SEVERE NOISE-INDUCED DEAFNESS - A 10-YEAR REVIEW OF CASES

P Tay

ABSTRACT

Noise Induced Deafness (NID) is the leading occupational disease in Singapore. Every year, over 500 new cases of NID are detected by the Department of Industrial Health (DIH). Severe NID is a disabling disease which is compensable under the law.

A retrospective study was conducted to elicit the profile of workers with severe, disabling NID. From 1 January 1985 to 31 December 1994, the DIH confirmed 127 of such cases.

Of these, 57 (44.9%) were involved in the building and repair of ships and boats, 30 (23.6%) with the basic steel industries, manufacture and fabrication of metal products and storage batteries, 9 (7.2%) with the transport and allied support industries, 7 (5.5%) in granite quarrying, 7 (5.5%) in the manufacture of food and drinks, 5 (3.9%) in the manufacture of wooden furniture and 7 (5.5%) in other industries such as manufacture of glass, electricity generation, construction, textiles, printing and so on.

The mean age of these workers upon diagnosis of severe NID was 48 years (SD 8.07). The mean duration of exposure to noise was 24 years (SD 9.11). The mean of the average hearing thresholds at 1, 2 and 3 kHz for these workers was found to be 61.5 dBA (SD 4.26). The main jobs at risk were grit blasters, steel workers, fitters, boiler fabricators, panel beaters and carpenters. Noise dosimetry was performed on 46 of the cases and the mean time-weighted exposure level was 90 dBA (SD 10.00). Finally, 82.7% of cases already had audiometric evidence of severe deafness at the time of notification.

Keywords: *severe noise-induced deafness, compensation, industries and job-types at risk, average hearing threshold, noise dosimetry*

SINGAPORE MED J 1996; Vol 37: 362-364

INTRODUCTION

Many workers are exposed to noise in their workplaces. Prolonged exposure to excessive noise can result in irreversible damage to the sensitive hair cells of the cochlea and lead eventually to noise-induced hearing loss or deafness[1-4].

In Singapore, all workers exposed to excessive noise in their workplaces are required to undergo pre-employment (within 3 months of commencing work), and thereafter, annual audiometric examinations under the Factories (Medical Examinations) Regulations[5] which were promulgated in 1985. In 1994, over 50,000 workers underwent such examinations in our country[6].

As Noise Induced Deafness (NID) is a notifiable disease under the Factories Act[7], any medical practitioner seeing a patient whom he suspects of having NID is required to notify the Chief Inspector of Factories [c/o the Department of Industrial Health (DIH) of the Ministry of Labour]. These workers are then called up to the DIH for further investigations including audiometric examinations and history taking to elicit a detailed noise exposure profile.

NID has been and is the leading occupational disease in Singapore. In 1994, 754 new cases of NID[6] were detected, accounting for more than three-quarters of all occupational diseases confirmed for that year. Of these, 46 had severe, disabling deafness which is compensable under the Workmen's Compensation Act[8].

NID is thus important in Singapore not only because of its prevalence in the working population but also because of cost to the individual worker with severe disease in terms of disability and reduced quality of life as well as cost to the employer in terms of disability benefits and increased worker insurance premiums.

A retrospective study was conducted from November 94 to March 95 in order to characterise workers confirmed by DIH to have severe NID. In this study, the duration and level of noise exposure, as well as the main industries and job types at risk were of particular interest.

MATERIALS AND METHODS

Workers with NID are classified according to severity of the disease. Those with high frequency sensori-neural hearing loss (4 and/or 6 kHz) and with a noise exposure duration of 5 or more years are classified by the DIH as early NID or NID(e). Those with 10 or more years history of noise exposure and with high frequency sensori-neural hearing loss, together with a hearing disability (defined as an average hearing threshold in the speech frequencies of 1, 2 and 3 kHz) of 50 dBA or more in the better ear, are classified as severe NID or NID(p) [NID proper][9]. DIH diagnostic criteria for NID are given in Table I.

All workers classified as NID(p) from 1 January 1985 to 31 December 1994 were included in this study and their records scrutinised. Data on patient profile, exposure history, results of noise dosimetry (if any) and audiometric results were recorded onto a form (Appendix I) and keyed into a database (dBase IV).

Table I – Diagnostic criteria for NID

Category	NID(e)	NID(p)
Sensori-neural hearing loss at	4 & or 6 kHz	4 & or 6 kHz
Duration of exposure	≥ 5 years	≥ 10 years
Average hearing threshold at 1,2 & 3 kHz in the better ear	< 50 dBA	≥ 50 dBA

Note : other causes of hearing loss should be excluded
NID(e): early noise induced deafness
NID(p): proper or severe noise induced deafness (compensable)

Department of Industrial Health
Ministry of Labour
18 Havelock Road
#05-01 MOL Building
Singapore 059764

