INCIDENCE AND PREVALENCE OF NOISE INDUCED HEARING LOSS IN WORKERS OF A METALLURGICAL COMPANY IN MANAUS – AM, BRAZIL

Incidência e prevalência de perda auditiva induzida por ruído em trabalhadores de uma indústria metalúrgica, Manaus – AM, Brasil

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ABSTRACT

Purpose: to estimate the incidence and prevalence of hearing loss suggestive of Noise Induced Hearing Loss and its association with age and time of service in metallurgical industrial pole workers in Manaus. **Methods:** cross-sectional study in workers who underwent audiometric testing periodical in 2012, totaling 1499 subjects. To estimate the incidence were selected 763 audiometrys with normal hearing at the reference testing and after compared with the current audiometry. Statistical analyses were performed using measures of central tendency, dispersion and frequency distributions. To verify statistically significant differences, we used the chi-square test, with significance level ($p \leq 0.05$). **Results:** the prevalence of hearing loss was estimated at 44.23% and 28.89% suggestive of Noise Induced Hearing Loss. There was a higher prevalence of hearing loss among workers aged from 45 years and time of service exceeding 21 years. Only 11.1% of workers over 21 years of service have normal hearing and 61.9% loss of these features suggestive of Noise Induced Hearing Loss. The classification of Not Suggestive of Noise Induced Hearing Loss remains stable in individuals below 20 years of occupational exposure (14.9%), and in people exposed to more than 20 years, increases to 27%. The incidence of hearing loss was 28% and within this total, 19.7% were suggestive of Noise Induced Hearing Loss. Most hearing loss, both suggestive of Noise Induced Hearing Loss, or not, were classified in light. **Conclusion:** the prevalence and incidence of hearing loss increased with age and time of service. Companies should strive to implement Hearing Conservation Program to minimize these losses.

KEYWORDS: Hearing; Hearing Loss, Noise-Induced; Occupational Exposure

INTRODUCTION

The existing noise pollution in modern life is considered one of the ills in the last century and represents a threat to the human habitat[1]. As years go by, technology has brought countless advantages, making activities fast and practical. On the other hand, some observed disadvantages interfere in the quality of human life. Noise, byproduct of such development, has contributed with the increase human hearing loss[2,3].

Frequently severe and irreversible hearing loss may be observed in work environments in which the level of exposure to noise is high and there is not adequate protection[4,5]. Noise in the work environment, when its levels are excessive, may harm workers´ auditory systems and generate hearing loss when noise levels are excessive[1,3,5]. The tolerated limit of noise in the work environment during 8 hours is 85dBA[6], but the risk of hearing

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loss varies from person to person. Actions to avoid hearing loss must be taken as soon as the worker is submitted to continuous exposure to 80 dBA noise level during a 8 hour shift[7].

Noise induced hearing loss (NIHL) is a highly prevalent disease in industrial countries[8], including Brazil. It is characterized as being sensorineural, predominantly cochlear, irreversible, progressive, developed over a period of time of 6 to 10 years, beginning in high frequencies, frequently bilateral, symmetrical, and stabilized in non exposure[5,8,9]. And even though NIHL is a disease that may affect several of the human being functions, studies about it are still scarce, especially in Brazil.

Physically, noise is an acoustic signal originated from the superposition of several vibration movements in different frequencies, which are not interconnected[3]. Noise is exposed to thousands of people daily, affecting their physical and mental well being[10]. In big cities, even during sleep, thousands of people are immersed in noise, to which they get accustomed[11]. Modern society has introduced in its everyday life different pieces of equipment, both individual (earphones, noise making toys) and collective, which have potentiate this phenomenon[12].

Measuring noise levels permits more precise analyses of frequency, amplitude and duration, which are vital in determining how harmful they are. It is important to learn how much sound energy an individual worker accumulates during his shift in noisy environments[3]. In order to determine causality between occupational exposure to noise and hearing loss, conclusive and differential diagnoses are the doctor´s discretion, who will determine the connection. In the analysis, the audiometric lineation or the sequential evolution, along with other factors such as clinical and work history, age, previous and current time exposure of the worker to levels of high sound pressure in and out of the work environment and other risk factors to the auditory system are considered[8,9,12].

