ORIGINAL ARTICLE

The Noise Exposed Factory Workers: The Prevalence of Sensori-neural Hearing Loss and Their Use of Personal Hearing Protection Devices

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Summary

A total of 524 industrial workers were studied. They consisted of 442 noise exposed and 82 non-noise exposed workers. The purpose was to compare the prevalence of sensori-neural hearing loss among the noise exposed and the non-noise exposed workers, to study their knowledge on the hazard of noise to hearing and the workers' attitude towards the hearing protection devices. The prevalence of sensori-neural hearing loss was significantly higher among the noise exposed workers, i.e., 83% versus 31.7% ($p<0.01$). However, the prevalence of hearing impairment was much lower for both groups, being 30.1% for the noise exposed and 3.7% for the non-noise exposed group. Although hearing protection devices were provided to 80.5% of the workers, only 5.1% were wearing them regularly. The possibility of developing hearing loss due to exposure to excessive noise was only known by 35.5% of the noise exposed workers. This awareness was found to have a positive correlation with the workers' compliance to the hearing protection devices. Our findings highlight the need for workers to be educated on the hazards of excessive noise exposure to hearing.

Key words: Occupational health.

Introduction

There are many industrial pollutants but none so widespread and common as noise. Although noise has long been recognised as harmful to the hearing, steps to protect workers from excessive exposure have only been taken quite recently. In Malaysia, the Noise Regulation came into force in early 1989. The Factories and Machinery (Noise Exposure) Regulation 1989, requires all workers exposed to noise levels exceeding 85 dBA to be protected[1].

Methods for reducing noise exposure levels include the reduction of noise levels at source (engineering controls), administrative control and the use of personal hearing protectors. Due to technical and economical reasons, hearing protection devices are usually considered to be the most reasonable solution. However, the practicality of this solution has been challenged by various studies[2,3,4]. Among others, Lofgreen indicates that, without proper supervision and reinforcement, the usefulness of hearing protection devices in conserving hearing is doubtful[2].

In view of the increasing industrial activity in this country, this cross-sectional study was undertaken to study the prevalence of hearing loss among factory workers and to study their awareness on the hazards of noise to hearing and its impact on the attitude towards hearing protection devices. It is hoped that this

study will provide a clearer picture on the seriousness of the problems among our industrial workers and help in developing effective preventive measures.

Materials and Methods

A total of 578 randomly selected workers of 4 factories were studied. They consisted of 488 noise exposed workers (noise level 90 dB Equivalent Continuous Sound Level [Leq] or more) and 90 workers working in 'quiet' environments (noise level less than 80 dBLeq). Each subject was personally interviewed and underwent otoscopic examination before pure tone audiometry was performed.

Measurement of noise level

Sound level measurements were obtained at various work stations using the Quest 2800 sound level meter. The levels were sampled repeatedly over a well-defined sampling period and Equivalent Continuous Sound Levels (Leq) were calculated. All workers were stationed at the same area during the whole 8 hours day of work.

Interview

Information, including the work history and hearing status, was noted. The present and past medical histories, including hobbies, were carefully obtained to rule out other possible causes of hearing loss. The workers' knowledge on the hazards of noise to hearing and compliance towards hearing protection devices was also recorded.

Pure tone audiometry

Pure tone audiometry was performed using a diagnostic audiometer calibrated according to American National Standards Institute (ANSI) 1969 specifications. The air and bone conduction thresholds were obtained by the Hughson-Westlake technique. Testing was done in a sound-proof cabin. To minimise the effect of temporary threshold shift, the recommendation by the Factory and Machinery Department on Noise Exposure was followed, whereby all noise exposed workers were examined after a period of at least 14 hours free from noise[1]. Masking by narrow band noise was done when necessary.

Data analysis

Hearing was divided into various categories according to the following classifications:

Normal hearing

Air conduction threshold of 20 dB or less at all test frequencies.

Hearing loss

Air conduction threshold of 25 dB or more at any of the test frequencies.

Hearing impairment

Arithmetic average of air conduction thresholds at 500, 1000, 2000 and 3000 Hz of 25 dB or more.

Results

Subject

Out of 578 workers, only 524 were included in the study. They consisted of 442 noise exposed and 82 non-noise exposed workers. Fifty four workers (46 from the noise exposed and 8 from the non-noise exposed groups) were excluded as they either had perforated drums, conductive loss or history suggestive of illnesses or conditions which might be responsible for sensori-neural hearing loss. The age of workers

in the noise exposed group was between 18 to 52 years with a mean age of 36.5 years and 3 to 29 years exposure to noise. The non-noise exposed group were between 18 to 53 years, mean 33.2 years and with a working duration of 0.3 to 34 years. For both groups, males were more than females in a ratio of 1:2.3 for the noise exposed and 1:3.8 for the non-noise exposed.

