HEARING IN MIDDLE AGED ADULTS AND ELDERLY: ASSOCIATION WITH GENDER, AGE AND COGNITIVE PERFORMANCE

Audição em adultos e idosos: associação com sexo, idade e cognição

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ABSTRACT

Purpose: to verify whether the presence and level of hearing loss in adults and elderly as well as their performance in tests are linked to their gender, age and cognitive tracking. **Methods:** subjects with ages between 52 and 92 years old took part in this study. They all answered a sociodemographic questionnaire and went through Mini-Mental State Examination as well as pure-tone threshold audiometry. **Results:** out of the 90 individuals, 22 (24,4%) were male and 68 (75,6%) were female. It was seen that only 11 right ears and 11 left ears presented normal auditory thresholds. It was possible to verify that age was indeed linked to the auditory thresholds increase, making it clear that older individuals present higher levels of hearing loss (p<0,005). There was no statistical difference between the auditory thresholds of male and female (p=0,1). It was observed that 80% of the individuals whose cognitive tracking results were normal presented least affected auditory thresholds, while 60% of those whose cognitive tracking results were altered presented a higher level of hearing loss. It is possible to identify a relation between these audiological findings and the cognitive tracking test results, proving that the individuals with the altered Mini-Mental State Examination results present higher hearing loss (p<0,001). **Conclusion:** There was an association between the presence and degree of hearing loss with the result of the Mini-Mental State Examination. Increasing age was proportional to the increase in hearing thresholds. There was no association between gender and hearing in the sample.

KEYWORDS: Hearing Loss; Aged; Cognition

INTRODUCTION

Data from the *Instituto Brasileiro de Geografia e Estatística* (IBGE) point out that the growth of the elderly population in Brazil is evident. According to the last population census[1], subjects older than 60

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years represent 12% of brazilian population (about 18 million people), which accounts for a 4% increase if compared to the previous census. This elderly population growth is unfolding a greater pursuit, on behalf of professionals of several different fields of work, for getting to know the aging process as well as finding alternatives to preventing and treating diseases, in order to provide better quality of life for those individuals.

One of the things that most affects the quality of life of the elderly is hearing loss. Presbycusis, which is age-related hearing loss, is characterized by bilateral loss, initially at high frequencies, and by the speech intelligibility decrease[2]. It is believed that presbycusis starts at 30 in males and at 32 in females[3]. Besides aging, other factors may accentuate loss of hearing. Therefore, in most cases, the hearing loss which affects the elderly is of multifactorial origins, that means, stimulated by both intrinsic and extrinsic factors[4], hitting up to 82,1% of the elderly[5].

Just like hearing, cognitive performance also goes into a decline with aging. Researches point the relation between hearing and cognition, showing that hearing loss may affect the cognitive performance of the elderly person[6,7]. With that, speech understanding may be damaged since this task demands brain power for both working memory and rapid information processing[8].

Studies on hearing and aging have motivated researchers to seek for explanations about understanding disorders in individuals whose auditory thresholds were not so damaged[9]. It is known that both a neurological disease can jointly determine cognitive and sensorial deficiencies as a chronic sensorial deficiency can trouble cognition[10].

So as to make communication process more efficient it is necessary for the listener, during the course of his life, to accumulate information based on the sensorial entry as well as to cognitively interpret the speaker's intention. In order to understand a speech in acoustically unfavorable environments, for instance, a person with hearing loss is demanded with greater effort, for he/she predominantly uses cognitive resources to interpret the information, which may lead to stress and social separation. A Deficiency in any sensorial entry and/or cognitive process – all necessary for the interpretation of the speech sounds – results in obstacles to communication. Thus, whenever the entry is compromised, more cognitive resources become necessary for speech understanding, activating compensatory processes to obtain better performance[11].

It is this conjecture which inspired this study. We aim to verify whether the presence of hearing loss (HL) in middle age adults and older people as well as their performance in tests are linked to their gender, age and cognitive tracking.

METHODS

The research was approved by the Ethics in Research Committee of the *Institute of Psychology at Federal University of Rio Grande do Sul* (nº 2010035), and by the *Nossa Senhora da Conceição Hospital* (nº 11-187).

