Screening among workers in a dockyard in the city of Varna

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Introduction

Hearing reduction and hearing loss are common among the industrial workers exposed to continuous and intensive occupational noise, although they are completely preventable. Hearing protection devices are more and more widely used in modern industry, however, they are not efficient enough. That is why preventive otorhinolaryngologic examinations should regularly been performed to enable the early diagnosis and timely treatment of this severe pathology. Several recent investigations deal with the damage of the medium and inner ear as well as of the hearing characteristics caused by intensive and long-lasting industrial noise, especially in construction in the USA (Wu, et al., 1998; Edelson, et al., 2009), in dockyards (Sliwinska-Kowalska, et al., 2004; Zamyslowska-Szmytke, et al., 2007), in a liquefied petroleum gas cylinder infusion factory in Taiwan (Chang, et al., 2009), in a semiconductor factory (Chou, et al., 2009), in steel mills, lumber mills and marble shops in Brazil (Boger, et al., 2009), among truck drivers (Krishnamurti, 2009; Karimi, et al., 2010), etc. The combined harmful effects of workplace noise and various agents such as chemicals (Morata, et al., 1993; Sliwinska-Kowalska, et al., 2004; Sliwinska-Kowalska, et al., 2005) and heat (Singh, et al., 2010) are intensively studied, too. Binaurial hearing impairment caused by simultaneous exposure to occupational noise and cigarette smoke is proved, too (Mohammadi, et al., 2010). The role of shift-work on noise-induced hearing loss is emphasized (Borchgrevink, 2009; Chou, et al., 2009). The purpose of the present paper is to analyze the dynamics of hearing reduction of dockyard workers by twofold comprehensive screening examinations as a first step in a broad prevention programme.

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Methods

In 2002, several otorhinolaryngologists from St. Marina Diagnostic and Consulting Centre of Varna performed prophylactic examinations of a total of 270 male workers from Varna dockyard. In 2009, examinations of the same type of a total of 256 workers of which 184 (72%) had already been examined in 2002 were carried out. According to their profession and occupation, the workers belonged to the following groups: helpingists (25%), pipe fitters (23%), ship-gear fitters and turners (22% each), moulders and woodworkers (3% each), and millers (2%). Screening consisted in comprehensive clinical investigations such as otoscopy with microscopy, anterior and posterior rhinoscopy, mesopharyngoscopy, tonal threshold and over-threshold audiometry, otoacoustic emissions and vestibular tests. Digital audiometer enabling automatic data analysis was made use of. Besides, CT and MRI examinations were done when proved necessary. Statistical data processing was done by means of variation analysis as significance was read at a confidence level of $P<0.05$.

Results

Some pathological findings of the workers exposed to noise during both screening examinations are summarized on Table 1.

Workers' distribution according to the individual length of service in a noisy environment in 2002 and in 2009 is demonstrated on Figure 1. There are insignificant changes of this specific staff's characteristics during the period of observation.

The numbers of workers presenting with different degree of hearing reduction at various noise intensity and according to the audiometric frequency in 2002 are shown on Figure 2 while those in 2009 - on Figure 3.

Table 1. Dynamics of workers' hearing reduction features from 2002 till 2009.

Clinical features	2002		2009	
	n	%	n	%
Tympanic membrane perforation	10	3,70	5	2,96
- Small central tympanic membrane perforation	5	1,85	3	1,23
- Total tympanic membrane perforation	5	1,85	2	1,23
Tinnitus	41	15,18	55	21,48
Vestibular complaints	7	2,59	2	0,78
Hearing reduction by >65 dB for one ear	105	38,88	112	43,75
Hearing reduction by >65 dB for both ears	63	23,33	43	16,80
Hearing reduction by 25-30 dB for one ear	33	12,22	28	15,21
Hearing reduction by 25-30 dB for both ears	12	4,44	18	7,03

There exist numerous statistically significant differences concerning the diagnostic value of the concrete audiometric frequencies at single noise intensities in both years. Let us mention only some of them.

In 2002, at 21-50 dB, the number of workers examined at 500 Hz is significantly smaller than those at 1000 Hz and 4000 Hz (P<0.001) and that at 2000 Hz (P<0.05). At 61-70 dB, the number of workers examined at 500 Hz is significantly smaller than those at 2000 Hz and 4000 Hz (p<0,001) while at 51-60 dB, the numbers of workers examined at 500 Hz and at 1000 Hz are significantly smaller than that at 2000 Hz (P<0.001).

In 2009, at 21-50 dB, the number of workers examined at 500 Hz is significantly smaller than that at 4000 Hz (P<0.001). At 61-70 dB, the number of workers examined at 500 Hz is significantly smaller than those at 4000 Hz (P<0.01) and at 2000 Hz (P<0.001).

These results suggest that the tonal threshold audiometry is more sensitive at higher frequency and should obligatorily be used in mass screening for early hearing reduction among workers occupationally exposed to noise. It should be noted that the different incidence rates of high- and low-frequency tinnitus among the workers from these age groups age in both years of screening examinations could be due to the relatively small number of cases in this sample. As a whole, the increasing number of young and medium-aged workers with tinnitus in 2009 is an alarming fact. During this 7-year period, despite the implementation of the preventive measures, the number of the patients with acoustic nerve neuritis gradually increased. On the other hand, neither CT, nor MRI revealed any middle and inner ear pathological alterations at all. The patients with tinnitus underwent a symptomatic drug treatment. However, no significant subjective improvement in an increasing number of tinnitus patients could be observed. Ossicular prosthesis placement was recommended to all the patients presenting with a considerable hearing loss. It should be emphasized that it resulted in a less manifested hearing status worsening - in 5% of the patients only. The patients with vestibulopathy were favourably influenced by the medicamentous therapy. It is noteworthy that despite the regular usage of noise-protective means a hearing reduction by 25-30 dB was established in 15% of the workers already examined in 2002.