Hearing threshold of the noise exposed and non-noise exposed workers

Fig 1 compares the mean threshold level of the 2 groups. For each frequency tested, the noise exposed workers showed a significantly higher threshold of hearing ($p<0.01$). Marked differences were noted, especially at the frequencies of 3000, 4000 and 6000 Hz. This correlates well with noise induced hearing loss, which primarily affects the high frequency region.

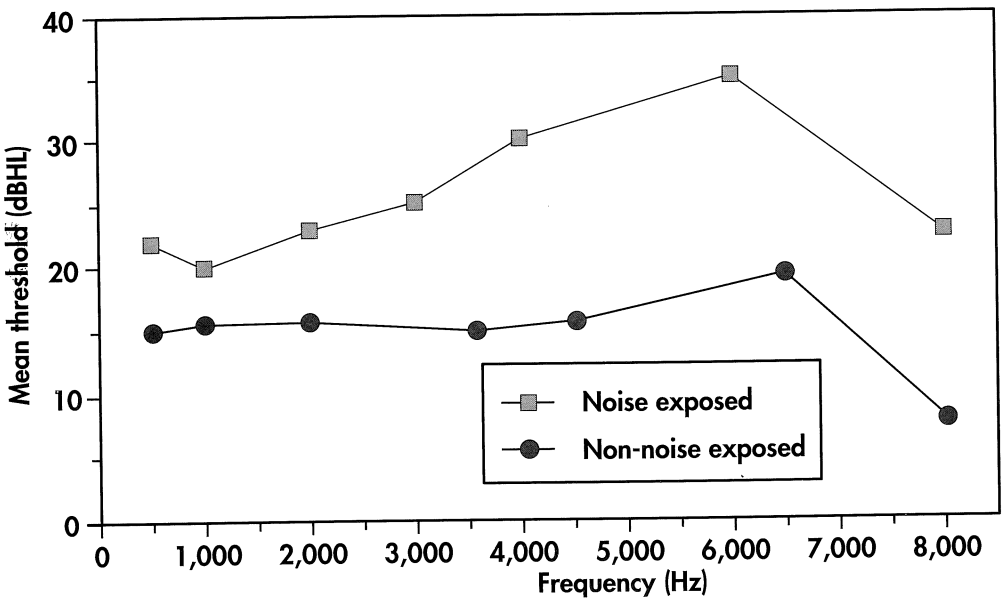

Fig 1: Mean hearing thresholds for the noise exposed and non-noise exposed groups.

Prevalence of sensori-neural hearing loss

The prevalence of hearing loss was significantly higher among the noise exposed workers (83%), compared to the non-noise exposed workers at 31.7% ($p<0.01$). Fig 2 compares the prevalence of hearing loss at various test frequencies. For all the test frequencies, the prevalence of hearing loss was significantly higher among the noise exposed group ($p<0.01$). The prevalence of hearing impairment was lower for both groups, i.e., 30.1% for noise exposed workers and 3.7% for non-noise exposed workers.

Complaints of hearing problems

Good hearing threshold at essential speech frequencies (500 to 3000 Hz) is important for speech discrimination. This study showed, however, that the majority of the noise exposed workers did not complain of any hearing difficulty despite the presence of hearing impairment as shown by their audiograms. Only 16.9% of the workers with hearing impairment complained of having difficulty in hearing while 83.1% alleged to have normal hearing.