It is a quantitative, transversal, observational, descriptive study. Those middle aged [12] and elderly[13] Individuals who participated in the extension activities offered by the university and individuals attended in a audiology service of a hospital in Porto Alegre/RS/Brazil were included in the research. They all agreed to voluntarily take part on the research, signing a term of free and clear consent. Individuals with age inferior to 50 years old, hearing prosthesis users and those who presented history of disease and/or admission due to neurological, cognitive and/or psychiatric problems and people with language difficulty which made it impossible to answer the test were excluded.

The sample was composed by 90 subjects, aged between 52 and 92 years old, being 22 (24,4%) male and 68 (75,6%) female.

After signing the consent form, participants completed a socio-demographic questionnaire and a cognitive screening test Mini Mental State Examination (MMSE). The test consists of 30 questions, with verbal and nonverbal responses that evaluate spatial and temporal orientation, word registration, attention and calculation, recall, language, and constructive praxis[14-16]. Each correct answer gets 1 point – being the minimum possible score 0 (zero) and maximum of 30 points. The result is analyzed under education. Facing the several existing cutoffs in both national and international literature, we have chosen the classification by Bertolucci et al[17]: 13 points for illiterate, 18 for low and medium education and 26 for high education.

After making this initial assessment, an external acoustic meatus visual inspection was made, using a Welch Allyn® otoscope. After, the individuals were taken to an acoustically treated cabin to go through a pure-tone threshold audiometry (PTA). Interacoustics® audiometer, models AC30 and AD229e were used. The tone thresholds were examined in both air (250Hz - 8000Hz) and bone (500Hz - 4000Hz) pathways, through the usage of pure modulated tone (warble) and ascending-descending method[18].

In order to calculate the HL level we adopted the WHO classification, which consists of calculating the average of the thresholds obtained in

500Hz, 1000Hz, 2000Hz and 4000Hz frequencies. Averages up to 25dBNA indicate that the auditory thresholds are normal; values between 26dBNA and 40dBNA configure mild hearing loss; those between 41 dBNA and 60dBNA classify moderate HL; severe hearing loss is defined between 61dBNA and 80dBNA; at last, averages above 81dBNA indicate profound hearing loss[19].

Considering that the process of aging causes hearing loss primarily in high frequencies and that many individuals present lowering just in these frequencies, we chose to include "hearing loss restricted to high frequencies" in our classification[20]. That last one was used when the average reached value between -10 and 25dBNA, but there were auditory thresholds higher than 25dBNA in frequencies from 3000Hz and on.

For all the analyses, we used SPSS (version 18.0) software. Descriptive statistical techniques were used, with charts of simple frequency and crosstabs. Comparing the average age of the participants and the classifications of hearing loss level, we used variance analysis with Tukey Multi Comparison Test, applying 5% of significance level. So as to check the relation between hearing and gender as well as to compare proportion we used a Chi-Square Statistic test – for that, we applied 5% of significance level. Fisher's Exact Test was run to check the relation between the MMSE and the auditory thresholds' classification. It is here emphasized that we considered the average of the best ear for analyzing whether hearing loss, age, gender and cognitive tracking test results are linked[19].

RESULTS

The sample we worked with was predominantly of women (75,6%) – with either incomplete (24,4%) or complete (24,4%) primary school degree. The participants age ranged between 52 and 92 years old – with average of 72 ± 7,7 years old. Out of the participants, 50% were 73 years old.

Regarding hearing (Table 1), it was possible to observe that there was predominance of mild and moderate hearing loss in both ears.

Table 1 - Classification of degree of audiometry according to ear side

Degree of audiometry	Right Ear		Left Ear	
	n	%	n	%
Normal	11	12.2	11	12.2
Mild	23	25.6	23	25.6
Moderate	30	33.3	27	30.0
Severe	2	2.2	5	5.6
Profound	2	2.2	2	2.2
HL restricted to high frequencies	22	24.4	22	24.4
Total	90	100	90	100

n – absolute values % - relative values

The analysis of the relation between age and hearing loss is presented in Table 2. For that analysis, the individuals with moderate and severe hearing losses were gathered in a group, making it possible to carry out statistical test. It was noticeable that older they were the higher were auditory thresholds. Those with normal hearing are, in average, younger than those with mild hearing loss (p=0,001*) as well as moderate/severe ones (p=0,000*). In addition to that, individuals with HL restricted to high frequencies presented lower average of age than those with moderate/severe HL (p=0,000*).

