

# PERFORMANCE IN THE AUDITORY ABILITIES OF SELECTIVE ATTENTION AND HEARING MEMORY IN A GROUP OF ELDERLY WITH HEARING AIDS: INFLUENCE OF HEARING LOSS, AGE AND GENDER

## *Desempenho nas habilidades auditivas de atenção seletiva e memória auditiva em um grupo de idosos protetizados: Influência de perda auditiva, idade e gênero*

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### ABSTRACT

**Purpose:** to verify the performance in the auditory abilities of selective attention and hearing memory of elderly with prosthesis and relate it to the degree and the configuration of hearing loss, the gender and the age. **Method:** 29 elderly people from 60 to 84 years old were evaluated, 17 of them (58,62%) females and 12 (41,38%) males. The evaluations carried out included meatoscopy, audiometry evaluation and the use of the SSW test in Portuguese. **Results:** the analysis of the data showed that, in this group of individuals, the age and the degree of auditory loss influenced significantly in the scores obtained in the evaluation of the auditory process, unlike the other variables. The elderly that showed light degree with horizontal configuration obtained scores significantly higher than the ones who had auditory loss in moderate degree with horizontal configuration or moderate degree with descending configuration. Elderly belonging to the age range 60 to 69 years old obtained performance significantly superior when compared with the ones in the age range of 80 to 89 years old. **Conclusion:** it was concluded that the degree of hearing loss and the age influenced the evaluation of the auditory processing. The gender and the configuration of hearing loss were not significant determining factors in the evaluation of the auditory processing.

**KEYWORDS:** Aged; Aging; Hearing Loss; Hearing Disorders; Auditory Perception

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### ■ INTRODUCTION

The hearing disorder, which prevents the elderly to fully play their role in society, is one of the most disabling disorders of communication. The presbycusis is a loss in the sensitivity of hearing resulted from aging. It is characterized by bilateral high-frequency sounds due to degenerative and physiological change in the auditory system<sup>1</sup>, accompanied by a decrease in speech discrimination<sup>2</sup>.

Hearing loss is considered a public health problem, given its prevalence that affects approximately 84.2% of elderly<sup>3</sup>. For these, the loss of peripheral sensitivity correlates with the difficulty

of speech recognition, especially in noisy environments<sup>4,5</sup>. Presbycusis compromises the ability for activities of daily living of the elderly and increases the risk of functional decline.

The way the auditory system receives, analyzes and organizes what we hear is called auditory processing<sup>6</sup>. The evaluation of the auditory processing checks as the individual receives the acoustic information, using auditory skills that are essential to understanding what is heard<sup>7</sup>.

The interest in the relationship between aging and auditory processing has been increasing. This growth is due to the existence of older people who have integrity peripheral hearing and/or elderly with hearing aids with functional gain of the hearing aid suitable for hearing loss, but present auditory manifestations incompatible with such features<sup>8</sup>.

Studies have shown that the difficulties of speech recognition in unfavorable acoustic environments may be related to loss of ability to perform auditory processing of sounds associated with aging. It is shown, therefore, the importance of these people learn to understand what is heard and not just listen to the sounds, without knowing their meanings<sup>9-10</sup>.

The technology of hearing aids has evolved greatly in recent years, especially with the introduction of digital hearing aids, which allow customized adjustments and different settings for different environments. These are intended to provide the largest possible amount of acoustic information. This characteristic favors elderly that have suitable functional gain for their type and degree of hearing loss. However despite the high technology implemented in hearing aids, it is known that many elderly still complain of not understanding speech in adverse acoustic environments, thereby warranting the need to study the performance of the SSW test in Portuguese in elderly with prostheses.

It is therefore important to know the association between hearing loss and auditory processing disorder, especially in the elderly, given that, in most cases, these disorders are not noticeable until its effects compromise the communication. Early diagnosis and subsequent intervention cause significant positive effects.

