Original Article

Artigo Original

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Evaluation of participation restriction and cognitive processes in the elderly before and after audiologic rehabilitation

Avaliação da restrição de participação e de processos cognitivos em idosos antes e após intervenção fonoaudiológica

Keywords

Elderly
Deafness
Hearing aids
Questionnaires
Cognition

ABSTRACT

Purpose: To evaluate the restriction of participation in activities of daily living and cognitive processes in older adults, according to gender and age, before and after rehabilitation. **Methods:** The study included 50 individuals, 23 females and 27 males. The elderly were divided into two groups: Group 1 to 24 individuals aged between 60 and 74 years (11 females and 13 males), Group 2 - 26 elderly aged above 75 years (12 of female and 14 male). The elderly were evaluated before one year after the adaptation of hearing aids through the HHIE test and MMSE. Bimonthly follow-ups were conducted a total of seven meetings, to ensure the effective use of the prosthesis. As for the statistical analysis were performed descriptive and statistical analysis. **Results:** There was a reduction of the restriction of participation in social and emotional scales HHIE post-intervention in both groups, individuals of both genders. The MMSE test results were better in the post-intervention, regardless of gender and age of the participant. **Conclusion:** There is little perception of the restrictions on participation in activities of daily living after rehabilitation. Moreover, the elderly of different ages and both genders decreased cognitive constraints refer after hearing aid fitting.

Descritores

Idoso
Deficiência auditiva
Auxiliares de audição
Questionários
Cognição

RESUMO

Objetivo: Avaliar a restrição de participação em atividades de vida diária e de processos cognitivos em idosos, de acordo com gênero e faixa etária, antes e após intervenção fonoaudiológica. **Métodos:** Participaram 50 idosos, 23 do gênero feminino e 27 do gênero masculino. Os idosos foram distribuídos em dois grupos etários: Grupo 1 – 24 idosos, com idade entre 60 e 74 anos (11 do gênero feminino e 13 do gênero masculino); Grupo 2 – 26 idosos com idade igual ou superior a 75 anos (12 do gênero feminino e 14 do gênero masculino). Os idosos foram avaliados antes após um ano de adaptação da prótese auditiva, por meio do questionário HHIE e o teste MEEM. Foram realizados acompanhamentos bimestrais totalizando sete reuniões, a fim de garantir a utilização efetiva da prótese. Quanto à estatística, foram realizadas análises descritivas e análise de variância. **Resultados:** Houve redução da restrição de participação nas escalas emocional e social do HHIE no período pós-intervenção, nos dois grupos, em indivíduos de ambos os gêneros. Os resultados do teste MEEM foram melhores no período pós-intervenção, independentemente do gênero e idade do participante. **Conclusão:** Há menor autopercepção das restrições de participação em atividades de vida diária após intervenção fonoaudiológica. Além disso, idosos de diferentes idades e de ambos os gêneros referem diminuição de restrições cognitivas após adaptação de prótese auditiva.

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INTRODUCTION

Hearing loss is one of the main sensory alterations that affect individuals during the aging process. The association of aging with hearing loss causes physical, psychological and social changes, affecting communication and the interaction of the elderly with the society.

Presbycusis, which is aging of the auditory system, promotes reductions in the ability to understand, speech intelligibility, verbal communication and social contact in the elderly and may cause emotional changes. Among all of the sensory privations, the inability to communicate with other people due to hearing loss may be one of the most frustrating consequences for the elderly[1].

The first sign of presbycusis is the moment where the elderly are no longer able to follow a conversation, principally in an environment with competitive noise, such as television, music or other parallel conversations. These restrictions negatively impact their relationships with other people and may result in depression and isolation, which affect their quality of life[2].

The health changes caused by aging may affect the autonomy and independence of the elderly and, consequently, damage their social life and welfare. Thus, hearing loss can restrict daily living activities and increase functional decline in the elderly. Moreover, the degree of hearing loss can affect the cognitive performance of the elderly[3,4].

The use of hearing aids to improve cognitive performance is an active area of study. Hearing aids promote improved attention, reversal of isolation and communication difficulties and improved quality of life[5-7].

