



Auditory ability of background-figure in three different groups of elderly

Habilidade auditiva de figura-fundo em três diferentes grupos de idosos

Habilidad auditiva de figura-fondo en três distintos grupos de adultos mayores

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Abstract

Objective: Compare the auditory ability of background figure for verbal sounds in three different groups of elderly. **Methods:** A total of 36 elderly from a UBS (basic health unit), of which 12 are hypertensive and diabetics, 12 from a living group which are active and practice physical activity, and 12 elderly from a ILPI (long permanence institution for elderly). The totality of the participants was submitted to the same procedures: Anamnesis, Visual Inspection of External Acoustic Meatus, Pure-Tone Threshold Audiometry, Logaudiometry, Acoustic Immitance Measure and Auditory Ability of Figure-Background Evaluation for verbal sounds using the Dichotic Digits Test (DDT) in the binaural integration. Were included in the sample individuals with normal auditory threshold, or hearing loss from mild to moderate (Lloyd and Kaplan, 1978). **Results:** There were not observed statistical significant differences between groups related to age and classification of hearing threshold. There were statistical significant differences between groups concerning the DDT percentage of correct answers, where the active elderly group achieved better results than the other groups and the elderly from the institution obtained the worst results in the ability. **Conclusion:** The active elderly group presented better performance in the auditory ability of background-figure for verbal sounds compared to diabetic and hypertensive and to the elderly from an institution.

Keywords: Auditory Perception; Aging; Homes for the Aged; Diabetes Mellitus; Hypertension.

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Authors' contributions: RSB participated in the preparation and study design, collection, analysis and interpretation of data, as well as in the development of the discussion and conclusions of the study; TS and BP participated in data collection, MB and RAL helped in the development of the discussion and conclusions of the study. MVG was responsible for the design and overall direction of the implementation and preparation of the manuscript.

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Resumo

Objetivo: Comparar a habilidade auditiva de figura-fundo para sons verbais em três diferentes grupos de idosos. **Método:** Participaram 36 idosos, dos quais, 12 idosos hipertensos e diabéticos provenientes de uma UBS, 12 idosos ativos praticantes de atividade física, provenientes de um grupo de convivência e 12 idosos de uma ILPI. Todos os participantes foram submetidos aos mesmos procedimentos: Anamnese, Inspeção visual do meato acústico externo, Audiometria Tonal Liminar (ATL), Logaudiometria, Medidas de Imitância Acústica e avaliação da habilidade auditiva de figura-fundo para sons verbais com o Teste Dicótico de Dígitos (TDD) na etapa de integração binaural. Foram incluídos na amostra apenas indivíduos com limiar de audibilidade normal ou perda auditiva até moderada (Lloyd e Kaplan, 1978). **Resultados:** Não foi observada diferença estatisticamente significativa entre os grupos em relação à faixa etária e classificação do limiar auditivo. Houve diferença estatisticamente significativa entre os grupos em relação ao percentual de acertos no TDD, em que o grupo de idosos ativos foi melhor que os demais e o grupo de idosos institucionalizados apresentou piores resultados para a habilidade. **Conclusão:** Os idosos ativos apresentam melhor desempenho na habilidade auditiva de figura-fundo para sons verbais se comparados com idosos diabéticos hipertensos e idosos institucionalizados.

Palavras-chave: Percepção auditiva; Envelhecimento; Instituição de Longa Permanência para Idosos; Diabetes Mellitus; Hipertensão.

Resumen

Objetivo: Comparar la habilidad auditiva de figura-fondo para sonidos verbales en tres distintos grupos de adultos mayores. **Método:** Participaron 36 adultos mayores, de los cuales, 12 son hipertensos y diabéticos provenientes de una UBS, 12 adultos mayores físicamente activos provenientes de un Grupo de Convivencia 12 adultos mayores de una ILPI (Hogares para ancianos). Todos los participantes del estudio fueron sometidos a los mismos procedimientos: Anamnesis, Examen del Conducto Auditivo Externo, Audiometría Tonal, Logaudiometría, Impedanciometría y evaluación de la habilidad auditiva figura-fondo para sonidos verbales con el Teste Dicótico de Dígitos (TDD) en la etapa de integración binaural. Se incluyeron en el estudio sólo los sujetos con umbral auditivo normal o pérdida de audición hasta el grado moderado (Lloyd y Kaplan, 1978). **Resultados:** No hubo diferencias estadísticamente significativas entre los grupos con respecto a la edad y clasificación del umbral de audición. Hubo diferencia estadísticamente significativa entre los grupos en relación al porcentaje de éxito en el TDD, en el que el grupo de adultos mayores físicamente activos era mejor que los demás y el grupo de adultos mayores institucionalizados mostraron peores resultados en esta habilidad. **Conclusión:** Los adultos mayores que son activos tienen un mejor rendimiento en la capacidad auditiva de figura-fondo para sonidos verbales en comparación a los adultos mayores diabéticos, hipertensos e institucionalizados.