Unfortunately, even though the disease reaches endemic proportions in the industrial environment, studies are relatively scarce, and the national legal advances inertially follow the scientific, knowledge and harm protection lack of stimulus for Brazilian workers.

Considering that the Manaus industrial center employs a great number of workers in the Northern region, this study has the objective of estimating the incidence and prevalence of noise induced hearing loss in workers of a metallurgical company in this region and its association with age an occupational exposure.

METHODS

This work has the approval of the Ethics Committee in Research of the National School of Public Health Sergio Arouca, according to CAAE: 0170.0.031.000-11, ruling Nº 156/11.

It is a cross sectional study, carried out from January to July of 2012, which estimated the incidence and prevalence of NIHL and its association with age and time of employment of workers in a metallurgical company in the Manaus industrial center.

The age stratification of the workers corresponded to 15 to 34, 35 to 45 and 46 and older. Occupational exposure was classified into 0 to 10, 11 to 20 and 21 or more years in the studied company.

The sample comprised 1499 audiometric tests for workers occupationally exposed to noise. All the workers in the company in the first semester of 2012 were tested. Therefore, there was no need for exclusion criterion.

In order to estimate incidence of hearing loss, audiometric tests of 763 workers with hearing ability within the normal levels according to the reference test were selected and then compared to current (2012) scores.

The audiometric tests were performed in acoustic enclosure manufactured by Interacoustics, model AC 33, with two channel audiometer with TDH 39P headphones and audiometer manufactured by Kamplex, model AD229, duely calibrated according to ISO/DIS standards.

The audible thresholds for analysis were obtained airborne, tested in the 0.5 1, 2, 3, 4, 6, and 8 kHz frequencies. The assessment of the results of the audiometric tests considered the 3, 4 and 6 KHz frequencies as hearing threshold averages for they were the most affected by NIHL. These figures were also used to separate the lineation into suggestive and non-suggestive of NIHL. Besides the clinical and occupational history, the chosen criterion for the characterization of the audiograms into normal and non-suggestive of NIHL was the following: (a) audiogram compatible with normal levels: workers who scored all the thresholds equal to or under 25 dB(HL) – HL = hearing level and (b) NIHL suggestive audiogram: workers who presented an indentation with audiometric thresholds over 25 dB(HL) in the 3Khz, 4Khz and/or 6Khz frequencies, air and bone conduction (sensorioneural hearing loss). Audiograms that did not fit in this pattern were classified as non-suggestive of NIHL[13].

To classify hearing loss according to its intensity, Silman & Silverman (1991) [14] methodology was adopted, and hearing level ≤ 25 dB was deemed

normal, between 26 and 40 dB was deemed mild hearing loss, and between 41 and 55 dB was considered moderate hearing loss, between 56 and 70 dB was deemed moderately severe, between 71 and 90 dB was considered severe, and over 91 dB was considered profound hearing loss.

In order to estimate the incidence and prevalence of hearing deficit suggestive of NIHL and its association with age and occupational exposure to noise for workers, measures of central tendency, dispersion and frequency distribution were applied. The significance level used was $p< 0.05$ and the significant value was marked with *. The EPI INFO® version 3.5.3 software was utilized to carry out data analysis.

RESULTS

The population of the study comprised 1499 workers, among which 52 (3.47%) were female and 1447 (96.53%) were male. The dominant age range was from 15 to 34 years. The estimated prevalence of hearing loss was of 44.23%, among which 28.89% were NIHL. In the event of considering all the affected, 65.3% were suggestive of NIHL.

In Table 1 is the distribution of hearing level of the population according to age and occupational exposure time. It was verified that prevalence of the level of hearing loss increased with age and time of occupational exposure to noise. Workers over 45 years of age presented greater prevalence of hearing loss, as well as those with occupational exposure to noise over a period of 21 years. Only 11.1% of workers over 21 years of occupational exposure to noise presented normal hearing levels and 61.9% presented hearing levels suggestive of NIHL. The classification of non-suggestive of NIHL remained stable in workers under 20 years of occupational exposure to noise (14.9%) and it increased to 27% in workers exposed to noise for a period of time greater than 20 years.

Table 2 shows the incidence of NIHL. From the 793 workers with normal reference test, 19.7% developed hearing loss suggestive of NIHL.