Thus, it is important to study the relationship between hearing loss and cognitive performance in the elderly. Based on these considerations, the objective of this study was to evaluate the restriction of participation in daily life activities and cognitive processes in the elderly with regard to gender and age, both before and after audiologic intervention

METHODS

This study was evaluated and approved by the Ethics in Research Committee of the Federal University of São Paulo under protocol number 0913/08. The study was carried out by the Association for Prevention, Specialized Care and Inclusion of People with Disabilities in the city of Ribeirão Pires, São Paulo. The patients were oriented and signed the Free and Informed Consent form based on resolution 196/96 of the National Commission on Ethics in Research.

The eligibility criteria for inclusion in the sample were age greater than or equal to 60 years, presenting of a severe degree of symmetrical bilateral sensor neural hearing loss and a Speech Recognition Percent Index (IPRF) greater than 50%, showing indications to use bilateral hearing aids, presenting no evidence of other impairments and being literate.

The sample consisted of 50 elderly patients: 23 female (46%) and 27 male (54%). There were 24 (48%) who were in the 60-74 year age range and 26 (52%) older than 75 years. Considering the three schooling categories, we observed that none of the elderly in the sample was illiterate, 49 (98%) had 1 to 11 years of schooling, and only one (2%) had 12 or more years of schooling.

The elderly were subdivided in two age groups: Group 1, 24 elderly (48%) aged between 60 and 74 years (11 female and 13 male) and Group 2, 26 elderly (52%) aged 75 years or older (12 female and 14 male). We used the *Hearing Handicap Inventory for the Elderly* (HHIE)[8] questionnaire, which was developed to evaluate the psychosocial, emotional and social effects of hearing loss in elderly patients. The HHIE was originally written in English and adapted to the Portuguese language[9]. Paper and pencils were used to complete the questionnaire, as all the elderly were literate.

The HHIE is composed of 25 questions, among which 13 explore the emotional effects of hearing loss and 12 explore the social and situational effects of the deficiency. The degree of participation restriction was determined by the global score for the 25 questions, where four points were attributed to each 'yes' response, two points for 'sometimes' and zero points for 'no'. Summing all of the attributed points, the total score can vary from 0% (suggesting the absence of the *handicap*) to 100% (suggesting total perception of *handicap*). A higher score indicates a greater perception of participation restriction; i.e., the auditory and non-auditory difficulties imposed by the deficiency are greater. The points are distributed in the following manner based on the perception of restriction: no perception of restriction (0 to 16), light-moderate perception (18 to 42) and severe–substantial perception (>42).

The Mental State Mini Exam (MSME) was also used to evaluate cognitive processes. The MSME was translated and adapted to Portuguese[10.11]. It contains questions relating to immediate memory, memory recall, temporal orientation, spatial orientation, attention and calculations and language. This test contains questions grouped in seven categories that evaluate specific cognitive functions: temporal orientation (five points), spatial orientation (five points), word recognition (three points), attention and calculation (five points), word memory (three points), language (eight points) and visual constructive capacity (one point). The MSME score can vary from 0, which indicates the greatest degree of cognitive impairment, to 30 points, which corresponds to the highest cognitive capacity. Due to the necessity of using different cut-off points according to each individual's schooling, the following situations were considered to represent altered cognition: illiterates with scores less than 13 points; individuals with average schooling (up to eight years of formal instruction) with scores less than 18 points; individuals with extended schooling (more than eight years of instruction) with scores less than 26 points[12]. The test was applied with instructions from the researchers so that the understanding of the proposed items was guaranteed.

Bi-monthly follow-up meetings were scheduled for a total of seven meetings, with the objective of facilitating the process of hearing aid fitting. In these meetings, the patients received orientation about the use, care and handling of the prosthesis and instruction about communication strategies. At the first meeting, the elderly received all written information about the objective of the study and a card containing all of the dates for

scheduled meetings until the end of the study. Also at the first meeting, the elderly completed the HHIE questionnaire and the MSME. By the second meeting, the elderly had already adapted to their hearing aids. During the subsequent meetings, the subjects received clarification regarding their doubts about use, handling and care; the use of dehumidifier accessories; air puffers to clean away mould; the use of the telephone; and communication strategies. In the last meeting, after approximately one year of hearing aid use, all of the elderly completed the HHIE questionnaire and MSME again.

