

# A Study on Compliance to Hearing Conservation Programme among Industries in Negeri Sembilan, Malaysia

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**Abstract:** Noise is one of the hazards faced by workers. A cross-sectional study was conducted among industries in Negeri Sembilan with the objective to assess their compliance to Hearing Conservation Programme (HCP). The other objectives of this study were to determine the factors influencing it and to show the industries' compliance to each element of the programme. It was also to identify the association between compliance to HCP and the prevalence of hearing impairment and standard threshold shift. Data for this study were collected using questionnaires sent by mail and also the results of the latest audiometric tests. A total of 167 industries were analysed for this study. It was found that 41.3% of these industries fully complied to the programme. It was also found that the industries preferred to provide hearing protection device (92.8%) and least complied to noise control (61.1%). There were significant associations ( $p < 0.05$ ) between compliance and number of employees, status of ownership and the presence of officer in charge of hearing conservation programme. Having at least 150 employees actually raised the compliance to HCP in two folds ( $\beta = 0.717$ , OR = 2.048, C.I 95% = 1.063 to 3.944). The prevalences of hearing impairment and standard threshold shift were 23.9% and 5.2% respectively. There was no significant association between the prevalence for hearing impairment and compliance to HCP. The prevalence for standard threshold shift was inversely related to compliance. This study showed that compliance percentage need to be improved as an effort to prevent the hearing problems among workers exposed to noise.

**Key words:** Hearing conservation programme, Compliance, Industries, Hearing impairment, Standard threshold shift

## Introduction

Million of workers in the world are exposed to noise at work place. Exposure to noise is the second most important cause of hearing loss after aging process<sup>1</sup>. Noise induced hearing loss (NIHL) is a sensorineural hearing loss caused by prolonged exposure to noise. More than 70% of noise exposure occurs in manufacturing industries<sup>2</sup>. Therefore, workers should be protected from this hazard to prevent

further occurrence of NIHL.

In Malaysia, hearing conservation programme (HCP) was introduced under Noise Regulation 1989<sup>3</sup>. The main objective of hearing conservation programme is to protect workers from noise exposure and hence preventing NIHL. After more than 14 yr of Noise Regulation enforcement, the industries' compliance towards HCP is still unknown.

There are 7 elements in HCP. These elements are the government policy and owner policy, noise exposure monitoring, noise control, providing hearing protection device (HPD), audiometric programme & treatment, training

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programme and record keeping. Every workplace which has noise hazard must comply to these elements. Compliance to HCP is expected to give positive effect in the reduction of noise exposure at work place. Therefore, the prevalence of NIHL among workers exposed to noise is expected to be reduced.

There are several factors which influence industries in the compliance to HCP. These factors include ownership of the industries, duration of the industries in operation, number of employees and the presence of officer in charge of HCP. The ownership status of the industries might have some influence on the administration aspect. For example, ownership status of a hospital has some impact on factors related to operation system, financial management and issues related to workers welfare<sup>4)</sup>. In Malaysia, Philippines and Thailand, the ownership of industries have some influence in the industries activities<sup>4)</sup>. Number of employees reflects the size of the industries. However, the definition of industries size varies from country to country. International Regulations have less effect to small and medium industries<sup>5)</sup>. It means that, small and medium industries are less comply to International Regulations compared to bigger industries. The presence of officer in charge of HCP is expected to give positive influence in the compliance to the programme. The Safety and Health Officer is a competent person who is registered to Department of Occupational Safety and Health (DOSH) and has a responsibility to give advice to the management to comply with rules and the regulations and also to ensure safety and health of the workers.

