



EVALUATION OF THE FIRST TWO AUDIOMETRIC EXAMINATIONS AMONG METALLURGY WORKERS

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ABSTRACT It is estimated that 10% of the world's population is exposed to potentially harmful sound pressure levels. The objective: to compare admission and initial periodic pure-tone audiometry examinations at frequencies of 250, 500, 1000, 2000, 3000, 4000, 6000 e 8000 Hz, among metallurgy workers.

Methodology: Cross-sectional historical cohort. The mean value of thresholds in the all frequencies was calculated, regarding their right and left ears and each type of examination: at admission and first periodic examinations.

Results: 1,382 workers were evaluated. There was an increase in audiometry thresholds over time, between the admission examinations and periodic examinations. Statistically significant difference was observed in comparing the admission examination with subsequent the most of periodic examinations.

Conclusion: Metallurgy workers exposed to occupational noise had a statistically significant worsening in the audiometric thresholds in all frequencies evaluated, except for 6000 Hz

KEYWORDS : noise-induced, hearing loss, audiometric examinations

Introduction

The World Health Organization (WHO) has estimated that 10% of the world's population is exposed to potentially harmful sound pressure levels^{1,5}. Noise is considered to be the most frequent physical agent in the work environment⁶⁻⁸.

The hearing loss decrease the quality of life of workers. It can lead to limitation in activities and restricted participation in noisy environments. It may lead to psychosocial consequences, such as stress and anxiety, and it can deteriorate social life. Exposure to noise, occupational or not, is increasing and it is linked to auditory symptoms (hearing loss, tinnitus, difficulty understanding speech, and hyperacusis) and nonauditory symptoms (irritation, sleep disorders, and cardiovascular diseases)^{9,13}.

All workers exposed to noise must undergo audiometry examinations periodically. The regulations for hearing preservation programs are variable in the world. The most legislations¹⁴⁻¹⁸ require annual audiometry examinations after the admission.^{1,4,5,6,14-18} There are no studies that compare the two first sequential audiometry examinations.

Objective

To compare admission and initial periodic pure-tone audiometry examinations at mean values among frequencies 250, 500, 1000, 2000, 3000, 4000, 6000 e 8000 Hz, among metallurgy workers exposed to occupational noise.

Methodology and Results

The present study was approved by the Research Ethics Committee under No. 915/2011.

Type of Study: cross-sectional historical cohort study.

Audiometry examinations conducted between January 1999 and January 2016 on male and female workers in metallurgy company in the state of São Paulo were included. Only workers exposed to noise with sound pressure of 85 dB / 8 hours per day were evaluated. All workers wear ear protectors at work.

The examinations were performed by the same outsourced company, which had been hired by company's specialized service for safety engineering and occupational medicine. The equipment used for the evaluation were submitted to annual calibration. The audiometric cabins with internal noise standards allowed by Brazilian law.

The admission examination was considered to be the first examination that the employee underwent before beginning his/her job. The first periodical examination was done at one year of contract.

A total of 1,382 workers and 2,764 examinations were included in the present study. The workers' mean age, at the time of their admission examination, was 28.3 years, and 92.64% of workers were under 40 years of age..

The first two sequential audiometry examinations on each worker (one for admission and two periodic examinations) were evaluated. The periodic examinations were identified as "Periodic". It was evaluated only workers with audiometry thresholds until 25 dB at all frequencies at admission

The mean values for audiometry thresholds at the frequencies of 250, 500, 1000, 2000, 3000, 4000, 6000 e 8000 Hz were obtained (Table 1).

Table 1 – Mean values and standard deviations for the frequencies of 250, 500, 1000, 2000, 3000, 4000, 6000 e 8000 Hz in the first two sequential audiometry examinations, separated according to side.

