

# Disabling hearing loss: analysis of associated factors

## Perda auditiva incapacitante: análise de fatores associados

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### ABSTRACT

**Introduction:** The World Health Organization (WHO) estimates that 360 million people in the world suffer from disabling hearing loss. **Purpose:** Investigate the association between disabling hearing loss and clinical, sociodemographic, communicative, behavioral and health services characteristics in a population with hearing loss treated in a public healthcare center. **Methods:** This cross-sectional study utilized secondary data from the assessment protocol for authorizing the provision of personal sound amplification products (PSAPs) used in an auditory health service. The sample consisted of 745 patients from May 2009 to May 2013. As a variable response to incapacitating hearing loss and as explanatory variables: healthcare, communicative and behavioral aspects, sociodemographic and clinical data. Descriptive analyzes, univariate logistic regression and hierarchical logistic model were performed. **Results:** Hierarchical logistic model detected five explanatory variables from distinct blocks which maintained a statistically significant association with disabling hearing loss: etiology of acquired hearing loss, elementary education, previous use of PSAPs, present hearing responses without the use of PSAPs, are accompanied at the time of the evaluation. **Conclusion:** In the study population, individuals with congenital hearing loss, elementary school education, who previously used hearing aids, absence of hearing reactions without hearing loss, or who had an accompanying person at the time of the evaluation were more likely to present disabling hearing loss when compared to individuals without these characteristics.

**Keywords:** Hearing loss; Disabled persons; Unified Health System; Hearing; Hearing aids

### RESUMO

**Introdução:** A Organização Mundial de Saúde (OMS) estima que 360 milhões de pessoas no mundo sofram de perda auditiva incapacitante. **Objetivo:** Investigar a associação entre perda auditiva incapacitante e características clínicas, sociodemográficas, comunicativas, comportamentais e assistenciais de uma população com deficiência auditiva, atendida em um serviço público. **Métodos:** Trata-se de estudo realizado com dados secundários, oriundos do protocolo de avaliação para autorização da concessão de Aparelho de Amplificação Sonora Individual (AASI), utilizado em um serviço de saúde auditiva. A amostra foi constituída de 745 usuários atendidos em um serviço de saúde auditiva, no período de maio de 2009 a maio de 2013. Foi considerada como variável resposta a perda auditiva incapacitante e como variáveis explicativas os dados assistenciais, aspectos comunicativos e comportamentais, dados sociodemográficos e dados clínicos. **Resultados:** A análise multivariada do modelo hierárquico demonstrou que cinco variáveis explicativas pertencentes a blocos distintos permaneceram com associação significativa à perda auditiva incapacitante, tais como: provável etiologia da perda auditiva adquirida, escolaridade em nível de ensino fundamental, pessoas que fizeram uso do AASI anteriormente, apresentação de reações auditivas sem o AASI, presença de acompanhante no momento da avaliação. **Conclusão:** Na população estudada, os indivíduos com perda auditiva congênita, escolaridade em nível de ensino fundamental, que usaram o AASI anteriormente, com ausência de reações auditivas sem o AASI, ou que possuíam acompanhante no momento da avaliação tiveram maiores chances de apresentarem a perda auditiva incapacitante, quando comparados aos indivíduos sem essas características.

**Palavras-chave:** Perda auditiva; Pessoas com deficiência; Sistema Único de Saúde; Audição; Auxiliares de audição

Study conducted at Universidade Federal de Minas Gerais – UFMG – Belo Horizonte (MG), Brazil.

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## INTRODUCTION

The World Health Organization (WHO) estimates that 360 million people globally suffer from disabling hearing loss, of which 165 million are elderly over the age of 65 and 32 million are children and adolescents aged 15 years or younger<sup>(1)</sup>.

Hearing loss in childhood can compromise the appropriate development of speech, language, cognition and socialization<sup>(2)</sup>. In adults, the negative effects involve limiting activities, interfering in abilities to understand speech in silence and noise, restricting participation in social events, and, as a result, reducing quality of life<sup>(3)</sup>. In the elderly, there is impairment of cognitive function, quality of life and emotional, behavioral and social well-being<sup>(4)</sup>.

