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# Cognition and benefit obtained with hearing aids: a study in elderly people

## *Cognição e benefício obtido com o uso de próteses auditivas: um estudo em idosos*

### Keywords

Audiology  
Hearing Aid  
Cognition  
Elderly  
Quality of Life

### Descritores

Audiologia  
Auxiliares de Audição  
Cognição  
Idosos  
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### ABSTRACT

**Purpose:** To verify the effects of cognition on the benefit obtained with the use of hearing aids and on the quality of life of elderly people with hearing loss. **Methods:** 17 elderly people with moderate sensorineural hearing loss (SNHL) bilateral were evaluated. The elderly people were divided into two groups according to the results of 10-point cognitive screening 10-CS: G1- seven elderly people without change and G2-10 elderly people with a suggestive result of cognitive alteration. Study protocol: self-evaluation questionnaire – (Hearing Handicap Inventory for the Elderly (HHIE)), geriatric depression scale (GDS), quality of life questionnaire – (Short-Form 36 (SF36)) and evaluation of the listening effort through the Visual Analogue Scale (VAS). After the evaluation, the elderly people received hearing aids. After three months of effective amplification, the protocol was reapplied with the inclusion of the International Questionnaire for the Evaluation of Hearing Aids – (IOI-HA). **Results:** The sample was characterized according to age, schooling, *Critério de Classificação Econômico Brasil Associação Brasileira das Empresas de Pesquisa (ABEP)*, degree of loss, *Índice Percentual de Reconhecimento da Fala (IPRF)* and *Speech Intelligibility Index (SII)* of the ear with better audibility. The statistical study revealed that there was significant difference only in relation to age. The comparative study before and after the intervention revealed a significant improvement in the 10-CS scores in the group G2, in the participation restriction - HHIE, in the listening effort and in some areas of the SF36. There was no difference in QI-AASI between groups second the factor 1, factor 2 and Total Score. **Conclusion:** There was improvement of the quality of life after three months of amplification use. There was no effect of cognition on the benefit obtained with the use of hearing aids.

### RESUMO

**Objetivo:** Verificar o efeito da cognição no benefício obtido com o uso de próteses auditivas e na qualidade de vida de idosos com perda auditiva. **Método:** Foram avaliados 17 idosos com perda auditiva neurosensorial de grau moderado bilateral. Os idosos foram distribuídos em dois grupos segundo os resultados da triagem cognitiva 10-CS: G1- sete idosos sem alteração e G2- dez idosos com resultado sugestivo de alteração cognitiva. Protocolo de estudo: questionário de avaliação de restrição de participação - *HHIE*, escala de depressão geriátrica - *EDG*, questionário de qualidade de vida - *SF36* e avaliação do esforço de escuta por meio da escala visual analógica. A seguir, os idosos receberam as próteses auditivas. Após três meses de uso efetivo da amplificação, o protocolo foi reaplicado com a inclusão do Questionário Internacional - *QI-AASI*. **Resultados:** Caracterizou-se a amostra quanto à idade, escolaridade, *Critério de Classificação Econômica Brasil - ABEP*, grau da perda, reconhecimento de fala e índice de Inteligibilidade de fala (*SII*) da orelha com melhor audibilidade. O estudo estatístico revelou diferença somente com relação à idade. O estudo comparativo antes e após intervenção revelou melhora significativa nos escores do 10-CS no grupo G2, na restrição de participação, esforço de escuta e alguns domínios do questionário de qualidade de vida. Não houve diferença no *QI-AASI* entre grupos segundo Fator 1, Fator 2 e Escore Total. **Conclusão:** Houve melhora da qualidade de vida após três meses de uso de amplificação. Não houve efeito da cognição no benefício obtido com o uso de próteses auditivas.

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## INTRODUCTION

Population aging is now a universal phenomenon, characteristic of both developed and developing countries. According to “*Instituto Brasileiro de Geografia e Estatística (IBGE)*”, the number of elderly people in Brazil grew by 18% in 5 years, exceeding 30 million in 2017<sup>(1)</sup>. The importance of studying this population has grown over the years with a view to developing methods to promote longevity with quality of life.