P Tay, MBBS, M Med (OM)
Occupational Health Physician

Correspondence to: Dr P Tay
NatSteel Ltd
22 Tanjong Kling Road
Singapore 628048

Appendix I – Survey of NID(P) cases

1. Name:
2. NRIC No.:
3. DOB: Age:
4. Total noise exposure duration (years):
5. Exposure History:
   A. SSIC Code:
   B. Job-Type:
6. Year of first Audiogram:
7. Year first seen by DIH;
8. Year at first "E" picture:
9. Year at first "P" picture:
10. Serial AHL results:

Year	AHL (1,2,3 kHz)	EAR (R/L)

11. Compensation Awarded (%):

RESULTS

A total of 127 workers were diagnosed to have NID(p) during the 10-year period. The profiles of these workers are tabulated in Table II. The mean age of the workers at the time of diagnosis of NID(p) was 48 years (SD 8.07) and the mean exposure duration was 24 years (SD 9.08). One hundred and five (82.7%) of the workers already had audiometric evidence of severe NID when notified to the DIH.

Table III gives the main industries and job-types at risk. Forty-five percent of cases were from the shipbuilding and shiprepair industries followed by the basic metal, metal working and metal fabrication industries (24%). Other industries such as transportation, granite quarrying, manufacture of food and drinks, furniture and others accounted for the rest (31%).

Forty-six of the workers had representative noise exposure levels recorded. Estimation of workers' time-weighted average noise exposure levels were performed using calibrated noise dosimeters (Metrosonics 301 or 307) set at 85 dBA threshold and 5 dB exchange rate. The mean time-weighted average noise exposure level was 90 dBA (SD 10.0) and the main job-types at risk are shown in Table IV, together with their average noise exposure levels. Jobs with the highest noise-exposures were found mainly in the shipbuilding & shiprepair and the metal industries.

DISCUSSION

Various methods have been used to assess disability in severe cases of NID; these include audiometric examinations, speech audiograms[10] and questionnaires[11]. Of these, audiometric assessment is by far the commonest method in use today. The criteria for diagnosis of NID(p) used by the DIH is adapted from those used in the United Kingdom. Assessment criteria looking at other frequencies and average hearing thresholds exist or have been proposed[12,13]. The common denominator, however, is assessment of hearing thresholds at the "speech frequencies" which vary in different assessment schemata from 0.5 kHz to 4 kHz.

In the workers studied, the mean age at the time of diagnosis of severe NID was 48 years with a mean noise exposure duration of 24 years. This is consistent with the findings of other published data which showed that the deterioration in hearing at 4 kHz is

Table II – Profile of workers with NID(p)

	Mean	S.D.
Age (yr)	48.0	8.1
Exposure duration (yr)	24.0	9.1
Average hearing threshold**/dBA	61.5	10.0

SD : standard deviation
** : at 1, 2 & 3 kHz in the better ear

Table III – Main industries and job-types at risk

Industry	No. (%)	Job-type
Building & repair of ships and boats	57 (44.9)	Steel workers Fitter Grit blaster
Basic metal industries, metal stamping & forging, manufacture of metal products, manufacture and repair of machinery and manufacture of storage batteries	30 (23.6)	Fitter Boiler maker Grinder Machine operator
Transportation and allied supporting services	9 (7.2)	Panel beater Aircraft technician Tractor driver
Stone quarrying	7 (5.5)	Blaster Driller Crusher
Manufacture of food and drinks including dairy products	7 (5.5)	Spice grinder Machine operator
Manufacture of wooden furniture	5 (3.9)	Carpenter
Manufacture of glass, cement and structural clay products	5 (3.9)	Fitter Mechanic
Others	7 (5.5)	Boilerman Piling captain
Total	127 (100)	

Table IV – Main job-types at risk and noise exposure levels

Job-type	Lav*/dBA
Grit blaster (shipyard)	100
Boiler maker (includes other pressure vessels)	96
Steel worker (shipyard)	95
Grinder (spice)	95
Grinder (metal cylinders)	94
Panel beater	93
Fitter (shipyard)	93
Operator (weaving machine)	93
Operator (stamping & other machines)	92
Carpenter	91
Forklift driver (metal industry)	91

*: indicates time-weighted average values

rapid in the first 10-15 years, whereas that at 2 kHz occurred after 20-40 years of exposure[14].

It was surprising to find that the majority (82.7%) of our workers already had audiometric evidence of severe NID when notified to the DIH. Two explanations are possible. Firstly, and the most likely, is that cases with severe NID were only detected during their first audiometric examination when the Factories (Medical Examinations) Regulations[5] came into force in 1985. It was found, in addition, that some factory managements did not send all their noise-exposed workers for these statutory examinations that year but had delayed audiometric tests for a number of years. Enforcement action may thus need to be stepped up on such errant factories.

Another possible reason is that the designated factory doctors (DFD) performing such examinations for workers tended to classify them as "suspected cases" of NID subject to a review the following year, especially if they were seeing the particular worker for the first time. The problem of continuity would then arise as the DFD may not be awarded the tender contract to do audiometric examinations for the same company the next year. This would result in the workers being seen by another DFD who may decide again not to notify the worker. DFD's should therefore be reminded to notify all cases and suspected cases of NID as required under Section 67 of the Factories Act[7].