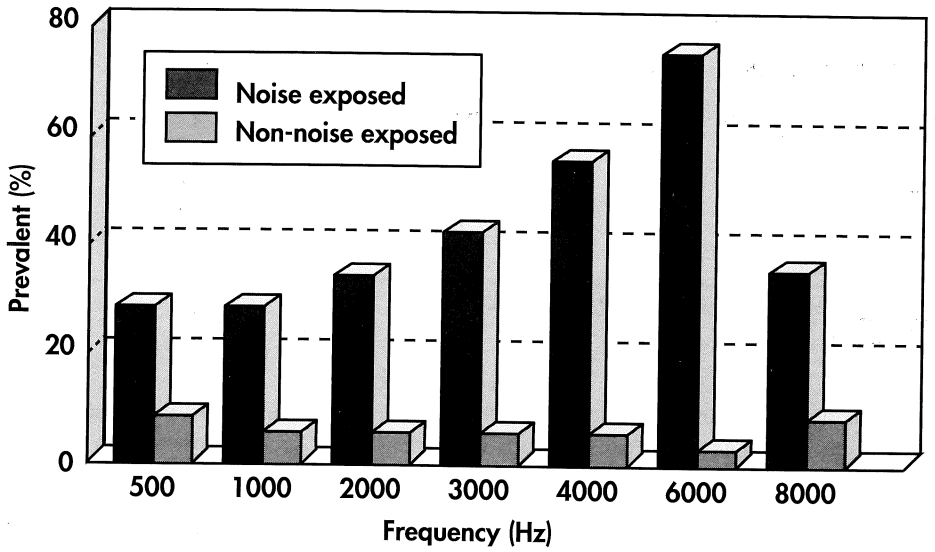

Fig 2: Prevalence of hearing loss across the test frequencies.

Personal hearing protection devices

Personal hearing protection devices were supplied to only 356 out of 442 noise exposed workers. However, only 284 (79.8%) still had them in possession. Seventy two (20.2%) had lost their devices.

Table I shows the workers compliance towards the hearing protection devices. Only 18 workers (4.1%) used the hearing protection devices regularly and 141 wore them at times, while the majority, 283 (64%) never put the devices on. Among the common reasons for not using these devices were discomfort, difficulty in understanding conversation and being used to working in noisy environments.

Table I
The use of hearing protection devices among the noise exposed workers

Usage	Number	Percentage
Routine	18	4.1
Sometimes	141	31.9
Never	283*	64.0
Total	442	100.00

* ***86 workers were not provided with hearing protectors and 72 had lost the devices.***

Knowledge on the hazards of noise to hearing

Only 35.5% of the noise exposed workers knew that exposure to loud noise might damage hearing. Table II shows the relationship between this awareness and compliance towards the hearing protection devices. Chi-square test showed a correlation between this awareness and compliance towards hearing protection devices.

Table II
The compliance towards hearing protection devices according to awareness towards noise hazards

Usage	Awareness	
	Yes	No
Routine	9	9
Sometimes	76	65
Never	83	200
Total	168	274

Significant difference was noted between the 2 groups (p<0.01).

Discussion

The effect of prolonged exposure to noise can basically be divided into 2 categories, temporary threshold shift and permanent threshold shift. A major study by Burns *et al* (1973), showed that an exposure to moderately intense noise of 85 to 105 dBLeq for 8 hours produced a temporary threshold shift of less than 40 dB[5]. It was further noted that with this amount of shift, complete recovery of hearing threshold occurs within 16 hours after noise cessation. However, when noise exposure is higher and the amount of temporary threshold shift is more than 40 dB, a much longer period is needed for complete recovery. This type of shift blends imperceptibly with permanent threshold shift.

Sensori-neural hearing loss is a common problem, yet hardly realised among the noise exposed workers. Gradual onset of hearing loss, with primary involvement of the high frequency region without affecting the speech frequencies and frequent hearing difficulty experienced at work place, may explain this low rate of awareness.

Although hearing protection devices were provided to the majority of the workers, only 4.1% were using them routinely. This shows the lack of seriousness of both the employers and the workers in carrying out the hearing conservation programme. The importance of using hearing protectors during the whole period of exposure to noise must be stressed to the workers. This is because the prophylactic effect of ear protectors declines very rapidly when the frequency of use is less than 100% of the exposure duration[6].

Generally, it is easier to provide hearing protectors than to persuade the workers to wear them. They are frequently uncomfortable and most important, the danger of not using them is not apparent.

The correlation between awareness on hazard of noise to hearing and attitude towards hearing protection devices shown in this study is worth noting. It suggests the importance of educating the workforce to ensure better compliance in obeying the regulation. An ongoing educational programme on noise hazards and the protective effect of ear protectors on hearing is needed. Undoubtedly, the Industrial Health Service has a very important role in these matters.

Conclusion

The high prevalence of hearing loss among the noise exposed factory workers is a cause for deep concern. Steps to motivate the users are vital if hearing protection devices are to be an effective part of the hearing conservation programme.

Although a 14 hour period of noise-free time will minimise the contamination from temporary threshold shift in exposure to moderate noise, a longer period is required especially in cases where noise exposure exceeds 105 dBLeq. This should not pose any problems if noise exposure levels are kept at a safe level by ensuring a routine use of properly selected ear protectors.

Acknowledgement

This study was sponsored by IRPA (03-07-03-34). The authors thank the staff of the Audiology Unit, Universiti Kebangsaan Malaysia, for their assistance in data collection.

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