Hearing loss often affects the elderly population, since in the aging process there is a decline in physiological and sensory functions. Presbycusis (age-related hearing loss), hearing loss due to aging, is characterized by a decline in auditory function, with increasing hearing thresholds<sup>(2)</sup>. Difficulty understanding speech in noisy or challenging environments is the main hearing complaint reported by the elderly people, regardless of hearing sensitivity<sup>(3)</sup>.

As there is no clinical or surgical treatment that restores the normal hearing of patients with sensorineural hearing loss, speech-language therapy rehabilitation through the fitting of hearing aids is indicated.

Cognitive function is also affected with aging. Some studies have verified the relationship between hearing loss and cognitive decline in the elderly people, proving that hearing loss is associated with the risk of developing dementia, due to its severity in the elderly population<sup>(4)</sup>. Thus, there is a relationship between the degree of hearing impairment and the risk of dementia<sup>(5)</sup>.

Like presbycusis, dementia is usually chronic and progressive in nature. Dementia affects various cortical functions, including memory, comprehension, calculation, learning ability, language, and judgment. The estimated number of individuals with dementia was 35.6 million in 2010, estimated to double every twenty years<sup>(6)</sup>. In order to identify dementia, different cognitive screening instruments were proposed, such as the Mini Mental State Examination (MMSE)<sup>(7)</sup>, the Cognitive Abilities Screening Instrument - Short Form (CASI-S)<sup>(8)</sup>, the Montreal Cognitive Assessment (MoCA)<sup>(9)</sup>, among others. Recently, Apolinario et al.<sup>(10)</sup> conducted a study in which they demonstrated that a combination of subtests that assess orientation, word recall, and verbal fluency is an efficient instrument for screening for dementia and acceptable for screening for any cognitive impairment. In this study, the authors proposed an easily administered screening tool called 10-point Cognitive Screening (10-CS) with potential advantages compared to longer tests, such as the MMSE<sup>(10)</sup>.

It is also important to highlight that hearing has a significant influence on quality of life, since the distancing from the family and social environment due to hearing loss can lead to or aggravate social isolation or depression.

To assess the benefits and difficulties that sound amplification provides to hearing aid users, self-evaluation questionnaires can be used. These questionnaires are applied to determine the patient's hearing needs in order to develop the intervention plan and, after the intervention, to assess the effectiveness of rehabilitation.

The present study aims to verify if there is a relationship between the results of the 10-CS<sup>(10)</sup>, the effort required for the individual to listen and the benefit that the use of hearing aids provides for their life. Thus, the way to accurately evaluate

geriatric patients in terms of cognition, hearing and social well-being is enriched.

This study aimed to verify the effects of cognition on the benefit obtained with the use of hearing aids, and also on the quality of life in elderly people with hearing loss due to aging.

## METHODS

This is a prospective and cross-sectional study with a convenience sample.

This study was conducted at “*Núcleo Integrado de Assistência, Pesquisa e Ensino em Audição*” (NIAPEA), of the department of Speech-Language Therapy of the “*Escola Paulista de Medicina*”, from Universidade Federal de São Paulo (UNIFESP).

The project was approved by the “*Comitê de Ética em Pesquisa*” at UNIFESP (Project CEP/UNIFESP n: 1369/2016). Patients received the Informed Consent Form (ICF) with all necessary information about the study. In addition, they also received the contact numbers of CEP-UNIFESP and the researchers involved in the study to answer any questions.

## Sample

Seventeen elderly people with moderate acquired bilateral sensorineural hearing loss without previous experience with hearing aids were evaluated. Eight (47.1%) males and nine (52.9%) females, mean sample age of 77 ( $\pm 6.57$ ) years. These elderly people were waiting for hearing aids to be dispensed at the Hearing Health service of Hospital São Paulo. For the sample composition, the following eligibility criteria were established:

- Age 60 and over, considered elderly for developing countries by the World Health Organization (WHO)
- Present symmetric sensorineural hearing loss of moderate degree acquired (mean thresholds at frequencies of 500, 1000, 2000 and 4000 Hz, according to the WHO, 2014)
- Be candidates for hearing aids
- Did not make use of sound amplification prior to the start of the research
- Do not have obvious cognitive and / or psychiatric impairment.