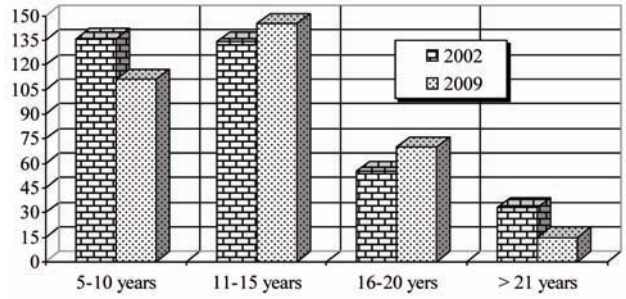

Figure 1. Workers' distribution according to length of service.

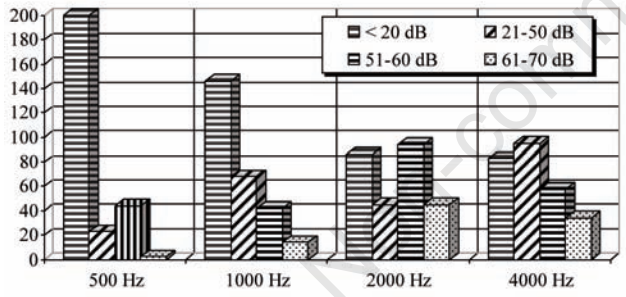

Figure 2. Hearing loss reduction of workers at different tonal audiometric frequencies in 2002.

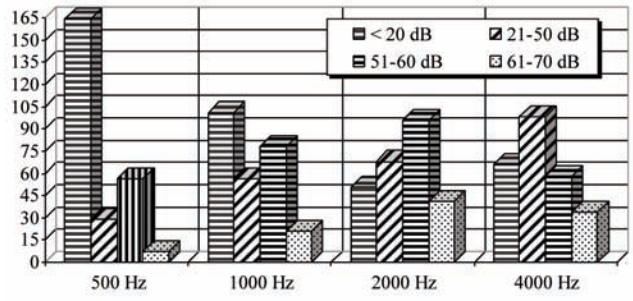

Figure 3. Hearing loss reduction of workers at different tonal audiometric frequencies in 2009.

Discussion

Our results are, to a certain extent, in agreement with the data reported by other authors. Some significant effects of age on the noise-induced permanent threshold shifts in workers with bilateral sensorineural hearing loss are established (Krishnamurti, 2009). There is a statistically significant association between hearing loss level and degree of discomfort introduced by tinnitus among the workers exposed to occupational noise (Dias, et al., 2008). The audiometric characteristics of the noise-induced hearing loss should obligatorily include hearing threshold shift at high frequencies, with a typical notch at 4000-6000 Hz (Sliwinska-Kowalska, et al., 2007).

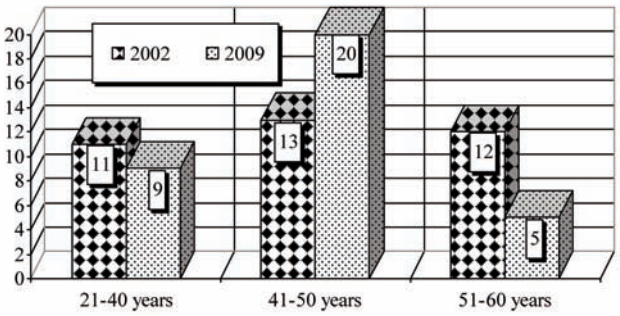

Figure 4. Age distribution of workers with high-frequency tinnitus in 2002 and in 2009.

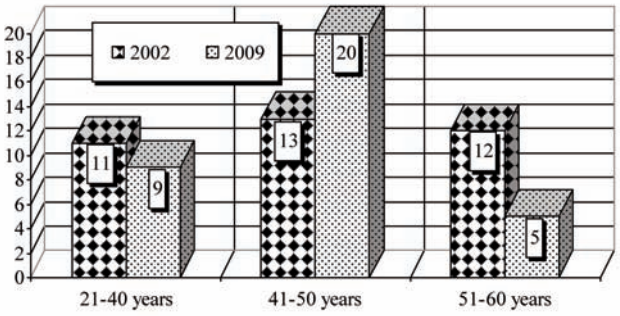

Figure 5. Age distribution of workers with low-frequency tinnitus in 2002 and in 2009.

In Bulgaria, hearing loss prevention is obligatory in all the industrial enterprises. The control of the regular usage of the hearing protection devices should be more effective. We agree with other investigators (Edelson, et al., 2009) who argue that the effects of safety climate are mediated by perceived risk of noise exposure, perceived effects of noise and value placed on the use of hearing protection devices as well as that education level, a belief that wearing these devices is not uncomfortable, self-efficacy, and percentage of shift spent in high noise are of importance in this respect, too (Edelson, et al., 2009).

Conclusions

Our initial comparative analyses convincingly demonstrate the necessity of annual screening of the patients with hearing reduction who work in a noisy medium. The regular usage of noise-deadening devices should be strongly recommended to the workers at any age group. Application of hearing prostheses contributes to long-lasting hearing preservation even in the presence of harmful occupational factors.

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