Statistical methods

Tables with descriptive statistical values were constructed for the HHIE questionnaire and MSME scores according to time period, gender and age range. To compare the averages of the scores in the two evaluation periods, genders and age ranges, an analysis of variance (ANOVA) with repeated measurements was applied[13]. The averages of the differences between the pre- and post-intervention periods were estimated, and 95% confidence intervals were constructed. The MMSE was also categorised as normal or altered based on the established criteria[12] and according to the patient's scoring and schooling. The probabilities of the occurrence of subjects in these categories in the pre- and post-intervention periods were compared with the McNemar test[14]. For each hypothesis test, we adopted a 0.05 significance level, and the significant p-values are marked with an asterisk (*).

RESULTS

The descriptive statistics were established for the total HHIE questionnaire scores before and after the audiologic intervention. The average score obtained from the elderly in the pre-intervention period (32.9%) was lower than after the intervention (8.8%) (Table 1).

Table 1. Descriptive statistics for the total scoring of the HHIE in the pre- and post-audiologic intervention periods

Variable	n	Average	SD	Minimum	Median	Maximum
Total pre	50	32.9	5.9	20	34	42
Total post	50	8.8	5.1	0	8	22

Pre x Post: p<0.0001* (ANOVA with repeated measures)
Legend: SD = standard deviation

Next, the descriptive statistics were established separately for the Emotional scale of the HHIE questionnaire, before and after the intervention for the two gender and age groups. ANOVA was applied to determine whether there was a difference between the scores obtained in the two age groups, genders and the pre- and post-intervention conditions. The difference between the relative average scores on the HHIE Emotional scale in the pre- and post-intervention periods depended on gender (p=0.021) and age range (p=0.008) (Table 2).

Next, we studied the effects of gender and age on the average pre- and post-intervention scores on the Social/Situational scale of the HHIE. Gender was a significant determining factor (p=0.004), but no differences were present between the two age groups (p=0.061) or time periods (p=0.076). Before the intervention, the average score calculated for the elderly males was higher than that for the females (p<0.0001) (Table 3).

In the second stage of the study, the descriptive statistics and ANOVA were evaluated for the scores obtained from the MMSE. The obtained results demonstrate that the average

Table 2. HHIE Emotional scale score by gender and age range, pre- and post-intervention

Gender	Age range	Period	n	Average	SD	Minimum	Median	Maximum
Female	60 to 74	Pré	11	12.7	3.6	8	12	18
		Pós	11	4.0	2.0	0	4	6
	≥75	Pré	12	15.2	4.0	10	16	20
		Pós	12	3.8	3.8	0	3	12
	Total	Pré	23	14.0	3.9	8	14	20
		Pós	23	3.9	3.0	0	4	12
Male	60 to 74	Pré	13	15.8	3.8	10	18	20
		Pós	13	4.9	2.5	0	6	8
	≥75	Pré	14	17.6	2.7	12	18	20
		Pós	14	3.4	3.1	0	2	12
	Total	Pré	27	16.7	3.3	10	18	20
		Pós	27	4.1	2.9	0	4	12
Total	60 to 74	Pré	24	14.4	4.0	8	14	20
		Pós	24	4.5	2.3	0	4	8
	≥75	Pré	26	16.5	3.5	10	17	20
		Pós	26	3.6	3.3	0	2	12
	Total	Pré	50	15.5	3.8	8	16	20
		Pós	50	4.0	2.9	0	4	12

ANOVA (p≤0.05): Pre x Post x Gender: p=0.021*. Female x Pre x Post: p<0.0001*. Male x Pre x Post: p<0.0001*
Pre x Female x Male: p=0.003*. Post x Female x Male: p>0.999. Pre x Post x Age range: p=0.008*
G1 (60 to 74 years) x Pre x Post: p<0.0001*. G2 (≥75 years) x Pre x Post: p<0.0001*. Pre x G1 (60 to 74 years) x G2 (≥75 years): p=0.026*
Post x G1 (60 to 74 years) x G2 (≥75 years): p=0.916
Legend: SD = standard deviation

score was higher in the post-intervention period than before the intervention (p<0.001). This difference was independent of gender (p=0.279) and age range (p=0.997) (Table 4).