The elderly selected were divided into two groups according to cognitive status:

Group 1 - seven elderly people with acquired sensorineural hearing loss with normal result in (10-CS).

Group 2 - ten elderly people with acquired sensorineural hearing loss with a suggestive result of cognitive impairment in (10-CS).

All research participants underwent anamnesis of the referred service that includes identification data and demographic variables. The Brazilian Economic Classification Criteria (in Portuguese ABEP) was applied. The Brazilian Criteria, a way of economically classifying the Brazilian population, is a standardized estimator of the consumption capacity of Brazilian households. It is a tool that allows the comparison between studies carried out in different regions of the country, by different companies and at different times.

Brazilian 2014 Economic Classification Criteria is based on ownership of goods and access to services, linking each item with a number of points based on the study of the “*Pesquisa de Orçamentos Familiares*” (POF) at “*Instituto Brasileiro de Geografia e Estatística*” (IBGE).

The researcher asked the participant questions in a quiet room and the respondent answered them verbally. From the answers given by the patient, the researcher calculated the quantity of goods, according to the value stipulated for each item by ABEP, then it was possible to classify the classes according to table 1.

## Evaluation protocol

The protocol elaborated for this research was applied before the hearing aids adaptation process and after three months of their effective use. The time of three months was defined in order to consider the acclimatization period and in addition to the acoustic stimulation time through the use of hearing aids necessary to effect the possible use of neuronal plasticity that also occurs in the elderly people. Effective use was considered to be at least 8 hours daily - according to the hearing aid data record.

The hearing aid fitting process was performed as recommended by the Hearing Health Ordinance and the adjustment of the devices was verified by *In Situ* measurement performed with the Audioscan model equipment Verifit 1. Microphone probe measurements were obtained with speech stimulus International Speech Test Signal (ISTS)<sup>(11)</sup> at 65 dB NPS, whose acoustic gain target was defined by the National Acoustic Laboratories – Nonlinear 2 (NAL-NL2) prescriptive method. The amplified speech was sought to be within the target values  $\pm 4$ dB. From this measurement, the Speech Intelligibility Index (SII) was obtained. A SII greater than or equal to 50 was sought to provide sufficient audibility to demonstrate significant benefit in various outcome measures<sup>(12)</sup>. The Maximum Power Output (MPO) was evaluated using a tone burst scan at 85 dB SPL according to the values defined by Pascoe<sup>(13)</sup>.

## Procedures

All elderly people who met the criteria for inclusion in the study and agreed to participate voluntarily in the study underwent the following procedures:

**Table 1.** Classification of socioeconomic level according to the ABEP criteria

CLASS	POINTS	AVERAGE INCOME (R\$)
A1	42-46	9.733
A2	35-41	6.564
B1	29-34	3.479
B2	23-28	2.013
C1	18-22	1.195
C2	14-17	726
D	8-13	485
E	0-7	277

**Caption:** ABEP – Associação Brasileira de Empresas e Pesquisa – Critério de Classificação Econômica Brasil

1. 10-CS-10 is a brief screening tool for detecting cognitive disabilities, developed by Apolinário et al.<sup>(10)</sup>. It evaluates the temporal orientation of three items (date, month, year), category fluency (1-minute animal naming) and three-word recall (Car, Vase and Brick).

Each correct question was assigned the value of one point, and the animal naming score is scaled up to four points, namely:  
 0 – 5: zero points 6 – 8: one point 9 – 11: two points  
 12 – 14: three points  $\geq 15$ : four points  
 The maximum value of the test is 10 points.  
 The test is adjusted for educational level:

- No formal education (add two points - to a maximum of 10);
- 1-3 years of education (add one point - to a maximum of 10).

The cutoff points are:

- From 0 to 5 points: Probable cognitive impairment;
- From 6 to 7 points: Possible cognitive impairment;
- $\geq 8$  points: Normal Exam.

