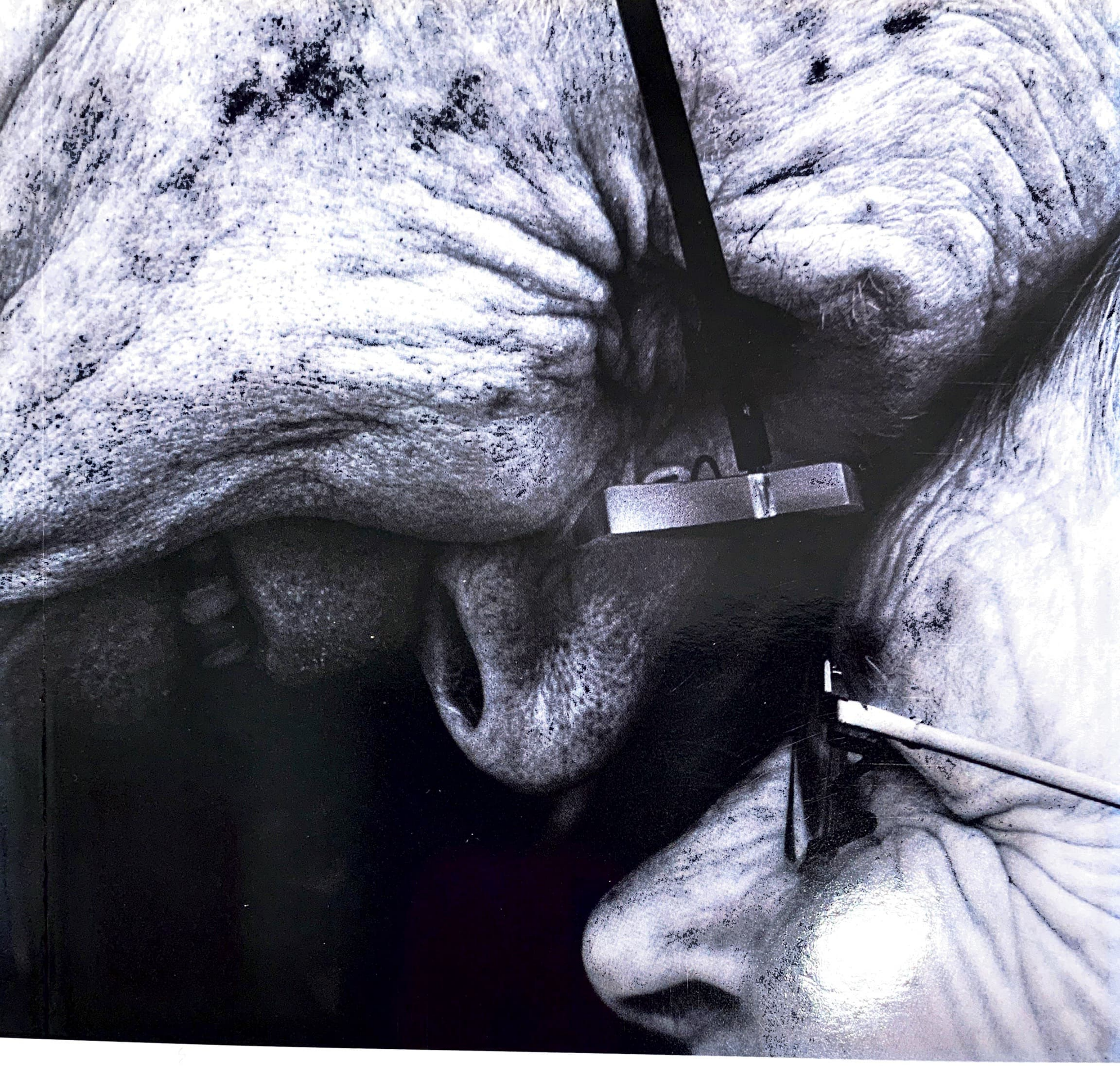

O ENVELHECIMENTO COMO UM TODO

LIVRO DE ATAS DO AGEINGCONGRESS 2020

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Primera edición, 2020

THOMSON REUTERS PROVIEW™ eBOOKS
Incluye versión en digital

Editorial Aranzadi, S.A.U.
Camino de Galar, 15
31190 Cizur Menor (Navarra)
ISBN: 978-84-1345-390-3
DL NA 1244-2020
Printed in Spain. Impreso en España
Fotocomposición: Editorial Aranzadi, S.A.U.
Impresión: Rodona Industria Gráfica, SL
Polígono Agustinos, Calle A, Nave D-11
31013 – Pamplona

