RELATION OF NOISE-INDUCED HEARING LOSS AND TOBACCO USE AMONG WORKERS IN A FOOD INDUSTRY

Relação da perda auditiva induzida por ruído e o uso de tabaco em trabalhadores de uma indústria alimentícia

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ABSTRACT

Purpose: to determine whether tobacco use enhances the effects of noise caused hearing. **Methods:** 153 workers of both sexes, smokers and nonsmokers, from an food sector industry, randomly chosen from among 14 sectors of the company, whose band noise was presented a variation from 85 to 109 dB, answered a questionnaire about time exposure to noise as well as on smoking habits and submitted to audiometry. **Results:** the hearing thresholds in the frequencies of 4000 Hz and 6000 Hz were significantly higher in the group of smokers / ex-smokers when compared to nonsmokers in both ears, these thresholds, characteristic of hearing loss induced by noise. These differences remained significant after age adjustment and exposure time. **Conclusion:** through the obtained results it was possible to conclude a correlation between the use of tobacco and hearing loss.

KEYWORDS: Noise; Hearing Loss Noise-Induced; Tobacco; Hearing

INTRODUCTION

The worry with the workers' health has increased over the years, causing several studies are performed with the intention of preventing the injuries that work can lead to the individual. Among the health problems related to work, Noise Induced Hearing Loss (NIHL) is one of the most frequent worldwide[1].

The NIHL, also called Induced Hearing Loss High Sound Pressure Levels (HSPLIHL), it feature is sensorineural, affecting the hearing thresholds in one or more frequency band of 3 to 6 KHz. Progresses as time of exposure and is characterized be irreversible[2].Some symptoms associated with NIHL may arise, such as tinnitus, difficulty in speech understanding, algiacusia, ear fullness and feeling of "muffled" hearing, as well as recruitment, present in virtually all cases[2,3].

Currently, one of the biggest challenges in the area of occupational health constitutes in the studies on the effects of combined occupational exposures, since many physical and chemical agents can be found in the work environment[4]. Chemicals such as acetone, styrene, resins, cobalt, among others, associated with exposure to noise favor a higher incidence of hearing loss[5].Also, with respect to concomitant exposure to insecticides and noise, the average time for the development of hearing disorders is lower than when the exposure is performed only to the noise[6]. Other researches indicates that carbon monoxide can have a direct effect on the cochlear metabolism[7].There are other ototoxic chemicals found in the workplace: arsenic and its compounds, lead and its compounds, ethylene glycol, hydrogen sulfide gas, mixtures of solvents, toluene, xylene, and others[8]. With respect to physical agents, studies point vibration as an aggressive agent not only hearing, but the agency as a whole[9].

Other factors, not only agents found in the workplace can contribute to the onset and worsening of hearing loss. The literature presents studies that link smoking as a risk factor for conductive hearing loss and sensorineural[10-13].The hearing may

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be affected by the effect of cigarette antioxidant mechanism or by suppressing vascular hearing system. Some studies have also indicated that smokers show changes in the hearing pathway in the low nerve and the central hearing pathways in subcortical regions[13].

According to the literature, smoking is associated with lower blood oxygen levels, vascular obstructions and changes in blood viscosity, which may have an ototoxic effect[10]. However, as tobacco results in the burning of more than 4000 components, including nicotine, carbon monoxide, carbon dioxide, methanol, nitrogen and oxidants, is difficult to determine whether nicotine would be the cause of the greater adverse effect or would be combination of several components[13].

Studies indicated that smoking is one of the most prevalent addictions throughout the world, and in Brazil, according to a survey conducted in 2005, more than 10% of the population between 12 and 65 years makes use of tobacco[14].

Thus, with NIHL one of the biggest health problems related to work, smoking have a high prevalence worldwide and also considering that there are findings in the literature that indicate that smoking can harm hearing, this work was to check whether the use of tobacco potentiates the effects of noise caused hearing.