2. Quality of Life Questionnaire, Short-Form Health Survey (SF36). The SF-36 Questionnaire (Medical Outcomes Study 36 - Short Item Health Survey - SF 36) was developed by Ware and Sherbourne in 1992<sup>(14)</sup>, translated and validated to Portuguese by Ciconelli in 1999<sup>(15)</sup>. The SF-36 is an easily administered and understandable quality of life assessment tool. It is a multidimensional questionnaire that evaluates both positive and negative aspects of health. It consists of 36 items comprising eight domains: functional capacity (10 items), physical aspects (four items), pain (two items), general health (five items), vitality (four items), social aspects (two items), emotional aspects (three items), mental health (five items) and a question of comparative assessment between current health conditions and those of a year ago.

The scores range from zero to 100, with zero being the worst result and 100 the best. This score is performed by domain.

3. Hearing Handicap for the Elderly (HHIE) Questionnaire: Prepared by Ventry & Weinstein<sup>(16)</sup> and translated and adapted to Portuguese by Wieselberg<sup>(17)</sup>. It consists of 25 questions - patients should choose one of three possible alternatives in each question: yes, sometimes or no. The “yes” answer is awarded four points, “sometimes” two and “no” zero points. The higher the score indicates the higher the self-perceived restriction. It aims to identify the restrictions imposed by hearing loss. This study was applied as an interview.

4. Geriatric Depression Scale (GDS) was created by Yesavage et al.<sup>(18)</sup>. The GDS-15 (shortened version) was translated and adapted to Portuguese for application in Brazil by Stoppe Junior et al.<sup>(19)</sup>. The GDS-15 places more emphasis on emotional and cognitive aspects than on somatic aspects of depression. This scale identifies patients with evidence of depression and suicidal ideation. The scale is composed of 15 questions, in which the patient’s answer may be “yes” or “no”.

Each question was assigned the value of one point. The cutoff points are<sup>(20)</sup>:

- Normal or without depressive symptoms (N) - less than five points;
- Mild depressive symptoms (M) - between five and 10 points;
- Severe depressive symptoms (S) - over 10 points.

5. Visual Analog Listening Effort Scale: The Visual Analog Scale (VAS) was developed to assess pain<sup>(21)</sup>. In this study, however, it was used to evaluate the listening effort. The patient was presented with a 10 cm (not millimeter) line, in which the left end (zero) corresponds to no effort to hear and the right end<sup>(10)</sup>, total effort. The patient was instructed to indicate with a vertical risk the location of the scale that represented the effort required to be able to hear.

After applying the instruments of the research protocol, the elderly people received hearing aids dispensed by Sistema Único de Saúde (SUS). After three months of effective use of amplification, the protocol was reapplied with the inclusion of the IOI-HA questionnaire:

6 International Outcome Inventory - Hearing Aids (IOI-HA): The IOI-HA questionnaire was proposed by Cox et al.<sup>(22)</sup> and was translated into Portuguese in 2002 as the International Questionnaire for the Evaluation of Hearing Aids. Quantifies the performance that the hearing aid patient can achieve with amplification. It consists of seven questions that evaluate seven domains: 1. Usage; 2. Benefit; 3. Limitation of activities; 4. Satisfaction; 5. Restriction of residual participation; 6. Impact on others; and 7. Quality of life. The questions were elaborated with five possibilities of answers, being graded from left to right, so that the first option refers to a worse performance, to which a point is attributed; the last option indicates better performance, receiving five points. The questionnaire is divided into Factor 1 (sum of questions one, two, four and seven) and refers to the interaction of the individual with their hearing aid and Factor 2 (sum of questions three, five and six), which concerns the interaction of the individual with other people in their environment. These domains are evaluated with individuals using hearing aids.

## Statistical method

Descriptive analyzes were performed and the data were analyzed with Generalized Linear Models (GLM). To verify the homogeneity of the groups regarding the study variables, the Levene test was applied and the assumption of normality was assessed by the Shapiro-Wilk test. The significance level of 5% was adopted.

## RESULTS

The elderly participants were divided into two groups according to cognitive status, at the evaluation stage, based on the results of the 10-CS screening: Group of elderly people without cognitive impairment (G1) with seven participants, three (42.9%) of the participants were male and four (57.1%) female; and group of elderly people with possible/probable cognitive impairment (G2) with ten participants, five (50%) males and five (50%) females.