In Brazil, the 2010 census identified 7.5 million people declaring hearing difficulties, 1.79 million with great difficulty and 344,206 with total hearing loss<sup>(5)</sup>.

The literature contains studies<sup>(3,6)</sup> highlighting the relationship between hearing, disability and function. Thus, the term 'disabling hearing loss' has been adopted in national studies<sup>(7,8)</sup> and corresponds to hearing loss where the better ear presents thresholds above 41 dB for adults and 31 dB for children under 15 years old, including reversible hearing loss (for example, otitis media). However, the term 'disabling hearing loss' adopted by the WHO only includes permanent hearing loss and uses the same thresholds as the Brazilian studies<sup>(7)</sup>.

The Brazilian population with disabling hearing loss has access to hearing healthcare through the Hearing Healthcare Services, accredited by the Ministry of Health and implemented through ordinances 587 and 589 from October 2004<sup>(9,10)</sup>.

The Hearing Healthcare Services guarantee healthcare to people with hearing impairment from diagnosis to rehabilitation<sup>(9,10)</sup>. Furthermore, it provides, in continuous flow, for the adaptation of personal sound amplification products, medical follow-up and speech therapy both for adjustments and periodic inspections of the technical condition and benefits of these products. Other services offered include follow-up with social workers and psychologists<sup>(9,10,11)</sup>.

Analyzing the characteristics of users of the Unified Health System (SUS) with disabling hearing loss and the associations with functional, sociodemographic and healthcare service characteristics can contribute, not only to the adoption of preventive measures, but also to the organization of health services which are more equitable and better prepared to deal with the functional limitations of these individuals. Another perspective of research with the characteristics of this study is the possibility to comprehend the reality of services to propose therapeutic projects or even public policy for intervening in this reality.

The objective of this study was to investigate the association between disabling hearing loss and clinical, sociodemographic, communicative, behavioral and health services characteristics of a population with hearing loss treated in a public healthcare

center. This study is important because it allows for the development of prevention, promotion and intervention strategies for hearing health.

## METHODS

This observational, analytic cross-sectional study utilized secondary data from hearing health service records.

This study was conducted at a reference hearing health clinic for a health region in Minas Gerais State called the Betim Microregional Hearing Board (JSAM, in the Portuguese acronym), serving 13 municipalities with an approximate population of 623,582 people. Betim is an important national industrial hub and reference city<sup>(5)</sup>.

Data was collected from the protocol for evaluation and authorization of personal sound amplification products (PSAPs)<sup>(12)</sup>, containing the following themes: clinical, healthcare, sociodemographic, communicative and behavioral data.

Medical records of patients with evaluations for a PSAP from May 2009 to May 2013 were included. The service users with incomplete evaluation files (above 20% incompleteness) or with missing files were excluded. Of a total of 906 medical records, 49 were excluded due to incomplete data and 112 were not located in the files onsite. Therefore, the total sample consisted of 745 service users with ages ranging from 1 to 98 years.

The data collected was entered into an Excel® database. STATA (Stata Corporation, College Station, Texas), version 12.0, was used to analyze data through descriptive analysis, univariate logistical regression and multivariate hierarchical logistical model.

Adults with hearing threshold of 41 dB or greater in the better ear and children under 15 years with a hearing threshold of 31 dB or greater in the better ear, including temporary hearing loss, a tritone average of 500 Hz, 1,000 Hz and 2,000 Hz, were considered to have disabling hearing loss.

In the univariate logistical regression, the explanatory variables were compared to the outcome variable of disabling and non-disabling hearing loss. Subsequently, they were grouped into a hierarchical analysis model (Chart 1). The most distal variables compose the first block until the most proximal variables in the last block considering the clinical experience of the research team and the biopsychosocial model (structure and function)<sup>(3)</sup>.

