Noise Exposure and Permanent Hearing Loss of Textile Workers in Thailand

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(Received September 6, 1989 and in revised form October 5, 1989)

Abstract: Hearing loss induced by noise exposure in a large scale textile mill (number of workers=1,611) in Thailand was investigated on the basis of interviews, noise measurements, and audiometric tests. The frequency of subjective symptoms relating to noise exposure was higher in the weavers than among other mill workers and office workers. The average noise levels in the weaving sections and other sections were 101.3 ± 2.7 dBA and 89.8 ± 5.3 dBA, respectively. The results of the audiometric tests revealed the significantly higher noise-induced hearing loss among workers in the weaving section compared to other mill workers and office workers ($P < 0.01$). Among weavers, hearing levels decreased with the longer years of work. Concerning personal noise protective devices, 38.6% of the weavers never used them. It was concluded that hearing loss status in the workers of the mill was serious. Improvements by means of integrated work organization activities were recommended.

Key words: Noise—Hearing loss—Textile mill—Developing country—Thailand

INTRODUCTION

Many developing countries are aiming at industrialization and there is greater and greater concern for occupational safety and health issues. Thailand is also experiencing rapid industrialization, and the textile industry is one of the major growth industries for export purposes. Noise is one of the major health threats to textile workers. It leads some systemic symptoms in exposed workers as well as hearing loss.¹⁾ Noise and hearing loss problems in developing countries have been rather well documented in Iran,²⁾ India,³⁾ Thailand,⁴⁾ and Singapore.⁵⁾ Those studies have revealed worker exposure to serious levels of noise. Therefore, in

order to determine the need and appropriate ways of improving noise problems, the noise hazards in a large-scale textile mill in Thailand were investigated on the basis of interviews, noise measurements, and audiometric tests.

MATERIALS AND METHODS

General features of the mill

The mill surveyed was located in Samut Prakarn Province close to Bangkok. It was a large-scale mill with 1,611 workers. The mill consists of 4 factory buildings. They process raw cotton yarn into fabrics. Work hours are 8 hours a day, and a weekly rotated three-team three-shift system was adopted. Sunday is a holiday. As shown in Table 1, the majority of workers are female.

Workers

Fifty-five employees working outside the factory, such as drivers, housemaids, janitors, were excluded from the noise survey. All of the rest of the workers ($N = 1,556$) were divided into three groups according to noise exposure level, i.e., (1) workers in the weaving section, (2) office workers, and (3) other mill workers. Number of workers, their mean ages, and mean length of employment are shown in Table 1. In the weaving section, most of male workers were engaged in machine maintenance while female workers were engaged in weaving. Neither male nor female workers leave their work places until their shift is over except when going to the toilet for a few minutes or taking an hour long break for a meal. Thus, they were exposed continuously to severe noise stemming from weaving machines. Other workers are doing various factory work such as warping, winding, spinning, dyeing, inspecting, and drawing with less exposure to noise than weavers.

Interview survey

All employees were personally interviewed. Interview items consisted of age, length of employment, work section, exposure to noise, subjective symptoms, use of personal noise protective devices (PPD), and reason for or for not using them. The interviews were conducted by trained Thai university students. Chi-square analysis was applied to evaluate the relative significance of the frequency of

Table 1. Work sections

Section	No. of workers			Age (mean $\pm$ S.D.)	Work years (mean $\pm$ S.D.)
	male	female	total		
Weaving	177	436	613	29.0 $\pm$ 6.0	7.9 $\pm$ 4.3
Office	32	73	105	32.3 $\pm$ 8.4	7.4 $\pm$ 4.2
Other mill workers	191	622	813	28.3 $\pm$ 4.9	7.9 $\pm$ 3.8

symptoms in various work sections.