METHODS

This research was approved by the CEFAC Research Ethics Committee under No. 016/11.

This is a cross-sectional study of 246 workers at a food company in the state of Santa Catarina, in the period November 2010 to May 2011.The selected workers presented aged 15 to 60 years, with time of exposure to noise between 1 and 15 years and were chosen randomly from 14 sectors of the company, whose noise band had presented a variation 85-109 dB HL. The values of noise levels in each sector were obtained from the company's Program for Prevention of Environmental Risks, that reported providing hearing protection to all employees exposed to noise, making use of the same requirement.

Before beginning the study, all subjects involved were informed of the objectives and methodology of the same receiving a letter of explanation and a term of free and informed consent to be read and signed. After this, the researcher carried out a questionnaire (Figure 1), where information were collected as: identification of the worker, working time in current role and this company, work history in other companies with exposure to noise, use of protective headset, stunted and current diseases, medication use, symptom of tinnitus and intolerance to loud sounds, type of tobacco, amount and time of use, as well as extra-occupational exposure to loud sounds.

After the questionnaire, inspection of the external auditory canal was performed to exclude patients with presence of cerumen or any abnormality that could mischaracterize the research objective. Subjects with any of these characteristics were duly referred to the ENT.

Moreover, were exclusion criteria for research: conductive or mixed hearing loss, profound hearing loss or deafness, mellittus diabetes, hypertension, and previous work with solvent and / or pesticides.

Individuals who did not have any criteria for exclusion, underwent pure tone audiometry at frequencies from 250Hz to 8kHz. Search bone conduction at frequencies between 500Hz and 4kHz and speech audiometry tests with Speech Reception Threshold (SRT) and Speech Recognition Index (SRI) were performed when the thresholds were not within the normal range (below 25dBNA). The equipment used for application of the test was 259 Interacoustics audiometer and also audiometric booth Vibrasom VSA50, both subject to the annual electroacoustic calibration.

Induced hearing loss (NIHL) were those in which auditory thresholds at 3 and / or 4 and / or 6KHz were above 25 dB HL, and higher than other tested frequencies, whether altered or not, both air conduction test as in bone conduction test, on one or both sides[15].

Regarding the statistical analysis, quantitative variables (thresholds) were described by median and interquartile range, by presenting skewed distribution. Qualitative variables (other) were described by absolute and relative frequencies.

To compare the hearing thresholds between groups, the Mann-Whitney test was used. Ever, to evaluate the association between qualitative variables, the Pearson's chi-square test was applied. In case of statistical significance, the test set of residues was calculated to aid in locating associations.

In order to control for possible confounding factors (age and total exposure time), Analysis of Covariance (ANCOVA) was used to assess the association between smoking and hearing thresholds. As these thresholds showed an asymmetric distribution, the square root transformation was applied to the raw data to be possible to perform the ANCOVA data.

The level of significance was set at 5% ($p \leq 0.05$), and analyzes were performed using SPSS (Statistical Package for Social Sciences) 18.0 program.

QUESTIONNAIRE

(adapted from the doctoral thesis of speech and language pathologist Alice Penna)

A. IDENTIFICATION

Date of interview: |__||__|-|__||__|-|__||__|

A1. Name: _____

Initials (name-surname (s)): |__| |__| |__| |__|

A2. Date of birth: |__||__|-|__||__|-|__||__|

A3. Age: |__||__| anos

A4. Sector Work: _____

A5. Function: _____

A6. Time working at current company |__||__| years |__||__| months

If less than 1 year, encode as 00 years and then the number of months.