Frequencies (Hz)	Ear	Admission	Periodic
250	Right	9,20 (7,44)	10,82 (7,33)
	Left	10,09 (8,18)	11,47 (8,44)
500	Right	9,34 (8,08)	10,17 (7,86)
	Left	9,72 (8,81)	10,45 (8,84)
1,000	Right	7,35 (9,24)	8,50 (8,95)
	Left	7,45 (10,30)	8,71 (10,40)
2,000	Right	6,21 (9,91)	7,23 (9,79)
	Left	7,13 (11,76)	8,37 (11,15)

3,000	Right	7,50 (11,13)	8,32 (11,04)
	Left	8,19 (12,16)	8,62 (12,19)
4,000	Right	9,58 (12,01)	10,97 (12,09)
	Left	11,16 (13,05)	12,23 (13,17)
6,000	Right	11,73 (12,65)	11,90 (12,40)
	Left	13,48 (13,55)	13,70 (13,61)
8,000	Right	10,07 (12,62)	10,94 (12,51)
	Left	10,84 (13,13)	11,87 (13,49)

Caption: “Admission” – Audiometry examination for admission. “Periodic 1” – First periodic audiometry examination. “Periodic 2” – Second periodic audiometry examination. Standard deviation between parentheses.

The nonparametric Wilcoxon test was used for statistical analysis. Results with alpha lower than 5% were considered statistically significant. The calculations were performed using the *Action Stat* software, version 3.1. Table 2 presents a comparison of occupational audiometry examinations.

Table 2 – Comparison among occupational audiometry examinations using the mean values of the frequencies of 250, 500, 1000, 2000, 3000, 4000, 6000 e 8000 Hz, classified according to side.

Frequencies (Hz)	Ear	Admission Versus Periodic
250 Hz	Right	P=0,00
	Left	P=0,00
500 Hz	Right	P=0,00
	Left	P=0,00
1000 Hz	Right	P=0,00
	Left	P=0,00
2000 Hz	Right	P=0,00
	Left	P=0,00
3000 Hz	Right	P=0
	Left	P=0
4000 Hz	Right	P=0
	Left	P=0
6000 Hz	Right	P=0,7085
	Left	P=0,5371
8000 Hz	Right	P=0,0024
	Left	P=0,0035

Caption: “Admission” – Audiometry examination for admission. “Periodic 1” – First periodic audiometry examination. “Periodic 2” – Second periodic audiometry examination.

There was a significant difference between the admission examinations and periodic examinations for the right and left ears in almost frequencies, except at 6000 Hz.

Discussion

Table 1 shows that there was an increase in audiometry thresholds over time, between the admission examinations and periodic examinations. A high standard deviation was observed due to the great variability of the population studied. The auditory threshold was increased at all frequencies after one year of noise exposure, reaching up to 1.62 dB in the mean 250 Hz in the right ear.

Age is a factor that can contribute towards an increase in hearing thresholds²¹. Most of the population studied (98.94%) was younger than 50 years of age at the time of admission, with a mean of 28.3 years. But even in this case, the presbycusis cannot be excluded completely.

The mean of the left ear thresholds is higher than the mean right ear thresholds in all frequencies and in the two exams evaluated. This asymmetry can be attributed to the cortical pathways, specifically to the more pronounced efferent auditory system on the right side, which reduces the susceptibility of the right ear to cochlear insult, to the head shadow effect, and to physiological differences^{22,23}.

Noise-induced hearing loss is expected after 5 year of noise exposure^{2,8,14,15,16}. But in this study, a significant difference was founded in all frequencies, with one year of exposure to noise, except at 6000 Hz

The auditory frequency at 6000 Hz showed the highest mean of the

thresholds in relation to the other frequencies, in the right ear and the left ear. But in the right ear there is an increase of 0.17 dB and in the left ear of 0.22 dB between the two examinations. This small difference was reflected in the statistical analysis. There was not statistically significant difference between the first and second exams only for this frequency. No similar data were found in the literature. Further studies are needed to evaluate the behavior of the 6000 Hz frequency in the first years of exposure to noise

This study contributes to control of workers from the beginning of exposure noise. Despite the wear ear protection measures, was evidencing a worsening of hearing thresholds and a statistically significant difference from one year of exposure to most of the frequencies evaluated.

Conclusion

Metallurgy workers exposed to occupational noise, after one year of admission, had a statistically significant worsening in the audiometric thresholds in all frequencies evaluated, except for 6000 Hz.

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