Palabras claves: Percepción Auditiva; Envejecimiento; Hogares para ancianos; Diabetes Mellitus; Hipertensión.

Introduction

Auditory processing encompasses mechanisms and processes of the auditory system, which are responsible for the noise location and lateralization; auditory discrimination; auditory pattern recognition; temporal aspects of hearing; auditory performance in the presence of competitive signals and auditory performance with degraded acoustic signals¹.

This series of processes and / or skills to succeed in time and allows an individual to perform a meta-cognitive analysis of the sound effects, which leads to understanding of speech^{2,3}.

This process can be hampered by many factors, including aging, which usually occurs a decrease in the speed of information processing, which can cause impaired perception of speech⁴. This decline in central auditory function is manifested by changes in hearing, among them the ability to figure-background for verbal sounds^{5,6}.

Furthermore, as the individual ages, there may be a reduction in quality of life⁷. A common complaint of those individuals with regard to the difficulty in understanding speech, especially in poor communication situations, such as in noisy environments or increased speech rate. The ability to figure background for verbal sounds is essential at such times as it provides the ability to focus attention on what is important and relegate to the background what not interested at the time⁸.

Still, aging before its different manifestations, it can also be accompanied by other changes such as metabolic, in which most are Hypertension and Diabetes⁹.

Diabetes Mellitus (DM) is a chronic disease resulting from inadequate production of insulin by the pancreas or the body's inability to use effectively this insulin, which leads to increased glucose levels in the blood¹⁰.

Involvement of the vessels supplying the inner ear and the changes that occur in the vascular striae in diabetic patients are facts proven by several authors, who believe in the relationship between hearing loss and diabetes^{11,12}.

Already, Systemic Arterial Hypertension (SAH), characterized by high and sustained levels of blood pressure in the vascular system can result in bleeding in the inner ear, since it receives derived blood supply of the anterior inferior cerebellar artery, which provides support to the artery the inner ear. This artery splits into cochlear artery and anterior vestibular artery, and in the case of very high pressure can lead to sudden or progressive hearing loss¹³.

Another factor influencing the maintenance of functional abilities of the elderly is the daily physical exercise, which should be accompanied preferably by a proper diet and good access to health care for prevention and treatment of diseases that may be associated with aging, so that it maintains a healthy life¹⁴.

In long permanence institution for elderly, for example, there is a routine with few activities, information / stimulation which can result in increased communication difficulties, memory and other skills that involve information processing¹⁴.

Still, the institutionalized elderly, may experience metabolic changes associated with the aging process however, that most influences and is evidenced in this population, it is the environment in which they are, isolation, lack of stimulation and

consequently the loss in communication and in personal relationships. SANTOS 2013)¹⁵

The rationale of this study is focused on understanding an important auditory skill for communication of the three groups of elderly people, as authors^{8,16} refer that the difficulty in hearing ability of figure-background is one of the most common in the elderly. This fact added to the altered metabolic processes and poor quality of life can lead to even more difficulties in their daily routines.

Thus, the aim of this study is to compare the auditory ability of figure- background for verbal sounds in three different groups of elderly. Still, our hypothesis is that a healthy life, with physical activity, promotes maintenance of an important hearing ability for human communication.

Methods

This study is part of a project developed in a Federal University and has quantitative and transversal types. The research project was approved by the Research Ethics Committee in humans of this institution on the number of protocol 25933514.1.0000.5346.

To constitute the study population and form the three different groups of seniors, older people with SAH and DM from a Basic Health Unit (BHU) were invited to participate in this survey, who had physician-diagnosed hypertension and diabetes mellitus type I and were in treatment. They were also older guests from a group of coexistence of the research institution that were considered active and healthy for not having any comorbidity and are in medical monitoring. And to form the third group, elderly in a ILPI (long permanence institution for elderly in Portuguese) in the same city were invited. This third group was composed of elderly who also had the same metabolic diseases and even some with symptoms of depression, both controlled by medication.