The general objective of this study is to assess the compliance of HCP among industries in Negeri Sembilan, Malaysia. The specific objectives are to determine the overall percentage of compliance to HCP and also to identify the relationship between compliance to HCP and the ownership of the industries, the number of employees, the duration of the industries in operation and the presence of officer in charge of HCP. This study also aims to determine the percentage of industries compliance to each element of HCP and the percentage of industries which have Safety and Health Committee and Safety and Health Officer/officer in-charge of HCP. It is also to identify the prevalence of hearing impairment and standard threshold shift among factory workers in Negeri Sembilan. The hypotheses are that the compliance percentage is higher among industries which are own by foreign investors, with at least 150 workers, shorter duration in operation and have officer in charge of HCP compared to each of the opposite group. This hypotheses were based on the factors studied in this study.

## Materials and Methods

This is a cross sectional study which was conducted from July 2003 till September 2003 among industries registered to Department of Occupational Safety and Health (DOSH), Negeri Sembilan. Negeri Sembilan, one of the 14 states in Malaysia is situated at about 50 km from Kuala Lumpur and in the west coast of Malaysia. The industrial sector is the major contributor to the state capital income. In June 2003 with, there were 687 industries registered to DOSH, Negeri Sembilan.

Sampling method used for this study was universal sampling. However, only industries which had at least 40 workers and noise hazard were included in the study. Sample frame used for this study was list of industries registered to DOSH, Negeri Sembilan. From the list of registered industries, the number of employees was identified. There were 272 industries which had at least 40 workers. The sample unit was industry with at least 40 workers, with the existence of noise hazard and in Negeri Sembilan. Sample size was calculated using epi-info based on previous compliance percentage of 54% by Reilly et al in 1998<sup>2)</sup>. Epi-info is a statistical software programme introduced by Centre of Communicable Disease Control, United State of America (CDC-USA). Minimum sample size calculated was 190. However, it was increased 15% to 218 in view of possible non response.

Data was collected using self administered questionnaires and also the results of latest audiometric test done by competent person for the industries. The questionnaires consist of three parts. Part A was used to get the information about the sociodemographic and job title of the officers completing the questionnaires. Part B was used to identify the factories which have noise exposure of > 85 dB(A). This part was also used to gather the information of the industries regarding type of industry, ownership, number of employees, duration in operation and formation of Occupational Safety and Health Committee (OSHC). Part C was needed to get the information related to each element of HCP and the Noise Regulation 1989. Information taken from the latest audiometric report were number of employees who were exposed to noise and had undergone pure tone audiometric test and number of employees with hearing impairment and standard threshold shift.

This study was done in collaboration with DOSH, Negeri Sembilan. Questionnaires and letter from DOSH Director explaining the study and its confidentiality were sent to 272 industries which had at least 40 employees. The letter also mentioned that the latest audiometric reports must be sent

along by the industries upon replying. For non respondents, follow up letter were sent after 2 wk and follow up by phone were made after that. Phone calls were made to either the managers or safety and health officers (SHO) of the industries which did not respond.

Full compliance to HCP was defined as complied to all seven elements of HCP. The industries were considered as not fully complied if they were complied to less than seven elements. (i.e. complied to 1–6 elements). Ownership of the industries was defined as Malaysian if the industries were fully owned by Malaysian and foreign investors/joined venture if the industries were fully owned by foreign investors or shared between Malaysian and foreign investors. Hearing impairment and standard threshold shift were determined using audiogram results. Pure tone audiometric test was conducted by competent person using approved and calibrated audiometer conforming with requirements of Malaysian Factories and Machinery Act (Noise Exposure Regulation, 1989)<sup>3</sup>. Hearing level were tested at 0.5, 1, 2, 3, 4 and 8 kHz. After explaining the procedure to the subjects, the test were performed at the better ear first than on the other ear. An employee was considered as having hearing impairment if his/her average intensity at frequency 0.5, 1, 2 and 3 kHz was 25 dB or more. If the difference of the average intensity at frequency 2, 3 and 4 kHz between the latest audiogram and the baseline audiogram was more than 10 dB, the employee was determined as having standard threshold shift.

Statistical analysis was conducted using Statistical Package for Social Science (SPSS) version 10.0. Chi-square test was used to identify statistically significant differences between the independent variables tested. Logistic regression was used to identify the relationship between compliance status and all the factors studied.