Todos os artigos, foram sujeitos a procedimento de avaliação científica traves do método, double-blind peer review, pelo Comité Científico do AGEING CONGRESS 2020

Este trabalho foi financiado por fundos nacionais através da FCT –Fundação para a Ciência e a Tecnologia, I.P., no âmbito do projeto "UIDB/04647/2020" do CICS.NOVA– Centro Interdisciplinar de Ciências Sociais da Universidade Nova de Lisboa.

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Benefits of Auditory Training on Elderly People with Hearing Loss

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(On behalf of the AGA@4life Consortium)

ABSTRACT

Background: With ageing, the presence of an additional difficulty in the speech perception is notorious, independently of the associated hearing loss degree, mainly in situations of difficult listening. Therefore, the auditory training becomes relevant in order to minimise these difficulties in speech comprehension and to decrease the impact of hearing loss in elderly people's life. **Purpose:** Evaluate the benefit of auditory training in the oldest population with hearing loss. **Methodology:** Cohort study. The subjects were divided in two groups in which the type of auditory training varied in order to evaluate the training influence. All the ethic requirements were respected. The population of the study was constituted by 16 subjects with hearing loss, between light to moderate. The average age

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This work is co-financed by the Fundo Europeu de Desenvolvimento Regional (FEDER), through the Portugal Partnership Agreement 2020 – Programa Operacional Regional do Centro (CENTRO 2020), within the project CENTRO-01-0145-FEDER-023369 AGA@4life: AGA–Abordagem Geriátrica Ampla for the promotion of a healthy and active ageing– implementation of a multidisciplinary and integrated intervention programme.

of the subjects was 78.6 ±10.9 years. The data collection was done through a brief anamnesis based on demographic factors as well as on the auditory story of each subject. In the practical part we proceeded to peripheral evaluation of the auditory system through otoscopy, tympanogram, simple tonal audiogram and we also evaluated the central part through the speech in noise test with a signal-noise relation of 10dB and 15dB. **Results:** All the individuals revealed benefits with the auditory training once the speech perception in noise showed statistically significant improvement. **Conclusion:** The auditory training will benefit subjects with hearing loss and difficulties in speech perception, minimizing the impact the hearing loss has in elderly people's life.

Key Words: auditory training; auditory perception; elderly people; hearing loss.

INTRODUCTION

For a Human Being, it is essential to manage keeping a coherent speech and its perception as being a social being he needs to be an entity endowed with a verbal language (Nunes, 2015).

Audition belongs to a complex system that receives the sound vibrations through the tympanic membrane and in turn will be converted in sound signals that in a final phase will be transmitted through the auditory pathway to the brain. All this processing is the key part for sound perception (Nunes, 2015). In order to get a correct perception of sounds, the subject auditory system must be intact (Silva et al., 2019).

The upward auditory pathways begin the complex of the cochlea nucleus whereas the downward pathways begin in the superior olivary complex ending in the medial geniculate complex that in turn will lead the sound impulses up to the cortex. (Moore et al., 2010).