Individuals who agreed to participate in the study were informed about the procedures to be performed, possible discomforts, benefits and confidentiality of research, and when in agreement, signed the Informed Consent Form (ICF). The eligibility criteria for the sample were: subject to 60 years of age or older, of both genders, with threshold normal auditory and / or sensorineural hearing loss degree to moderate¹⁶ and not have middle ear disorders.

Thus, the sample was composed of 36 elderly distributed as:

- DM group (metabolic diseases): Twelve elderly patients with metabolic disorders;
- A / S group (active / healthy): Twelve healthy and active elderly;
- ILPI group (long permanence institution for elderly): Twelve elderly belonging to ILPI and metabolic changes.

All of them were subjected to the same procedures: anamnesis and audiological evaluation, composed by visual inspection of the external auditory canal, pure tone audiometry (PTA), speech audiometry and acoustic immittance measures. To assess the auditory ability of figure-background for verbal sounds, we used the dichotic listening test (DLT) in binaural integration stage.

The evaluation began the interview, which was to obtain information about the audiological history, physical activities and data of the current routine.

For basic audiological evaluation we used audiometer Itera II brand, TDH-39 headphones and acoustically treated booth for air search and bone conduction. The normal criterion was the tone average (500, 1000 and 2000 Hz) less than or equal to 25 dB NA¹⁷.

In speech audiometry was searched Speech Recognition Threshold (SRT) and the Index of Speech Recognition (SDT) monaurally. For SDT added to 40 dB on the average of the frequencies of 500, 1000 and 2000 Hz. The level of comfort was also researched¹⁸.

For Acoustic Immittance was used middle ear analyzer Interacoustics brand, model AT 235 with tone-probe 226 Hz.

After completing the basic audiological evaluation, followed with TDD2, which was applied to 40 dB NS. To perform the test, it was used TDH 39 and audiometer Itera II headset connected to a computer. The test was the presentation of twenty sequences of four digit each which two were presented in one ear and the other two in the opposite ear simultaneously (dichotic task). The elderly were asked to verbally repeat the four digits ears, regardless of the presentation of the same order. The normal criteria used for the elderly with normal hearing threshold in binaural integration stage was greater than or equal to 78% of correct answers and the elderly with sensorineural hearing loss were greater than or equal to 60% of correct responses².

Statistical analysis of the data was performed using the Fisher's exact test and the Kruskal-Wallis test. It was considered statistical significance level of $p < 0.05$ (5%), and the results showed statistical significance, indicated by an asterisk (*).

Results

The study population consisted of 36 elderly of which 12 elderly were the DM group (from BHS), aged 12 were the group A / S (participants living group) and 12 elderly were the ILPI group (from a ILPI).

Table 1 shows the average age of the subjects in each group. In this analysis, there was no statistically significant difference between groups.

Table 2 shows the frequency of hearing loss in the three groups. Just as the age groups showed no statistically significant difference in relation to the hearing.

Table 1. Descriptive statistical variable age in years for each group and p-value calculated for comparison groups

Group	N	Average	S.D.	Min.	Q1	Median	Q3	Max.	P-value ¹
ILPI Group	12	77.83	8.27	65	70.5	79.00	85.0	89.0	
DM Group	12	77.58	5.79	66	71.0	72.00	74.5	89.0	0.295
A/S Group	12	73.50	5.95	67	68.5	71.50	79.5	84.0	

¹Kruskal-Wallis Test. N: subject number; S.D.: standart deviation; Min: minimun age; Q1: first quartile; Q3: third quartile; Max: maximum age.

Table 2. Descriptive statistical of classification variable of threshold hearing for each group and p-value calculated for comparison groups

Hearing		ILPI	DM	A/S	Total	P-value ¹
Normal	N	3	3	3	9	0.099
	%	25.00	25.00	25.00		
Mild Shl.	N	5	9	9	23	
	%	41.67	75.00	75.00		
Mod Shl.	N	4	0	0	4	
	%	33.33	0.00	0.00		
Total	N	12	12	12	36	

¹ Fisher's exact test. Mild Shl: mild sensorineural hearing loss; Mod Shl: moderate sensorineural hearing loss.

