Original Article

Audiology Profile in the Military Police State of São Paulo

Perfil Audiológico em Policiais Militares do Estado de São Paulo

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Summary

Introduction: The military police are a population exposed to noise impact due to training with firearms.
Objective: To investigate the audiological profile of the military police in São Paulo state, and to correlate the age and duration of exposure and audiological findings.
Method: In this study of case series, cross-sectional audiological evaluation was performed in 200 police officers being 169 (84.5%) were male and 31 (15.5%) females, aged between 25 and 45 years (mean 38.83 ± 5.05), average service time of 16.80 ± 6.27 years.
Results: The main complains were: tinnitus (n=52/26%), hearing loss (n=36/18%), ear fullness (n=24/12%) and autophonia (n=24/12%). Impedance were found in 100% of type A curves (Jerger, 1970), and recruitment was present in 20 (10%) cases. According to the results of audiometry, the data showed that 54 (27%) right ears and 56 (28%) left ears had hearing loss. The degree of loss with higher prevalence was 1 and 2 (Merluzzi et al., 1979), 85 (42.5%) cases. There was significant correlation between age and exposure time with the worsening of audiometric thresholds in both ears.
Conclusion: From the audiological data analysis was possible that the military police are a population that presents a risk to develop hearing loss. Thus, we see the need for implementation of hearing conservation program for the military police.
Keywords: police, occupational noise, hearing loss.

Resumo

Introdução: Os policiais militares constituem uma população exposta a ruído de impacto devido aos treinamentos com armas de fogo.
Objetivo: Pesquisar o perfil audiológico em policiais militares do estado de São Paulo, e correlacionar à idade e o tempo de exposição com os achados audiológicos.
Método: Neste estudo de série de casos, transversal, foi realizada avaliação audiológica em 200 policiais militares sendo 169 (84,5%) do gênero masculino e 31 (15,5%) do feminino, com idades entre 25 e 45 anos (média de 38,83±5,05), com média de tempo de serviço de 16,80±6,27 anos.
Resultados: As principais queixas apontadas foram: zumbido (n= 52 / 26%), disacusia (n=36 / 18%), plenitude auricular (n=24 / 12%) e autofonia (n=24 / 12%). Na imitanciometria foram encontradas 100% de curvas tipo A (Jerger, 1970), e houve presença de recrutamento em 20 (10%) casos. Segundo os resultados da audiometria tonal, os dados obtidos demonstraram que 54 (27%) orelhas direita e 56 (28%) orelhas esquerda apresentaram perda auditiva. Os graus de perda com maior ocorrência foram 1 e 2 (Merluzzi et al., 1979), com 85 (42,5%) casos. Houve correlação significativa entre a idade e o tempo de exposição com a piora dos limiares audiométricos em ambas as orelhas.
Conclusão: A partir da análise dos dados audiológicos foi possível verificar que os policiais militares são uma população que apresenta risco para desenvolver a perda auditiva. Sendo assim, vemos a necessidade de implementação de programa de conservação auditiva para os policiais militares.
Palavras-chave: polícia, ruído ocupacional, perda auditiva.

Introduction

Exposure to noise over a long period of time can cause major differences to human, the noise-induced hearing loss (NIHL) is characterized by a change in hearing thresholds, sensorineural, progressive and irreversible. Hearing loss affects mainly the cochlear hair cells located about 50 to 10 mm of the vestibular window, just in the region receiving stimuli from 4 to 6 kHz (1). A PAIR initially affects the frequency range between 3 and 6 kHz, where the threshold for 8 kHz must be better than the worst threshold (3, 4 or 6 kHz) (2.3).

Some studies found that the frequency of 6 kHz is the most affected in the audiometric tests suggestive of NIHL (4, 5, 6), while other studies have indicated that the frequency of 4 kHz is the most compromised (7, 8, 9).

Tinnitus and hearing loss are important complaints related to NIHL reported in the literature (10, 11). In a study to assess the prevalence and degree of noise-induced hearing loss in soldiers, hearing loss were diagnosed in 68% (n = 475) of cases, in 42.5% of these were continuous tinnitus (12) .

The investigation of the auditory effects in workers exposed to occupational noise in a study of 400 individuals found that the longer the exposure, the greater the impairment of hearing thresholds obtained. In this population, 24.75% of the audiograms showed hearing loss induced by noise (8).

The Standard Occupational Hygiene (13) Fundacentro gives a formula for calculating the amount of impact pulses to which the employee may be exposed on each working day, according to the magnitude of the impulse. The Regulatory Standard 15 (NR-15) also stipulates that workers should not be exposed to sound pressure levels exceeding 130 dB (C) (14).

