



Study of audiological evaluations and cognitive function in institutionalized elderly people with suspected hearing loss

Estudo da avaliação audiológica e triagem da função cognitiva em idosos institucionalizados com suspeita de perda auditiva

Estudio de evaluación audiológica y tamizaje de la función cognitiva de ancianos en instituciones con sospecha de pérdida auditiva

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Abstract

Objective: The purpose of this research was to study a group of institutionalized elderly people with suspected hearing loss regarding gender, age, education and to compare the results of their hearing evaluations of audiometric screening and transient-evoked otoacoustic emissions with their level of self-perception of participation restriction and their performance in cognitive functions screening. **Procedures:** It is a case report of ten elderly patients who went through medical evaluation, cognitive screening (Mini-Mental State Examination), hearing screening, register and analysis of the transient-evoked otoacoustic

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emissions, who answered the Hearing Handicap Inventory for the Elderly Screening Version questionnaire. **Results:** Nine of them presented hearing loss in the hearing screening and eight presented absent transient-evoked otoacoustic emissions. Six subjects presented some degree of participation restriction through the Hearing Handicap Inventory for the Elderly Screening Version and seven of them did not reach the cut-off score of the cognitive screening. **Conclusion:** Most of subjects with suspected hearing loss were women, with advanced age, low education level, absence of transient-evoked otoacoustic emissions and mild and moderate degree of hearing loss. It was observed that there is no total compatibility between the Hearing Handicap Inventory for the Elderly Screening Version and the degree of loss by the elderly patients. It was also observed that the greater the degree of hearing loss, the greater the cognitive deficit.

Keywords: Hearing loss, aged, Homes for the aged, cognition, auditory perception

Resumo

Objetivo: Este estudo tem o objetivo de estudar um grupo de idosos institucionalizados com suspeita de perda auditiva com relação ao gênero, idade e escolaridade e relacionar os resultados audiológicos referentes à triagem audiométrica e ao teste das emissões otoacústicas transientes com seus níveis de autopercepção da restrição de participação e desempenho no Mini-exame do Estado Mental. **Procedimentos:** Trata-se de um relato de caso de dez idosos que passaram por avaliação médica, triagem auditiva, emissões otoacústicas, aplicação do questionário Hearing Handicap Inventory for the Elderly Screening Version e triagem cognitiva (Mini-Exame do Estado Mental). **Resultados:** Nove indivíduos apresentaram perda auditiva com base na triagem auditiva e oito apresentaram emissões otoacústicas ausentes. Seis sujeitos apresentaram algum grau de restrição de participação por meio do Hearing Handicap Inventory for the Elderly Screening Version e sete não atingiram o ponto de corte da triagem cognitiva. **Conclusão:** Observou-se que a maioria dos sujeitos com suspeita de perda auditiva eram mulheres, com idade avançada, baixa escolaridade, ausência de emissões otoacústicas transientes e perda auditiva de grau leve e moderado. Não houve total compatibilidade entre o Hearing Handicap Inventory for the Elderly Screening Version e o grau da perda dos idosos. Observou-se ainda que, quanto maior o grau de perda auditiva dos sujeitos avaliados, maior o déficit cognitivo apresentado pelos mesmos.

Palavras Chave: Perda auditiva, idoso, Instituição de Longa Permanência para Idosos, cognição, percepção auditiva

Resumen

Objetivo: Estudiar un grupo de ancianos de un asilo con sospecha de pérdida auditiva cuanto al género, edad, nivel de educación y relacionar los resultados de sus evaluaciones auditivas con respecto de las emisiones otoacústicas transientes y grado de pérdida auditiva con los niveles de autopercepción de la restricción de participación y desempeño en detecciones de enfermedades cognitivas. **Procedimiento:** Se trata de un diagnóstico de diez ancianos que pasaron por evaluaciones médicas, detecciones de enfermedades cognitivas (Mini-Examen del Estado Mental), detección de enfermedades auditivas, y emisiones otoacústicas y respondieron al cuestionario Hearing Handicap Inventory for the Elderly Screening Version. **Resultados:** Nueve presentaron pérdida auditiva en las pruebas auditivas y ocho emisiones otoacústicas ausentes. Seis personas presentaron algún grado de restricción de participación por medio del Hearing Handicap Inventory for the Elderly Screening Version y siete no alcanzaron el punto de corte de la búsqueda de enfermedades cognitivas. **Conclusión:** Se observó que la mayoría de los sujetos eran mujeres de avanzada edad, nivel bajo de escolaridad, ausencia de emisiones otoacústicas transientes y pérdida auditiva leve a moderado. Se observó que no hay compatibilidad total entre el Hearing Handicap Inventory for the Elderly Screening Version y el grado de la pérdida auditiva de los ancianos. También se observó que cuanto mayor es el grado de pérdida auditiva, mayor deterioro cognitivo.