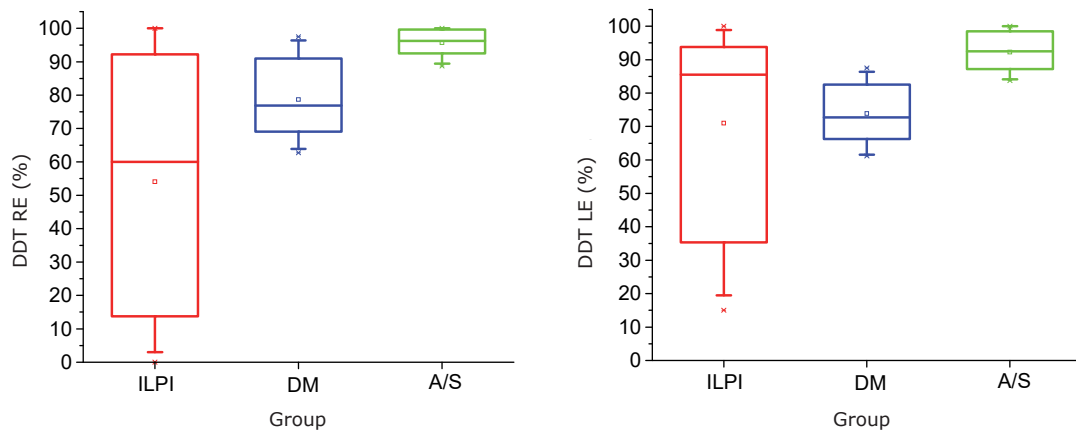
Regarding the auditory ability of figure-background evaluated by DDT, it is observed in Table 3 that there was a statistically significant difference between the groups in which A / S group was statistically better than the other and ILPI group showed worse results for test.

In graphic 1, the responses of percentage it has been for DDT in both ears, for the three groups of elderly, it can be observed that the LE was less variation in the percentage of correct answers for both ILPI group and for the DM group.

Table 3. Descriptive statistical variable setting percentage in ddt in ear for each group and p-value calculated for comparison between ears

Group	DDT	Average	S.D.	Min.	Q1	Median	Q3	Max.	P-value ¹
ILPI	RE	54.06	37.87	0.00	17.50	60.00	88.13	100.00	0.002* (A)
	LE	71.02	30.50	15.00	40.63	85.50	92.50	100.00	
	Average	62.12	27.43	20.00	40.00	67.50	82.75	98.12	
DM	RE	78.68	11.52	62.75	69.35	76.88	89.38	97.50	0.001* (A)
	LE	73.88	8.67	61.20	67.50	72.70	82.50	87.50	
	Average	76.28	9.75	63.87	67.95	74.00	84.69	90.60	
A/S	RE	95.73	3.90	88.70	92.53	96.25	99.38	100.00	0.001* (A)
	LE	92.29	5.69	83.75	88.13	92.50	96.88	100.00	
	Average	94.01	4.36	86.85	90.63	94.37	96.87	100.00	

¹ Kruskal-Wallis test. Significant differences by testing multiple comparisons DUNN (p <0.05): (A) A / S ≠ DM; A / SL ≠ ILPI. DDT: Dichotic Digits Test; RE: right ear; LE: left ear; S.D.: standard deviation; Min: minimum percentage of correct answers; Q1: first quartile; Q3: third quartile; Max: maximum percentage of correct answers.



Graphic 1. Box-plot of correct answers percentage in DDT for each ear

Discussion

Limitations of this study were that most seniors refuse to participate in the survey due to the difficulties of movement and transport of institutionalized elderly as well as the lack of a caregiver to accompany them in exams. Still, with a small sample, we support the hypothesis that a healthy life, with physical activity, promotes maintenance of an important hearing ability for human communication.

This study compared three different groups of elderly people, which showed no difference in the average age as shown in Table 1, even when comparing active seniors, living group of participants with institutionalized elderly who typically are older. The average found approaches to findings¹⁹ in a study of institutionalized elderly. Still, the current study agrees with age found in other studies^{20,21} with active and inactive elderly.

Similarly, the groups showed no difference between them as to the characterization of hearing as shown in Table 2, given that the elderly are mostly presbycusis adversely affecting primarily at high frequencies, which makes the average tritonal of audiogram remains within the normal range or is classified as mild degree of hearing loss²².

In the institutionalized group, the current study was 41.66% of individuals with mild hearing loss and 33.33% of individuals with hearing loss of moderate degree, which meets the findings of a study²³ that assessed the hearing loss degree in institutionalized elderly and reported an hearing loss predominantly mild (35%) and moderate (40%).