Table 1 – Distribution of the study population according to hearing condition, associated with age range and time of occupational exposure to noise

Variables		Hearing Condition			Total
		Normal	NIHL	NON-NIHL	
		N (%)	N (%)	N (%)	
Time of exposure*	0 to 10 years	725 (60.6%)	294 (24.6%)	178 (14.9%)	1197
	11 to 20 years	104 (43.5%)	100 (41.8%)	35 (14.6%)	239
	21 years or more	7 (11.1%)	39 (61.9%)	17 (27.7%)	63
Age range**	15 to 34 years	619 (65.7%)	204 (21.7%)	119 (12.6%)	942
	35 to 44 years	195 (47.9%)	138 (33.9%)	74(18.2%)	407
	45 years and over	22 (14.7%)	91 (60.7%)	37 (24.7%)	150

*p=0,0000 **p=0,0000 Chi-square Test

Table 2 – Noise Induced Hearing Loss

Variables	N	%
Normal	571	72%
Suggestive of NIHL	156	19.7%
Non suggestive of NIHL	66	8.3%
Total	793	100%

The relationship of incidence of NIHL with age and occupational exposure to noise time is demonstrated in Table 3. Workers over 45 years of age presented greater incidence (54.4%). The incidence for workers with over 20 years of occupational exposure to noise presented incidence of 51.9%.

Table 3 – Incidence of Hearing Loss in the population of the study according to age range and time of occupational exposure to noise

Variables	Normal N (%)	NIHL N (%)	Non NIHL N (%)	Total N (%)
Age range*				
15 to 34 years	399 (80.3%)	67 (13.5%)	31 (6.2%)	497 (100.0)
35 to 44 years	155 (68.0%)	52 (22.8%)	21(9.2%)	228 (100.0)
45 years and over	17 (25.0%)	37 (54.4%)	14(20.6%)	68 (100.0)
Time of exposure				
0 to 10 years	473 (78.4%)	92 (15.3%)	38 (6.3%)	603 (100.0)
11 to 20 years	92 (56.4%)	50 (30.7%)	21(12.9%)	163 (100.0)
21 years and over	6 (22.2%)	14(51.9%)	7(25.9%)	27

* p=0.0000 Chi-square Test

As for which ear was affected, it was established bilateral hearing loss, followed by left ear hearing loss as shown in Table 4.

Table 5 shows that mild hearing loss is dominant, among which 59.6% are non-suggestive of NIHL and 88.5% are suggestive of NIHL.

Table 4 – Prevalence of hearing loss according to symmetry

Variables	Right Ear	Left Ear	Bilateral
Normal			836 (56.0%)
Hearing Loss	119 (7.9)	197 (13.1)	347 (22.9)

Table 5 – Distribution according to the degree of hearing loss

Type of Loss	Slight	Mod N (%)	Mod-Sev N (%)	Severe	Profound	Total N (%)
Suggestive of NIHL	383 (88.5)	44 (10.2)	6 (1.4)	0	0	433 (100.0)
Non NIHL	137 (59.6)	24(10.4)	20 (8.7)	7(3.0%)	42(17.8%)	230 (100.0)

Legend: mod = moderate, mod-sev = moderate-severe

DISCUSSION

In this study, the prevalence of estimated hearing loss was of 44.23%, from which 28.89% were suggestive of NIHL. In a study about the effects of noise in workers of a marble factory in the Federal District, the prevalence of hearing loss was found to be 48% in the studied sample, and the most affected frequency was 6 KHz, particularly for the left ear[15]. As for such asymmetry, the left ear was found to be more susceptible lesion by noise, however, such study does not present evidence for such statement.

In a comparative study of prevalence of NIHL in professionals of sound (sound technicians, audio operators, VT operators and editors, and microphone operators) and professionals of other fields, the former presented a prevalence of hearing loss of 57.3% and the latter 15.8%[16].

In a research about the audio health conditions in workers exposed to occupational noise[17], the results showed 50% of normal hearing level, 31.25% classified as normal but with indentation, which suggests the development of NIHL, 13.5% of prevalence of hearing loss suggestive of NIHL, and 6.25% classified as other audiometric distortions.

The history of occupational hearing loss caused by noise revealed that workers who have up to 10 years of occupational exposure to noise may present permanent hearing loss. Even though the lesion in this group is in its beginning stage, the injuries are already irreversible and easily detectible by audiometric tests[18]. In the present study, workers over 45 years of age and with more than 21 years of occupational exposure to noise were the ones most susceptible to lesions due to the continuous occupational to noise.

