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Self-reported hearing loss and cognitive impairment: a cross-sectional analysis of the EpiFloripa Aging study

Perda auditiva autorreferida e comprometimento cognitivo: análise transversal do estudo EpiFloripa Idoso

Pérdida auditiva autorreportada y deterioro cognitivo: análisis transversal del estudio EpiFloripa Anciano

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Abstract

This study aimed to investigate the association between self-reported hearing loss and cognitive impairment in older adults in a city in Southern Brazil. In this cross-sectional, population-based cohort study of older adults, data were collected in the third wave of the EpiFloripa Aging study (2017/2019), which had been performed since 2009 in the city of Florianópolis, Santa Catarina State. Cognitive impairment was the dependent variable analyzed by the Mini-Mental State Examination *(MMSE), and self-reported hearing loss, which was included in the cohort only in the last wave, was the main exposure variable. Logistic regression analyses were conducted, considering the study design and sample weights. Data from 1,335 older adults were evaluated. The prevalence was 20.5% for cognitive impairment and 10.7% for hearing loss. Older adults with hearing loss were 2.66 (95%CI: 1.08-6.54) times more likely to have cognitive impairment than older adults without hearing loss. The association between hearing loss and cognitive impairment highlights the need to integrate the early identification of these problems into primary care, as both are risk factors for healthy aging and potentially preventable and/or treatable conditions.*

Primary Health Care; Telemedicine; Costs and Cost Analysis; Public Health Systems; Emergency Medical Services

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Introduction

The decade from 2021 to 2030 was named the Decade of Healthy Aging by the United Nations General Assembly, since the number of older adults is expected to increase by 34%, representing 1.4 billion individuals worldwide [1]. Most older adults live in developing countries, thus, this population will grow more rapidly in these countries (from 652 million in 2017 to 1.7 billion in 2050), while in more developed countries, the increase will be from 310 to 427 million [2]. Projections show that the global older population will have more than doubled by 2050, reaching 2.1 billion, and nearly 80% of them will live in less developed countries [2].

Following the growth of the older population, age-related hearing loss has also been increasing [3]. One in five people (1.57 billion) worldwide is expected to have hearing loss, of which 62.1% are aged over 50 years. By 2050, hearing loss will affect 2.45 billion people of all ages, representing an increase of 56.1%, with stable age-standardized prevalence [3].

Even with a significant prevalence of hearing loss, hearing aid use is at an early stage in most countries [3,4]. In the United States, about two-thirds of adults aged 70 years or older have clinically significant hearing loss [5], but only 17% to 22% wear hearing aids [6]. In China, 67.2% of older adults (> 65 years) have hearing loss, but only 6.9% use hearing aids [7]. In Australia, a study showed that 33% of this population have hearing loss, but only 11% use hearing aids [8].

Knowledge about these health needs becomes even more important in low- and middle-income countries. However, these data are scarce due to insufficient access to technological, physical, and/or human resources for diagnosis in these locations [3,9].

With population aging and the increase in the number of individuals with hearing loss, the demand for hearing health services, which are already insufficient worldwide, will grow even more [9]. Therefore, projections of the number of individuals with hearing loss can help develop appropriate public policies for planning and meeting future health needs [5]. Besides its high prevalence, age-related hearing loss is associated with several adverse outcomes that can affect communication, quality of life, and cognitive function [3,9,10].

Hearing loss was identified as an important modifiable risk factor for dementia, accounting for about 8.2% of cases [11]. A recent study estimated the proportion of dementia cases attributable to nine risk factors (poor early childhood education, hearing loss in middle age, hypertension, obesity, smoking, depression, sedentary lifestyle, social isolation, and diabetes) in low- and middle-income countries [12]. It was found that these risk factors are more common and, therefore, the potential for dementia prevention is greater compared with high-income countries [12].

However, most studies on the association between hearing loss and cognitive function (or dementia) were performed in high-income countries [13,14,15]. Thus, studies on this topic in low- and middle-income countries are required. This type of research can fill gaps in health needs in these countries, besides supporting the need to develop measures for future hearing and cognitive screening aimed at early identification of these problems for better health care for older adults.

Thus, this study aimed to investigate the association between self-reported hearing loss and cognitive impairment in older adults in a city in Southern Brazil.

Materials and methods

Study design and location

This cross-sectional study used data from the third wave of EpiFloripa Aging, a population-based cohort study on the life and health conditions of older adults (60+ years old) residing in the urban area of Florianópolis, Santa Catarina State, Brazil. The survey began in 2009/2010 interviewing 1,705 older adults. Follow-ups were performed in 2013/2014 and 2017/2019 (with 1,197 and 1,335 older adults, respectively). This is a cross-sectional study because hearing data were included only in the third wave of the cohort.