All of the variables associated with disabling hearing loss with a p-value  $\leq 0.20$  were included in the multivariate hierarchical model, considering only the variables within the same block. The significance level of 5% with a confidence interval of 95% were considered. To evaluate if the adjustment between blocks was significant the Akaike information criterion (AIC) was used.

The strength of the associations were measured with the odds ratio with 95% confidence intervals.

**Chart 1.** Variables grouped into a hierarchical univariate analysis model

Block 1	
<b>Theme</b> Healthcare	<b>Variables</b> Wait time 1 (time waiting for the PSAPs evaluation), wait time 2 (time waiting for PSAPs acquisition), companion present at the evaluation, previous use of PSAPs, type of adaptation, otorhinolaryngological indication for using PSAPs, type of exam, undergoes speech therapy, complexity of the referral.
Block 2	
<b>Theme</b> Communication and behavior	<b>Variables</b> Auditory reactions without PSAPs, level of motivation to use PSAPs, sociocultural context (autonomy in using PSAPs, oral language, acceptance, behavior, socialization regarding hearing loss).
Block 3	
<b>Theme</b> Sociodemographic	<b>Variables</b> Age, gender, profession, residence, educational attainment, functional status.
Block 4	
<b>Theme</b> Clinical	<b>Variables</b> Probable cause of hearing loss, type of hearing loss, degree of hearing loss, risk factors for deafness.

This study received consent from the participating institutions and was approved by the Committee for Research Ethics of the *Universidade Federal de Minas Gerais*, protocol CAAE 0671.0.203.000-11. The Term of Free and Informed Consent was waived.

## RESULTS

The study identified that the users were mostly retired (53.9%), women (56.9%), over 60 years old (58.4%) and with elementary education (68.8%). In the univariate analysis of the sociodemographic data, educational attainment (higher education) was significantly associated with disabling hearing loss (Table 1).

Regarding the clinical and care related data, wait time to undergo evaluations for PSAPs (wait time 1) was 3 to 6 months (60%) and the wait time for adaptation of the PSAP after the evaluation (wait time 2) was 4 to 6 months (41.1%).

Most users did not have a companion with them at the time of the evaluation (52.8%) and had not previously used a PSAP (84.7%). When a PSAP was previously used, the most common PSAP was a behind-the-ear device (93.6%) and were adapted for the right ear (39.8%). An important portion of the patients presented otorhinolaryngological indication for using PSAPs (88.0%), a basic audiological evaluation with pure tone audiometry, logaudiometry and immittance audiometry (96.4%), only pure tone audiometry (34.3%), probable acquired hearing loss (89.1%), sensorineural hearing loss in the right ear (81.3%) and in the left ear (83.9%).

In the univariate analysis of clinical and healthcare data, the variables wait time 2, a companion at evaluation, previous use

of a PSAP, otorhinolaryngological indication for PSAPs and probable acquired hearing loss were significantly associated with disabling hearing loss (Table 2).

Regarding communicative data, the majority of users presented auditory reactions without using a PSAP (80.4%), reported good motivations for using PSAPs (91.1%), considered that they had autonomy to independently use a PSAPs (94.6%), could use oral language (96.1%), presented good acceptance of hearing loss (98.5%), considered themselves calm (39.1%), had normal social lives (99.5%), did not previously undergo speech therapy (96.5%) and was referred from secondary health services (93.9%).

Univariate analysis of the data on communication identified significant association between disabling hearing loss and the variables: present auditory reactions without a PSAP, autonomy for independent use, not using oral language, calm behavior and high referral complexity (Table 3). Referral complexity describes if the candidate for using PSAPs presents another disability (high complexity) and if there is an association with the disabling hearing loss.

The hierarchical analysis detected in block 1 a significant association between previous use of PSAPs and having a companion during the consultation ( $p < 0.001$ ).

The accompanied service user had a 1.85 chance of disabling hearing loss compared to those who were unaccompanied (95% CI 1.35-2.53). Previous use of PSAPs increased by 3.19 the chance of disabling hearing loss (95% CI 1.87-5.43).