When the Audiologist evaluates the auditory system he should check if the person hears properly, through calibrated equipment and specific tests namely the Simple Tonal Audiogram and the Vocal Audiogram but also if the person can process and interpret the sound properly (Sweetow & Henderson Sabes, 2018). The importance of the evaluation of the auditory processing is recognised as most adults present alterations at the CAP (Central Auditory Processing) level due to ageing or to a subjacent neurologic involvement (Tiffin & Gordon-Hickey, 2018; Silva et al., 2019). In this way, this is carried out through behavioural auditory tests in controlled ambiances and this will grant the Audiologist to understand how the subject analyses the sound received and interpret acoustically the sound information (Nunes, 2015; Silva et al., 2019). This can be evaluated through different tests that study the various functions of the ACNS (Auditory Central Nervous System) such as the binaural interaction tests, low redundancy monaural speech tests, temporal processing tests and finally the dichotic speech tests (Bellis, 1996; Bellis & Beck, 2000).

According to the ASHA (1996), when there is a CAP disorder, the subject makes complaints executing at least one of the tasks described above which many times, although the auditory thresholds are within normality and there are no cognitive alterations, the individual makes complaints about the speech discrimination when there is noise, about the memorization of words or numbers or even will present difficulties in following orders leading us to conclude that there is preservation at the peripheral auditory system level however, there is an involvement at the central level that will have an impact on the analysis of the auditory information. Thus the CAP diagnosis will also have to include the evaluation of the auditory thresholds (AHSA, 1996; Machado, 2003; Hamlyn et al., 2018; Heeke et al., 2018).

If there are difficulties in the perception and discrimination of the sound stimulus for a norm hearer, for the elderly person who has undergone a set of transformations associated with ageing that bring about psychological, physiological, biological alterations and where the appearing of bilateral progressive sensorineural auditory alterations is common as it is the case of presbycusis caused by the degeneration of the ciliated cells of the inner ear, it is correct to assert that the elderly person will have difficulties in the discrimination of the speech as all these alterations mentioned above will have an impact on the CAP level (Martin & Jerger, 2005; Veras & Mattos, 2007). This set of alterations will have an influence on the individual's quality of life at a psychosocial level (Martin & Jerger, 2005; Veras & Mattos, 2007).

The CAPD (Central Auditory Processing Disorders) diagnosis, it is essential to analyse the results obtained. It will permit to understand the main difficulties of the subject and start the individual and personalized auditory training, taking into account his/her limitations and focusing mainly on the areas that must be stimulated (Machado, 2003; Neves & Feitosa, 2003; Nunes, 2015).

The auditory training is constituted of a set of exercises and strategies that permit to improve the auditory skills in which the subject has a difficulty (Nunes, 2015; Sweetow & Henderson Sabes, 2018). The training is essential and is possible because the central nervous system has neuroplasticity, even in the ageing process. This permits the individual to work his/her brain, which leads us to conclude that the auditory training must be always carried out (Nunes, 2015). According to some authors, the formal auditory training must have between 8 and 12 sessions at least once a week (Nunes, 2015). Therefore, the objective of this study is to evaluate the benefit that the auditory training can bring to the oldest population with an associated hearing loss.

METHODOLOGY

The current study was constituted of 16 subjects with an average age of 78.6 ±10.9 years, all members of a Day Care Centre in Coimbra district, Portugal. All the individuals who participated in the study had a normal bilateral otoscopy, bilateral type A tympanogram and a medium tonal hearing loss under to 50 dB (deciBel) in both ears.

The tests used were the otoscopy, tympanogram and the Simple Tonal Audiogram in the frequencies 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz was carried out. Posteriori, all the subjects with a light to moderate hearing loss underwent the CAP test, speech in noise test with a SNR (Signal/Noise Relation) of 10 dB and 15 dB. This exclusion criterion is that the CAP evaluation, as well as the auditory training, are carried out 50 dB above the medium tonal loss and the severe to deep losses exceed the possible maximum values to test with the audiometer.

After carrying out evaluation of the auditory system, the formal auditory training starts. The formal auditory training was constituted of 10 sessions during 5 weeks where the subjects were divided in two groups of 8 elements. The group 1 (G1) underwent an auditory training based on the speech in noise test and the group 2 (G2) underwent the filtered speech test. This distribution was made according to the difficulties showed during the evaluation of the speech in noise test. Those who revealed more difficulties in the speech in noise test integrated the G2.