A previous study presented the sampling details, operational aspects, and strategies used in the first two waves [16]. As it is a longitudinal study, at the beginning of the third wave, the data from the participants of the previous waves were updated by telephone calls and using the Brazilian Mortality Information System (SIM) to collect data on deaths. In the third wave (2017/2019), the sampling plan was designed based on the processes of the first two waves and on the 2010 census data to maintain the representativeness of the older population in Florianópolis.

The third wave was redesigned as an open cohort and new participants were added. For their inclusion, the sample size was reassessed, maintaining the parameters previously used for sample calculation and updating the second-stage unit: households. Adults aged 60 years who participated in the EpiFloripa Adult study were also included.

Data collection tool

A questionnaire prepared by the research group – which includes professors and students from different graduate courses at the Federal University of Santa Catarina (UFSC) – was used as a data collection tool (available at: https://epifloripaidoso.paginas.ufsc.br/). It was applied in face-to-face interviews by trained interviewers. Most questions asked in 2013/2014 were kept, as it was a longitudinal study, and new questions were included, especially regarding hearing (self-reported hearing loss and use of hearing aids). The content, clarity, and length of the interviews were assessed by supervisors and interviewers.

Main exposure variable

In this study, self-reported hearing loss was the main exposure variable, determined by the interviewer's questions on this sensory deficit. Despite the inherent limitations of self-reported data due to its subjective nature, studies indicate good sensitivity and specificity values for self-reported hearing loss in population studies, making them possible when pure-tone audiometry, the gold standard test, is not available [17].

Dependent variable

Cognitive impairment was analyzed using the *Mini-Mental State Examination* (MMSE). Tests scores ≤ 19 and ≤ 23 were considered indicative of cognitive impairment for older adults without education and with some level of education, respectively [18].

Covariates

In this study, covariates were related to sociodemographic characteristics and the health status of individuals [14,19,20]: such as gender (man; woman); self-reported ethnicity/skin color (white; mixed-race; black; Asian/indigenous); age group (60-69; 70-79; ≥ 80 years); schooling level (0-8; 9-11; ≥ 12 years); and use of hearing aids (no; yes, in one ear; yes, in both ears). Self-reported morbidities were also considered: diabetes mellitus (no; yes); systemic arterial hypertension (no; yes); depression (no; yes); and stroke history (no; yes).

Data analysis

For categorical variables, data were represented by absolute and relative frequencies with 95% confidence intervals (95%CI). The association between the main exposure variable and the outcome was analyzed. For both crude (bivariate) and adjusted analysis of covariates, the odds ratio (OR) was used as a measure of association, estimated by logistic regression analysis. The main exposure variable was adjusted for all covariates, regardless of the p-value. Variables were included simultaneously in the adjusted analysis and the significance level was set at 5%. Data analysis, considering the study design and sample weight in the database, was conducted with the *svy* command in Stata, version 14.0 (https://www.stata.com).

Ethical aspects

EpiFloripa Aging 2017/2019 study was approved as an amendment to EpiFloripa 2013/2014 by the Human Research Ethics Committee of the UFSC (CAAE n. 16731313.0.0000.0121). All participants signed an informed consent form.

Results

We analyzed data from 1,335 older adults, of which most were women (63.7%), white (88.3%), aged 70-79 years (43.6%), and had a low schooling level (0-8 years; 54.9%). The prevalence was 20.5% for cognitive impairment, 10.7% for self-reported hearing loss, and 7.5% for use of hearing aids (3.6% in one ear and 3.9% in both ears). Regarding health issues, 59.5% of participants had systemic arterial hypertension, 25.7% had diabetes mellitus, 21.7% had depression, and 9.5% had stroke history (Table 1).

The prevalence of cognitive impairment was higher among black older adults (36.5%), aged 80 years or older (37.3%), who had a low schooling level (0-8 years; 32.1%), and reported hearing loss (32.9%), systemic arterial hypertension (21.7%), and stroke history (41.4%). Notably, cognitive impairment was more common among participants who used a hearing aid in one ear (33.3%) compared with those who used hearing aids in both ears (26.4%) (Table 2).

Older individuals with hearing loss were more likely to have cognitive impairment compared with those without hearing loss, both in crude (OR = 2.31; 95%CI: 1.38-3.87) (Table 2) and adjusted analyses (OR = 2.66; 95%CI: 1.08-6.54) (Table 3).