In a recent study on the acoustics and psychoacoustics of noise of the main weapons used by military police, we analyzed the firing of the .38 revolver and .40 pistol (both in Taurus), with the use of digital sound level meter and acoustic analysis through *Praat software.* Data were compared with the audiograms of 30 police officers with hearing loss (worse than 25 dB threshold). The maximum peak of 113.1 dB were measured (C) .40 pistol and 116.8 dB (C) for 38 revolver. The values obtained in psychoacoustic analysis were between 17.9 ± 0.3 Barks, corresponding to the band between 4120 and 4580 Hz audiometric measurements showed greater hearing loss in the range 4 kHz to 86.7% of cases, followed by frequency 6 kHz (66, 7%).Conclusions from the acoustic analysis of the shots, we could demonstrate cause and effect between the main areas of excitation energy in the cochlea (cochleogram *Praat)* and frequencies with a decrease of auditory acuity (9).

During training in the firing range, the number of police participants ranged between 12 and 15, and each individual made 50 shots. Thus, multiplying the number of shots, the number of individuals were calculated from 600 to 750 pulses per period of training impact (9).

Studies on the auditory in military conducted in Brazil revealed a high rate of hearing loss in this population, which is associated with excessive exposure to impact noise without the use of personal protective equipment, since the measurement of sound pressure level sound emitted by the light automatic rifle (FAL 7.62 mm) was 147 dB (C) (15).

A survey of the auditory profile of the Brazilian Army, conducted through interviews, otoscopy and audiometric observed otological picture suggestive of noise-induced loss Audio in 38.1% of patients evaluated in the military. Also found that hearing loss was more severe with increasing age and length of service (6).

Another study examined the prevalence of deafness among workers in the maintenance sector of rotorcraft in a unit of the Brazilian Air Force. Our study has shown a prevalence of sensorineural hearing loss by continuous exposure to high sound pressure levels of 32.4 %, which can be identified as main factors behind the loss: working time and age (16).

Relevant research in the field of hearing health showed statistically significant correlation between duration of occupational noise exposure and hearing thresholds (6, 8, 17). In the Singapore Armed Forces an experiment was conducted to investigate the effects of basic military training at the hearing. The authors analyzed the audiograms of 85 soldiers before and after training and found a prevalence of 9.4% of hearing loss, which remained the same after one year. The study concluded that the existing hearing conservation program in the Singapore Armed Forces is efficient and protects the hearing health of their military (18).

An important research conducted the survey of audiological profile of five instructors from the military police shooting of Montes Claros - MG. In the measurement of sound pressure levels, the average level found at the shooting range was 97.4 dB and analyzed two of the five policemen had audiometric curve with slot configuration,

one unilateral and one bilateral and one had sensorineural hearing loss mild at high frequencies, with configuration of audiometric curve in gout (19).

In France a study was conducted to assess the risk of noise-induced hearing loss in the police. The results demonstrated that the police were 1.4 times more likely to have hearing loss in relation to civil servants. This probability increased to three times, considered the police motorcyclists. The authors stressed the need to work with police because of the scarcity of such studies compared with the soldiers (20).

The prevalence of noise-induced hearing loss among traffic policemen in Dhaka Metropolitan City (Bangladesh) showed hearing loss in 24% of 100 police officers evaluated, and the frequencies most affected were those of 4 and 6 kHz. Regarding medical history, 23 subjects had tinnitus and only 5 complained of hearing loss (21).

In the military police in São Paulo state is evident from the high level of unhealthiness in the firing range, however we have to consider other sectors and / or police services that can also expose the officer to the risk of hearing loss, they are: the Monetary Policy Committee (Operations Center of Military Police) telephony sector provided by the corporation to meet the emergency police and for coordinating the activities of patrolling, the police road that runs the monitoring services, policing and traffic control and Rocam (Rounds with Ostensivas Motorcycle Support) which has had major role in road safety (22).

The aim of this study was to investigate the audiological profile in the military police in the state of Sao Paulo, and to correlate the age and duration of occupational exposure to the audiological findings.

Method

The present study evaluated 200 military police of the 9th Military Police Battalion of the Interior - 9 º BPM-I, with 169 (84.5%) were male and 31 (15.5%) females, aged between 25 and 45 years (mean 38.83 ± 5.05), mean service time of 16.80 ± 6.27 years.

The officers participated in the audiological evaluation on a voluntary basis, the study included all officers who were older in the age group proposal.

The procedures used were audiologic interview (Appendix), otoscopy, pure tone audiometry and tympanometry.

The audiometric tests were performed in a soundproof booth, using *Grason Stadler GSI 61*. To measure the acoustic impedance was used immittanciometer *GSI 38 Grason Stadler*.