Based on the described theoretical assumptions, this study aims to check whether there is a relationship between the degree and the configuration of hearing loss, age and gender on the performance of the auditory abilities of selective attention and memory impairment in a group of elderly people with hearing aids.

## METHOD

This sample was selected from the records of patients from a private institution located in the city of Santa Maria (RS, Brazil), from September 2009 to June 2010, 30 elderly hearing aid users with bilateral symmetrical sensorineural hearing loss of mild to moderate degree who agreed to participate.

To compose the sample, individuals were selected according to the following eligibility criteria:

- Being older than 60 years old (according to the criteria for classification of the elderly by the World Health);
- Presenting sensorineural hearing loss from mild to moderate in both ears;
- Introducing index of symmetrical speech recognition to be equal or greater than 72% bilaterally hits;
- Being an ITE hearing aid user in both ears for at least three;
- Not having (apparent) neurological, motor, mental changes or associated syndromes that may hinder understanding and realization of the proposed tasks.

To determine the degree of hearing loss and its settings, we used the classification of Carhart, 1945 and Lloyd and Kaplan, 1978<sup>13</sup>. This consists of the average of the hearing thresholds for frequencies of 500, 1,000 and 2,000 Hz. It was considered normal the results of 0-25 dB HL, mild hearing loss of 26-40 dB HL, moderate 41-55 dB HL; moderately severe 56-70 dB HL, severe 71-90 dB HL; deep those higher than 91 dB HL. In regards to the audiometric configuration, it is the changes between octaves of frequency from 1,000 Hz.

Audiometric configurations were considered those who had ancestors in response to an improvement equal to or greater than 5 dB per octave toward the high frequencies; horizontal ones where audiometric hearing thresholds alternated improvement or worsening of 5dB per octave at all frequencies, and audiometric descending worsening 5-20 dB per octave toward the high frequencies.

The following will describe the procedures performed for assessing auditory processing:

Anamnesis was conducted through a questionnaire with closed questions proposed by Pereira and Schochat<sup>14</sup> for auditory processing, being adapted for elderly hearing aid users.

It was also held on otoscopy, in order to exclude from the sample those individuals with a change in the external auditory canal that could interfere with the results of the evaluations proposed.

Subsequently, the patient underwent audiometry which consisted of: pure tone audiometry by air

and bone conduction, with individuals making use of bilateral ITE hearing aids with similar settings in both ears; investigation on the speech recognition threshold (SRT), and research on the percentage index of speech recognition (PISR). Also measurements were performed of the acoustic impedance through the tympanometry and research on the acoustic reflexes both contra and ipsilateral modes.

After, the auditory processing assessment was done which consisted of the following test:

*Staggered spondaic word – SSW* in Portuguese: used as sound stimuli disyllabic paroxitone words, presented to the individual at 50 dB SL, based on the average of hearing thresholds at 500, 1,000 and 2,000 Hz for each ear. 40 items were formed with 4 words each, a total of 160 stimuli. Each ear was stimulated by two words, whereas the stimulus began by alternating ears. The first and fourth words were presented separately and in an isolated way each of the ears and the second and third words were displayed partially overlapped. Thereafter, quantitative analysis was carried out, the test using the average competitive conditions (CR and CL)<sup>14</sup>. In this classification, it considered normal the individual who presents the average DC + EC and total hits higher than or equal to 90%. Individuals with scores below 90% are considered carriers of auditory processing disorder. All subjects of the sample performed the SSW test in Portuguese using bilateral hearing aids.

This study is part of a research project entitled “Efficacy of the rehabilitation of auditory processing in a group of elderly hearing aid users,” approved

by the Ethics Committee in Research of Federal University of Santa Maria under case number 23081.008171/2010-18 and authorized by patients by signing the Free and Informed Consent.