Palabras clave: Pérdida Auditiva; Anciano; Hogares para Ancianos; Cognición; Percepción Auditiva

Introduction

The technology modernization and science improvement have contributed to increase in life expectancy and, thus, to population increase all around the world. The national politics for elderly people, with the World Health Organization (WHO) define as elderly 60 year old people and older than it, regardless gender and applicable health state¹.

Alterations in several functional systems reach human beings during senescent process. Some of these alterations are related to physical health, such as posture and body mobility alterations, motor coordination and decrease of visual, auditory and taste acuity^{2,3}. Besides, there can be cognitive aging, characterized by brain, functional and structural alterations which do not affect global cognitive state.

In relation to auditory sensitivity reduction, when it comes from aging process, it is named presbycusis. It is caused by environment or genetics⁵. Presbycusis impairs the ability to perform daily activities and it increases risks of functional decline⁶. Studies verify relationship between auditory impairments and cognitive performance, because elderly people with hearing loss present lower scores in cognition evaluations, if they are compared to people without hearing loss^{4,6,7}.

Besides, it was observed that elderly people who live socially isolated, without participating in social activities or groups also present higher cognitive decline⁸. Such fact may be also observed in elderly people who are sent to long-term care institutions, because of health problems, low income or family issues^{9,10}.

When the hearing loss and the institutionalization process occur concomitantly, elderly people may suffer even more loneliness. The difficulty in speech comprehension may cause familiar and social environment distance, and it may negatively influence their quality of life¹¹. These psychological and social manifestations caused by hearing loss are named by WHO (1980) participation restriction.

However, it is noticed lack of Audiology studies related to institutionalized elderly people. It restricts knowledge about negative effects of these factors - presbycusis and institutionalization - about elderly quality of life¹².

Considering this context, the purpose of this research is to study a group of institutionalized elderly people with suspect of hearing loss in relation to gender, age and education and to relate the auditory results regarding audiometric screening and transient otoacoustic emissions test with their levels of participation and performance restriction self-perception in the mini-mental state organization.

Method

Presentation of cases

This study is part of the research project named *Attention to auditory health of institutionalized elderly people*, with register in the projects section at the health sciences center from the university, n. 027310 and approved by the Ethics Committee. The participants were informed about the research objectives and procedures and they signed the free and clarified informed consent term.

This research is a case study, explanatory descriptive and cross-sectional. The study was performed at a long-term care institution in Santa Maria, RS, Brazil.

At this institution, there are 39 elderly people who live there. It has the capacity for 60 people. The subjects stay in two halls, one for man and another for women. The bedrooms are collective, with the average of three people in each of them. The infrastructure is proper, with leisure areas, living rooms with televisions, porches, plazas and an ample dining room. The professionals who work in the institution are a social assistant, a doctor, a nurse and six nurse technicians.

To organize the sample, the following eligibility criteria were established:

- To be over 60 years old, considered as elderly people for developing country by the World Health Organization and, also, according to what is established by the statute for aged people¹;
- To be referred by nurse technicians/caregivers to auditory rehabilitation, because they believe the subjects present hearing difficulties;
- No visible middle and/or external ear alterations in visual inspection of the external acoustic meatus.

Considering such criteria, ten institutionalized elderly people participated in the present study.



The first procedure was the research of the air-conducting auditory thresholds in frequencies from 250Hz to 8.000Hz, characterized by hearing screening. It was performed using a screening audiometer, by Interacoustics, model AS 208, into a silent room. To determine the degree of hearing loss, it was used criteria by the WHO (1997), which considers the average among the frequency thresholds 500Hz, 1000Hz, 2.000Hz and 4.000Hz.