## Results

From 272 industries, 31 industries did not respond to the questionnaires and 16 industries were no longer in operation. Response rate calculated was 87.9%. However, from 225 industries which responded, 37 industries claimed did not have noise exposure at or above 85 dB(A) and 21 industries had reduction in number of employees (< 40 employees). Therefore, only 167 industries were included for analysis. As for the non respondents, 8 (25.3%) were industries which manufacture wood and wood products including furniture. Twenty three (74.2%) of the non respondent were industries with less than 150 employees.

From 167 industries analysed, 102 (61.1%) of the

industries were owned by Malaysian and 65 (38.9%) were owned by foreign investors/joined venture between Malaysian and foreign investors. For this study, the total number of employee was divided into two groups. One group is industries with employees between 40 to 149 and the other group is industries with at least 150 workers. Ninety (53.9%) of the industries analysed had total number of employees between 40 to 149. The duration of industries in operation was also divided into two groups i.e. less than 10 yr in operation and at least 10 yr or more. Industries which have been longer in operation i.e. at least 10 yr or more were 90 (53.9%), the rest or 69 (41.3%) were less than 10 yr and 8 factories did not answer the question. As for types of industries, 39 (23.4%) were chemical followed by metal, machinery & equipment industry i.e. 34 (20.4%) and wood process and furniture industry i.e. 29 (17.4%) (Table 1).

This study revealed that most industries i.e. 160 (95.8%) formed Safety and Health Committee and 71 (42.5%) of the industries had officer in charge for HCP. Officer in charge for HCP is either Safety and Health Officer or an officer selected by the industries to be responsible for the HCP.

This study found that, 69 (41.3%) of the industries were fully complied to HCP. The rest were complied to 6 elements (35 industries or 21.1%), to 5 elements (15 industries or 9.0%), 4 elements (22 industries or 13.2%), 3 and 2 elements (11 industries or 6.6% each) and 1 element (4 industries or 2.4%). As for the compliance to each element of HCP (Table 2), the highest compliance were to government policy and owner policy where 164 industries (98.2%) complied to this element followed by providing hearing protection device (HPD) i.e. 155 industries (92.8%). The lowest compliance was to noise control i.e. 102 industries (61.1%).

In general, full compliance to HCP according to types of

**Table 1. Distribution of industries according to types of industries**

Types of industries	n (%)
Chemical	39 (23.4)
Metal, machinery & equipment	34 (20.4)
Wood process and furniture	29 (17.4)
Food, drink and tobacco	18 (10.8)
Non-metallic	12 (7.2)
Basic metal	8 (4.8)
Paper and printing	4 (2.4)
Textile, leather and wearing apparel	3 (1.8)
Quarry and mining	3 (1.8)
Electric, gas, water & sanitary services	3 (1.8)
Others	14 (8.4)
Total	167 (100.0)

**Table 2. Percentage of industries compliance to elements of hearing conservation programme**

Elements of hearing conservation programme	Complied n (%)
1. Government policy and owner policy (n=167)	164 (98.2)
2. Personal monitoring (n=167)	127 (76.0)
3. Hearing protection device (HPD) (n=167)	155 (92.8)
HPD approved by *DOSH (n=155)	142 (91.6)
4. Training (n=167)	130 (77.8)
At least 2 yearly (n=130)	104 (80.0)
Noise hazard (n=130)	118 (90.8)
Importance, correct way of wearing HPD (n=130)	122 (93.8)
5. Audiometric test (n=167)	124 (74.3)
14 hr noise free before test (n=124)	104 (83.9)
Audiometric test for new employees exposed (n=124)	59 (47.6)
Periodic audiometric test (n=124)	80 (64.5)
Management / treatment for those with hearing problems (n=124)	78 (62.9)
Repeat audiometric test within 3 months for employees with standard threshold shift (STS). (n=124)	52 (41.9)
Re-explain the importance of HPD to those with STS (n=124)	88 (71.0)
6. Noise control (n=167)	102 (61.1)
Engineering and administrative (n=102)	55 (53.9)
Engineering (n=102)	39 (38.2)
Administrative (n=102)	8 (7.8)
7. Record keeping (n=167)	114 (68.3)
Presence of officer in-charge (n=114)	111 (97.4)
Kept records at least 5 yr (n=114)	109 (95.6)