Based on the results of auditory processing, we used descriptive statistics such as frequency tables and simple cross. To compare the results of the assessment and the degree of processing and audiometric configuration of hearing loss, we used the Mann-Whitney test. All data were statistically analyzed by a professional in the field in order to verify the relationship between the variables hearing loss, age, gender and the performance of auditory processing.

## ■ RESULTS

Data analysis showed that out of the 29 (100%) elderly patients, 17 (58.62%) were female and 12 (41.38%) were male. Ages ranged from 60 to 84 years old: 14 (48.28%) were from 60 to 69 years old, 10 (34.48%), from 70 to 79 years old, 5 (17.24%), from 80 to 89 years old. According to the data obtained, it was found that most of the elderly sample was female and aged 60-69 years old.

Out of the 29 patients included, it was found that 7 had mild hearing loss with horizontal configuration, 4 had mild hearing loss and descending configuration, and 1 had mild hearing loss with ascending configuration, 12 had moderate hearing loss with horizontal configuration and 5 showed moderate hearing loss and descending configuration, as table 1 shows.

**Table 1 – Degree and configuration of hearing loss of the sample components**

Hearing	N	%
Mild horizontal	7	24,14
Mild descendant	4	13,80
Slightly upstream	1	3,44
Moderate horizontal	12	41,38
Moderate descendant	5	17,24
Total	29	100

Legend: N = absolute value;% = relative values

According to the findings, it was found that most of the elderly had moderate hearing loss with horizontal configuration (41.38%), followed by mild hearing loss with horizontal configuration (24.14%), with most elderly having moderate hearing loss, 18

(62.06%), and audiometric configuration was predominantly horizontal, 19 (65.51%).

Table 2 contains the data analysis of the results obtained in the evaluation of auditory processing in relation to gender.

**Table 2 – Scores from auditory processing evaluation – SSW test (total hits) in relation to gender**

Gender	Minimum	Maximum	Average	Standard Deviation	p value
Female	36,75	98,75	78,06	17,16	0,2318 <sup>ns</sup>
Male	34,45	98,75	69,78	21,05	-

Legend: ns = not significant p value p value

The male subjects reached a minimum value of 34.25 and a maximum of 98.75. The average of correct responses was 69.78. The female subjects had a minimum value of 36.25 and a maximum of 98.75 hits with an average of 78.06, having the minimum and average values for the females increased when compared to males.

To verify the relationship between the degree and configuration of hearing loss and performance on auditory processing, analysis was performed considering the degree and configuration of hearing loss and the average scores of the SSW test – total hits. The results are shown in Table 3.

**Table 3 – Scores of SSW test according to the degree of hearing loss**

Degree of loss	N	Minimum	Maximum	Average	SD
Mild horizontal	7	84,37	98,75	93,62	6,03
Mild descendant	4	67,25	90,62	82,49	11,03
Slightly upstream	1	88,37	88,37	88,37	-
Moderate horizontal	12	36,25	93,18	69,34	17,76
Moderate descendant	5	34,45	76,25	53,82	14,72
Total	29	-	-	-	-

It was found that elderly people with mild hearing loss had significantly better scores than older people with moderate hearing loss ( $p = 0.0020$ ). There was no statistically significant difference taking into account only the audiometric configurations of hearing loss.

Figure 1 contains the analysis of the results obtained in the SSW test the condition of total correct in relation to age.

These findings confirm that the higher the age, the worst performance in the test, i.e., age can influence the performance of auditory processing. It was observed, in general, a gradual reduction in scores with the increasing age, this reduction is statistically significant when compared to the age group of 60-69 and 80-89 ( $p = 0.0052$ ).