A7. Working time in current function |__||__| years |__||__| months

We would like that you relate all the work that you had in previous noisy environments this company.

firm: _____function _____
function: _____
total weekly hours of exposure to noise: _____
total years of exposure to noise: _____
wore ear protection: no ( ) yes ( )

firm: _____function _____
function: _____
total weekly hours of exposure to noise: _____
total years of exposure to noise: _____
wore ear protection: no ( ) yes ( )

firm: _____function _____
function: _____
total weekly hours of exposure to noise: _____
total years of exposure to noise: _____
wore ear protection: no ( ) yes ( )

A8. Breed:

(1) White (2) Mulatto (3) Black (4) Indian (5) Oriental |__|

B. DISEASES AND EVENTS

B1. Do you have or had you high blood pressure?

(1) Yes (2) No |__| If **no**, go to C4

B2. If yes, did you have a diagnosis of hypertension conducted in medical consultation?

(1) Yes (2) No |__|

B3. Do you control your hypertension taking any prescribed medication?

(1) Yes (2) No |__| Which? _____

B4. Do you have or had you diabetes?

(1) Yes (2) No |__| If **no**, go to C7

B5. If yes, did you have a diagnosis of diabetes conducted in medical consultation?
(1) Yes (2) No |__|
B6. Do you control your diabetes taking any prescribed medication?
(1) Yes (2) No |__| Which? _____
B7. Do you have tinnitus?
(1) Yes (2) No |__| Which ear?_____
B8. Do you have an intolerance to loud noise?
(1) Yes (2) No |__|

C. ASSOCIATED HABITS

C1. Do you smoke or had smoke an average of 1 cigarette, cigar, tobacco pipe and corn husk cigarettes daily? | _ _ |
Never smoked (2) Only in the past (3) Yes, still smokes
(if stopped smoking a period of up to 12 months tick yes, still smokes).
We would like that you describe the periods of your life when smoked cigarette, cigar or tobacco pipe, the quantities smoked and other details. Please try to remember the most important changes regarding the amount and type of cigarette. Ignore changes that occurred for short periods (less than 1 year).
Note to interviewer: *Avoid overlapping years for the same type of cigarette, for example: 30-40, 41 to 45 instead of 30-40, 40-45.*
Obs: Following the fill options: Place the fields corresponding to the numbers in the boxes blank table attached below: Tobacco type: Cigarette: 01 Cigar: 02 Tobacco pipe:03 Corn husk cigarettes: 04

C2. What kind of tobacco do you smoke or had smoke?

Tobacco type	Age of onset	Age who stopped	Number per day

C3. Leisure habits and other exposures:

Activity	No/Yes	Total (years)	Days/Week	Protector (yes/no)
Military service				
Fire arm				
Touching musical groups				
Motorcycle without a helmet				
Racecar				
Walk-man				
Saw				
Balls and clubs				
Religious cults				
Which. Other?				

D. MEATOSCOPY

RE |__| LE |__|

(1) Without obstruction

(2) With partial cerumen

(3) With full cerumen

LEAF ANNOTATION OF AUDIOLOGICAL EXAMS

Audiometry:

	250	500	1000	2000	3000	4000	6000	8000
VA OD								
VO OD								
VA OE								
VO OE								
MASC.								
LOGO - OD	SRT		IPRF	MO		DIS		
LOGO - OE	SRT		IPRF	MO		DIS		

Exclusion in research:

( ) Yes→Reason: _____

( ) No

Figure 1 – Questionnaire

RESULTS

The sample consisted of 153 workers with female predominance (60.9%), aged between 21 and 40 years (68.0%) being allocated most of the gutting and shipping sectors (45.1%). The prevalence of smokers or ex-smokers in the sample was 20.9% (32/153). Regarding the distribution of smokers and non-smokers were similar between men and women, age groups and industry (Table 1).

The association between smoking and the variables related to the total time of noise exposure and hearing problems was presented in Table 2.

The total exposure time to the noise and the smoke had statistically significant association (p = 0.016). The group of smokers / ex-smokers had significantly longer total exposure, especially between 10 and 15 years.