\* DOSH = Department of Occupational Safety and Health.

industries was considered low. For example, 20 of 39 (51.3%) chemical industries, 14 of 34 (41.2%) metal, machinery and equipment industry and 8 of 29 (27.6%) wood process and furniture industry were fully complied (Table 3).

The full compliance to HCP according to ownership status was higher among industries owned by foreign investors/joint venture where 33 of 65 industries (50.8%) owned by them were fully complied compared to only 36 of 102 industries (35.3%) owned by Malaysian were fully complied. The difference was significant ( $p < 0.05$ ). As for number of employees, it was found that there was also a significant difference ( $p < 0.05$ ) in the percentage of full compliance. The full compliance for industries with at least 150 employees was higher where 40 of 77 industries (51.9%) were fully complied compared to industries with employees between 40 and 149 people where only 29 of 90 industries were fully complied. For operational duration, 40 of 90 industries (44.4%) which has been in operation for more than 10 yr and 27 of 69 industries (39.1%) which had been in operation for less than 10 yr were fully complied to HCP. However, the difference was not significant ( $p > 0.05$ ). It was found

**Table 3. Full compliance to HCP according to types of industries**

Type of industries	Full compliance n (%)
Chemical (n=39)	20 (51.3)
Metal, machinery & equipment (n=34)	14 (41.2)
Wood process and furniture (n=29)	8 (27.6)
Food, drink and tobacco (n=18)	9 (50.0)
Non-metallic (n=12)	6 (50.0)
Basic metal (n=8)	1 (12.5)
Paper and Printing (n=4)	1 (25.0)
Textile, leather and wearing apparel (n=3)	2 (66.7)
Quarry and Mining (n=3)	1 (33.3)
Electric, gas, water & sanitary services (n=3)	3 (100)
Others (n=14)	4 (33.3)

that industries which had officer in charge for HCP were more complied to HCP (38 of 71 industries or 53.5%) compared to industries which did not have officer in charge for HCP (31 of 92 industries or 33.7%). The difference was significant ( $p < 0.05$ ) (Table 4). Industries owned by

**Table 4. Relationship between compliance to HCP and factors studied**

	Compliance		Total	$\chi^2$ value	p value	
	Fully complied					Not fully complied
	n	%				
1. Ownership status				3.921	0.048*	
Malaysian	36 (35.3)	66 (64.7)	102			
Foreign investors/joint venture	33 (50.8)	32 (49.2)	65			
2. Operational duration				1.378	0.502	
<10 yr	27 (39.1)	61 (67.8)	69			
≥10 yr	40 (44.4)	28 (55.6)	90			
3. Number of employee				6.660	0.010*	
40–149 workers	29 (32.2)	61 (67.8)	90			
≥150 workers	40 (51.9)	37 (48.1)	77			
4. Officer in charge of HCP				6.452	0.011*	
Present	38 (53.5)	33 (46.5)	71			
Absent	31 (33.7)	61 (66.3)	92			

\*Statistically significant  $p < 0.05$ .

American investors were found to be most complied to HCP (Table 5). Further analysis using logistic regression was done for all statistically significant factors influencing the compliance to HCP i.e. number of employees, ownership of the industries and the existence of officer in charge of HCP. This analysis was used to determine the association of the above independent variables and dependent variables i.e compliance. It was found that having at least 150 employees raised the full compliance to HCP in 2.048 folds (constant = 0.177,  $\beta = 0.717$ , OR = 2.048, confidence intervals 95% = 1.063 to 3.944).