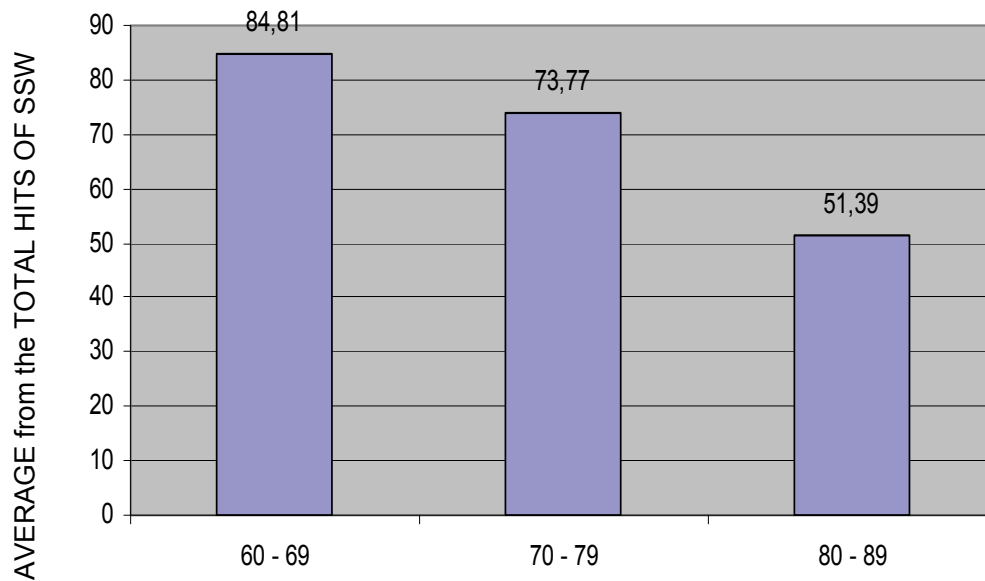


Figure 1 – Comparison between SSW scores and age groups

## ■ DISCUSSION

Obtaining information on the performance in the auditory selective attention and auditory memory depends on the achievement test that is sensitive to detect impairment of certain regions of the auditory system.

In Table 1, in relation to the degree of hearing loss of the sample, the majority of elderly subjects has hearing loss from mild to moderate, and the audiometric configuration was predominantly horizontal, results similar to those obtained by other authors<sup>3,15,16</sup>. This degree of hearing loss does not completely prevent the individual to perceive environmental sounds, but generates a series of auditory disorders which with hearing aids are partially solved, because hearing aids amplify the sound generated naturally, thus eliminating the deficit peripheral auditory system, causing the acoustic signal to be further developed in the central auditory system.

In regards to gender, as shown in Table 2, females obtained higher scores than the males, with the average hits for females as 78.09 and for males as 69.78. The analysis showed that the gender variable has no statistically significant difference in the results of auditory processing. These findings confirm the findings of other authors<sup>17,18</sup>. However, research on gender and auditory processing are controversial due to reduced comparative literature on the subject and the procedures used for processing evaluation. In some cases, however, what we see is that most women have poorer performance

on auditory processing, perhaps because they live longer<sup>19,20</sup>.

As shown in Table 3, when comparing individuals with mild to moderate with audiometric horizontal ( $p = 0.0020$ ), as well as individuals who have mild to moderate and setting horizontal and descending ( $p = 0, 0014$ ), it was observed minimum, maximum and average higher in elderly people with mild hearing loss with horizontal configuration, and these differences were statistically significant. This finding confirms what has already been observed by other authors<sup>21,22</sup> in regards to the degree of hearing loss it significantly influences the performance of auditory processing, mainly due to the fact that the greater the loss in the peripheral auditory system, the greater the central auditory disorder of that individual, causing even a deficit in the auditory selective attention and auditory memory, among others.

Regarding the audiometric configuration of hearing loss, despite having found decreased average, minimum and maximum values in descendent configurations when compared with ascending configurations and horizontal configurations, these differences were not statistically significant, as the degree of hearing loss was the same, with the degree of hearing loss evidently related to the performance of auditory processing.

