Efficacy of the Auditory Protection for Insertion Into a Program of Hearing Losses Prevention

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SUMMARY

Introduction: The noise causes effects on the hearing and all organism. In hearing it may produce a threshold temporary shift (TTS): for a short term the auditory sensitivity is increased due to the metabolic exhaustion of the hair cells in the presence of intense sounds. When the noise is eliminated, the hearing returns to its normal threshold. The individuals who work exposed to noise may acquire a permanent threshold shift (PTS). One of the ways to avoid the TTS/PTS is using the auditory protection when in the presence of noise.

Objective: The objective of this research was to verify the efficacy of the auditory protections used by workers exposed to noise of 96.5 dB (L) in a metallurgic factory in the countryside of the State of São Paulo.

Method: Tonal audiometry before and after the working journey in 13 workers users of auditory protection of insertion type, exposed to 96.5 dB (L), to determine whether there is TTS.

Results: We confirmed that the hearing of workers did not undergo statistically significant audiometric thresholds shifts between the pre-journey and post-journey exam.

Conclusion: This research showed that the use of auditory protections of insertion type was efficient, because it did not produce TTS in the workers exposed to noise.

Keywords: audiometry, worker's health, hearing loss.

INTRODUCTION

The noise is characterized as the most prevalent factor in the origin of occupational diseases as well as the most common physical agent harmful to health (1).

The hearing loss induced by high sound pressure level (PAINPSE) is the permanent threshold change resulting from continuous exposure, of neurosensorial type, generally bilateral and symmetric, irreversible, with a level ranging from normal and light and audiometric configuration of incision type, in the frequencies range of 3000, 4000 and/or 6000 Hz. It progresses slowly, may reach frequencies of 8000, 2000, 1000, 500 and 250 Hz and reaches its maximum level in the highest frequencies, in the 10 to 15 first years of continuous exposure under a high sound pressure level (SPL) The hearing loss prevalence is raised as the noise exposure time increases (3,4).

Regulation Norm no. 15 (NR-15) of Administrative Rule no. 3.214/1978 (BRAZIL, 1978) set forth 85 dB as the tolerance limit for an exposure to continuous or intermittent noise during 8 daily hours (1,5).

Out of the necessary provisions for the promotion of health and prevention in the combat of occupational diseases and work accidents in a company include the implementation and deployment of programs.

The Hearing Loss Prevention Program (PPPA) is an integral part of the Prevention Program of Environmental Risks (PPRA) - NR 9, Medical Control Program of Occupational Health (PCMSO) - NR 7 and the Systems of Management of Safety and Health at Work. PPPA aims at promoting the auditory health and prevention of auditory damages and extra-auditory effects, provoked by the exposure to high levels of sound pressure and ototoxic chemicals (1).

The noise exposure may provoke different symptoms in workers, which may be auditory and/or extra-auditory, depending on the risk characteristics, the exposure and the individual exposed. The recognized auditory effects are tinnitus (the most frequent symptom) (6), hearing loss and difficulties in speech understanding. The extra-auditory symptoms considered include sleep and communication disorders, neurological, vestibular, digestive, behavioral, cardiovascular and hormonal problems (7).

The noise causes effects on hearing and in the entire organism. In hearing there occurs threshold temporary change (MTL): In short term, the auditory sensitivity threshold is increased due to the metabolic exhaustion of the ciliary cells in the presence of intense sounds. After an auditory resting, hearing returns to is normal threshold (8).

As to the noise danger, studies carried out (9) highlighted that if a noise does not cause MTL, it will not cause permanent hearing loss.

Studies published (10) remark the main factors that contribute for this risk: sound level, sound spectral distribution, duration and distribution of noise exposure. It reported that for MTL occurrence the noise levels must exceed 60 to 80 dBNA in exposures that last from 8 to 16 hours. Values above this limit are sufficient to cause cochlear damage (11).

When the collective control measures on the source are enough, it is necessary to use the Hearing Protection Device (HPD), taken as the temporary method and the last resource for hearing protection (12).

Morata and Santos reported that individuals who operate exposed to noise without using HPD and do not have hearing rest between the day's work are more susceptible to acquire have threshold alteration (MPL) (13). The hearing protections may prevent alterations in the cochlea (14). The individual's susceptibility and the noise characteristic relate to the easiness to acquire hearing loss (15).

Therefore NIOSH and OHSA (the USA's federal research and inspection agencies) recommend to apply correction factors (of low precision) to reduce the high rates of attenuation. In 1997 a new norm was approved: ANSI S12.6 - 1997 (B), which based on the performance of the tests with inexperienced hearers without train nor help by the test executer to put the protection. This method is called "Subject fit = sf" or placing by hearers and the NRR correspondent is called NRRsf.

There are about 1500 trademarks of hearing protections that vary according to the type of fitting carried out: insertion, auricle, canal cap and coupled to helmet. The main parameters for the protection selection are comfort, level of noise reduction (NRRsf) of the protection, type of environment, time of use and compatibility with other safety equipment. In addition to these factors there is the need for a suitable training of how to use them (16).