The sample was characterized by age, education, ABEP socioeconomic questionnaire, degree of hearing loss, best ear Speech Recognition Percentage Index (SRPI), Speech Intelligence Index (SII) with and without better hearing aids.

The characterization of the sample and the comparative study between the two groups are presented in Table 2. It could be observed that the elderly people in group G2 had a significantly higher mean age (80.7 years) than those in group G1 (71.7 years) ( $F=13.949$ ;  $\text{Eta-squared}=0.482$ ;  $p=0.002$ ).

The study of the average education of the two groups showed no significant difference ( $F=2.588$ ;  $\text{Eta-squared}=0.147$ ;  $p=0.129$ ). The elderly people in group G1 had an average education of 11.4 years and those in group G2 of 6.8 years.

The mean of *Índice Percentual de Reconhecimento da Fala* (IPRF) of the best ear was 72.6% in G1 and 58.8% in G2. The average SII of the best ear was in the condition without hearing aid of 32.4% in G1 and 30.5% in G2 and with hearing aid of 57.7% in G1 and 56.1% in G2. There was no significant difference between the SII obtained in both groups under both conditions.

The socioeconomic level of the participants was classified according to the ABEP criteria. The economic class C2 has the largest number of participants, with eight (47.1%) elderly people, and the ratings A and B1 were not represented in this research, which shows that both groups were composed of elderly people with low socioeconomic status.

The study of the scores obtained in the application of the HHIE, which evaluates the participation restriction imposed by hearing impairment through the repeated measures GLM test, showed that there was no statistically significant difference between groups G1 and G2 ( $F<0.0001$ ;  $\text{Eta-squared}<0.0001$ ;  $p>0.9999$ ). Significant differences were found between the evaluation and reassessment steps in group G1 ( $F=22.079$ ;  $\text{Eta-squared}=0.595$ ;  $p<0.0001$ ) and in group G2 ( $F=30.147$ ;  $\text{Eta-squared}=0.668$ ;  $p<0,0001$ ). It could be observed that the elderly people in both groups showed less perception of restriction in activities of daily living after three months of hearing aids. In G1, the scores went from 62% to 11.4% and in G2, from 62% to 12%.

The analysis of the listening effort results revealed no statistically significant difference between groups G1 and G2 ( $F=0.254$ ;  $\text{Eta-squared}=0.017$ ;  $p=0.622$ ). There was a significant difference between the results obtained in the two evaluation

**Table 2.** Characterization of the sample regarding the variables age, sex, education, SRPI, SII with and without hearing aids

	G1 (N)	G2 (A)
Individuals	7	10
Age * $p=0.002$	71,7	80,7
Male	42,9%	50%
Female	57,1%	50%
Educational Level $p=0.129$	11,4	6,8
SRPI of the best ear $p=0.095$	72,6%	58,8%
SII S/ AASI $p=0.724$	32,4%	30,5%
SII C/ AASI $p=0.731$	57,7%	56,1%

**Caption:** G1 - group without cognitive impairment; G2 - group with cognitive impairment; \*p - statistically significant; p - not significant



stages in group G1 ( $F=24.265$ ;  $\text{Eta-squared}=0.618$ ;  $p<0.0001$ ) and in group G2 ( $F=55.905$ ;  $\text{Eta-squared}=0.788$ ;  $p<0.0001$ ), which demonstrates a significant reduction in listening effort after three months of amplification use in G1 (from 7.8 to 2.6) and G2 (from 8.1 to 1.4). The comparison between HHIE and VAS scores obtained in the evaluation and reassessment are presented in table 3.

The scores of the IOI-HA questionnaire were analyzed according to factor 1, factor 2 and global score and, in both groups, the values were 17, 14 and 31 points, respectively. There was no significant difference between the values obtained in Factor 1, Factor 2 and Total IOI-HA score between the two groups. All values were considered satisfactory and are presented in table 4.

The study of non-auditory aspects, cognitive screening, depressive symptoms and quality of life is presented in table 5.

