Comparison of hearing loss in elderly with and without history of occupational noise exposure

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ABSTRACT

The multiplicity of metabolic and circulatory alterations related to noise may cause the onset of several symptoms, including hearing loss. The purpose of the study was to assess the prevalence of hearing loss in elderly with and without history of occupational noise exposure. A cross-sectional study was realized in a population sample with 399 individuals aged over 60 years in Londrina - Brazil, through anamnesis and audiological evaluation. The variables studied were frequency of hearing loss and history of occupational noise. Non-conditional logistic regression was used in order to control likely confusion or modification of effect to the other variables on interest associations. Hearing loss was reported in 84.31 % of cases, elderly with history of occupational noise exposure and in 63.80 % of controls, elderly without history of occupational noise exposure. A high frequency of hearing loss was detected in the population under investigation, with significantly statistic difference between the presence of hearing loss and history of occupational noise. There were no differences in the laterality of the first affected ear. In the population with hearing loss, the study suggests that the history of occupational noise exposure is accelerating degeneration factor of the hearing apparatus. The result in this research, through evidence of association between history of occupational noise and hearing loss, can allow for an integrated work of health professionals concerned with alterations caused by occupational noise.

INTRODUCTION

The multiplicity of metabolic and circulatory alterations related to noise may cause the onset of several symptoms, including hearing loss with onset slow and progressive. Subjects with Noise-Induced Hearing Loss (NIHL) have frequently several symptoms such as tinnitus, vertigo, gradual decrease or distortion in sound and alterations in speech comprehension. The NIHL is irreversible and permanent but it is preventable by use of hearing protectors when exposed to noise. The magnitude of hearing loss results from excessive exposure to noise and depends on factors associated with the exposure, sound pressure level, duration, type of noise, frequency, and the characteristics of the individual being exposed, susceptibility to NIHL, age, prior history of hearing damage. Besides occupational exposures, hearing loss has been associated with smoking, diabetes, hypertension, aging, health history and activities leisure-time (Marchiori et al. 2006; Agrawal et al. 2009; Collee et al. 2011).

The incidence of hearing symptoms in the ear seems to be correlated with the noise exposure during entire life (Jokitulppo et al. 2005).

Presbyacusis can be defined as the hearing loss associated with aging. Presbyacusis reflects the loss of hearing sensitivity associated with advanced aging and is the third most common chronic condition reported by the elderly people (Lethbridge-Cejku et al. 2004).

The typical audiometric profile observed clinically in presbyacusis is a bilateral symmetric high-frequency sensorineural hearing loss that progresses with advancing age (Krishnamurti 2009).

The first sign of hearing loss from noise exposure is a notching of the audiogram at 3,000, 4,000, or 6,000 Hz, with recovery at 8,000 Hz. In early stages of NIHL, the average hearing thresholds at 500, 1,000, and 2,000 Hz are better than the average at 3,000, 4,000, and 6,000, and the hearing level at 8,000 Hz is usually better than the deepest part of the notch. This notch is in contrast to age-related hearing loss, which also produces high frequency hearing loss, but in a down-sloping pattern without recovery at 8,000 Hz (Krishnamurti 2009).

Data from the gerontological and geriatric population study of Gothenburg, Sweden, indicates that the age-related deterioration of the frequencies 1, 2 and 8 kHz is more pronounced in elderly men exposed to noise compared with those not exposed to noise from age 70 to age 75 (Gates et al. 2000).

However, one of the limiting factors of differential diagnosis sensorineural hearing loss in the elderly is that typically age-related hearing loss tends to be confounded by previous effects of noise exposure in those individuals employed previously in a noisy workplace environment. Sensorineural hearing loss related to noise exposure typically does not produce a loss greater than 75 decibels (dB) in high frequencies and 40 dB in lower frequencies. Noise-induced hearing losses along with superimposed age-related losses may have hearing threshold levels in excess of these values (Krishnamurti 2009).

A lifetime of exposure to noise increases the probabilities of negative effects on hearing, but is difficult to determine the interaction between noise-induced hearing loss (NIHL) and age-related hearing loss. Age-related hearing loss has a complex etiology including both intrinsic and extrinsic factors. The influence of noise on presbyacusis has been postulated in numerous reports for almost a century. However, it is difficult to identify one single factor to the effects of prolonged noise exposure, with duration of many decades. The effect of noise is equivocal. The interactions between noise-induced hearing loss and age-related hearing loss are complex, difficult to determine, and poorly understood. One major problem is that age related hearing loss is extremely multifactorial (Rosenhall 2003).