Table 2 - Descriptive analysis of the association between the degree of audiometry in the better ear and age of the study participants

	n	Average	Standard deviation	Age		Minimun	Maximun
				95% Trust			
				Inferior Limit	Superior Limit		
Normal	22	66.36	6.659	63.41	69.32	52	83
Mild	28	73.43	7.115	70.67	76.19	61	87
Moderate/Severe	25	77.76	6.071	75.25	80.27	67	92
High Frequencies	15	68.20	4.828	65.53	70.87	61	77

Tukey Multi Comparison Test p< 0,005 n- absolute values

Table 3 presents data concerning hearing and gender. This analysis proved that there was no statistically significant difference between men's and women's hearings (p = 0,100). In order to evaluate that, individuals with moderate and severe hearing losses were gathered in a group, so as to apply this statistical test.

It was checked that most of the individuals were classified as *normal* in the MMSE (81,1%). The score ranged between 5 and 30, with average of 23,30 ± 6,06 points. Fifty percent of the individuals in the study scored up to 25 points.

In order to analyze hearing evaluation's and cognitive tracking test's results, we chose to separate the participants in two groups. Group 1 (G1) was composed of members with normal hearing, mild hearing loss and those with HL restricted to high frequencies. Group 2 (G2) included members with moderate and severe hearing loss. The decision for making that division was due to hearing losses up to 40dBNA not be considered disabling by WHO[19].

Eighty (80) percent of the individuals whose MMSE results were normal belonged to G1. Sixty (60) percent of those who presented altered results in the MMSE were in G2 (Table 4). The analysis proved there is a positive association between the altered result of the MMSE and the higher levels of hearing loss in the classification of the best ear (p=0,001*).

Table 3 - Analysis of the frequency and association of hearing in the better ear and the gender variable

Degree of audiometry	Male		Female	
	n	%	n	%
Normal	2	10.0	20	30.0
Mild	7	30.0	21	30.0
Moderate/Severe	10	50.0	15	20.0
High Frequencies	3	10.0	12	20.0

Chi-Square Statistic test p=0,100 n – absolute values % - relative values

Table 4 - Analysis of the frequency and association between the results of audiologic and cognitive screening

Classification	MMSE Normal		MMSE Altered		P
	n	%	n	%	
G1	59	80	6	40	<0,001*
G2	14	20	11	60	

G1 – individuals with normal hearing, mild hearing loss and those with HL restricted to high frequencies.
G2 – individuals with moderate and severe hearing loss
MMSE – Mini Mental State Examination
n- absolute values % - relative values
*Fisher's Exact Test

DISCUSSION

The results clearly showed that the sample was mainly composed of females. This corroborates earlier studies which point out the preponderance of women in the studied age range[21]. In addition to that, part of the group was composed of the elderly, where there's also predominance of women.

Regarding education, most participants had primary school, either complete or incomplete. That is also a characteristic of the age in study. The population in this age range in Brazil presents low educational level and this data may influence their cognitive performance[22].

The evaluation of auditory thresholds demonstrated that both the elderly and adults assessed in this study presented HL – whether in mild, moderate or restricted to high frequencies. This result confirms other scientific studies[2,7,23-25]. It is known that mild and moderate hearing loss – as well as that restricted to high frequencies – do not hinder hearing of some environmental sounds, however they may compromise speech understanding and, therefore, generating too much hearing effort. This effort might lead in reducing resources to process and store information[26]. As consequence, the person will have more difficulty to hear, triggering communication disorders that eventually result in social isolation.

Regarding the classification of hearing loss levels and age, a link was again perceived. This result not only confirms previous studies but also what was expected by the researchers, since it has been described in both national and international literature[5,24-39]. The age of the individuals caused an increase in auditory thresholds, which may lead to an even more harmed speech comprehension. So, older people are more susceptible to cognitive decrease, since they present higher hearing impairment. The summation of these factors may reduce the socialization of elderly even more, once these people isolate themselves from the family environment due to their difficulty in understanding what is being said.