More comfortable protectors, that are less attenuating may be more efficient because the HPD is very good from a technical viewpoint, but as it is not used its effect is not obtained (17). However, the HPD attenuation is difficult to measure for the acoustic condition for its evaluation do not correspond to the real condition for use and there is a variability of time and difference between persons (18).

Several studies seek to measure the HPD efficacy for prevention of PAINSPE (16, 17, 18, 19). If the HPD is actually achieving its objective, to protect the ear against noise, we may raise the hypothesis the temporary changes in the thresholds are not present in workers who use this protection.

The objective of this research is to verify the efficacy of hearing protection used by workers exposed to noise of 96.5 dB (L).

Method

This project was approved by the Ethic Committee in Research with protocol number 067/08, on 08/13/08. It is a quantitative transversal study.

This sample was composed by 13 workers who met the following inclusion criterion: 1-hearing within normality standards in both ears, according to the criterion established by the Federal Council of Phonoaudiology- (Tonal audiometry up to 25 dB NA); 2-working in an environment whose level of noise was equal or higher than 96.5 dB (L); 3-regular use of hearing protection of the insertion type. 3-regular use of the insertion type hearing protection of trademark 3 M and CA 5674; 4-previous training of the correct use of HPD.

Exclusion criteria: 1- outsourced workers; 2-employees who worked in the sector with a level of noise lower than 96.5 dB (L); 3- workers with alterations visible upon otoscopy and/or some auditory alteration (hearing loss, otitis and tinnitus); workers who refused to take part in or retrieved their Free and Clarified Consent.

The industry sector (machining), that presented the determined noise level, included 38 individuals, of which 15 were excluded for having hearing loss and 10 refused to take part in the study because they had already been submitted to periodical exam in the month of the sample collection.

The sample was composed by 13 male workers aged between 20 to 60 years old with work shifts of 8 daily hours. They were exposed to noise of 96.5 dB (L) and used insertion type hearing protections, expanded foam, for all the day's work. The collection of information and the audiometric tests were carried out at a company in the countryside of São Paulo, in the period from September through October 2008.

The workers signed the term of authorization, and were informed about the purpose of the exams and how the respective results were used. After authorization they answered the anamnesis (20) and a questionnaire for collection of information regarding the presence or absence of auditory complaint, the otologic history of the patient and use of Hearing Protection Device (21).

All participants were submitted to visual inspection of the external auditory meatus for verification of the presence of earwax and/or foreign body or secretion of the external acoustic meatus, by means of TK otoscope.

Conventional tonal audiometry in the frequencies of 250 to 8000 Hz, carried out in acoustic cabin, with TDH 39 supra-aural phone, calibrated according to the CFFa determinations (Resolution no. 364 and 365 of March 30 2009). For obtainment of the audibility thresholds the descending/ascending technique and a clinical audiometer of the Maico trademark - model MA 41, were applied.

All workers had their hearing evaluated at two moments: 1. before the day's work, and 2 at the end of the day's work, after 8 hours of work.

For determination of the interval of hours of noise pre-exposure and post-exposure, a pilot study was performed with participation of 5 individuals. In this stage, the 5 individuals were submitted to audiologic evaluation at 4 moments: 1 - hearing rest; 2- after 4 hours of work; 3-after lunch (without noise exposure); 4- at the end of the day's work (8 hours). The results showed that the use of this methodology raised no difference between the auditory thresholds measures obtained.

Results

In Table 1 it is possible to view the results of the descriptive analysis of age variables, time of work in the sector and time of work in noise area. Table 2 describes the findings of the anamnesis and Table 3 describes the responses obtained for the questionnaire about the Hearing Protection Device.

Analysis of the auditory thresholds before and after the day's work.

We observed that in all comparisons performed no MTL was found.

Discussion

It was confirmed that the workers hearing did not undergo any statistically significant audiometric thresholds alterations between the exam before and after the day's work (22).

Table 1. Description of the descriptive analysis of the age variables (years), time of work in noisy area (years) and time of work in the sector with 96.5 dB (A).

Variable	N	Average	Standard deviation	Minimum	Maximum	Medium
Age (years)	13	28,69	10,18	20,00	60,00	25,00
Time of work in noisy area (years)	13	7,67	9,92	0,42	39,00	5,00
Time of work in the same sector (years)	13	4,36	8,37	0,25	30,00	1,25

Table 2. Description of the descriptive analysis of the answers presented by the workers upon anamnesis.

Variable	YES		NO				Total	
	freq.	%	freq.	%	freq.	%	freq.	%
1. Do you hear well?	13	100,0%	0	0,0%	0	0,0%	13	100%
2. Do you feel it's difficult to talk in noisy environment?	0	0,0%	8	61,5%	5	38,5%	13	100%
3. Have you had ear inflammation?	1	7,7%	12	92,3%	0	0,0%	13	100%
4. Do you have tinnitus, squeaking or whistle in the ear?	1	7,7%	12	92,3%	0	0,0%	13	100%
5. Do you fell discomfort/pain with intense sounds?	2	15,4%	11	84,6%	0	0,0%	13	100%
6. Have you worked with chemicals?	4	30,8%	8	61,5%	1	7,7%	13	100%
7. Have you been close to any explosion or fire gun?	4	30,8%	9	69,2%	0	0,0%	13	100%
8. Do you go to noisy places (night clubs, soccer stadium, cult/church)?	8	61,5%	3	23,1%	2	15,4%	13	100%
9. Do you hear radio, IPOD or MP3?	8	61,5%	4	30,8%	1	7,7%	13	100%
10. Do you play musical instruments:	2	15,4%	11	84,6%	0	0,0%	13	100%
11. Do you work as locksmith, carpenter, cabinet-maker or mechanic/tinsmith?	0	0,0%	13	100,0%	0	0,0%	13	100%

Table 3. Description of the analysis of the questionnaire answers about the use of auditory protector device.