During the auditory test, the presentation of the sound stimulus was done at random so that the subjects could not know the order of the stimulus presentation or if the given response corresponded to the stimulus presented. After carrying out all the sessions of auditory training, we proceeded with the Simple Tonal Audiogram and with the speech in noise test with the same parameters used before beginning the training sessions.

RESULTS

Before carrying out the auditory training, the MTHL (Medium Tonal Hearing Loss) for the right ear was of 32,50 dB (±10,39) and of 31,48dB

(±9,03) for the left ear. After the test, the MTHL decreased to 32,2 dB (±10,59) for the right ear and to 31,25dB (±9,9) for the left ear (see Figure 1 and Figure 2). However, these results are not statistically significant for the MTHL (p=0,864; p=0,838, respectively).

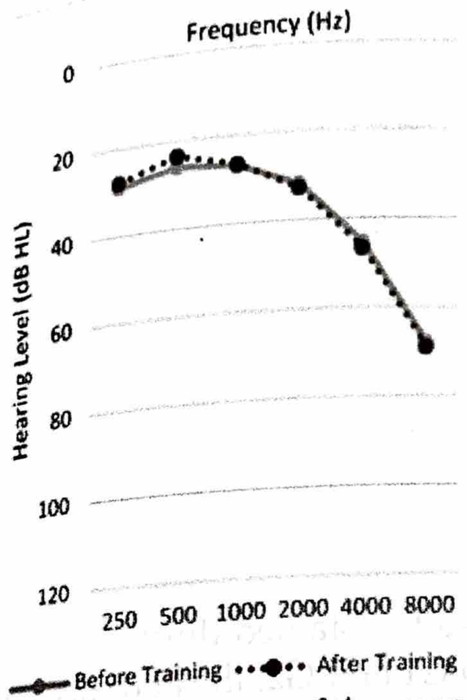

Figure 1 Representation of the mean MTHL score obtained before and after hearing training in right ear.

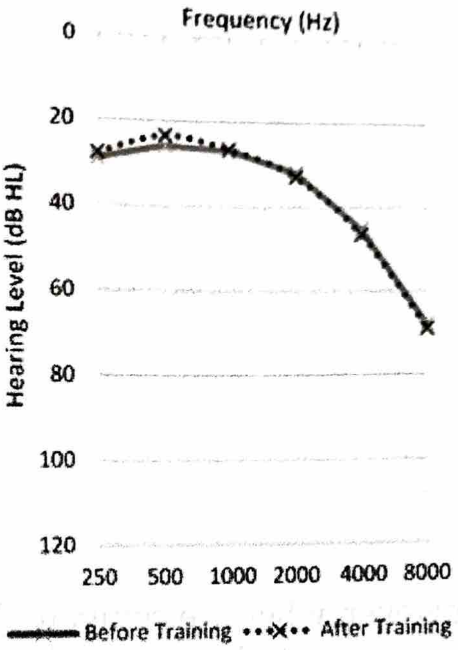

Figure 2 Representation of the mean MTHL score obtained before and after hearing training in left ear.

Through the comparison of the results of elderly people performance in the speech in noise test, pre and post-test, the increase of successes in both ears is notorious and statistically significant, independently if the SNR is of 10 dB or of 15 dB (see Table 1).

		Group 1 (n=8)			Group 2 (n=8)			Total (n=16)		
		T0	T1	p	T0	T1	p	T0	T1	p
Righ Ear	10 dB	0,30 ±0,14	0,583 ±0,14	<0.001	0,179 ±0,17	0,204± 0,16	0,492	0,243± 0,16	0,393 ±0,24	0,002
	15 dB	0,425 ±0,14	0,658 ±0,15	<0.001	0,246 ±0,19	0,265 ±0, 14	0,608	0,336 ±0,19	0,461 ±0,25	0,03
	Total	0,366 ±0,13	0,621 ±0,14	<0.001	0,213 ±0,17	0,246 ±0,14	0,327	0,289 ±0,19	0,434 ±0,24	0,001
Left Ear	10 dB	0,444 ±0,15	0,583± 0,19	0,004	0,179 ±0,16	0,220 ±0,16	0,006	0,311 ±0,20	0, 401 ±0,25	0,001
	15 dB	0,490 ±0,18	0,659± 0,19	0,003	0,213 ±0,18	0,228 ±0,19	0,689	0,351 ±0,23	0,443 ±0,29	0,012
	Total	0,465 ±0,16	0,623 ±0,19	0,002	0,196 ±0,16	0,208 ±0,18	0,754	0,331 ±0,21	0,415 ±0,18	0,013

Table 1 Results before (T0) and after (T1) the auditory training.