Noise Measurement

Major noise sources were weaving machines and other machines which produced steady noise. Level and character of noise were measured with a Sound Level Meter (Model NA-20, Rion, Japan) on A-weighting and Octave Filter Unit (Model NX-01, Rion, Japan). Noise measurements were carried out in the passageways between machines where workers were engaged in performing their jobs. Noise levels at 107 sites in the weaving sections and 42 sites in other sections were measured.

Audiometric tests

After the tympanic membranes of workers were examined clinically using an otoscope, audiometric tests were performed. Those diagnosed as having ruptured tympanic membranes consisted of 5 weavers, 9 other mill workers, and 1 office worker. They were all excluded from the study. The tests were performed before the workers entered their workshift to prevent contamination of hearing level data with temporary threshold shift due to recent noise exposure. The tests were performed in a quiet room in the factory, because we were not allowed to take the workers outside the factory. The background noise level in the examination room was 55 dBA. After instructing the workers, all of the audiometric tests were carried out using the 5 dB-step method. The audiometer (Model 1707, Grason-stadler, Sweden) was calibrated both before and after testing the subjects. All of the hearing tests were carried out by the same researcher who had been trained on audiometric techniques. Student t-tests were calculated for mean hearing level data to evaluate relative significance among different working sections.

RESULTS

Interview survey

As shown in Fig. 1, ear distention and speaking in a loud voice were the most common subjective symptoms in the surveyed mill. It was found that the prevalence of symptoms was highest among weavers. As shown in Fig. 2, younger weavers tended to complain more frequently of subjective symptoms of ear pain, ear distention, and tinnitus.

Noise measurement

In the weaving section, the mean noise level at 107 measurement points was 101.3 ± 2.7 dBA (S.D.), i.e., above 90 dBA, the threshold limit stated in the Thai labor law. The range of values was 92 to 104.5 dBA. In other sections, the

Fig. 1. Subjective symptoms due to noise; percentage of respondents. Relative significance of office groups are shown by chi-square analysis. ** $p < 0.01$, * $p < 0.05$.

Fig. 2. Subjective symptoms of weavers according to length of employment; percentage of respondents.

mean at 42 measurement points was 89.8 ± 5.3 dBA. The range of measured values was 78 to 100 dBA.

Audiometric test

As shown in Fig. 3, workers in the weaving section had significantly greater hearing loss than office workers and other mill workers. The audiograms of weaving workers turned out to be typical of hearing loss induced by noise exposure, the greatest hearing loss occurring at 4000 Hz. The hearing levels of weavers were worse than those of office workers and the differences were statistically significant ($P < 0.01$) at every frequency. Compared with office workers, other mill workers also had significantly poorer hearing levels ($P < 0.05$) at every frequency. As shown in Fig. 4, the hearing levels of weavers were lower the longer they had worked. The hearing levels of the longest employed group (more than 10 years; mean worker age $\pm$ S. D. 33.8 ± 5.5) were worse than those of the shortest employed group (less than 4 years; mean age 24.3 ± 4.2) and the difference was statistically significant ($P < 0.01$) except at 1000 Hz. Significant differences were also detected between the middle group (5 to 9 years; mean age 27.3 ± 3.9) and the shortest group at 4000 Hz ($P < 0.01$) and at 8000 Hz ($P < 0.05$). It was noteworthy that many of the young workers in their 20's and 30's had already developed noise-induced hearing loss.

PPD usage

Attitudes toward PPD usage in 469 weaving workers were surveyed. Among them, 215 workers (45.8%) answered that they often use PPDs, 73 (15.6%) sometimes use them, and 181 (38.6%) never use them. There were no differences in average length of employment among the three groups, i.e., there were 7.5 ± 4.0 in the "often use" group, 8.4 ± 4.3 in the "sometimes use" group, and 8.7 ± 4.7 in the "never use" group. Table 2 shows the reasons why 181 workers never use PPDs. Annoyance was the most prevalent reason. Fig. 5 shows a significant difference in hearing levels in weavers who used or failed to use PPD for noise. The "never use" group had significant hearing loss ($P < 0.01$) at frequencies of 2000 Hz, 4000 Hz, and 8000 Hz compared to the "often use" group. Compared with the "sometimes use" group, the hearing levels of the "never use" group were significantly worse at 2000 Hz ($P < 0.01$), 4000 Hz ($P < 0.05$), and 8000 Hz ($P < 0.05$). A striking finding was that even workers using PPDs were found to have hearing loss.