The frequency distributions and joint percentages of the MMSE scores were calculated according to the results, which were categorised as normal and altered. We observed that the probability of altered cognition was lower in the post-intervention period than in the pre-intervention period (p<0.0001) (Table 5).

DISCUSSION

The descriptive statistics were calculated for the total HHIE score in the pre- and post-intervention periods. The results show that in the pre-intervention period there was a moderate perception of participation restriction in daily living activities. However, after audiologic intervention there was no perception of such a restriction.

According to studies that have used the HHIE question-

Table 3. HHIE Social scale score by gender and age range, pre- and post-intervention

Gender	Age range	Period	n	Average	SD	Minimum	Median	Maximum
Female	60 to 74	Pré	11	14.2	4.2	8	16	20
		Pós	11	4.4	3.9	0	4	10
	≥75	Pré	12	17.0	2.6	12	16	20
		Pós	12	4.8	2.8	2	4	10
	Total	Pré	23	15.7	3.7	8	16	20
		Pós	23	4.6	3.3	0	4	10
Male	60 to 74	Pré	13	18.5	2.0	14	20	20
		Pós	13	5.1	3.0	0	6	8
	≥75	Pré	14	19.3	1.5	16	20	20
		Pós	14	4.7	2.8	2	4	12
	Total	Pré	27	18.9	1.8	14	20	20
		Pós	27	4.9	2.8	0	6	12
Total	60 to 74	Pré	24	16.5	3.8	8	18	20
		Pós	24	4.8	3.4	0	6	10
	≥75	Pré	26	18.2	2.4	12	20	20
		Pós	26	4.8	2.7	2	4	12
	Total	Pré	50	17.4	3.2	8	18	20
		Pós	50	4.8	3.0	0	4	12

ANOVA (p≤0.05): Pre x Post x Gender: p=0.004*. Female x Pre x Post: p<0.0001*. Male x Pre x Post: p<0.0001*
Pre x Female x Male: p<0.0001*. Post x Female x Male: p>0.999. Pre x Post x Age range: p=0.061
G1 (60 to 74 years) x Pre x Post: p=0.076 . G2 (≥75 years) x Pre x Post: p=0.076
Legend: SD = standard deviation

Table 4. MSME score by gender and age, pre- and post-intervention

Gender	Age range	Period	n	Average	SD	Minimum	Median	Maximum
Female	60 to 74	Pré	11	21.4	3.9	16	20	29
		Pós	11	25.5	3.2	20	26	30
	≥75	Pré	12	20.4	3.8	16	20.5	26
		Pós	12	24.3	3.3	20	24.5	29
	Total	Pré	23	20.9	3.8	16	20	29
		Pós	23	24.9	3.2	20	26	30
Male	60 to 74	Pré	13	22.7	4.3	16	22	28
		Pós	13	25.9	3.6	20	28	30
	≥75	Pré	14	21.9	3.9	17	21	29
		Pós	14	25.4	3.4	17	25.5	29
	Total	Pré	27	22.3	4.0	16	22	29
		Pós	27	25.7	3.4	17	26	30
Total	60 to 74	Pré	24	22.1	4.1	16	21.5	29
		Pós	24	25.8	3.3	20	26	30
	≥75	Pré	26	21.2	3.8	16	20.5	29
		Pós	26	24.9	3.3	17	25	29
	Total	Pré	50	21.6	3.9	16	21	29
		Pós	50	25.3	3.3	17	26	30

ANOVA (p≤0.05): Pre x Post: p<0.001*. Pre x Post x Gender: p=0.279. Pre x Post x Age range: p=0.997
Legend: SD = standard deviation

Table 5. Distribution of the number of elderly according to the MSME results (normal and altered) in the pre- and post-audiologic intervention periods

Pre		Post		Total
		Altered	Normal	
Altered	n	7	19	26
	%	14	38	52
Normal	n		24	24
	%		48	48
Total	n	7	43	50
	%	14	86	100

Pre x Post: p<0.0001* (McNemar test)

naire, to minimise the psycho-social effects of hearing loss in the elderly, it is necessary to include the elderly in auditory rehabilitation programs. After participation in the program, the elderly present reduced participation restriction, which demonstrates the importance of using hearing aids in the elderly[15]. The findings of the present study demonstrate that the elderly present significantly reduced self-perception of participation restrictions after one year of hearing aid use, and this reduction is independent of gender and age range. This improvement can be attributed simply to the adoption of the use of hearing aids, as previously mentioned[15-17]. However, it is important to emphasise that we conducted bi-monthly follow-ups of the patients. This procedure may have influenced the results.

