearing aid) against Group 1 (those with no hearing loss), reflecting the impact this condition has on disability in older adults. Even after adjusting our analysis for potential confounders the differences remained statistically significant in a consistent manner along the examined activities.

Previous studies have found independent associations between hearing loss and functional disability measured by ADL, cognitive function and quality of life (Gobbens, 2018; Gopinath et al., 2012). The performance of IADLs in our sample is affected by hearing impairment, since less than 9% of those with said condition were using hearing aids at the time the study took place. Although age-related hearing loss has no known cure (Davis et al., 2016), we demonstrate that the use of hearing aids may have an impact in functionality measured by IADLs. Our results suggest that use of hearing aids could be associated to better performance of IADLs. As shown, after adjustment there were no statistically significant differences in IADLs when comparing people with hearing loss corrected by the use of hearing aids (group 2) against participants without hearing loss (group 1), pointing to the fact that individuals with a support device could perform as well as those without hearing impairment.

Our study has some limitations to disclose, that warrants a careful interpretation of our results. This is a cross-sectional study; therefore, causality cannot be determined. Self-report is one of the main issues, leading to memory bias, and under-diagnosis of assessed conditions. It is a secondary analysis from a study not designed specifically for solving our hypothesis. For the original design of the SABE study there is lack of information regarding the duration and severity of the hearing impairment, and duration of hearing aids use, which in turn could possibly bias our findings. Residual confounding is always a concern in association studies, we acknowledge that variables such as depressive symptoms or locus of control could have some impact over the strength of the reported association, our results should be interpreted with caution regarding this matter. Finally, the available information did not allow us to determine the intensity or duration of the hearing loss problem. On the other hand, our study has some strengths, including the fact the data was taken from a representative sample of a whole country in the Latin American region. Furthermore, our results are consistent and provide relevant information for health care providers regarding a prevalent condition that is potentially amenable to intervention. Thus, prevention of disability and recovery of function in older persons seem a likely possibility.

5. Conclusion

Our results are consistent with previous findings and support the need for an appropriate treatment of hearing loss in older adults. We highlight the potential effect of hearing aids for improving performance of IADLs. However, longitudinal studies are required. Also, further evidence regarding this matter should be sought in other populations as well, aiming to produce tools for enhancing well-being of older adults.

Declarations of interests

None.

Source of funding

The Health, Well-Being, and Aging (SABE) Colombia study was supported by a fund (2013, no. 764) from Colciencias y Ministerio de Salud y la Protección Social de Colombia.

Acknowledgements

We thank to all the members of the student research group: Semillero de Neurociencias y Envejecimiento from the Pontificia Universidad Javeriana. Bogotá, Colombia.

References

Albala, C., Lebrao, M. L., Leon Diaz, E. M., Ham-Chande, R., Hennis, A. J., Palloni, A., et al. (2005). The Health, Well-Being, and Aging ("SABE") survey: Methodology applied and profile of the study population. *Revista panamericana de salud publica = Pan American journal of public health, 17*, 307–322.

Cano, C. A., Borda, M. G., Arciniegas, A. J., & Parra, J. S. (2014). Hearing disorders in elderly people, associated factors and quality of life: SABE Study, Bogota, Colombia. *Biomedica: Journal of the National Institute of Health, 34*, 574–579.

Cardemil, F., Aguayo, L., & Fuente, A. (2014). Auditory rehabilitation programmes for adults: What do we know about their effectiveness? *Acta Otorrinolaringologica Espanola, 65*(4), 249–257. https://www.ncbi.nlm.nih.gov/pubmed/24602838.

Dalton, D. S., Cruickshanks, K. J., Klein, B. E., Klein, R., Wiley, T. L., & Nondahl, D. M. (2003). The impact of hearing loss on quality of life in older adults. *Gerontologist, 43*, 661–668.

Davis, A., McMahon, C. M., Pichora-Fuller, K. M., Russ, S., Lin, F., & Olusanya (2016). Aging and hearing health: The life-course approach. *Gerontologist. 56*, S256–S267.

Díaz, C., Goycoolea, M., & Cardemil, F. (2016). Hypoacusia: Transcendence, incidence and prevalence. *Medical Journal Las Condes Clinic, 27*, 731–739.

Gobbens, R. (2019). Associations of ADL and IADL disability with physical and mental dimensions of quality of life in people aged 75 years and older. *PeerJ, 2018*(6), e5425.

Gomez, F., Corchuelo, J., Curcio, C. L., Calzada, M. T., & Mendez, F. (2016). SABE colombia: Survey on health, well-being, and aging in Colombia – Study design and protocol. *Current Gerontology and Geriatrics Research, 2016*.

Gopinath, B., Schneider, J., McMahon, C. M., Teber, E., Leeder, S. R., & Mitchell, P. (2012). Severity of age-related hearing loss is associated with impaired activities of daily living. *Age and Ageing, 41*(2), 195–200.

Guerra-Zuniga, M., Cardemil-Morales, F., Albertz-Arevalo, N., & Rahal-Espejo, M. (2014). Explanations for the non-use of hearing aids in a group of older adults. A qualitative study. *Acta Otorrinolaringologica Espanola, 65*, 8–14.

Heine, C., & Browning, C. J. (2002). Communication and psychosocial consequences of sensory loss in older adults: Overview and rehabilitation directions. *Disability and Rehabilitation, 24*, 763–773.

Icaza, M., & Albala, C. (1999). *Minimental State Examinations (MMSE) del estudio de demencia en Chile: Analisis estadistico.* Washington, D.C.

Lee, R. (2003). The demographic transition: Three centuries of fundamental change. *The Journal of Economic Perspectives, 17*, 167–190.

Lin, F. R., Metter, E. J., O'Brien, R. J., Resnick, S. M., Zonderman, A. B., & Ferrucci, L. (2011). Hearing loss and incident dementia. *Archives of Neurology, 68*, 214–220.

Lin, F. R., Thorpe, R., Gordon-Salant, S., & Ferrucci, L. (2011). Hearing loss prevalence and risk factors among older adults in the United States. *The Journals of Gerontology Series A, Biological Sciences and Medical Sciences, 66*, 582–590.

Sindhusake, D., Mitchell, P., Smith, W., Golding, M., Newall, P., Hartley, D., et al. (2001). Validation of self-reported hearing loss. The blue mountainshearing study. *International Journal of Epidemiology, 30*(6), 1371–1378.

Skrzypek, A., Sekula, A., Derylo, M. B., Kuśmierczyk, J., & Talar, M. (2014). The assessment of hearing impairment in patients over 60 years of age using hearing aids. *Otolaryngologia Polska = the Polish Otolaryngology, 68*, 25–29.

Viljanen, A., Kaprio, J., Pyykko, I., Sorri, M., Pajala, S., Kauppinen, M., et al. (2009). Hearing as a predictor of falls and postural balance in older female twins. *The Journals of Gerontology Series A, Biological Sciences and Medical Sciences, 64*, 312–317.

Who.int (2018). *Hearing loss in persons 65 years and older based on WHO global estimates on prevalence of hearing loss*.