In block 2, only auditory reactions without PSAPs remained, indicating that individuals with auditory reactions had 21% less chance of presenting disabling hearing loss than those users without auditory reactions (95% CI 0.12-0.39).

**Table 1.** Association between disabling hearing loss and sociodemographic characteristics of users of the Betim Microregional Hearing Board, from May 2009 to May 2013

Variables	Categories	Disability				OR	p-value	95% CI OR
		Absent		Present				
			%	n	%			
Gender	Female	143	33.7	281	66.3	1.00		-
	Male	112	34.9	209	65.1	0.95	0.740	0.70-1.29
Age group (years)	0 to 14	14	31.1	31	68.9	1.00		-
	15 to 59	84	31.8	180	68.2	0.97	0.925	0.49-1.91
	60 or older	157	36.1	278	63.9	0.80	0.507	0.41-1.55
Educational attainment	Illiterate	52	38.2	84	61.8	1.00		-
	Elementary education	163	32.7	336	67.3	1.28	0.224	0.86-1.89
	High school	26	33.8	51	66.2	1.21	0.516	0.68-2.18
	Higher education	10	76.9	3	23.1	0.19	0.014*	0.05-0.71

\* Significant value ( $p \leq 0.20$ ) – Univariate logistical regression

Subtitle: OR = odds ratio; CI = confidence interval

In block 3, educational attainment remained being that possessing an elementary education was the only characteristic associated with disabling hearing loss (OR 1.74, 95% CI 1.10-2.77).

In block 4, probably cause of hearing loss was associated with disabling hearing loss with individuals with acquired hearing loss had less chance of disabling hearing loss than those with congenital causes (OR 0.41, 95% CI 0.19-0.88).

The adjustments between blocks was conducted with AIC, presenting a decrease with each block, showing that the variables add information to the model (Table 4).

## DISCUSSION

The International Classification of Functioning, Disability and Health (ICF) defines disability as problems in body function or structure with significant deviation or loss<sup>(3,6)</sup>. Disability refers to the consequences, from a functional perspective (performance of activities), or disadvantages (handicaps) which require adaptations to the environment or can lead to temporary or permanent barriers to work<sup>(3,13)</sup>.

In this study, it was possible to investigate disabling hearing loss and associated characteristics in a population receiving care in a central region of Belo Horizonte with an important industrial center at the national level. The magnitude of the clinical, sociodemographic, behavioral and healthcare related characteristics impact individual behavior and, once these characteristics are known, it is possible to plan surveillance activities, healthcare interventions and public policy accordingly.

Multivariate analysis with the hierarchical model exhibited five explanatory variables belonging to distinct blocks which remained significantly associated with disabling hearing loss: probable congenital cause of hearing loss, elementary educational attainment, previous use of PSAPs, and absence of auditory reactions without PSAPs and presence of a companion at the evaluation.

Regarding the clinical data, service users with congenital hearing loss had four times greater chance of presenting disabling hearing loss compared to those with acquired etiologies.

Congenital hearing loss can occur during gestation or in the first days after birth. The most common causes are related to very low birthweight (under 1,500g), hyperbilirubinemia, congenital infections such as rubella, toxoplasmosis, cytomegalovirus, syphilis and contact with ototoxic drugs in the neonatal period, in addition to congenital malformations of the head and/or neck, or syndromes<sup>(14)</sup>.

A retrospective study<sup>(2)</sup> with 133 children between 2 and 12 years old identified that the most frequent risk factors for hearing loss were family complaints of delayed acquisition and development of speech and language or hearing problems (22.56%), otitis media that is recurring or persists for more than three months (22.56%), use of ototoxic drugs (19.55%), neonatal ICU stay for 48 hours or longer (14.29%), and congenital infections (12.78%). Regarding the type of loss, sensorineural prevailed (66%), with bilateral hearing loss presenting the greatest degree (26.3%).