In review with compilation of 11 investigations by different authors regarding the progression of hearing deterioration during severe long-term exposure to noise in mines, shipyards, forges, weaving mills, other factories and industries and from field artillery and hunting, with one exception, the reports concern conditions at times when ear protection was virtually unknown or only seldom used. The different investigations are described in a broad outline with their essential measurement and background data. Despite the great diversity in the character and level of the noise, the compilation shows for the higher ages in the range of 3 to 8 kHz a similar median hearing loss from nearly all investigations; however, at 1 kHz and, particularly, at 2 kHz the differences in the character of the noise are apparent in a wide spread of the median hearing loss between the different studies. In addition, it was found that at higher ages and hearing loss levels of more than 45 to 50 dB it is not possible to distinguish between the effect of the noise, on the one hand, and that of ageing, on the other; the ad hoc assumption of their additivity is no longer valid and thus the term age correction inadequate (Rosler 1994).

Many authors have considered hearing loss related to presbyacusis as result of various negative extrinsic and intrinsic factors. As a polycausal chronic disease it is difficult to define hearing loss in the elderly as a decline in auditory sensitivity caused only by age-related degeneration. In a Brazilian Study the prevalence of hearing loss was significant and in accordance with other relevant international epidemiological studies (Mattos & Veras 2007).

Noise-induced hearing loss is a major cause of deafness and hearing impairment in the United States (Daniel 2007). Hearing loss caused by exposure to recreational and occupational noise results in devastating disability that is virtually 100 percent preventable. Noise-induced hearing loss is the second most common form of sensorineural hearing deficit, after presbyacusis. Noise-induced hearing loss can be prevented by avoiding excessive noise and using hearing protection such as earplugs and earmuffs. Patients who have been exposed to excessive noise should be screened. When hearing loss is suspected, a thorough history, physical examination and audiometry should be performed. If these examinations disclose evidence of hearing loss, referral for full audiologic evaluation is recommended (Rabinowitz 2000).

The study by Krishnamurti indicates that the effects of noise exposure on hearing varied across age-groups and highlights the importance of applying age- and gender-corrections prior to determining the relative contribution of occupational noise exposure in patients with SNHL. This suggests more research to address the weighted contributions of aging and noise effects in the occupation NIHL population (Krishnamurti 2009).

In an epidemiological search of elderly persons Pratt et al. (2009) have studied the impact of age, gender, and race on the prevalence and severity of hearing loss in elder adults, aged 72–96 years, after accounting for income, education, smoking, and clinical and subclinical cardiovascular disease. Hearing loss was more common and more severe for the participants in their 80s than for those in their 70s—the men more than the women and the White participants more than the Black participants. The inclusion of education, income, smoking, and cardiovascular disease (clinical and subclinical) histories as factors did not substantially impact the overall results. They suggested that hearing loss is more substantial in the 8th than the 7th decade of life and that race and gender influence this decline in audition. Given the high prevalence in the aging population and the differences across groups, there is a clear need to understand the nature and causes of hearing loss across various groups in order to improve prevention and develop appropriate interventions (Pratt et al. 2009).

The possible correlations between hearing function and history of occupational noise exposure in elderly reveals a complex situation, considered the multitude of intrinsic and extrinsic etiologies associated with age.

The purpose of the study was to assess the prevalence of hearing loss in elderly with and without history of occupational noise exposure.

METHODS

A cross-sectional study was carried out at UNOPAR in Londrina, Brazil. The study protocol was approved by the bioethical committee of the UNOPAR University. This was the first large rigorous survey to examine 500 elderly in the city concerned. The subjects were sent by EELO project. The total population of this study consisted of sample of 399 first elderly evaluated. Individuals aged over 60 years with and without history of occupational noise exposure, evaluated through anamnesis and audiological evaluation (798 ears).

The anamnesis included questions about age, gender, hearing loss complaint, related noise exposure history and medical history. The audiological evaluation was performed individually in a sound-proof booth with an Interacoustics Audiometer.

The variables studied were frequency of hearing loss and history of occupational noise. Mean values and standard deviation were used as descriptive statistics. To select the variables in order of their P-values, it was performed association statistic, applying the chi-square test and logistic regression, represented by values of odds ratio (Odds Ratio - OR) and their respective confidence intervals 95%. The logistic regression was used in order to control confusion or modification of effect to the other variables on interest associations. The procedures were performed using SPSS software, version 10.0, adopting a significance level of 5 %.

RESULTS

The total study population consisted of a sample of 399 first elderly evaluated. Hearing loss was reported in 84.31 % of elderly with history of occupational noise exposure and in 63.80 % of elderly without history of occupational noise exposure.

A high frequency of hearing loss was detected in the population under investigation, with significantly statistic difference between the presence of hearing loss and history of occupational noise. There were no differences in the laterality of the affected ear. The symmetrical hearing loss was the most frequent form in elderly without history of occupational noise exposure and the asymmetrical hearing loss was the most frequent form in elderly with history of occupational noise exposure. The asymmetrical hearing loss was the most frequent in the male compared to the female. The history of occupational noise and male gender proved to be independent risk factors for hearing loss.