Figure 1 contains the analysis of the results of the assessment of auditory processing in relation to age. According to findings from the age group of 60-69 years old, it had an average score on the SSW of 84.81. From the 70-79, the average of hits was 73.77. From 80-89 the average of hits was 51.39. These findings confirmed that the higher the



age, the worse the performance of auditory processing, with a gradual decrease in scores with increasing age. It was observed that there were statistically significant differences between the age groups 60-69 and 80-89. These results ratified studies by other authors<sup>2, 23</sup>. This is due to the fact that the greater the age, the higher is the central auditory disorder population.

The gradual loss of hearing, as in presbycusis, leads to increasing difficulty in oral communication and the consequent social isolation, with implications on the results of auditory processing, reaching elderly of both genders and of any age<sup>24</sup>. The proper use and proper fitting of hearing aids is associated with an increased possibility of rehabilitation<sup>25</sup>, which may be related to possible improvements in the performance of auditory processing<sup>24, 26</sup>. These agree with the specified by the studied sample, because there were elderly of both genders and different age groups as well, all seniors were using bilateral hearing aids. It also should be mentioned that the non-use of hearing aids by the elderly, probably would lead to different results from those found by the sample, with these scores worsened when compared to those found by the sample.

We raised some hypotheses that may explain our findings:

The aging could affect certain auditory skills, depending on the susceptibility of each individual;

The involvement observed in all elderly sample would not be just due to aging, and could be caused by other health problems throughout life, general physiological factors, lifestyle, among others.

The use of bilateral hearing aids, only, does not eliminate the central auditory disorder, and this fact is independent of hearing loss, age and gender.

Understand the functioning of the auditory pathway is essential for the understanding of how the brain integrates and discriminate auditory stimuli such as speech sounds. Understanding how the central structures of the auditory system react to different stages of the elderly, as well as to different degrees and configurations of hearing loss can help in the development of methods to ensure better use for the communication of the individual.

Research involving the relationship among hearing loss, age and gender with auditory skills intends to understand changes related to different variables that occur with the process of auditory information during aging and possibly contribute to the process of human communication

## ■ CONCLUSION

From the analysis of the results obtained in this study, it is concluded that the variables configuration of hearing loss and gender have no direct relationship in auditory skills. The variables degree of hearing loss and age have compared the performance of the auditory abilities of selective attention and auditory memory as, senior citizens who have mild hearing loss, aged 60-69 years old have a better performance than the others studied in elderly sample.

## RESUMO

**Objetivos:** verificar o desempenho nas habilidades auditivas de atenção seletiva e memória auditiva de idosos protetizados e relacioná-lo com o grau e configuração de perda auditiva, o gênero e a idade.

**Método:** foram avaliados 29 idosos de 60 a 84 anos, sendo 17 (58,62%) do gênero feminino e 12 (41,38%) do gênero masculino. As avaliações realizadas incluíram meatoscopia, audiometria tonal liminar e aplicação do teste SSW em português.

**Resultados:** a análise dos dados permitiu verificar que, neste grupo de indivíduos, a idade e o grau de perda auditiva influenciaram significativamente nos escores obtidos na avaliação do processamento auditivo, diferentemente das demais variáveis. Os idosos que apresentaram perda auditiva de grau leve com configuração horizontal obtiveram escores significativamente superiores na avaliação do processamento auditivo comparados com os portadores de perda auditiva de grau moderado com configuração horizontal ou grau moderado com configuração descendente. Idosos pertencentes a faixa etária de 60-69 obtiveram desempenho superiormente significativa comparado com idosos na faixa etária de 80-89 **Conclusão:** concluiu-se que o grau de perda auditiva e a idade influenciam nos resultados da avaliação do processamento auditivo. O gênero e a configuração de perda auditiva não foram fatores determinantes na avaliação do processamento auditivo.

**DESCRIPTORIOS:** Idoso; Envelhecimento; Perda Auditiva; Transtorno da Audição; Percepção Auditiva

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