These findings demonstrate that when congenital hearing loss occurs, difficulties may arise in the development of communication and language of the child due to the disabling degree of hearing loss. It is important that mothers obtain the necessary prenatal care and participate in primary healthcare programs in an effort to reduce the risk factors for deafness.

To minimize the effects of delayed diagnosis and treatment, a Universal Neonatal Hearing Screening<sup>(2,14,15)</sup> is possible with guidance for parents regarding child development so that they can be attentive to the occurrence of hearing alterations.

In the block of behavioral characteristics, individuals reporting the presence of auditory reactions without using PSAPs had less chance of presenting with disabling hearing loss.

A cohort study<sup>(5)</sup> with 211 elderly people, with an average age of 75 years and 24 months, concluded that with advancing

**Table 2.** Association between disabling hearing loss and clinical and healthcare data of users of the Betim Microregional Hearing Board from May 2009 to May 2013

Variables	Categories	Not disabling		Disabling		OR	p-value	95%CI OR
		n	%	n	%			
Wait time 1 (months)**	0 to 3	152	34.1	294	65.9	1.00	-	-
	4 to 6	46	38.0	75	62.0	0.84	0.421	0.56-1.28
	7 to 11	47	31.3	103	68.7	1.13	0.537	0.76-1.68
	> 12	10	38.5	16	61.5	0.84	0.648	0.36-1.87
Wait time 2 (months)***	0 to 3	79	37.8	130	62.2	1.00	-	-
	4 to 6	105	32.2	221	67.8	1.28	0.185*	0.89-1.84
	7 to 11	53	31.7	114	68.3	1.31	0.222	0.85-2.01
	> 12	16	43.2	21	56.8	0.80	0.531	0.39-1.62
Accompanied	No	161	40.9	232	59.1	1.00	-	-
	Yes	95	27.0	257	73.0	1.87	<0.001*	1.37-2.55
Previous use of PSAPs	No	237	37.6	394	62.4	1.00	-	-
	Yes	18	15.8	96	84.2	3.21	<0.001*	1.89-5.44
Type of PSAPs	Microcanal	0	0.0	1	100.0	1.00	-	-
	Intracanal	2	40.0	3	60.0	0.00	0.992	-
	Intracanal-Auricular	0	0.0	1	100.0	1.00	-	-
	Retroauricular	15	14.7	87	85.3	0.00	0.993	-
Adaptation	Unilateral - Right	7	16.3	36	83.7	1.00	-	-
	Unilateral - Left	7	18.4	31	81.6	0.86	0.799	0.27-2.73
	Bilateral	3	11.1	24	88.9	1.56	0.550	0.37-6.62
Indication for using PSAPs	No	22	25.9	63	74.1	1.00	-	-
	Yes	222	35.7	399	64.3	0.63	0.075*	0.38-1.05
Exam	Basic audiological evaluation	251	34.9	467	65.1	1.00	-	-
	Electrophysiological evaluation	1	25.0	3	75.0	1.61	0.681	0.17-15.55
	Audiological and electrophysiological evaluations	3	15.8	16	84.2	2.86	0.970	0.83-9.91
	Basic audiological evaluation and others	1	25.0	3	75.0	1.61	0.681	0.17-15.55
Probable cause of hearing loss	Congenital	13	17.6	61	82.4	1.00	-	-
	Acquired	219	36.2	386	63.8	0.38	0.001*	0.20-0.70
Type of loss in RE	Conductive	4	28.6	10	71.4	1.00	-	-
	Sensorineural	218	36.0	388	64.0	0.71	0.570	0.22-2.30
	Mixed	33	26.4	92	73.6	1.11	0.862	0.33-3.80
Type of loss in LE	Conductive	3	27.3	8	72.7	1.00	-	-
	Sensorineural	223	35.6	402	64.4	0.68	0.568	0.18-2.58
	Mixed	30	27.5	79	72.5	0.99	0.986	0.25-3.97