The largest proportion of severe NID cases came from the shipbuilding & shiprepair and metal industries (69% of all cases). Job-types in these industries with high noise-exposure levels were grit blasters, steel workers, fitters, makers of pressure vessels and stamping machine operators.

The most effective method of prevention of NID is to reduce noise levels at its source[15,16]. This can be achieved by engineering methods such as regular maintenance of machines, process or personnel enclosure and the use of baffles and screens[17]. In many cases, as in those listed above, however, noise control is impractical. The wearing of proper hearing protectors is thus of utmost importance for workers in these jobs. However, compliance with hearing protector usage has been found to be poor in many countries[18,19]. For example, in New Zealand, where it was estimated in 1988 that over 400,000 workers were exposed to excessive noise, a survey of 998 noisy factories showed that only 43% of workers actually wore the hearing protectors provided[19].

A more comprehensive approach to the prevention of NID is thus needed. Since 1976, when the DIH launched a nation-wide hearing conservation programme (HCP) in Singapore, all noisy factories have been encouraged to implement self-regulatory in-plant programmes in order to prevent NID. The components of such a programme include detailed noise surveys, noise control (both engineering and administrative), personal protection, worker education and medical surveillance[20,21]. To date, over 800 noisy factories in Singapore have implemented a HCP[6].

NID is an incurable disease. Fortunately, however, it is completely preventable. The onus of prevention of NID falls mainly on the employer. Notwithstanding this, however, an effective HCP can only be achieved if all who are involved, including worker's representatives, the company nurse, safety officer, doctor and the worker himself, play their respective parts.

References

1. Irwin J. Occupational hearing loss and the 4 kHz dip. Occup Med 1994; 44: 222-3.
2. Osguthorpe JD, Klein AJ. Occupational hearing conservation. Otolaryngol Clin North Am 1991; 24: 403-14.
3. Acton I. Noise and occupational deafness. In: Gardner AW. ed. Current approaches to occupational health 2. Bristol, England: Wright PSG, 1982: 169-85.
4. Fearn RW. Damaging levels of noise. Hearing and Ventilating Engineer 1972; 46 No. 544: 227-30.
5. Republic of Singapore Government Gazette Subsidiary Legislation Supplement. The Factories (Medical Examinations) Regulations 1985. Singapore National Printers Ltd. (Government Printers).
6. Department of Industrial Health, Ministry of Labour Singapore. Annual Report 1994.
7. The Statutes of The Republic of Singapore Factories Act (Chapter 104), 1973. Singapore National Printers Ltd. (Government Printers).
8. Republic of Singapore Government Gazette Acts Supplement. The Workmen's Compensation Act, 1975. Singapore National Printers Ltd. (Government Printers).
9. Tempest W. The assessment of hearing handicap. Journal of The Society of Occupational Medicine 1977; 27: 134-7.
10. Lindeman HE. Relation between audiological findings and complaints by persons suffering from noise-induced hearing loss. Am Ind Hyg Assoc J 1971; 32: 447-52.
11. Atherley GRC, Noble WG. Clinical picture of occupational hearing loss obtained with the hearing measurement scale. In: Robinson DE. ed. Occupational Hearing Loss, British Acoustical Society Special Vol. 1. London: Academic Press 1971: 193-206.
12. Phaneuf R, Hetu R, Hanley JA. A Beyesian approach for predicting judged hearing disability. Am J Ind Med 1985; 7: 343-52.
13. Snow JB Jr. Otological considerations in noise-induced hearing loss. In: Henderson D, Hammernik RP, Dosanjh DS, Mills JH. eds. Effects of noise on hearing. New York: New York Raven Press, 1976: 467-78.
14. Taylor W, Pearson J, Mair A, Burns W. Study of noise and hearing in weaving. J Acoust Soc Am 1965; 38: 113-20.
15. Mutawe AM. Engineering versus administrative control of noise on a double-end router. Applied Occupational and Environmental Hygiene 1990; 5 No. 2: 101-6.
16. Glorig A. Industrial noise - hearing conservation. In: Tree DR. ed. Proceedings, National Conference on Noise Control Engineering. October 15-17, 1973, Washington D.C. Poughkeepsie, New York: Institute of Noise Control Engineering 1973: 314-20.
17. Salmon V, Mills JS, Peterson AC. Industrial noise control manual. U.S. Department of Health, Education and Welfare. Public Health Service, Center for Disease Control. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1975.
18. Reynolds JL, Royster LH, Pearson RG. Hearing conservation programs (HCP's): The effectiveness of one company's HCP in a 12-hr work shift environment. Am Ind Hyg Assoc J 1990; 51: 437-46.
19. Moore PWE. Industrial deafness. NZ Med J 1988; 101: 1627-8.
20. Dunn DE. Making the commitment to effective hearing conservation. Applied Industrial Hygiene 1988; 3: 16-8.
21. Sataloff RT, Sataloff J. eds. Establishing a hearing conservation program. In: Occupational Hearing Loss, New York: Marcel Dekker Inc., 1987: 635-54.