Twenty eight industries submitted the latest audiometric reports. Fifteen of these industries were fully complied to HCP and thirteen were not fully complied to HCP. There were 1926 employees who were exposed to noise and had undergone pure tone air conduction audiometric test. It was found that 461 (23.9%) of them had hearing impairment (HI) and 101 (5.2%) of them had standard threshold shift (STS). No significant difference was found in the prevalence of HI among industries which were fully complied to HCP (242 employees or 23.4%) and those which were not fully complied to HCP (219 employees or 24.6%). The prevalence of STS was higher for industries which were fully complied to HCP (67 employees or 6.5%) compared to industries which were not fully complied to HCP (34 employees or 3.8%). The prevalence of STS was found to be inversely related to compliance.

## Discussion

For this study, certain criteria of the industries i.e. status of ownership, number of employees, duration in operation and the existence of officer in charge were selected as the independent variables because it influences the compliance of the industries towards HCP. Foreign investors are mostly from developed countries where the law in their countries is more stringent and most of these investors apply their countries' related law and regulations locally. They are also usually answerable to the parent companies in the country of origin. Number of employees was chosen as one of the factors because it reflects the size of the industries i.e. big industry or small and medium industry. Big industries basically have more capitals and are able to allocate specific budgets on safety programmes such as HCP if compared to small or medium industries. Operation years was selected because older industries are proxy to older technology where it involves a lot of hazard<sup>6</sup>. Older types of machines or equipments are probably still in use at older industries, thus the noise hazard might be more prominent at these industries compared to newer technology at newer industries. Other than that, HCP was introduced in Malaysia more than 10 yr ago, hence the operation years is necessary to see whether the existence of the industries for more or less than 10 yr has certain influence in compliance towards HCP. Officer in charge of HCP is very important factor because they have the responsibility in ensuring that the employees are protected from noise hazard in the industry.

This study found that the percentage of full compliance

**Table 5. Distribution of compliance to HCP according to status of ownership**

Status of Ownership	Status of compliance n (%)	Fully complied (n=69)		Not fully complied (n=98)			
		6 elements (n=35) n (%)	5 elements (n=15) n (%)	4 elements (n=22) n (%)	3 elements (n=11) n (%)	2 elements (n=11) n (%)	1 element (n=4) n (%)
Malaysian (n=102)	36 (35.5)	22 (21.6)	10 (9.8)	14 (13.7)	7 (6.9)	9 (8.8)	4 (4.4)
American (n=10)	8 (80.0)	1 (10.0)	- -	1 (10.0)	- -	- -	- -
European (n=12)	7 (58.3)	1 (8.3)	2 (16.6)	1 (8.3)	1 (8.3)	- -	- -
Australian (n=3)	1 (33.3)	1 (33.3)	1 (33.3)	- -	- -	- -	- -
Asian (n=40)*	17 (42.5)	10 (25.0)	2 (5.0)	6 (15.0)	3 (7.5)	2 (5.0)	- -
Japanese (n=23)	9 (39.1)	7 (30.4)	1 (4.3)	4 (17.4)	2 (8.7)	- -	- -
Korean (n=6)	3 (50.0)	1 (16.7)	1 (16.7)	1 (16.7)	- -	- -	- -
Singaporean (n=4)	3 (75.0)	1 (25.0)	- -	- -	- -	- -	- -
Taiwanese (n=3)	- -	- -	- -	1 (33.3)	1 (33.3)	1 (33.3)	- -
Indonesian (n=2)	- -	1 (50.0)	- -	- -	- -	1 (50.0)	- -
Lebanese (n=1)	1 (100)	- -	- -	- -	- -	- -	- -
Indian (n=1)	1 (100)	- -	- -	- -	- -	- -	- -

\*Asian, not including Malaysian.

to HCP among industries in Negeri Sembilan, Malaysia was 41.3%. It is lower compared to the study done in Michigan by Reilly *et al.* in 1998<sup>2)</sup>. In their study, the compliance percentage was 54%. The elements of HCP in OSHA, USA is similar to HCP elements in Malaysia. The full compliance percentage was lower in this study compared to the Michigan study probably because the Noise Regulation was enacted earlier in USA i.e. in 1970s with the latest amendment in 1983, compared to Malaysia where Noise Regulation was enacted in 1989.