DISCUSSION

In the present study, it was found that weavers in the textile mill surveyed were exposed to serious levels of noise, i.e., above 90 dBA, the threshold limit value set by the Thai labor law. This was the first noise and hearing loss survey

Fig. 3. Mean hearing levels of various workers.

Fig. 4. Mean hearing levels of weavers according to duration of employment.

Table 2. Reason why PPD was never used

Reason	No. of respondents
Annoyance	142 persons
Accustomed to environment	16
PPD not given	12
No noise	9

Fig. 5. Mean hearing levels of weavers with or without PPD usage.

at this textile mill and no actions, except for PPD, have been taken to prevent noise hazards, e.g., reduction of consecutive exposure or work rotation. The audiometric test revealed that noise-induced hearing losses with subjective symptoms were especially prevalent among weavers. The longer they had worked the more their hearing levels had decreased. Though the present study was not conducted in accordance with the ISO's recommendation⁶⁾ due to unavailability of sound-proof rooms, in spite of this constraint, obvious noise-induced hearing loss was detected. It was striking that young workers in their 20's to 30's had already developed noise-induced hearing losses.

Hearing loss developed even in the group of workers who used PPDs. The same phenomenon was described in a Singapore study⁵⁾. One possible reason is that PPDs produced in the developed countries might not be well suited to Thai workers. Another possible reason is that several workers who answered that they use PPDs utilized only cotton plugs and they are not effective.

When considering the cause of noise problems, there are several relevant

factors. First, the source of noise should be considered. In the mill surveyed, the used machines were usually imported from developed countries. Moreover, less space was provided between machines to increase productivity resulting in a serious noise level of 101.3 dBA in the weaving sections. These negative effects of technology transfer were the first cause of noise hazards. Before using PPD, the possibility of reducing noise levels and exposure time should be considered.

Second, the noise problems shown in the present study were also related to underprivileged working conditions. In the previous survey, we pointed out that the lack of appropriate information transfer and work organizations was essential to occupational safety and health problems in Thailand.⁷⁾ Workers at the mill surveyed had less opportunity to receive the necessary information on noise hazards and be motivated to promote occupational health.

Third, workers' attitudes toward PPD usage suggested some important aspects from the viewpoint of occupational health promotion. 38.6% of weavers answered that they never used PPDs. The main reason they offered was annoyance. However, since workers' inconvenience due to noise was obvious through audiometric and interview surveys, appropriate work organization activities and education would motivate occupational health promotion. Since a recent study performed in Asia revealed that priorities for improvement were interrelated,⁸⁾ workers' and managements' self-generated comprehensive work organization activities as well as noise prevention programs appears to be essential.

In conclusion, in the textile mill surveyed, noise problems were found to be serious. To cope with the problems, self-generated work organization activities integrated with several occupational health promotion needs as well as noise prevention programs are required. In order to provide for an exchange of views, to obtain more information and promote necessary improvements in the local settings, the establishment of an action-oriented safety and health committee through managements' awareness and workers' involvement is recommended as a first step.

ACKNOWLEDGMENTS

The authors wish to express their appreciation to Prof. M Wongphanich, Mahidol university, Thailand, and Prof. T Takano, Tokyo Medical and Dental University, Japan, for their kind encouragement during this study, and also to Dr. Norio Kurumatani, Nara Medical University, Japan, and Ms. Sudsawat Ruangsrimun and Ms. Piyasiri Ruangsrimun for their technical advice and assistances.

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