Regarding the DM group, the current study found 75% of mild hearing loss, a figure slightly lower, but meeting the study¹² which revealed the occurrence of hearing loss in 88.88% of hypertensives and 90 % of elderly diabetics.

In relation to the hearing ability of figure-background for verbal sounds, it was observed in Table 3 that there were differences among the three groups in relation to the percentage of correct answers for the DDT, in which healthy elderly were statistically better than the other groups and institutionalized elderly showed the worst results.

It is believed that hearing loss has not influenced this result, since there was no statistically significant difference between groups. Thus, it is likely that other factors may have contributed to this difference in the ability of figure- background both in the group of hypertensive and diabetic patients

as well as the institutionalized group, being better than A / S Group.

Regarding the auditory processing, literature⁸ infer that the aging process tends to cause changes in the binaural synthesis ability, in other words, it increases the difficulty of verbal sound recognition distorted physically presented in dichotic task. This change leads to difficulties in dealing with missing elements in the auditory information and, therefore, the elderly can not understand the meaning of information. However, the current study shows that not only aging, but also the associated factors such as hypertension, diabetes and poor quality of life caused by the restriction of verbal and physical exercise may worsen this change.

The findings of this study agree with authors²⁴ who said it is common difficulties in information processing in the elderly and that this fact can be attributed to demyelination, loss of nerve cells, and decreased cerebral blood flow, which may be related to metabolic changes as diabetes and hypertension.

When the elderly are subjected to living in ILPIs, there is a major impact on their social relations. The slow and progressive hearing impairment only becomes noticed when it reaches high levels of commitment and adds to the difficulty of social integration and lack of interest in maintaining interpersonal relationships. This fact intensifies the barriers, the functional changes due to age, cognitive declines and depressive symptoms²⁵. In our study, we found that ILPI group presented a worse performance in the assessed ability, which can be exacerbated by the aforementioned factors.

In the literature, there are no studies that relate auditory skills with metabolic changes, however, with this study, we can infer that the quality of life directly influences the maintenance of functional capacity since A / S group, which has an active routine, tends to perform better in the ability of figure-background.

This functional capability is usually minimized by the aging process, but can be stabilized with the practice of physical exercises, which act as a form of prevention and rehabilitation of elderly health²⁶.

In the study²⁷, it was found that in a sample of 50 elderly, with a mean age of 70.24 years, the practitioner group of physical activities showed better quality of life in general. The same was seen in a survey²⁸, with a sample of 107 elderly aged over 60 years, which found a relationship of

interdependence between high quality of life for seniors and regular physical activities. Our study corroborates according to above mentioned, it was observed a better performance in auditory ability evaluated in A / S group regular physical activity practitioners (Table 3 / Chart 1).

This study also agrees with the findings in the literature that¹² conducted a survey of 61 elderly, in which 32.78% had diabetes mellitus; 59.01% had high blood pressure; 21.31% were classified as heavy drinkers of alcohol and 51.7% are or have been smokers or were passive smokers (daily contact with), and it was found that sensorineural hearing loss is the main type of hearing loss found in individuals with over 60 years, and increased proportionally with age, it was also concluded that diabetes mellitus, hypertension, alcohol consumption and smoking predispose hearing loss, especially when associated with presbycusis.

In the current study, there was a variability of responses to the DDT as can be seen in Chart 1, which shows that both the elderly with normal hearing threshold as those with hearing loss showed changes in hearing ability studied. Already, in the literature²⁹, when evaluating a population of 100 elderly people, 60 to 79, found that hearing loss does not trigger changes in hearing, but can be an aggravating factor in this difficulty especially in dichotic tasks. The study compared the performance of individuals with hearing loss and normal hearing threshold, the application of disyllables recognition test in dichotic task (SSW).

With the completion of exercise there is increased oxygenation capacity of the body, which allows the organic rejuvenation, improving functional capacity, quality of life, reducing the likelihood of metabolic chronic diseases, hospital admissions and mortality³⁰. This study demonstrated that A / S group has better performance in the proposed test, when compared to the group of DM or ILPI, showing thus the importance of adhering to proper habits to maintain a healthy aging and with quality.

Conclusion

When comparing the auditory ability of figure-background for verbal sounds in three different groups of elderly people, it was found that A / S group performed better in the studied skill compared to the elderly of the DM or ILPI groups.

The latter group showed the largest deficit in the studied skill.

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