Discussion

In this cross-sectional study with data from EpiFloripa Aging, we found that older adults who self-reported hearing loss were twice more likely to have cognitive impairment diagnoses than older adults without hearing loss, according to the MMSE in the analysis adjusted for sociodemographic and health covariates.

An epidemiological research has sought a possible link between age-related hearing loss and cognitive impairment, but its results are inconsistent [21]. Shedding light on this relationship is greatly important, especially in low- and middle-income countries, where data are scarce, since hearing loss is a modifiable risk factor that can contribute to the development of dementia [11,12,22].

Previous studies on the association between hearing loss and cognitive impairment in the older population suggest that older adults with hearing loss are at greater risk of cognitive impairment than individuals without it [13,15,21,22,23,24]. However, other studies did not have observe this relationship [25,26]

These differences in the literature may be related, in part, to the methodologies used: different populations, procedures, and criteria adopted for the assessment and analyses of hearing loss and/or cognitive function, the inclusion of different covariates, among others [27,28].

Regarding the characteristics of the study participants, most were white women with low schooling level. The low prevalence of self-reported hearing loss (10.7%) and hearing aid use (7.5%) differ from the findings of a previous study carried out with French adults aged 65 years or older [13]. The authors showed as a baseline a prevalence of 35% for self-reported hearing loss and 4% for hearing aid use among participants. In the 25-year follow-up, they found that self-reported hearing loss was associated with cognitive impairment and this impairment was reduced in older adults who wore hearing aids [13].

The discrepancies observed in the prevalence of self-reported hearing loss between our results and the study by Amieva et al. [13] may be influenced by several factors. Self-reports are always at risk of misclassification bias and factors such as age, gender, schooling level, and social representation of hearing loss interfere in the association between self-report and diagnosis (by objective methods) of hearing loss. Age is a particularly important influencing factor in this association, since it stimulates semantic fluency decline in very old adults [29], although older individuals seemed to perceive and

Table 1

Descriptive analysis of the sample characteristics. EpiFloripa Aging study 2017/2019 (n = 1,335).

Characteristics	n	% *	95%CI
Gender [n = 1,335]			
Man	510	36.3	33.0-39.5
Woman	825	63.7	60.4-66.9
Skin color [n = 1,334]			
White	1,172	88.3	84.6-91.1
Brown	86	6.8	5.0-9.0
Mixed-race	63	4.2	2.7-6.2
Asian/Indigenous	13	0.7	0.3-1.5
Age group (years) [n = 1,335]			
60-69	461	30.2	25.3-35.5
70-79	554	43.6	39.1-48.2
80 and over	320	26.2	22.3-30.2
Education (years of schooling) [n = 1,329]			
0-8	715	54.9	48.3-61.4
9-11	215	15.8	12.8-19.3
12 or more	399	29.3	24.4-34.6
Hearing loss [n = 1,332]			
No	1,183	89.3	86.3-91.7
Yes	149	10.7	8.8-13.6
Cognitive impairment [n = 1,323]			
No	1,065	79.5	75.9-82.6
Yes	258	20.5	17.3-24.0
Diabetes [n = 1,335]			
No	999	74.3	70.5-77.7
Yes	336	25.7	22.2-29.4
Hypertension [n = 1,335]			
No	516	40.5	35.7-45.4
Yes	819	59.5	54.5-64.2
Depression [n = 1,335]			
No	1,035	78.3	74.9-81.1
Yes	300	21.7	18.8-25.0
Stroke [n = 1,335]			
No	1,195	90.5	88.1-92.2
Yes	140	9.5	7.7-11.8
Use of hearing aid [n = 1,335]			
No	1,240	92.5	90.1-94.2
Yes, in one ear	42	3.6	2.4-6.3
Yes, in both ears	53	3.9	2.5-5.2

95%CI: 95% confidence interval.

* Weighted percentage.

Table 2

Prevalence of cognitive impairment according to study variables and crude analysis of the association between hearing loss and cognitive impairment. EpiFloripa Aging study 2017/2019.