The analysis of the relative scores on the Emotional scale of the HHIE questionnaire revealed the perception of a minor participation restriction in the post-intervention period. However, in the pre-intervention period, the obtained average score for the elderly males was higher than that obtained for the females, suggesting that elderly men present a greater degree of perception of restrictions than elderly women. Furthermore, the participation restriction analysis according to age range revealed a lower mean score in the post-intervention period. The average decrease between the pre- and post-intervention periods was greater in the >75 group, revealing that these elderly patients present a greater degree of perception of restrictions before audiologic intervention and derive a greater benefit from the audiologic intervention.

The analysis of the Social/Situational scale results revealed that the average decrease that occurred between the pre- and post-intervention periods was greatest in the elderly men. Such data again demonstrate that elderly men present a greater degree of perception of participation restriction and show greater social/situational benefits after audiologic intervention.

In a previous study, elderly men presented a greater perception of participation restriction than did elderly women[16], which is in accord with the results obtained in the present study. It is believed that this effect is due to the role of family provider that is traditionally assigned to men in our society, even to elderly men, which may exacerbate the perception of participation restrictions.

It has been shown that the benefit of using hearing aids can be measured by evaluating the reduction of participation restriction and can be evaluated after six weeks of effective prosthesis use, which is a sufficient period to demonstrate proportionate benefits[17]. In the present study, the re-evaluation was made almost one year after fitting, which is a time interval that is considered sufficient for reapplication of the questionnaire.

In the analysis of the MSME results, the average scores after the intervention were higher than those in the pre-intervention period. Thus, the cognitive performance of the elderly, evaluated by this triage instrument, improved after intervention, independent of gender and age range.

There is a correlation between hearing loss and the cognitive performance of elderly patients, and rehabilitation through the use of hearing aids contributes to improved cognitive performance. In a previous study, although the elderly women presented higher scores, indicating better performance, the results were not significant[4]. Such findings are similar to those obtained in the present study.

Moreover, the MSME was analysed after the results were classified into normal and altered categories[12]. This analysis demonstrated that of the 26 individuals (52%) showing altered cognition in the pre-intervention period, 19 (38%) presented normal results in the post-intervention period. Thus, it was verified that 52% of the elderly showed altered cognition in the pre-intervention period, whereas only 14% presented altered cognition in the post-period.

For the communication process to be successful, it is necessary that the listener accumulate information throughout life based on sensory input (*bottom-up*) and cognitively interpret the intention of the speaker (*top-down*). A large cerebral activation occurs when it becomes necessary to hear in difficult listening environments. To comprehend speech in acoustically unfavourable environments, the elderly with sensorineural auditory loss must put forth a great effort; thus, they predominantly use cognitive resources to interpret the information, which can lead to stress. The deficiency in any sensory input and/or in the necessary cognitive processes for interpreting speech sounds causes communication obstacles. Thus, when the input pathway is impaired, more cognitive resources are necessary to understand speech, activating compensatory processes to obtain better performance. Higher age and less schooling are related to reduced cognitive performance[18,19].

The results of the present study demonstrate that the elderly exhibit improved performance in the MMSE after one year of hearing aid use, which is encouraging because cognitive improvements were not expected from the use of the prosthesis. However, the fact that the elderly were more alert and aware due to auditory sensitivity improvements and consequently suffered less cognitive demand to understand speech may have led to an improvement in the cognitive performance measured by the MSME.

CONCLUSION

After a critical analysis of the results, it is possible to conclude that elderly patients perceive less participation restriction after audiologic intervention. However, elderly males present greater self-perception of participation restriction in the pre-

audiologic intervention period. The oldest elderly present a greater self-perception of restrictions in the pre-audiologic intervention period. Elderly individuals present greater cognitive performance scores after the audiologic intervention, regardless of gender and age range.

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