\* Significant values ( $p \leq 0,001$ ) – Univariate logistical regression

**Subtitle:** \*\* wait time 1 (wait time to undergo evaluations for PSAPs), wait time 2 (wait time for adaptation of the PSAP after the evaluation); PSAPs = Personal Sound Amplification Products; RE = right ear; LE = left ear; OR = odds ratio; CI = confidence interval

age the audiometric configuration presented a downward trend with greater limitations in high frequencies. Regarding speech intelligibility, the study observed a gradual decrease with increase in age. This finding can explain the results of

the present study, since initially the elderly presented auditory reactions without PSAPs, such as hearing doors closing, dogs barking, telephones ringing, and, with the passage of time, there was a decrease in the ability to hear environmental sounds and

**Table 3.** Association between disabling hearing loss and communicative characteristics of users of the Betim Microregional Hearing Board, from May 2009 to May 2013

Variables	Categories	Not disabling		Disabling		OR	p-value	95%CI
		n	%	n	%			
Auditory reactions without PSAPs	No	13	10.0	117	90.0	1.00		-
	Yes	220	41.2	314	58.8	0.16	<0.001*	0.08-0.29
Motivation for using PSAPs	Poor	1	33.3	2	66.7	1.00		-
	Regular	7	41.2	10	58.8	0.71	0.799	0.05-9.50
	Good	232	34.5	440	65.5	0.95	0.965	0.09-10.51
	Excellent	13	28.3	33	71.7	1.27	0.851	0.11-15.23
Autonomy for using PSAPs	Dependent	9	22.5	31	77.5	1.00		-
	Independent	247	35.0	458	65.0	0.54	0.109*	0.25-1.15
Oral language	Oralized	250	34.9	466	65.1	1.00		-
	Not oralized	5	21.7	18	78.3	1.93	0.198*	0.71-5.26
	Developing oral language	1	16.7	5	83.3	2.68	0.369	0.31-23.08
Acceptance	Frustrated	3	27.3	8	72.7	1.00		-
	Good acceptance	249	34.7	469	65.3	0.71	0.61	0.19-2.68
Functional situation	Retired	138	35.3	253	64.7	1.00		-
	Working	62	35.6	112	64.4	0.99	0.938	0.68-1.43
	Not working	53	33.5	105	66.5	1.08	0.697	0.73-1.60
	Leave of absence	0	0.0	3	100.0	1.00	-	-
Behavioral	Agitated	41	38.7	65	61.3	1.00		-
	Calm	89	30.9	199	69.1	1.41	<b>0.146*</b>	0.88-2.24
	Anxious	54	36.2	95	63.8	1.11	0.692	0.66-1.86
	Nervous	47	35.6	85	64.4	1.14	0.626	0.67-1.94
	Two or more	23	37.1	39	62.9	1.07	0.839	0.56-2.04
Auditory socialization	Isolated	1	25.0	3	75.0	1.00		-
	Normal social life	250	34.1	484	65.9	0.65	0.705	0.07-6.24
Speech therapy	Yes/Previous	7	26.9	19	73.1	1.00		-
	No	249	34.6	471	65.4	0.74	0.497	0.30-1.78
Referral complexity	Medium	233	34.5	442	65.5	-		-
	High	9	20.5	35	79.5	2.05	0.06*	0.96-4.34

\* Significant values (p<0.001) – Univariate logistical regression

**Subtitle:** PSAPs = Personal Sound Amplification Products; OR = odds ratio; CI = confidence interval

human voices with gradually increasing degrees of difficulty.

The present study population, composed mostly of elderly individuals older than 60 years and with a diagnosis of acquired hearing loss through presbycusis, frequently with sensorineural and moderate degrees<sup>(16)</sup>, which led to PSAPs users to have auditory reactions without the products but with impaired speech recognition. Interestingly the study demonstrated the presence of auditory reactions despite hearing loss. Among senior citizens, hearing loss is a disabling factor because it can contribute to the development of some psychiatric disorders<sup>(17)</sup>, to the extent that they become socially isolated due to difficulties communicating. Relatives of individuals with hearing disabilities often do not exhibit tolerance in dealing with the hearing loss and do not maintain dialogue

with the elderly person, instead communicating only essential information which can lead to embarrassment or catalyze a depressive state<sup>(17)</sup>.