Characteristics	Cognitive impairment		
	% *	Crude OR ** (95%CI)	p-value
Gender			0.406
Man	17.6	1.00	
Woman	20.7	1.22 (0.76-1.96)	
Skin color			0.014
White	18.1	1.00	
Brown	27.9	1.51 (0.85-2.68)	
Black	36.5	2.64 (1.42-4.88)	
Asian/Indigenous	7.7	0.70 (0.08-6.00)	
Age group (years)			< 0.001
60-69	9.8	1.00	
70-79	17.3	2.30 (1.25-4.23)	
80 or over	37.3	6.65 (3.41-12.99)	
Education (years of schooling)			< 0.001
0-8	32.1	1.00	
9-11	5.6	0.09 (0.04-0.20)	
12 or more	4.3	0.11 (0.04-0.27)	
Hearing loss			0.002
No	17.8	1.00	
Yes	32.9	2.31 (1.38-3.87)	
Diabetes			0.075
No	17.9	1.00	
Yes	24.2	1.55 (0.95-2.54)	
Hypertension			0.024
No	15.9	1.00	
Yes	21.7	1.51 (1.05-2.16)	
Depression			0.054
No	18.3	1.00	
Yes	23.5	1.56 (0.99-2.45)	
Stroke			< 0.001
No	16.9	1.00	
Yes	41.4	5.20 (3.59-7.53)	
Use of hearing aid			0.290
No	18.7	1.00	
Yes, in one ear	33.3	1.74 (0.43-6.91)	
Yes, in both ears	26.4	1.35 (0.66-2.77)	

95%CI: 95% confidence interval.

* Prevalence of cognitive impairment;

** Crude logistic regression.

Table 3

Adjusted analysis of the association between hearing loss and cognitive impairment. EpiFloripa Aging study 2017/2019.

Hearing loss	Cognitive impairment	
	Adjusted OR * (95%CI)	p-value *
No	1.00	0.033
Yes	2.66 (1.08-6.54)	

95%CI: 95% confidence interval.

* Analysis adjusted for gender, skin color, age group, education, use of hearing aid, diabetes, hypertension, depression and stroke.

report their hearing capacity limitations better than younger participants [19]. Moreover, a review shows differences in the perception and management of hearing loss among individuals with different cultural backgrounds, as it directly influences handicap perception, the search for hearing care, and hearing aid use [30,31].

Cognitive screening of older adults is an important tool, since it allows early detection of cognitive impairment (or decline, in the case of a longitudinal follow-up) and the development of an action plan aimed at this population, which may include the practice of physical activity and social engagement [32]. The pathophysiological process of dementia can begin at the brain level decades before a clinical diagnosis, which highlights the importance of detecting mild cognitive impairment (MCI) as a prevention strategy [33].

In addition to the preventive aspects of monitoring health markers in the community, which include hearing and cognitive function, actions aiming at promoting and encouraging a healthy lifestyle and social engagement of older adults in groups and activities in the community can represent important tools for the preservation of cognition [22]. This is because cognitive skills are influenced by both brain changes inherent to aging and individual issues related to exposures and lifestyle habits, the latter being essential to improve healthy aging [34].

Another important protective factor against dementia is hearing rehabilitation, which may involve the use of hearing aids [34]. As aforementioned, 7.5% of older adults reported the use of hearing aids (in one or both ears), similarly to what was found by an age-standardized hearing aid coverage mapping seen in a previous study [3]. Moreover, a higher prevalence of cognitive impairment was observed among older adults who reported wearing only one hearing aid (33.3%), compared to those who wore them in both ears (26.4%).

Some studies have described the influence of using hearing aids on cognitive function [35,36], such as less significant cognitive decline in older adults who wear hearing aids [13]; association between hearing loss and cognitive function seen only in older adults that do not wear hearing aids [35]; and decreased cognitive decline after the older people diagnosed with hearing loss start to use hearing aids [36].

Notably, auditory and cognitive aspects seem to worsen with aging because they are linked to brain signal processing, deviating cognitive resources that can result in the depletion of cognitive reserves. Therefore, individuals with hearing loss feel as if they were performing two tasks simultaneously. As the first task requires a high attentional load, the performance of the second decreases, as there are few resources available for cognitive tasks (cognitive load theory). On the other hand, aging would be a common factor responsible for the deterioration of both cognitive and non-cognitive processes; thus, hearing loss and cognitive impairment would be consequences of some common neurodegenerative processes of the senescent brain (common cause hypothesis) [37].

Some developed countries have proposed actions to fight aging. These aimed at improving access to education, government programs, and health systems and, as a result, the incidence of dementia decreased and/or stabilized [38]. In developing countries, this fight against population aging must also

focus on other dimensions to prevent modifiable risk factors. Thus, paying special attention to hearing and cognitive issues, which also minimizes the impact they have on depression, social isolation, and dementia [39], must be included in the health planning agenda.

The great strength of this study is the population-based data, which will allow for the follow-up of these older people in the next waves of the EpiFloripa Aging study. The methodology used is another highlight of the research because population surveys are an important tool for collecting epidemiological data, which may support more effective health care actions. Regarding study limitations, it is noteworthy that pure tone audiometry was not performed to confirm hearing loss although self-reported data on hearing loss have been widely used in population studies [19,40,41]. Furthermore, there is the possible reverse causality bias inherent to cross-sectional studies, as the longitudinal analysis was impossible due to data collection on participants' hearing were conducted only in 2017/2019.