The relation between the smoking and the audiometry was shown in Table 3. Hearing thresholds of air conduction at frequencies 4,000 Hz and 6,000 Hz were significantly higher in the group of smokers / ex-smokers compared to nonsmokers both in the right ear (p = 0.034 and p = 0.018, respectively) and the left ear (p = 0.021 and 0.001, respectively). These differences remained significant after adjustment for age and time of exposure. In addition, a new statistical difference appeared after the adjustment, the frequency of 250Hz in the right ear. Thus one can say that the statistical association found between smoking and hearing thresholds, plotted in Figures 2 and 3, was independent of age and duration of exposure.

Table 1 – Sample characterization

Variable	Total sample (n=153)	Never smoked (n=121)	Smoker/ Ex-smoker (n=32)	p*
	n (%)	n (%)	n (%)	
Gender				
Female	92 (60,1)	75 (62,0)	17 (53,1)	0,479
Male	61 (39,9)	46 (38,0)	15 (46,9)	
Age group				
15-20	25 (16,3)	21 (17,4)	4 (12,5)	0,343
21-30	70 (45,8)	55 (45,5)	15 (46,9)	
31-40	34 (22,2)	28 (23,1)	6 (18,8)	
41-50	21 (13,7)	16 (13,2)	5 (15,6)	
51-60	3 (2,0)	1 (0,8)	2 (6,3)	
Section				
Caixaria receiver	10 (6,5)	10 (8,3)	0 (0,0)	0,335
Quality control	1 (0,7)	1 (0,8)	0 (0,0)	
Plucking machine	7 (4,6)	6 (5,0)	1 (3,1)	
Packing	13 (8,5)	9 (7,4)	4 (12,5)	
Evisceration	43 (28,1)	36 (29,8)	7 (21,9)	
Expedition	26 (17,0)	17 (14,0)	9 (28,1)	
Ice factory	3 (2,0)	2 (1,7)	1 (3,1)	
Feedmil	5 (3,3)	5 (4,1)	0 (0,0)	
Federal inspection	15 (9,8)	13 (10,7)	2 (6,3)	
Maintenance	9 (5,9)	7 (5,8)	2 (6,3)	
Platform	8 (5,2)	6 (5,0)	2 (6,3)	
Entrails room	1 (0,7)	0 (0,0)	1 (3,1)	
Cutting room	12 (7,8)	9 (7,4)	3 (9,4)	

* Pearson's chi-square test

Table 2 – Variables related to the total exposure time and hearing problems

Variable	Total sample (n=153)	Never smoked (n=121)	Smoker/ Ex-smoker (n=32)	p*
	n (%)	n (%)	n (%)	
Total exposure time				
<1 year old	10 (6,5)	9 (7,4)	1 (3,1)	0,016
1 – 5 years old	79 (51,6)	65 (53,7)	14 (43,8)	
5,01 – 10 years old	38 (24,8)	29 (24,0)	9 (28,1)	
10,01 – 15 years old	16 (10,5)	8 (6,6)	8 (25,0)**	
> 15 years old	10 (6,5)	10 (8,3)	0 (0,0)	
Tinnitus				
Yes	9 (5,9)	8 (6,6)	1 (3,1)	0,686
No	144 (94,1)	113 (93,4)	31 (96,9)	
Intolerance to noise				
Yes	27 (17,6)	22 (18,2)	5 (15,6)	0,939
No	126 (82,4)	99 (81,8)	27 (84,4)	
Right acousticmeatus				
Without obstruction	139 (90,8)	109 (90,1)	30 (93,8)	0,735
With partial cerumen	14 (9,2)	12 (9,9)	2 (6,3)	
Left acousticmeatus				
Without obstruction	140 (91,5)	111 (91,7)	29 (90,6)	0,735
Com cerumen parcial	13 (8,5)	10 (8,3)	3 (9,4)	