Then, the elderly people were submitted to transient otoacoustic emissions tests with the equipment Oto Read. The parameters "PASS/FAIL" used in this research were described in the equipment protocol: click stimulus; 83 dB SPL (Sound Pressure Level) intensity; tested frequency band numbers: six (from 1500Hz to 4000Hz). It was considered the "PASS" result when the emissions presented a relation signal/noise of 4 dB in at least three frequency bands.

In order to evaluate the disadvantages of hearing loss (participation restriction) in the subjects' lives, it was used the questionnaire Hearing Handicap Inventory for the Elderly Screening Version (HHIE-S). The HHIE-S presents ten questions extracted from 25 questions from the questionnaire Hearing Handicap Inventory for the Elderly (HHIE) which was adapted to Portuguese by Wieselberg (1997). From the ten questions by HHIE-S, five of them are related to social scale and the others to emotional scale.

Considering the presence of institutionalized illiterate, the researcher read the questions for all the subjects, so they could answer "yes", "no" and "sometimes", scoring 4, 2 and 0, respectively. The total score varies from 0 to 40 points, divided in

three categories: 0-8 points (without participation restriction perception); 10-23 points (mild to moderate perception) and 24-40 (participation restriction significant perception).

Finally, the ten elderly subjects were evaluated by a voluntary doctor from the institution with the purpose of diagnosing cognitive alterations. This service is offered by the institution to all the institutionalized elderly people. In order to complement this diagnosis, it was performed a cognitive function screening. The used instrument was the mini-mental state exam (MMSE), by Folstein, Folstein, McHugh (1975)¹³. The MMSE evaluates cognitive function through tasks which cover temporal and spatial orientation categories, memory, attention, language and visual constructing capacity, with specific score for each of them. The maximum score is 30 points, with cut-off of 24 points¹³. Some authors suggest that the cut-off point analysis should be based on education, but in this study it was decided to follow the analysis originally suggested by Folstein, Folstein, McHugh (1975)¹³.

The obtained results from the auditory evaluations and from the questionnaires will be presented in descriptive way and they will be comparatively discussed in qualitative way.

Results

It is observed that in Chart 1 the characterization of the ten evaluated institutionalized subjects, regarding gender, age, education, level of hearing loss and transient evoked otoacoustic emissions test (TEOAE).

Subject	Gender	Age	Education	TEOAE	Hearing loss level	
					RE	LE
S1	F	85	Incomplete elem. school	absent	moderate	moderate
S2	F	72	illiterate	absent	moderate	moderate
S3	F	82	Incomplete elem. school	*	moderate	severe
S4	F	89	Complete elem. school	absent	moderate	moderate
S5	F	60	Incomplete elem. school	RE: * LE: absent	normal	normal
S6	F	87	Incomplete elem. school	absent	severe	moderate
S7	F	82	Incomplete elem. school	absent	profound	moderate
S8	F	65	illiterate	absent	mild	mild
S9	M	65	illiterate	being	mild	mild
S10	F	85	Incomplete elem. school	absent	mild	mild

Chart 1 – Elderly subjects characterization regarding gender, age, education, TEOAE and hearing loss level

Legend: TEOAE – transient otoacoustic emission; RE – right ear; LE – left ear; F – female; M – male ; *: not possible to perform

In Chart 2, there are the score and the results of HHIE-S and their level of hearing loss. the elderly subjects’ self perception questionnaire

Subject	HHIE-S	Result	Hearing loss level	
			RE	LE
S1	18	Mild to moderate	moderate	moderate
S2	16	Mild to moderate	moderate	moderate
S3	32	Significant	moderate	severe
S4	10	Mild to moderate	moderate	moderate
S5	0	No perception	normal	normal
S6	16	Mild to moderate	severe	moderate
S7	0	No perception	profound	moderate
S8	8	No perception	mild	mild
S9	*	*	mild	mild
S10	22	Mild to moderate	mild	mild

Chart 2- Score and results of self-perception by elderly subjects in HHIE-S questionnaire and hearing loss level

Legend: HHIE-S - Hearing Handicap Inventory for the Elderly Screening Version; RE – right ear; LE – left ear; *: not possible to perform.

In Chart 3, there is the characterization of the ten elderly subjects regarding the psychiatric diagnosis and MMSE score, considered as suggestive or not, to cognitive impairments, according to the

established cut-off point. Thus, as in the previous chart, these data were compared to the subjects’ level of hearing loss.