The percentage of industries which fully complied to HCP in this study was higher among industries which were owned by foreign investors/joint venture and among industries with at least 150 workers. It is probably because being from developed countries where law and regulation were in place for longer period and health effects of industrial hazards such as noise already known and understood for a longer time, the foreign investors/joint venture have higher level of awareness for the safety and health of their employees. Foreign investors are also expected to comply with local regulations. The compliance percentage was also higher for industries which had officer in charge for HCP. One of their responsibilities is to ensure compliance to act and regulation.

For unknown reason, industries owned by American investors were noted to have better compliance compared to other foreign investors from European, Australia or Asian countries. Certain types of industries e.g. chemical industries also found to have better compliance towards HCP. Again

the reason for this is not clear. Further studies pertaining to this area obviously need to be done in the future to find out why they were more compliant with HCP.

This study found that most industries preferred to provide HPD. Percentage for providing HPD found in this study was similar to the study done by Sirajuddin in 1995<sup>7)</sup> where percentage for providing HPD in a steel industry was 90.4%. DeJoy (1994)<sup>8)</sup> also stated that most factories prefer providing HPD to their workers for noise control. Although providing HPD is the last step in noise control, this method is much preferred by industries compared to engineering and/or administrative control for noise hazard. It is probably because this method is easier and cheaper compared to the other two methods.

The compliance percentage to provision of personal exposure monitoring obtained from this study was 76.0%. This percentage is higher than data from National Institute Occupational Safety and Health (NIOSH), USA<sup>9)</sup> where compliance percentage for personal exposure monitoring ranged between 0% and 29.5% according to size of the industries. The compliance percentage to provision of training programmes was 77.8%. This percentage is higher than percentage showed by a survey on compliance to training programme done by Ochsner and Greenberg (1998)<sup>10)</sup> for American Industrial Hygiene Association (AIHA) and American Society of Safety Engineers (ASSE). The compliance percentage was 44.2% for AIHA and 31.4% for ASSE.

The compliance percentage for conduction of pure tone

audiometric test was 74.3%. Among the industries, the compliance for conducting periodic audiometric test was 64.5%. According to Reilly *et al.* (1998)<sup>2)</sup>, percentage of workers had undergone audiometric test ranged between 29% and 100%. Workers from big industries had more frequent audiometric test compared to workers from small industries. In this study, record keeping was the second least complied element of HCP. This study also found that most industries were least compliance to control of noise exposure. Compliance percentage for noise control was also the lowest according to all of the factors studied. Most engineering control requires periodic maintenance to ensure permanent effectiveness<sup>11)</sup>.

The compliance percentage for government policy and owner policy from this study was higher than 47.0% given by Ministry of Human Resource in 2001<sup>12)</sup>. As for the formation of Occupational Safety and Health Committee, the percentage obtained from this study was also higher than 74.0% given by Ministry of Human Resource in 2001<sup>11)</sup>.

From this study, the prevalence for hearing impairment of 23.9% was similar to data (until June 1990) produced by Department of Occupational Safety and Health / Department of Factory and Machinery i.e. 22.0%<sup>13)</sup>. The prevalence of hearing impairment and standard threshold shift were higher among industries which were fully complied to HCP. These findings could be due to the small number of audiometric reports analysed. The prevalence obtained may not reflect the true magnitude of hearing impairment among industry workers. The prevalence of standard threshold shift was higher among industries which were fully complied to HCP probably because noise monitoring and audiometric test were done and in view of the occurrence of hearing impairment and standard threshold shift, the industries became more complied to HCP. Most industries failed to have an effective hearing conservation programme because they did not monitor and control the noise exposure, did not performed audiometric test to the employees exposed to noise and did not give training and education regarding noise hazard to the employees<sup>14)</sup>. Although age plays significant role in hearing level of a person, this factor was not included in this study. The audiometric test was conducted by the factories as a screening for hearing abnormality and for screening purposes correction for age is not required by Malaysian Law<sup>3)</sup>.