It was proved that hearing loss and gender are not related whatsoever. This datum differs from some classic – as well as present – studies on presbycusis which show that men present earlier HL - in addition to higher levels – than women[4,5,23,40]. Other authors, however had already proved there is no such relation[24]. Thus, it is believed that hearing loss and gender can be influential in some situations, but definitely not for all. There are hypothesis that this finding may be influenced by the history of the men surveyed – who, in the past, were more exposed to higher levels of noise in the work environment without proper protection. Perhaps middle aged and the elderly were not exposed to noisy environments during working hours, but that was not considered in the anamnesis – therefore limiting the study. Besides, there was predominance of female participants in the sample, which may have minimized the proportional emergence of the hearing alterations in men.

The analysis of the results for the cognitive tracking test in relation to hearing showed there was association between the MMSE altered results and HL of higher levels. Previous researches revealed similar findings,[7,27-31] therefore proving the association between hearing and cognitive decrease[32,33].

The higher the effort to hear, the greater the use mechanisms to store the information received, for the subject will be more attentive to the sensorial entrance of the information, decreasing the storing capacity[26-34]. Along with regular aging people suffer from attention decrease; especially regarding selective attention, presenting difficulty in carrying out simultaneous mental tasks – as in a conversation in presence of noisy background. This situation is aggravated with the decrease of hearing sharpness, for the difficulty in hearing plus the one in focusing corroborate the non-understanting of a message as well as possible social isolation[35].

Attention and working memory are strongly related in processing information, being very important to comprehension. In order to have good understanding of speech, it is necessary to temporarily store words – so that they are analyzed and understood [36,37]. Along with the process of aging there might be a deceleration of cognitive and perceptive operations[36], that might be accentuated with the presence of hearing loss[37].

In this piece of work it was observed that 60% of G2 members presented results indicating some alteration in the cognitive tracking test. This index confirms the relation between cognitive impairment and auditory sensorial restriction – which are factors that need to be taken into account in audiology evaluations. Thus, the identification of individuals with potential risk of developing cognitive alterations becomes mandatory once the early diagnosis enables the precise therapeutic intervention, avoiding – or delaying, in some cases – the beginning of dementia[38], reducing family stress, risk of accidents, isolation and consequential harm to the older person's quality of life.

Taking into account that life expectancy and the number of older people in the country tends to increase; it is believed that the relation of hearing and cognition hereby confirmed will reinforce – among professionals dealing with evaluation, diagnosis and treatment of auditory disturbs – the need for

investigations of those alterations, aiming the identification of the individuals affected and the lead to specific procedures of analysis and intervention.

CONCLUSION

The present work allowed to confirm the link between results of the audiological evaluation and cognitive tracking, evidencing that those members of the sample with MMSE altered results present higher levels of hearing loss. Age increase matched the increase of auditory thresholds, while no relation between gender and hearing was confirmed in this sample.

RESUMO

Objetivo: verificar a existência de associação entre a presença e o grau de perda auditiva em adultos e idosos e o desempenho em teste de rastreio cognitivo, o sexo e a idade dos mesmos. **Métodos:** participaram deste estudo sujeitos com idade entre 52 e 92 anos. Todos responderam a questionário sócio-demográfico, ao teste de Mini Exame do Estado Mental e à audiometria tonal liminar. **Resultados:** dos 90 indivíduos avaliados, 22 (24,4%) eram do sexo masculino e 68 (75,6%) dosexo feminino. Constatou-se que apenas 11 orelhas direitas e 11 orelhas esquerdas apresentavam limiares auditivos normais. Constatou-se que a idade estava associada com o aumento dos limiares auditivos, evidenciando que os indivíduos mais velhos apresentam maior grau de perda auditiva (p<0,005). Não houve diferença estatística entre os limiares auditivos de homens e mulheres (p=0,1). Observou-se que 80% dos sujeitos cujo resultado do rastreio cognitivo foi normal apresentaram os limiares auditivos menos afetados. Já 60% dos indivíduos cujo resultado do rastreio cognitivo foi alterado apresentaram maior grau de perda auditiva. Pode-se constatar a relação dos achados audiológicos com os resultados do teste de rastreio cognitivo, evidenciando que os sujeitos com o resultado alterado do mini Exame do Estado mental apresentam os maiores graus de perda auditiva (p<0,001). **Conclusão:** verificou-se que houve associação entre a presença e grau da perda auditiva com o resultado do Mini Exame do Estado Mental. O aumento da idade mostrou-se proporcional ao aumento dos limiares auditivos. Não foi constatada associação entre gênero e audição na amostra.

DESCRITORES: Perda Auditiva; Idoso; Cognição

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