However, when we compare the results obtained during the sessions of the auditory training with the group G1 and G2, the auditory training through the speech in noise test show values statistically significant when we compare the pre and post-training in all the conditions (see Table 1). In relation to the auditory training through filtered speech test, the values are not statistically significant, except for the left ear for a SNR of 10 dB (p=0.006) (See table 1).

DISCUSSION

With ageing hearing loss tends to increase, with impacts on speaking comprehension in noisy environments and thus affecting communication. Considering the results obtained in the Simple Tonal Audiogram, we verified that the values obtained, before the hearing training correspond to a light degree of hearing loss for both ears (BIAP, 1997). These values showed small improvement after hearing training, however without any statistically significant differences in the medium tonal loss when we compare the conditions before and after hearing training either for the right ear (*p=0,864*) as for the left ear (*p=0,838*). These results meet Musiek & Baran (2007) study where it is also verified that the hearing training has any influence at the level of the hearing thresholds and medium tonal loss.

In the current study we could clearly see that most part of the individuals present a light degree hearing loss so it wasn't expected that they would get such a low percentage of successes in speech in noise situations test for both ears, regardless the SNR being of 10 or 15dB. These results are indicative of CAPD, which translates into an increased difficulty in understanding speech in competing noise situations, even in the presence of a little hearing loss. Research and clinical practice concerning ageing and auditory communication have been driven by questions about age-related differences in peripheral hearing, central auditory and cognitive processing.

After undergoing ten sessions of hearing training according to the Table 1, we could verify statistically significant differences in the speech understanding. We also realized that the hearing training with the speech in noisy situations test used in Group 1 revealed to be quite efficient regardless the SNR, with statistically significant differences either for the right ear (*$p<0.001$*) as for the left ear (*$p=0.003$* for SNR of 10dB and *$p=0.004$* for SNR of 15dB) whereas the training with filtered speech test undergone by the Group 2 was not efficient. In spite of the increase of the successes percentage verified after the training, we hardly obtained a marginal statistical significance in SNR of 10dB (*$p=0.006$*).

Ferguson & Henshaw (2015) conclude that the auditory training resulted in generalized improvements in measures of self-reported hearing, competing speech, and complex cognitive tasks that all index executive functions. This suggests that for auditory training related benefits, the development of complex cognitive skills may be more important than the refinement of sensory processing. Furthermore, outcome measures should be sensitive to the functional benefits of auditory training. Similarly the study of Anderson et al., 2013, we verified that after training, the auditory training group with hearing loss experienced a reduction in the neural representation of the speech envelope presented in noise, approaching levels observed in normal hearing older adults. No changes were noted in the control group. Importantly, changes in speech processing were accompanied by improvements in speech perception. Thus, central processing deficits associated with hearing loss may be partially remediated with training, resulting in real-life benefits for everyday communication.

CONCLUSION

Considering that the MTHL average is of light degree in the sample evaluated (BIAP, 1997), it was expected that the discrimination in the speech in noise test would not obtain such low values but it was not verified as the percentage of successes was smaller of 50% for both ears in all the conditions tested. Contemplating the strong, positive and statistically significant relation, we can conclude that the auditory training has influence on the performance of the CAP evaluation tests. Although the auditory training has no influence at the MTHL level. As a result of the facts mentioned, we can assert that the auditory rehabilitation programmes interrelated with the auditory training can be ways to reach success, improving people's personal inter relationship, which will consequently lead to a better quality of life.

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