Subject	Psychiatric Diagnosis	MMSE	Results	Hearing loss level	
				RE	LE
S1	Depression	28	Not suggestive	moderate	moderate
S2	Depression and mild MR	17	Suggestive	moderate	moderate
S3	Depression	21	Suggestive	moderate	severe
S4	Depression	20	Suggestive	moderate	moderate
S5	**	27	Not suggestive	normal	normal
S6	**	17	Suggestive	severe	moderate
S7	**	21	Suggestive	profound	moderate
S8	mild MR	15	Suggestive	mild	mild
S9	mild MR	6	Suggestive	mild	mild
S10	**	29	Not suggestive	mild	mild

Chart 3- Score and results of MMSE of elderly people, subject or not to cognitive deficit and level of hearing loss

Legend: MMSE - Mini-mental state exam; MR: mental retardation; **: no alterations in the moment

Discussion

In the studied group, nine elderly subjects were women and one subject was a man. This predominance happened because the caregivers detected that the women presented more difficulty to hear. The age average was 77.2 years old (minimal age of 60 years and maximal age of 89 years old).

About education, three subjects were illiterate, five presented incomplete Elementary School degree and two of them finished Elementary School degree. Most of them presented incomplete Elementary School or was illiterate. It agrees with other researches, which presented low education degree among the elderly people population^{14,15}. It is important to highlight that these elderly people lived their childhood in an epoch in which education was not priority. It reflects the low instruction index of these people¹⁵.

In hearing screening, it was observed that eight out of the ten studied subjects presented hearing loss and absent TEOAE. This result was expected, because the TEOAE absence represents alteration of the external ciliated cells, usually evidenced in cochlear hearing loss, such as presbycusis^{16,17}. It should be emphasized that S5 presented absent TEOAE, although the subject presented normal hearing, considering the classification used in the study. This finding may be justified by the cochlear alterations which may be present before some

alteration in the auditory exam are evidenced^{16,18}. This data highlights the importance of using OAE, because they may contribute to the comprehension of the aging effects on the auditory organ, as it has been described by literature^{17,19}. Another evidence for such finding could be middle ear alterations, not evidenced by hearing screening.

S9 was the only elderly subject who presented present TEOEA, agreeing with auditory thresholds up to 30dBNA, verified in all tested frequencies¹⁶. This subject could not answer the HHIE-S, because he/she was not able to understand the questions. However, the subject did not report hearing loss. The nurse technicians and/or caregivers believe this individual present some type of auditory impairment, but the communication disorders are caused by another reason.

It was not possible to perform the TEOAE register and analysis in S3 and S5's right ear, because the subjects did not cooperate for the examination, as they presented intense grunting noise, without voluntary control ("babble"). According to Hall (2000)²⁰, body noise directly affects TEOAE capture. This is the evidence not to register the emissions, because the Oto Read-Screenig equipment performs the examination with proper conditions and in those cases the noise conditions did not allow test performance.

In relation to the HHIE-S, the questionnaire analysis detected that 60% of the institutionalized subjects presented self-perception of participation restriction. The level of hearing loss of the five

individuals who presented mild/moderate perception varied from mild to severe. The subject who reported significant perception presented moderate/severe loss level. It agrees with another study, which also observed increase of self-perception of participation restriction with auditory thresholds worsening²¹.

From the three subjects who did not present participation restriction, one did not present hearing loss and two of them presented hearing loss. S7 presented profound level in RE and moderate level in LE. S8 presented mild level bilaterally. It is highlighted that a subject (S9) was not able to respond the questionnaire, because of difficulties to understand the questions.

So, it was observed that there was no total compatibility between the HHIE-S and the hearing loss level, because the subjects with the same level of hearing loss presented different levels of participation restriction and one individual with severe/moderate level of hearing loss did not present participation restriction. The findings agree with literature, as other studies report low association between level of auditory sensitivity and self-perception of participation restriction^{14,21,22}.

According to Baruzziet al (2009)¹⁴, who performed a research about self-perception and auditory sensitivity of institutionalized elderly people, with severe level of hearing loss, may not present perception of participation restriction, as it was detected in S7 in the present study.