* Pearson's chi-square test

Table 3 – Variables related to audiometry

Thresholds air conduction	Total sample (n=153)	Never smoked (n=121)	Smoker/ Ex-smoker (n=32)	p*	p**
	Md (P25 – P75)	Md (P25 – P75)	Md (P25 – P75)		
250 Hz					
RE	15 (10 – 20)	15 (10 – 20)	15 (15 – 20)	0,054	**0,033**
LE	15 (10 – 20)	15 (10 – 20)	17 (15 – 20)	0,166	0,226
500 Hz					
RE	10 (10 – 15)	10 (10 – 15)	15 (10 – 20)	0,079	0,062
LE	15 (10 – 15)	10 (10 – 15)	15 (10 – 15)	0,422	0,419
1.000 Hz					
RE	10 (5 – 10)	10 (5 – 10)	10 (5 – 15)	0,286	0,211
LE	10 (5 – 15)	10 (5 – 15)	10 (5 – 15)	0,585	0,416
2.000 Hz					
RE	10 (5 – 15)	10 (5 – 15)	10 (5 – 10)	0,665	0,510
LE	10 (5 – 15)	10 (5 – 15)	10 (5 – 15)	0,756	0,755
3.000 Hz					
RE	10 (5 – 15)	10 (5 – 15)	10 (10 – 15)	0,297	0,123
LE	10 (5 – 15)	10 (5 – 15)	10 (5 – 19)	0,680	0,585
4.000 Hz					
RE	15 (10 – 20)	15 (10 – 15)	15 (10 – 20)	**0,034**	**0,048**
LE	15 (10 – 20)	15 (10 – 20)	20 (15 – 24)	**0,021**	**0,036**
6.000 Hz					
RE	15 (10 – 20)	15 (10 – 20)	20 (15 – 25)	**0,018**	**0,041**
LE	15 (10 – 25)	15 (10 – 20)	22 (15 – 25)	**0,001**	**0,009**
8.000 Hz					
RE	10 (5 – 20)	10 (5 – 20)	15 (10 – 20)	0,432	0,499
LE	15 (5 – 20)	15 (5 – 20)	15 (10 – 20)	0,246	0,354

RE=right ear; LE=left ear; Md=median; P25=percentile 25; P75=percentile 75
* Mann-Whitney test
** adjusted for age and total exposure time by Analysis of Covariance (ANCOVA), in the datas transformed by the square root.