Table 1: Hearing loss and history of occupational noise exposure – total sample

		Hearing loss			
With history of occupational noise exposure		Yes		No	
		n	%	n	%
Yes	(204 ears)	172	84.31 %	32	15.68 %
No	(594 ears)	379	63.80 %	215	36.19 %
Total	(798 ears)				

$\chi^2 = 78$ ($p<0.0001$)

Table 2: Logistic regression analysis of hearing loss and independent variables

Effect	Degree of freedom	Wald	p
Intercept	1	21,54508	0,000003
Gender	1	5,77976	0,016212
Noise exposure	1	6,36951	0,011610

This analysis suggests that independent variables were significant predictors. The history of occupational noise and male gender proved to be independent risk factors for hearing loss.

According to other studies, the search present shows interaction between hearing loss and history of occupational noise exposure.

Gates et al. (2000) describe that a lifetime of exposure to noise is likely to have negative effects on hearing, but the interaction between noise-induced hearing loss (NIHL) and age-related hearing loss is difficult to determine. The most commonly accepted assumption is a simple accumulating effect of noise and ageing on the hearing. However, both a less than additive effect as well as a supra-additive effect has been proposed. Recently an interesting interaction between NIHL and age-related hearing loss has been reported.

Another study indicates a pronounced difference between 70-year old men exposed to massive occupational noise, compared to a control group. This difference was not confined only to the NIHL-area, but also at 1 and 2 kHz. The most profound deterioration of the hearing between age 70 and age 75 was found at the frequency 2 kHz for both men exposed and not exposed to noise, but the deterioration was much more pronounced for the exposed group, the difference being more than 1 dB per year. The deterioration was considerably less at the NIHL frequency 4 kHz. The reduced deterioration was about the same for both groups at this frequency. The annual deterioration was much less for all frequencies with no apparent difference between the two groups between age 75 and 79 (Rosenhall 2003).

CONCLUSIONS

The prevalence of hearing loss in the elderly with and without history of occupational noise exposure in present search was high, in accordance with others epidemiological studies.

The limitation of this present study is its reliance on self-reported information over exposure to noise in a retrospective way because no objective measures were possible in elderly sample. In addition, this study did not control the confounding factor of noise intensity with history of occupational noise, which may affect the interpretation of results. Hence, these values need to be interpreted with caution.

According to other studies the symmetrical curve was the most frequent form of hearing loss in elderly without history of occupational noise exposure, which suggests that hearing loss was related to age. There was a higher rate of asymmetrical hearing loss in the case group compared to the control group; this could be explained by a greater exposure of cases to noise at work. Both the history of occupational noise and the male gender proved to be independent risk factors for hearing loss.

This study shows difficulty of investigating the relationship between history of occupational noise and age-related hearing loss in elderly. However, a high frequency of hearing loss was detected in the population under investigation, with significantly statistic difference between the presence of hearing loss and history of occupational noise, reflecting the association between histories of occupational noise and hearing loss. Based on results of the current study an integrated work of health professionals concerned with alterations caused by occupational noise is recommended.

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Using multiple media outlets to enhance a community based noise-induced hearing loss prevention program

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INTRODUCTION

While hearing loss can affect people of all ethnic groups, native Americans have twice the moderate to severe hearing loss of Caucasians (Barnes et al. 2005). It is thought that noise-induced hearing loss (NIHL) may play a significant role in this degenerative process. However, hearing loss prevention programs in tribal communities have been lacking (Martin et al. 2008a). To this end, a CDC-funded Prevention Research Center, the Oregon Health & Science University Center for Healthy Communities, has begun a project called "Listen for Life" aimed at reducing NIHL in Northwest tribal communities. In this effort, multiple health communication strategies are applied in the context of a community-based participatory research model (Minkler & Wallerstein 2008).

The effectiveness of a hearing loss prevention program is, in large part, dependent upon its cultural relevance to the intended target audience, and its concordance with the normative expectations in the target community (Martin et al. 2006, 2008b; Sobel & Meikle 2008). To be effective, interventions in a tribal community must reflect the tribal social norms in all respects. It is, therefore, critical to partner with a local community advisory group on message design and content. This paper will address the use of media messages created by this partnership and used as part of a larger effort that included a school-based prevention program (Dangerous Decibels®) and a community event.

Increasing awareness and salience in the community

McCombs & Shaw (1972) suggest that the mass media messages tell us "what issues to think about, not what to think about the issues." In other words, mediated messages that are printed or broadcast can effectively create a level of issue awareness and salience in a community. Individuals denote importance to issues they are exposed to over a period of time (McCombs 2005). The theory of "agenda setting" assumes that we tune into messages that we have identified as important (or salient) and we tune out other messages. Salience may result from one media source that the population is regularly exposed to, or many media sources that present similar stories over time. The communication literature has long accepted that exposure to issue-oriented mediated messages can create awareness and salience in a community (McCombs & Shaw 1972). Research regarding the agenda-setting theory has shown that issue awareness and salience can be created by messages specifically designed to identify healthy and unhealthy behaviors, as demonstrated in the arena