Results showed an association between self-reported hearing loss and cognitive impairment in older adults. In the analysis adjusted for sociodemographic and health covariates, a OR = 2.66 was found for older people with hearing loss compared to healthy individuals. Both dimensions of covariates are considered risk factors for healthy aging and potentially preventable and/or treatable. Comprehensive care for older adults is an important challenge to the structuring of health services which guarantees social participation, autonomy, and quality of life in aging, especially in middle-income countries such as Brazil.

Contributors

K. M. Paiva contributed to the study conception and design, writing, and review; and approved the final version for publication, besides assuming responsibility for all aspects of the study. A. L. Böell contributed to the study conception and design, writing, and review; and approved the final version for publication, besides assuming responsibility for all aspects of the study. P. Haas contributed to the study design and review; and approved the final version for publication, besides assuming responsibility for all aspects of the study. A. G. Samelli contributed to the study design and review; and approved the final version for publication, besides assuming responsibility for all aspects of the study. D. Hillesheim contributed to the study design, data analysis and interpretation, writing, and review; and approved the final version for publication, besides assuming responsibility for all aspects of the study. T. H. Figueiró contributed to the study design, data analysis and interpretation, writing, and review; and approved the final version for publication, besides assuming responsibility for all aspects of the study. E. d'Orsi contributed to the study design, writing, and review; and approved the final version for publication, besides assuming responsibility for all aspects of the study.

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Resumo

Este estudo teve como objetivo investigar a associação entre perda auditiva autorreferida e comprometimento cognitivo em idosos de uma cidade do sul do Brasil. Trata-se de um estudo transversal de coorte de base populacional com idosos. Os dados foram coletados na terceira onda do estudo EpiFloripa Idoso (2017/2019), realizado desde 2009 na cidade de Florianópolis, Santa Catarina. A variável dependente comprometimento cognitivo foi analisada pelo Mini-Exame do Estado Mental *(MEEM), sendo a principal variável de exposição a perda auditiva (autorreferida), incluída na coorte apenas na última onda. Foram realizadas análises de regressão logística levando em consideração o desenho do estudo e os pesos amostrais. Foram avaliados dados de 1.335 idosos. A prevalência de comprometimento cognitivo foi de 20,5% e de perda auditiva, 10,7%. Idosos com perda auditiva tem 2,66 (IC95%: 1,08-6,54) vezes mais chances de ter comprometimento cognitivo quando comparados a idosos sem perda auditiva. A associação encontrada entre perda auditiva e comprometimento cognitivo é um alerta quanto à necessidade de integrar a identificação precoce desses problemas na atenção primária, pois ambas as dimensões analisadas são fatores de risco para o envelhecimento saudável e potencialmente evitáveis e/ou tratáveis.*

Atenção Primária à Saúde; Telemedicina; Custos e Análise de Custo; Sistemas Públicos de Saúde; Serviços Médicos de Emergência

Resumen

Este estudio tuvo como objetivo investigar la asociación entre la pérdida auditiva autorreportada y el deterioro cognitivo en personas mayores de una ciudad del sur de Brasil. Se trata de un estudio transversal de cohorte de base poblacional con personas mayores. Los datos se recabaron de la tercera ola del estudio EpiFloripa Anciano (2017/2019), realizado desde 2009 en la ciudad de Florianópolis, Santa Catarina. La variable dependiente deterioro cognitivo se analizó mediante el Miniexamen del Estado Mental *(MEEM), y tuvo como principal variable de exposición la pérdida auditiva (autorreportada), incluida en la cohorte solo en la última ola. Se realizaron análisis de regresión logística teniendo en cuenta el diseño del estudio y los pesos de la muestra. Se evaluaron datos de 1.335 personas mayores. La prevalencia de deterioro cognitivo fue del 20,5%; y la de pérdida auditiva, del 10,7%. Las personas mayores con pérdida auditiva tienen 2,66 (IC95%: 1,08-6,54) veces más probabilidades de tener deterioro cognitivo en comparación con las personas mayores sin pérdida auditiva. La asociación encontrada entre pérdida auditiva y deterioro cognitivo llama la atención para la importancia de identificar precozmente estos problemas en la atención primaria, ya que ambas dimensiones analizadas son los factores de riesgo para un envejecimiento saludable y potencialmente prevenible y/o tratable.*

Atención Primaria de Salud; Telemedicina; Costos y Análisis de Costo; Sistemas Públicos de Salud; Servicios Médicos de Urgencia

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