A study<sup>(16)</sup> regarding quality of life of the elderly with and without presbycusis detected statistically significant differences between the groups. The elderly with hearing loss, even with the utilization of PSAPs, presented worse results in the environmental and social relationships categories when compared to those with normal hearing. This data permits inferring that hearing loss can limit an individual's access to the environment, leading to limits in human communications regardless of use of PSAPs.

A study in São Paulo<sup>(18)</sup> analyzing the implications of disabling hearing loss acquired in adulthood, detected setbacks

**Table 4.** Hierarchical multivariate logistic model for the multiple hierarchical logistic regression model of variables with associations with disabling hearing loss, according to the selected blocks

Variables	Categories	Block 1			Block 2			Block 3			Block 4		
		Healthcare			Communicative and behavioral			Sociodemographic			Clinical		
		OR	p-value	95%CI OR	OR	p-value	95%CI OR	OR	p-value	95%CI OR	OR	p-value	95%CI OR
Accompanied	No	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
	Yes	1.85	<0.001	<b>1.35</b> <b>2.53</b>	1.66	0.004	1.17 2.34	1.86	0.001	1.28 2.71	1.89	0.002	1.27 2.81
Previous use of PSAPs*	No	1.00	-	-	1.00	-	-	1.00	-	-	1.00	-	-
	Yes	<b>3.19</b>	<b>&lt;0.001</b>	<b>1.87</b> <b>5.43</b>	2.52	0.002	1.41 4.52	2.71	0.001	1.47 5.01	1.97	0.043	1.02 3.79
Auditory reactions	No				1.00	-	-	1.00	-	-	1.00	-	-
	Yes				<b>0.21</b>	<b>&lt;0.001</b>	<b>0.12</b> <b>0.39</b>	0.21	<0.001	0.11 0.38	0.21	<0.001	0.11 0.41
Educational attainment	Illiterate							1.00	-	-	1.00	-	-
	Elementary school							<b>1.74</b>	<b>0.019</b>	<b>1.10</b> <b>2.77</b>	1.77	0.019	1.10 2.86
	High school							1.53	0.235	0.76 3.06	1.21	0.625	0.57 2.57
	Higher education							0.24	0.096	0.05 1.29	0.07	0.051	0.00 1.01
Probable cause of hearing loss	Congenital										1.00	-	-
	Acquired										<b>0.41</b>	<b>0.022</b>	<b>0.19</b> <b>0.88</b>
AIC		925.720			794.563			767.678			700.554		

Hierarchical multivariate logistic model (p<0.001)

**Subtitle:** PSAPs = Personal Sound Amplification Products; AIC = Adjustment between blocks through the Akaike information criterion; OR = odds ratio; CI = confidence interval

in family and social life, as well as in employment conditions. They demonstrated factors of isolation and frustration among adults with hearing loss. Furthermore, the authors declare that emotional stability is important in the diagnostic and rehabilitative processes in order to address the difficulties arising from social and familial factors.

It is important that the elderly and their families are aware of the signs of hearing loss which can begin with simple requests to repeat what was said and evolve to a degree of functional dependence. In this context, the elderly may face limitations in their ability to interact with society and the familial group in which they live.

In this study, an elementary education, compared to other levels of educational attainment, had a significant positive association with disabling hearing loss. This data can be explained by the study population’s reflection of educational attainment in the elderly Brazilian population which, according to the IBGE (Brazilian census bureau)<sup>(19)</sup>, in 2012, possessed an average schooling of four years and two months, equivalent to an incomplete elementary education.