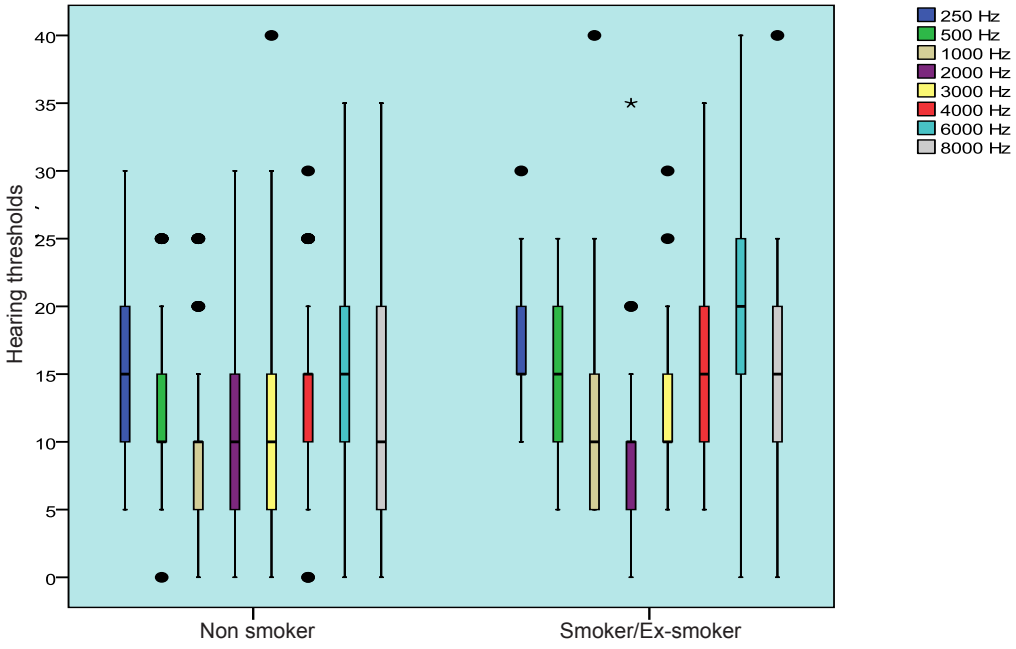

Figure 2 – Evaluation of hearing thresholds of the right ear at each frequency, by study group. The central line represents the median and the lower and upper limits of the box represent the 25 and 75 percentiles, respectively. The error bars represent the minimum and maximum values.

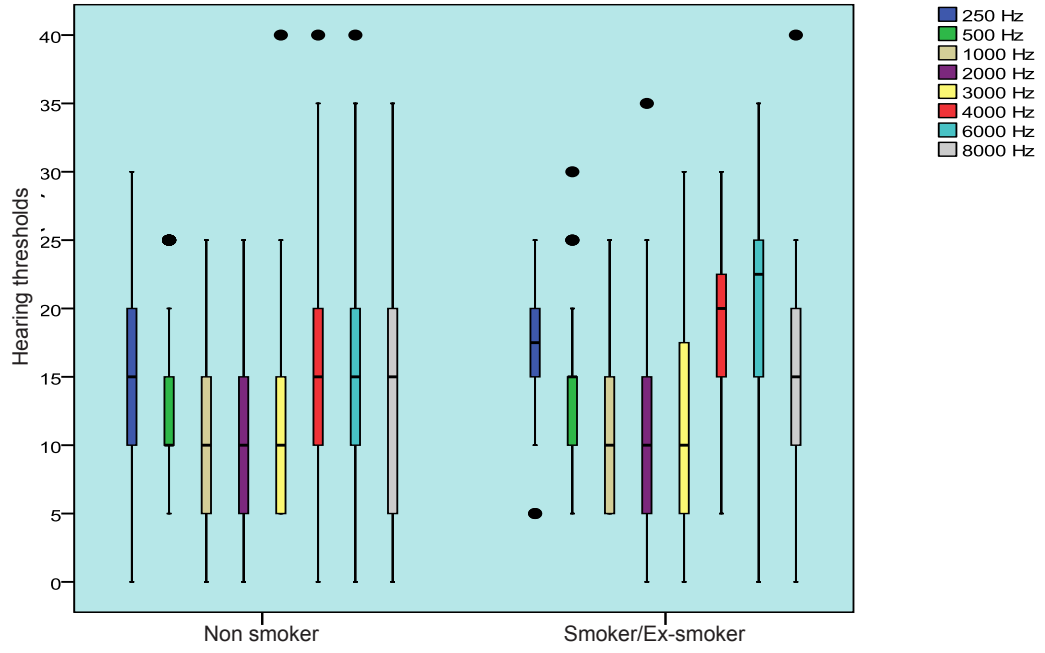

Figure 3 – Evaluation of hearing thresholds of the left ear at each frequency, by study group. The central line represents the median and the lower and upper limits of the box represent the 25 and 75 percentiles, respectively. The error bars represent the minimum and maximum values.

DISCUSSION

Based on the results it can be seen that the most of the sample (45.1%) of survey exercised its functions in evisceration and shipping sectors, presenting noise level equal to 88 and 91 dBA respectively. Despite the noise levels to 85dBA recommended in these sectors overcome, they are still below those found in other sectors of the company, where it was possible to observe levels of up to 109dB.

Some authors claim that the intensity of the noise seems to be the main risk factor for hearing loss, regardless of the frequency band[16].