The institutionalization process may justify the lack of compatibility among the auditory evaluation results and the participation restriction level, because, in these cases, there is distance from social coexistence and from communicative activities. These aspects are evident for S7, who do not participate in group activities proposed by the institution, living singly with little dialogue, which happens mainly with the caregivers. Moreover, the hearing loss denial by the subjects may be related to the results incompatibility¹⁴.

Besides, the questions from the HHIE-S questionnaire, in relation to communication difficulties in restaurants and with family members, embarrassment when introduced to unknown people and social life limitation related to hearing loss, for example, are not applied to elderly people from long-term care institutions.

Considering the psychiatric diagnosis, it was observed that the four subjects who present

depression also present hearing loss, which varied from moderate to severe level. It is known that the hearing loss, in elderly people, may sometimes be associated with depressive signs and social isolation, being possible to relate level of hearing loss and severity of depressive signs²³.

The impact caused in social life and life expectancy is huge when elderly people leave their home/families and go to a long-term care institution²⁴. When it is present, hearing loss intensifies these individuals' isolation because of limited conversation and social interaction situations, contributing for depression^{14,23}.

In relation to the MMSE, as it was observed in chart³, seven subjects did not reach the cut-off score. From them, S2, S8 and S9, according to the psychiatric diagnosis, present mild mental retardation, hearing loss and they are illiterate. Thus, it is possible to verify that cognitive alterations detected by the MMSE in these subjects probably come from mental retardation and other similar reasons – no literacy and hearing loss, because, according to literature, education is a factor that influences elderly subjects' cognitive performance²⁵⁻²⁶.

The four subjects who did not reach the cut-off point (S3, S4, S6 and S7) were literate and they presented the most significant hearing loss cases of the sample group, which varied from moderate to profound level. Such findings show that the level of hearing loss is directly related to their cognitive level. So, as higher the subjects' level of hearing loss is, higher is their cognitive deficit. Although the sample of this study is restricted, such findings agree with researches which verified that subjects with moderate to severe hearing loss level presented scores significantly lower when compared with individuals with better auditory thresholds^{6,7}.

It is highlighted, however, that the institutionalization is also a factor to be considered in the analysis of the sample's cognitive function, because cognitive wane, according to literature, is associated to lower level of physical/recreational activities and lower participation in social activities⁹.

The problems caused by hearing loss may be minimized through hearing aids, which provide the perception of speech and environmental sounds, causing communication improvements²⁷. So, the inclusion of elderly people in auditory rehabilitation programs minimizes psychological disadvantages of hearing loss and it favors individuals' return to social relationships⁷⁻²⁸.

Considering the rehabilitation importance, in the end of the evaluations, it was performed informal conversation with the subjects who present hearing loss, in order to verify their motivation to use hearing aids. Through this dialogue, four elderly subjects demonstrated interest in using hearing aids and had already participated in the process of selection and adaptation to the prosthesis.

Literature mentions that adaptation to hearing aids is essential to reduce depressive symptomatology, because it reinserts elderly people in communication and social interaction world, improving their quality of life²⁹. The cognitive performance is also positively influenced when there is adaptation of hearing aids, because there is auditory sensitivity and attention improvement, demanding less from cognitive factor^{7,29}.

Considering all advantages of hearing aids adaptation, it is highlighted that speech-language therapists should invest in this process, even in individuals who are inserted in a reduced social environment, such as the institutionalized elderly subjects.

Final comments

It was observed that the profile of the studied group was female, elderly, low education, TEOAE absence and mild and moderate hearing loss level.

The participation restriction evaluated through the HHIE-S application was not totally compatible with the subjects' level of hearing loss, although it was observed increase of participation restriction self-perception with auditory threshold worsening. It is highlighted that many of the HHIE-S questions were not relevant for the evaluated population, as the mentioned situations are not part of the reality of elderly people from long-term care institutions.

It was observed that the hearing loss level and the cognitive level are directly related factors, which should be investigated and correlated in any suspect of influence of one factor over other facts.

Observing the results of this study and confronting them with literature, it was evident the importance of auditory screening in institutionalized elderly people, because communication and social interaction difficulty may come from auditory decrease and/or other factors, as well as cognitive deficit and depressive symptomatology.

Finally, it is emphasized the importance of other studies about institutionalized people, in spite

of all challenges they concern, to better understand the necessary care to this population and to better define conducts by professionals.

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