Another study found evidence that hearing in male adults is about 4 dB(HL) lower in the left ear than that of the right ear[19]. According to Leme, this has also been observed in clinical practice, and during the audiogram, a better response of the right ear in relation to the left one may be observed. However, the possible physiological mechanisms for such difference seem to be unknown[20].

In a research conducted in the textile industry, the prevalence of NIHL was of 28.3%. The most affected age range was from 50 to 64. The workers with over 20 years of occupational exposure to noise proved to be the most affected (42.9%)[21]. Another research with a population of industrial workers in the metropolitan area of Salvador showed prevalence of 45.9% of hearing loss, 35.7% from which was noise induced[22].

As for the degree of hearing loss, the present research found the greatest percentage (88.5%) to be representative of mild hearing loss level, discovery similar to that of other epidemiological studies, comparable to the established criterion for the definition of noise induced hearing loss in relation to its prevalence in industrial workers. The data found corroborates the findings in the evolution of scientific knowledge about the topic.

Studies about the incidence of NIHL are scarce in the Brazilian literature, for it implies a longitudinal follow up of years of records of audiograms for industrial workers. A three-year long study of 80 metallurgical study showed a 63.75% of final prevalence of High Sound Pressure Induced Hearing Loss (HSPI HL), and incidence of 23.75%[23].

CONCLUSION

This study revealed the audiological profile of this population with greater prevalence of bilateral, mild level sensorioneural hearing loss. The incidence of hearing loss suggestive of NIHL was of 19.70% and the prevalence was of 48.89%. An association of the hearing loss with age and time of occupational exposure to noise was verified.

The term NIHL suggests that noise alone is responsible for the occupational hearing loss, not considering the harmfulness of other agents, such as vibration, radiation and chemical products, also present in the workplace which may prove to be as harmful or even more harmful to the auditory health of the workers. Moreover, individual factors sometimes neglected, such as metabolical diseases and use of medication harmful to the auditory system, may also potentiate auditory injuries.

It is necessary to broaden the scope of the studies about worker health in order to include the influence of such other agents which are aggressive to the auditory health of industrial workers in order to minimize or even eliminate these risks from the workplace.

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RESUMO

Objetivo: estimar a incidência e a prevalência de déficit auditivo sugestivo de Perda Auditiva Induzida por Ruído e sua associação com idade e tempo de serviço em trabalhadores de uma indústria metalúrgica do pólo industrial de Manaus. **Métodos:** estudo transversal descritivo em trabalhadores que se submeteram a exame audiométrico periódico no ano de 2012, totalizando 1499 sujeitos. Para estimativa da incidência foram selecionadas audiometrias de 763 trabalhadores com audição dentro da normalidade no exame de referência e comparados com exame atual. Realizou-se análise estatística por meio de medidas de tendência central, dispersão e distribuições de frequência. Para verificação de diferenças estatisticamente significantes utilizou-se o teste qui-quadrado, com nível de significância (p≤0,05). **Resultados:** a prevalência de perda auditiva foi de 44,23% sendo 28,89% sugestivo de PAIR. Houve maior prevalência de perda auditiva nos trabalhadores com faixa etária acima de 45 anos e com tempo de serviço superior a 21 anos. Apenas 11,1% dos trabalhadores acima dos 21 anos de serviço apresentaram audição normal, e 61,9% perda auditiva sugestiva de Perda Auditiva Induzida por Ruído. A classificação de Não Sugestivo de Perda Auditiva Induzida por Ruído permanece estável nos indivíduos abaixo de 20 anos de exposição laboral (14,9%) e nas pessoas expostas com mais de 20 anos aumenta para 27%. A incidência de perda auditiva foi de 28% e desse total 19,7% sugestiva de Perda Auditiva Induzida por Ruído. Houve maior prevalência de perda auditiva grau leve. **Conclusão:** a prevalência e a incidência de perda auditiva aumentaram com a idade e tempo de serviço. As empresas devem se empenhar na implementação do Programa de Conservação Auditiva a fim de minimizar essas perdas.

DESCRITORES: Audição; Perda Auditiva Provocada por Ruído; Exposição Ocupacional

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