Another study<sup>(20)</sup> with 625 people from 40 to 86 years old, suggested that household income and educational attainment could be inversely related to the prevalence of presbycusis. In the population studied in this manuscript, the higher the income and greater the educational attainment, the greater the access to information and healthcare services which can minimize the risk factors for presbycusis.

Furthermore, it should be noted that educational attainment is an important factor in studies investigating functionality<sup>(21)</sup>, since less education can compromise understanding of your own health and healthcare access.

Therefore, it is necessary to promote, in addition to aural rehabilitation, self-care practices and lifestyle changes among users of PSAPs. These actions should be guided by the understanding that promoting autonomy and user co-responsibility contribute to clinical and functional results.

Previous use of PSAPs showed a significant association with disabling hearing loss in this study. PSAPs enable aural rehabilitation by reducing the negative effects of hearing loss<sup>(22)</sup>. The greater the hearing loss, the more noticeable is the damage in communication and the need for aural therapy. In the present study, how previous PSAPs were acquired was not investigated; however, it can be inferred that some of the users with disabling hearing loss sought care in the supplementary health sector or acquired the PSAPs from commercial sources.

In the literature, a study<sup>(23)</sup> on perceptions of the elderly regarding PSAPs received from SUS, revealed that a majority of users did not have previous history with PSAPs adaptation and did not have the financial resources necessary for obtaining PSAPs on their own, indicating that the creation of the Hearing Healthcare Services made access to PSAPs a reality.

It should be noted that a study<sup>(18)</sup> with users of a Hearing Healthcare Service in inland São Paulo State demonstrated that the effective use of PSAPs positively influenced quality of life and contributed to significant improvements in psychological aspects of social relations. Similar results were observed in a study<sup>(24)</sup> evaluating the self-perception of active elderly adults regarding the impact of hearing changes on daily life and quality of life.

The fifth characteristic statistically associated with disabling hearing loss in the study population was the presence of a companion at the evaluation. The reason for the presence of the

companion was not investigated, but it was possible to make inferences based on the characteristics of the study population. First, it should be noted that among the elderly, difficulties in hearing together with other limitations associated with the aging process, can affect functional aspects such as their ability to go to the grocery store, the doctor's office, participate in religious or social events alone. Another relevant point is that more than 6% of the sample consisted of children and adolescents, a population group requiring the presence of companions at their appointments.

Another study<sup>(25)</sup> with 964 elderly adults concluded that the characteristics associated with moderate/severe dependence were: illiteracy, retirement, being a housewife, not owning their own home, age over 65 years, a multigenerational household, hospitalization within the last six months, presenting signs of changes in mental health, not visiting friends, problems with eyesight, a history of stroke, not visiting relatives, and a pessimistic self-evaluation of health in comparison with peers.

The fact that a person with disabling hearing loss is accompanied, is possibly associated with the disabling hearing loss, since this condition impacts the autonomy in performing daily and social activities, with other conditions which limit function or with age group.

Based on these study findings, it is possible to recommend interventions for early diagnosis of hearing loss among the elderly in hearing health services and preventive actions in primary healthcare among all age groups. These interventions should not be restricted only to the neonatal hearing screening and should include community interventions with information regarding risk factors and signs and symptoms of disability.

Early diagnosis of hearing loss among the elderly can allow for greater quality of social and family life, since the Hearing Health Program includes periodic evaluations of the degree of hearing loss and includes speech therapists who can assist with rehabilitation with verbal communication methods, attention to sounds and daily life.

## CONCLUSION

Disabling hearing loss was associated with clinical, healthcare, sociodemographic and behavioral characteristics.

In the study population, individuals with congenital hearing loss, elementary education, previous use of PSAPs, an absence of auditory reactions without PSAPs, or those with a companion at the time of the evaluation had a greater chance of presenting disabling hearing loss when compared to individuals without these characteristics.

The results suggest a need to develop criteria for characterizing and minimizing the impacts of disabling hearing loss among users of hearing health services. Furthermore, more research into the association between hearing and disability is needed which considers the healthcare, behavioral and environmental factors.

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