This study was approved by the Research Ethics Committee (Protocol No. 2762/2007).

The police are properly equipped with personal protective equipment (PPE), according to NR 620, Ordinance 3214/78 (14), being relevant to our study emphasize the use of hearing protection (shell type),

Annex. Audiological Anamnesis.

1. Identification
Name:_____
Date of Birth :__/__/__ Age ____ years Gender: () M () F
Date: / / Birthplace:_____

2.Complaint:
() Hearing loss () otalgia () Fullness headset
() Autofonia () Recruitment
() Understanding speech impaired
() Vertigo () Dizziness () Pruritus
() Tinnitus () Purge
() Oral Habits: () smoke () alcohol
() Otitis () Metabolic problems
() Hypertension () Familial Occurrence
() Other:_____

Duration and Evolution: Beginning_____
() Progressive () Non-progressive () outbreaks.
When: _____
() Slow () Rapid
Prevalence Hearing: () Right () Left
Treatment: () Medical () Psychological () Speech Therapy
() Other: _____
Drug :_____

3. Labor Data:
how long do you works with noise exposure (including prior service): _____ years _____ months (); _____ years _____ month (prior service)
Length of Day: _____Hours / Day; _____days weekly
Sector of work:_____
Function:_____
Noise exposure at work: _____ dB
Use of PPE (Personal Protective Equipment):
() Always () Sometimes () Almost never () Never
What type of hearing protectors?
() Plug () shell / () dir side. () Esq. () Dir. and left.
Has hearing repose: () Yes () No _____ Hours
() Right-handed () Left-Handed

with Certificate of Approval (CA) by the Ministry of Labor and Employment.

Regarding the data analysis were performed: comparison between threshold with age and exposure time, was also carried out the classification of hearing loss according to Merluzzi et al.(23). For comparative analysis was applied to *Spearman correlation analysis* with a significance level of 5%.

Results

The main complains during audiologic interview were tinnitus (n = 52/26%), deafness (n = 36/18%), ear fullness (n = 24/12%) and autofonia (n = 24/12%).

Tympanometry were found in 100% of type A curves (24), and recruitment was present in 20 (10%) cases.

Regarding the results of audiometry, it was observed that the population studied in 22.75% (OD = OE = 21.5% and 24%) of cases noise-induced hearing loss, below is Table 1 with the classification of hearing loss, according to Merluzzi et al. (23).

Statistical analysis of the correlation between time of exposure at work and hearing thresholds, we observed a significant correlation in the right ear at frequencies of 1, 3, 4, 6 and 8 kHz in the left ear in the frequencies of 4, 6 and 8 kHz.

Regarding the correlation between age and average hearing thresholds, statistical significance was found in both ears from the frequency of 2 kHz. Tables 2 and 3 show the correlation between exposure time and age with hearing thresholds.

Table 4 shows the distribution of audiometric change measured in the sample population by age for military service time were considered the ears with hearing loss, all cases with a threshold higher than 25 dB in one or more frequencies of the audiogram (54 cases right ear and left ear in 56 cases). The results showed a greater number of cases of hearing loss at frequencies of 4 kHz (56.22%) and 6 kHz (67.19%).

Table 1. Classification of audiometric findings according to Merluzzi et al. (23).

	Levels of Hearing Loss							
	Normal	1	2	3	4	5	6	7	Total
RE	146	24	16	1	2	0	0	11	200
%	73	12	8	0,5	1	0	0	5,5	100
LE	144	22	23	2	1	0	0	8	200
%	72	11	11,5	1	0,5	0	0	4	100

Legend: The levels of hearing loss is equivalent to: Levels 1-5 = hearing loss induced by noise, Level 6 = mixed hearing loss (noise + other cause), Level 7 = hearing loss of varying aetiology noise.

Table 2. Correlation between duration of occupational exposure and the average hearing thresholds of 200 police officers *(Spearman correlation analysis)*.

Frequency (Hz)	r		p	
	RE	LE	RE	LE
500	0,083	0,058	0,418	0,241
1000	0,058	0,803	0,018*	0,415
2000	0,064	0,056	0,432	0,369
3000	0,137	0,175	0,013*	0,053
4000	0,286	0,218	0,002*	< 0,001*
6000	0,224	0,231	0,001*	< 0,001*
8000	0,152	0,221	0,002*	0,031*

Legend: RE - the right ear / LE - left ear
r = correlation coefficient
* = Significant p <0.05

Table 3. Correlation between age and average hearing thresholds of 200 police officers *(Spearman correlation analysis)*.