The 10-CS cognitive screening was the instrument used to compose both groups. Thus, group G1 presented significantly better results than G2 in the evaluation stage ( $F=33.918$ ;  $\text{Eta-squared}=0.693$ ;  $p<0.0001$ ). The reassessment showed a significant improvement in the results obtained by the elderly people in group G2 after three months of hearing aid use ( $F=27.632$ ;  $\text{Eta-squared}=0.648$ ;  $p<0.0001$ ).

**Table 3.** Comparison between HHIE and VAS scores obtained in the Evaluation and Reevaluation and between groups G1 and G2

	G1 (N)		G2 (A)	
	AV.	RE.	AV.	RE.
HHIE	62,6	11,4 * $p<0,0001$	62	12 * $p<0,0001$
VAS Listening Effort	7,8	2,6 * $p<0,0001$	8,1	1,4 * $p<0,0001$

**Caption:** AV - evaluation; RE - reevaluation; G1 - group without cognitive impairment; G2 - group with cognitive impairment; \*p - statistically significant

**Table 4.** Average scores of IOI-HA test according to Factor 1, Factor 2 and Total

	G1 (N)	G2 (A)
Factor 1 $p=0.825$	17,4	17,7
Factor 2 $p=0.732$	14,3	14
Total $p=0.994$	31,7	31,7

**Caption:** G1 - group without cognitive impairment; G2 - group with cognitive impairment; p - not significant

**Table 5.** Mean values and comparative study between the scores obtained in the Evaluation and Reassessment for 10-CS, GDS and SF-36 of groups G1 and G2

	G1 (N)		G2 (A)	
	AV	RE	AV	RE
10-CS * $p<0.0001$	8,4	9 $p=0,228$	5,5	7,5 * $p<0,0001$
GDS $p=0.848$	5,1	4,1 $p=0,495$	5,9	3,8 $p=0,100$
Functional capacity	60	75,7	47	65 * $p=0,020$
Physical aspects limit	39,3	78,6	27,5	50 * $p=0,005$
Pain	54,7	67,3	40,5	52,8
General state of health	69,6	80	56,4	74,7 * $p=0,018$
Vitality	62,8	72,8	43,5	61 * $p=0,034$
Social aspects	75	91,1	53,7	77,5 * $p=0,046$
Emotional aspects limit	61,9	80,9	49,9	80
Mental health	78,8	85,7	72,8	80,4

**Caption:** G1 - group without cognitive impairment; G2 - group with cognitive impairment; AV - evaluation; RE - reevaluation; \*p - statistically significant; p - not significant

The study of the results of the GDS revealed that there was no statistically significant difference between the groups ( $F=0.038$ ;  $\text{Eta-squared}=0.003$ ;  $p=0.848$ ) nor between the evaluation and reassessment steps in the G1 group ( $F=0.968$ ;  $\text{Eta-squared}=0.032$ ;  $p=0.495$ ) and in the G2 group ( $F=3.078$ ;  $\text{Eta-squared}=0.170$ ;  $p=0.100$ ). Both groups had better scores in the reevaluation stage, since the mean value calculated in the evaluation characterized depressive symptoms and the same did not occur in the reevaluation in G1 (from 5.1 to 4.1) and G2 (from 5.9 to 3.8).

In the Quality of Life Questionnaire (SF36), a statistically significant difference was observed between the evaluation and reassessment stages of the questionnaire for the Functional Capacity Domains ( $F=6.730$ ;  $\text{Eta-squared}=0.310$ ;  $p=0.020$ ), Limiting Physical Aspects ( $F=10.899$ ;  $\text{Eta-squared}=0.421$ ;  $p=0.005$ ), General Health ( $F=6.997$ ;  $\text{Eta-squared}=0.318$ ;  $p=0.018$ ), Vitality ( $F=5.453$ ;  $\text{Eta-squared}=0.266$ ;  $p=0.034$ ) and Social Aspects ( $F=4.737$ ;  $\text{Eta-squared}=0.240$ ;  $p=0.046$ ). There was no significant difference between groups in all domains ( $p>0.384$ ). In all domains, the results obtained in the reevaluation were higher than in the initial evaluation (better quality of life).

## DISCUSSION

The results obtained in the sample characterization are consistent with the findings in the literature, as these results demonstrate that cognitive changes are more frequent in the female population, among individuals with low education, low economic status and advanced age<sup>(23)</sup>.