Variable	YES	NO		Total				
	freq.	%	freq.	%	freq.	%	freq.	%
1. I place the hearing protectors easily.	13	100,0%	0	0,0%	0	0,0%	13	100%
2. I use the hearing protectors with a relative comfort.	11	84,6%	0	0,0%	2	15,4%	13	100%
3. I am satisfied with the option made.	12	92,3%	0	0,0%	1	7,7%	13	100%
4. I feel protected with the HPDs supplied by the company.	12	92,3%	0	0,0%	1	7,7%	13	100%
5. The change/replacement of the HPD is easy.	13	100,0%	0	0,0%	0	0,0%	13	100%
6. I want to try another HPD model/material.	6	46,2%	7	53,9%	0	0,0%	13	100%
7. The HPDs are always placed before getting into noisy area and removed only after getting out of the noisy sector.	10	76,9%	2	15,4%	1	7,7%	13	100%
8. The selected HPDs allow the perception of alert/alarm signals.	12	92,3%	1	7,7%	0	0,0%	13	100%
9. I answer to the radio without difficulty, using hearing protection devices, by only putting it close to the ear.	8	61,5%	4	30,8%	1	7,7%	13	100%
10. By using HPDs, I talk to my colleagues without difficulties.	4	30,8%	7	53,9%	2	15,4%	13	100%
11. I use lip-reading support for communicating with my colleagues when I use HPD (I look at the mouth of my colleague).	5	38,5%	6	46,2%	2	15,4%	13	100%
12. I take part in noisy activities out of the company.	4	30,8%	8	61,5%	1	7,7%	13	100%
13. Out of the company I also use HPD in noisy activities.	1	7,7%	11	84,6%	1	7,7%	13	100%

Table 4. Descriptive analysis of the auditory thresholds values, in dB NA, obtained before and after the day's work, in the group of 13 workers who composed this sample.

	250		500		1000		2000		3000		4000		6000		8000 Hz	
	before	after	before	after	before	after	before	after	before	after	before	after	before	after	before	after
Average	8,3	8,7	8,3	8,8	7,5	7,9	6,9	6,7	7,3	7,5	9,4	9,8	13,8	14,2	7,5	6,9
DP	4,7	4,6	4,9	5,2	5,5	5,9	5,7	5,8	6,7	7,1	5,9	6,4	7,4	7,2	5,9	5,7
Medium	10	10	7,5	10	10	10	5	5	5	5	10	10	15	15	7,5	5
Modal	10	10	5	10	10	10	5	10	5	5	10	10	15	20	10	10
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	20	20	25	25	25	25	20	20	20	25	20	25	25	25	20	20

The analysis of the anamnesis responses (Table 2) showed that only a few cases of auditory symptoms complaints occurred (hearing loss, tinnitus, ear infection etc.), similar to the findings in other study (22). This confirms that the use of HPD offered advantages in the preventive aspect (12,14,23). Gerges considered the HPD to be a temporary method and the last resource for hearing protection when it is not possible to diminish the noise in the work environment (11).

In this study (Table 3), the participants did not show resistance to the use of HPD, and did not confirm the studies carried out (24,25,26). A program intended for the workers' health allows for auditory conservation, which prevents auditory damages and promotes the monitoring of possible losses and their evolution.

This study showed how import it is to carry out the audiometric monitoring with individuals with and without acoustic rest because if the noise does not cause MTL, the possibilities of permanent auditory loss occurrence may diminish. The MTL detection in workers who use HPD may be an important instrument for the determination of individual hearing protection measures review (9). Therefore, the HPD must be strongly recommended because it seems to be sufficient to diminish the noise to which the workers are exposed and prevents alterations in the cochlea (14).

We know that the occupational hearing loss prevention program success also depends on the worker for he or she needs to be aware of the risks he or she runs for not using the HPD.

The main parameters for the protection selection are comfort, level of noise reduction (NRRsf) of the protection, type of environment, time of use and compatibility with other safety equipment. In addition to these factors there is the need for a suitable training of how to use them (16).

Conclusion

Therefore, we conclude that the use of insertion type hearing protections, expanded foam, was efficient because it did not produce threshold temporary change. The results showed efficacy of the hearing protections in a Program for Prevention of Hearing Loss.

We believe that a major sample should be made to confirm this research and that the evaluation with otoacoustic emission should also be performed for this purpose, since it is an exam more sensitive to threshold temporary chance compared to the audiometry.

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