Frequency (Hz)	r		p	
	OD	OE	OD	OE
500	0,159	0,122	0,025*	0,084
1000	0,108	0,087	0,126	0,221
2000	0,153	0,187	0,031*	0,008*
3000	0,286	0,284	< 0,001*	< 0,001*
4000	0,351	0,388	< 0,001*	< 0,001*
6000	0,352	0,308	< 0,001*	< 0,001*
8000	0,337	0,392	< 0,001*	< 0,001*

Legend: RE - the right ear / LE - left ear
r = correlation coefficient
* = Significant p <0.05

Table 4. Distribution of audiometric change measured in the sample population of military personnel with hearing loss (threshold greater than 25 dB) for full-time service.

f (kHz)	Audiometric change	Service time (years)					Total	Total	Average RE/LE
		0 -10	11 - 15	16 - 20	21- 25	26- 34	N	%	%
< 3,0	RE	0	2	3	2	0	7	12,96	17,19
	LE	1	3	3	5	0	12	21,42	
3,0	RE	3	3	5	7	2	20	37,03	42,62
	LE	5	5	6	8	3	27	48,21	
4,0	RE	2	5	6	10	3	26	48,15	56,22
	LE	5	5	10	13	3	36	64,29	
6,0	RE	2	7	13	8	4	34	62,96	67,19
	LE	5	8	9	15	3	40	71,42	
8,0	RE	4	6	6	10	6	32	59,25	55,52
	LE	4	6	5	9	5	29	51,79	

Legend: RE right ear, LE: left ear, N: number of ears with audiometric change.

Discussion

In the analysis of case histories of the major complaints by the population, tinnitus (26%) and hearing loss (18%) are the same as those made more frequent by the literature (9, 10). However, a study of traffic police, showed a disparity between the complaints of tinnitus (24%) and hearing loss (5%), possibly by the degree of hearing loss was mild in 20% of cases and moderate in 4%, a fact this, which minimized the complaints of hearing loss, tinnitus-front (21).

The cases evaluated in this study did not show any changes and / or obstruction of the external ear canal that might bias the results of the audiological evaluation. Thus, in all cases, curves were tympanometry type A (24), consistent with normal operation of the middle ear or sensorineural hearing loss.

The results of audiometry were classified according to Merluzzi et al. (23), and considering the cases diagnosed as NIHL, the data obtained from the right ear showed that 43 (21.5%) ears had hearing loss. In the left ear were diagnosed 48 (24%) ears with hearing loss. These data were similar to those obtained by study of industrial noise environment (8) and with traffic police (21), however comparing the findings with those obtained in military career, there were more cases in recent loss (6, 12).

The largest number of cases with hearing loss in military can be explained due to the type of heavy weaponry used by the army, with noise levels exceeding 147 dB (C) (15). While measurements in firing range of military police, found values between 113.1 dB (C) for the pistol and .40 dB 116.8 (C) to the gun 38 (9).

Considering the formula recommended by the Standard Occupational Hygiene (13) Fundacentro, the maximum intensity for an exhibition of impact noise measured (compensation circuit C) to 600 pulses of impact is 109 dB. This data allows us to identify which military police have the impact noise of a firearm as a principal element harmful to hearing, since higher values were measured at 113.1 dB (C), at the firing range military police (9).

Other unhealthy elements for hearing impairment were identified in the police of France and Bangladesh, which are related to the use of motorcycles and the traffic noise (20, 21). The use of motorcycles and exposure to traffic noise, are also present in the performance elements of the military police of São Paulo (22).

In this study the frequency band with the highest percentage of hearing loss was between 4 and 6 kHz, since this coincides with the literature (1), and studies of traffic policemen in the city of Dhaka (21). Moreover, a recent study demonstrated the cause and effect relationship between the noise of firing of firearms, and these areas with the largest lesion in the cochlea (9).

Among these two frequencies (4 and 6 kHz), presented the highest number of cases with abnormal audiogram, in our results was 6 kHz. This finding is consistent with other studies of workers exposed to noise (4, 5, 6). However, there is no consensus in the literature regarding the frequency most affected, since, other studies have described the frequency of 4 kHz with greater percentage of deterioration in audiometry (7, 8, 9).

The study also revealed that there was a significant correlation between increasing age and years of service with the worsening of hearing thresholds at high frequencies in both ears. This is corroborated by other studies related to exposure time and PAIR (6, 8, 12, 16, 17).

Conclusion

From the analysis of the audiological data was verified that the military police are population presents a risk for developing hearing loss. And the comparison between age and exposure time with the auditory threshold, there was a significant correlation, demonstrating the danger of exposure noise. Thus, we see the need for implementation of hearing conservation program for the military police.

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