According to Regulatory Norm 15, a worker may not be exposed to a level exceeding 85 dBA noise 8 hours of work, in that case need to make use of hearing protectors[15]. This may explain the fact that in both groups was altered thresholds (above 25 dBA), since non-smokers also remain exposed to loud noises.

Actually, the ideal would be to reduce the noise source and implement the use of protectors since for the usage to be effective, there is need for education and training of employees continuously[17], as well as supervision of their use by checking the effectiveness of training conducted. Where it is not possible to reduce noise in the sound source, it is necessary the use of protectors. A recent study has shown effectiveness in educational activities training on the use of protectors to employees exposed to occupational noise, if well implemented[18].

By relating the results of audiometry with the use or nonuse of tobacco, it was noted that in the group of smokers/ex-smokers there was a significant increase in hearing thresholds of air conduction for frequencies of 4 and 6kHz, which define and characterize hearing loss as induced noise[15]. Despite smokers/ex-smokers do not exercise their functions in higher noise level sectors, have worse hearing thresholds for the frequencies that indicate NIHL.

A study conducted in 2005 in Japan with 2267 individuals corroborates the information found in this study, which found a significant increase in hearing thresholds in the frequency of 4 kHz in smokers compared to nonsmokers[12].

Another study conducted in Brazil in 2009 with smokers and non-smokers, found that the group of smokers had worse hearing thresholds at high frequencies (12500 and 14000Hz) and worst level of otoacoustic emissions in response to the frequency of 4 kHz in left ear, and a higher number of cases with cochlear dysfunction[10]. Some authors suggest the use of transient evoked otoacoustic emissions in order to identify minimal cochlear changes in individuals exposed to noise associated with other risk factors for hearing loss, preventing damage to the hearing system[19-21].

This study indicates that not just the use of hearing protection to prevent hearing loss, if any associated risk factors. In addition to the existing awareness against smoking campaigns, realizes the need for campaigns by employers in order to guide individuals to the hazards of tobacco use, not only the well known and as commented on by the media, but also hearing losses. Perhaps it's necessary a more specific training more careful monitoring for those employees who take other risk than that which is already given, in the case, the noise.

Although the results of this study suggest a relationship between tobacco use and noise-induced hearing loss, it should be noted that he has a subjective character, since it does not take into consideration the time and amount of tobacco used by the worker, and even it was observed, would not be possible to measure the amount of nicotine and carbon monoxide absorbed by the individual. Perhaps a study with a larger population of smokers (with duration of use and amount of smoke approximate) exposed and not exposed to noise could help to clarify the issue.

CONCLUSION

This study suggests that tobacco use may potentiate damage to hearing caused by noise, worsening cases of NIHL, since the group of smokers/ex-smokers showed greater injury in the characteristic frequencies.

RESUMO

Objetivo: verificar se o uso do tabaco potencializa os efeitos do ruído causados na audição. **Métodos:** 153 trabalhadores de ambos os sexos, fumantes e não-fumantes, de uma indústria do ramo alimentício, escolhidos aleatoriamente dentre 14 setores da empresa, cuja faixa de ruído apresentada teve uma variação de 85 a 109 dBNA, responderam a um questionário sobre tempo e exposição ao ruído bem como hábitos sobre fumo e passaram por exame de audiometria. **Resultados:** os limiares auditivos da via aérea nas frequências de 4.000 Hz e 6.000Hz foram significantemente mais altos no grupo de fumantes/ex-fumantes quando comparados aos não-fumantes tanto na orelha direita quanto na orelha esquerda; limiares estes, característicos da perda auditiva induzida por ruído. Essas diferenças se mantiveram significantes após o ajuste pela idade e pelo tempo de exposição. **Conclusão:** por meio dos resultados obtidos, concluiu-se que o uso do tabaco pode potencializar os danos causados pelo ruído à audição.

DESCRITORES: Ruído; Perda Auditiva Provocada por Ruído; Tabaco; Audição

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