The study of the age variable of the two groups showed that group G1 is composed of elderly people with an average age of 71.7 years, significantly lower than the average age of group G2 of 80.7 years. Older elderly people are known to have a higher prevalence of hearing loss and dementia<sup>(24)</sup>. This finding, therefore, is compatible with the literature data, since group 2 is the group composed of elderly people with results suggestive of cognitive impairment.

The study of the SRPI revealed that there was no statistically significant difference between the means obtained in the best ear in G1 (72.6) and G2 (58.8). However, better speech recognition was observed in the group without cognitive impairment. This

finding agrees with those researched in the specialized literature on the subject. Studies indicate that changes in speech recognition increase the chance of changes in cognitive performance<sup>(25)</sup>. Regarding the SII, it could be observed that both groups showed an improvement of SII of about 20% in the measure performed with amplification. Both groups reached from 50% to 55% SII, which is considered satisfactory<sup>(12)</sup>.

The results obtained in the questionnaire that evaluates restriction of participation in activities of daily living (HHIE) are similar to those observed in the study by Picinini<sup>(26)</sup>. This study demonstrated the benefit obtained by the elderly people with the use of hearing aids. The lower the participation restriction, the greater benefit from hearing aid use was perceived by users. Moreover, in another study, it was observed that the total HHIE score obtained in the pre- and post-intervention period showed significant improvement, being compatible with self-perception of moderate participation restriction in the pre-adaptation period and without perception of participation restriction in activities of daily living after one year of hearing aid use<sup>(27)</sup>.

The VAS was used to measure listening effort<sup>(28)</sup>. This study revealed that both groups had improvement in listening effort with the use of hearing aids. No studies were found in the literature that had applied VAS for this purpose. However, studies using pupillometry test to evaluate listening effort<sup>(29)</sup> were found, and the results showed that listening effort was higher in the signal/intermediate noise ratio.

Regarding the International Questionnaire of individual sound amplification device (IOI-HA), both factors obtained high scores, showing good results with the adaptation. In the total value of the IOI-HA, the results showed total scores with an average of 31.7 in both groups, demonstrating a positive evaluation of the experience with the use of hearing aids. This proves that the elderly people benefited from the use of sound amplification.

The study of the results of the 10-CS showed that there was a statistically significant difference between the groups ( $p < 0.0001$ ). This finding is due to the criteria defined for the formation of groups. However, what is interesting to note is that after the use of amplification, some participants in the group with results suggestive of cognitive impairment presented results compatible with normality. Thus, there was a significant difference between the assessment (5.5) and reassessment (7.5) stages of group G2 ( $p < 0.0001$ ). The same did not occur for group G1 ( $p = 0.228$ ). This better result expresses that, among other factors, the use of amplification by the elderly people can help the evaluated individual to perform the task more easily. It can also be inferred that this intervention may delay cognitive changes related to auditory perception and attention, enabling an aging with better quality of life<sup>(30)</sup>. Another study demonstrated that the use of amplification by the elderly people can attenuate the cognitive decline due to aging<sup>(24)</sup>.

The results obtained from the application of the SF36, showed that after the fitting of hearing aids, there was a significant improvement in the quality of life of the elderly people in the domains functional capacity and general health. Moreover, in all domains of the SF-36 questionnaire, the mean obtained in the reassessment stage was higher than the one found in the initial

assessment, as demonstrated in the study by Magalhães<sup>(27)</sup>, and it is possible to measure the improvement on quality of life, under the effect of speech-language therapy intervention.

Results of the GDS revealed that depressive symptoms decreased in both groups after amplification. A study that investigated the relationship between GDS and SF36 revealed that hearing rehabilitation provides improved attention, reverses social isolation, communicative and emotional difficulty caused by hearing impairment and contributes to improved functional health and quality of life of the elderly people<sup>(30)</sup>.

## CONCLUSIONS

Quality of life improved after three months of amplification use. There was no effect of cognition on the benefit obtained with the use of hearing aids.

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### Authors contributions

*LVR participated in the collection, analysis and interpretation of data and writing of the article; MCM participated, as advisor, in the conception of the study, analysis and interpretation of data and writing of the article.*