After 15 yr Noise Regulation (1989) was enacted in Malaysia, the full compliance percentage of 41.3% among industries in Negeri Sembilan can be considered low. Status of ownership, total number of employees and the presence of officer in charge of HCP influenced in compliance

percentage. However, only number of employees, i.e. at least 150 is able to predict the industries compliance to HCP. This study also found that most industries in Negeri Sembilan were least compliant in using engineering or administrative controls. In fact, they preferred to provide HPD. There is no improvement in prevalence of hearing impairment after HCP was introduced in 1989. It is hoped that compliant percentage can be improved by giving more emphasis on the importance of hearing conservation programme as an effort to tackle the hearing problems among workers exposed to noise. Findings from this study can be use as a reference to improve policy and regulation and also to increase enforcement activities by relevant authority.

## References

- 1) Rabinowitz PM (2000) Noise-induced hearing loss. *Am Fam Physician* **61**, 2749–56.
- 2) Reilly MJ, Rosenman KD, Kalinowski DJ (1998) Occupational noise-induced hearing loss surveillance in Michigan. *J Occup Environ Med* **40**, 667–74.
- 3) Factories and Machinery (Noise Exposure) Regulations (1989) Kuala Lumpur, Malaysia.
- 4) Baker CM, Messmer, PL, Gyrko, CC, Domagala SE, Conly FM, Eads TS, Harshman KS, Layne MK (2000) Hospital ownership, performance, and outcomes: assessing the state of the science. *J Nursing Admin* **30**, 227–40.
- 5) The Environmental Business Barometer (1997) Environmental management in Europe and some Asian issues. [http://www.iag.ucl.ac.be/recherchers/cese/research/IBEB\\_report/IBEB\\_five\\_asian\\_countries.pdf](http://www.iag.ucl.ac.be/recherchers/cese/research/IBEB_report/IBEB_five_asian_countries.pdf). Accessed January 2, 2004.
- 6) Devereaux PJ, Zandbergen PA, Martens ML. Complications in compliance: Variation in environmental enforcement in British Columbia's Lower Fraser Basin, 1985, 1996. <http://www.kellogg.nwu.edu/research/ford/confer/opne/chapt3.htm>. Accessed March 10, 2003.
- 7) Sirajuddin H (1995) Study on the use of personal protective equipment among workers of a steel industry (PERWAJA) in Terengganu. Thesis for Master Programme, University Kebangsaan Malaysia.
- 8) DeJoy DM (1994) Tactics against workplace hearing loss motivate employees to wear protection. *Occup Health Safety* **63**, 50–4.
- 9) US NIOSH (1998) Control of workplace hazard for the 21st century. White paper: Engineering noise controls and personal protective equipment. <http://www.cdc.gov/niosh/ctwnoise.html>. Accessed February 13, 2004.
- 10) Ochsner M, Greenberg M (1998) A survey of New Jersey industrial hygienists and safety engineers: health and safety conditions, practices, and priorities for OSHA reform. *Am Ind Hyg Assoc J* **59**, 261–8.
- 11) Nash JL (2001) OSHA gets serious about hearing. *Occup*

- Hazards **63**, 41–3.
- 12) Ministry of Human Resource, Malaysia (2001) Opening speech by Minister of Human Resource, YB Datuk, Dr Fong Chan Onn at the opening ceremony: “Regional Conference on Occupational Safety and Health” held at Mandarin Oriental Hotel, Kuala Lumpur on 20th March 2001. <http://www1.jaring.my/ksm>. Accessed May 1, 2003.
  - 13) Ministry of Human Resource, Malaysia (1991) Report of the national survey on hearing problems among industry workers.
  - 14) Nighswonger T (2001) The quest for hearing health. *Occup Hazard* **63**, 64–9.