Noise Levels and Hearing Ability of Female Workers in a Textile Factory in Vietnam

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Abstract: Noise and hearing ability profiles were determined in a textile factory in Vietnam. Noise mapping done in the weaving section showed that the noise levels exceeded the Vietnamese standard of 90 dBA by as much as 9 dBA in some areas. Audiometric tests performed on 69 female workers from the weaving section revealed that workers with more than 10 years of noise exposure had the worst hearing threshold levels at 1,000 and 4,000 Hz. Similar findings were observed for workers greater than 35 years old. The 4,000 Hz notch, suggestive of exposure to intense noise, was noted in the audiograms of 26 subjects.

Key words: Noise, Hearing ability, Textile factory, Vietnam

An earlier survey of working conditions in 10 manufacturing companies in Vietnam showed that noise is one of the most common health hazards in the workplace. Two textile factories were included in the study. An average of more than 50% of the workers who participated in the questionnaire survey replied that they were exposed to noise in the workplace5. Thus, it is not surprising that noise-induced hearing loss (NIHL) ranks 2nd and accounts for about 11% of all workers suffering from occupational diseases5.

In the context of preventing the onset and progression of noise-induced hearing loss (NIHL), the noise level in the workplace and the status of the hearing ability of the workers should be known. This study investigated these factors in a textile factory in Vietnam.

Sixty-nine (69) female workers from the weaving section of a textile factory in Hanoi were selected as subjects of the study. The mean age of the subjects is 29.4 ± 7.5 years. The mean duration of employment in the weaving section is 10.3 ± 7.5 years. All subjects work in one of the three 8-hr work shifts implemented in the factory. All subjects have no history of ear protective equipment use.

Noise in the weaving section emanated from over 500 weaving machines imported from China, South Korea and Russia. Noise levels were measured using an integrating sound level meter with octave filter (NL-01A, Rion, Japan). The measurements were evaluated using the Vietnam National Standard TCVN 3150-79, which is equivalent to the ISO recommendation for acoustics-determination of occupational noise and estimation of noise induced hearing impairment (ISO R 1999). To evaluate the hearing ability of the subjects, pure-tone air conduction audiometric tests were done using Audiometer AA67 N (Rion, Japan) at 6 frequencies, i.e., 250, 500, 1,000, 2,000, 4,000 and 8,000 Hz. Test at each frequency was performed separately for each ear. The subjects were
examined after cessation of noise exposure for more than 6 hr. The examinations were conducted in a quiet room with a background noise level less than 40 dBA. To rule out the presence of hearing loss from other causes, an otologic examination was done on all subjects. Subjects with histories of ear disorders were excluded from this study.

The audiometric tests were evaluated using the classification of hearing loss developed by Busquet and Mottier\(^5\) and Nguyen\(^6\) (see Annex). Results of the audiometric examination were related to the duration of work in the weaving section and the age of the subjects. One-way analysis of variance on ranks was used to determine significant differences in the hearing threshold levels among the age groups and work duration groups. Results of the ANOVA were subjected to Dunn's method of multiple comparison to determine significant differences between levels of the grouped variables. Statistical tests with \(p < 0.05\) were considered significant.

The plant layout of the weaving section grouped the machines coming from the same manufacturer in the same area. Noise measurements were taken in these 4 areas which correspond to 4 types/manufacturers of weaving machines. The number of machines per area is as follows: 100 units of China-made shuttlelooms (for broad width cloth production); 400 units of China-made shuttlelooms (for narrow width cloth production); 30 units of South Korean-made shuttlelooms; and 20 units of Russian-made shuttlelooms. The results of the noise level measurements are shown in Table 1. The noise levels in all areas exceeded the permissible level of 90 dBA\(^3\). Octave band analysis showed that the permissible levels for noise were exceeded at 1,000 Hz, 2,000 Hz, and 4,000 Hz.

The hearing levels of the subjects were adjusted to account for the effect of aging. The method was adapted from the data of Spoor\(^7\). The hearing threshold levels of the better ear were used for analysis. Results are presented as mean values at every frequency tested.

The results of the audiometric examinations showed that the hearing threshold levels were significantly higher at frequencies 1,000 \((p < 0.05)\) and 4,000 Hz \((p < 0.01)\) for subjects with the longest duration of employment (Fig. 1). Multiple comparison of the different duration groups showed that deterioration in hearing became prominent after 10 years of employment in the weaving section \((p < 0.05)\). Hearing threshold levels for subjects belonging to age groups \(\leq 5\) years and \(>5\) years but \(\leq 10\) years of employment were not significantly different for all frequencies.

Comparison of the different age groups showed that the hearing threshold levels were significantly higher among the subjects \(>35\) years old at 1,000 \((p < 0.01)\) and 4,000 Hz \((p < 0.01)\) (Fig. 2). At other frequencies, no significant differences in the mean hearing levels were noted among the different age groups.

Analysis of the audiometric tests conducted showed that 23% of the subjects (16 out of 69) examined suffer from varying degrees of hearing impairment (Table 2). Fourteen out of the 16 cases were classified to have slight degree of hearing impairment while the remaining 2 cases have moderate degree of impairment. The prevalence of hearing impairment increased with the increase in the duration of employment. Fifty percent (50%) of the cases worked for more than 10 years. The 2 most advanced cases of hearing impairment worked as weavers for 9.4 and 22.9 years, respectively. Two cases of slight hearing impairment had worked for less than 5 years in the factory.

Hearing impairment was also related to the age of the subjects. Subjects who were more than 35 years old accounted for about 44% of all cases of hearing impairment noted. The most advanced cases also belonged to this age group. Nonetheless, it is interesting to note that workers who are less than 30 years old have already developed slight impairment in their auditory faculties.

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Table 1. Result of noise survey in the weaving section

<table>
<thead>
<tr>
<th>Surveyed areas</th>
<th>Number of units</th>
<th>Sound level (dBA)</th>
<th>Equivalent continuous Sound Pressure Level (*), (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. shuttleloom for broad width cloth (China-made)</td>
<td>100</td>
<td>98</td>
<td>78 81 81 86 93 94 92 84</td>
</tr>
<tr>
<td>2. shuttleloom for narrow width cloth (China-made)</td>
<td>400</td>
<td>99</td>
<td>77 83 82 87 93 94 92 84</td>
</tr>
<tr>
<td>3. shuttleloom for broad width cloth (South Korean-made)</td>
<td>30</td>
<td>94</td>
<td>78 84 87 89 89 89 86 77</td>
</tr>
<tr>
<td>4. small shuttleloom (Russian-made)</td>
<td>20</td>
<td>92</td>
<td>99 83 86 85 86 86 84 77</td>
</tr>
<tr>
<td>Permissible noise level** (for 8 hr)</td>
<td></td>
<td>90</td>
<td>103 96 91 88 85 83 81 80</td>
</tr>
</tbody>
</table>

\*\(L_{eq}\) values. **in accordance with the Vietnamese standard TCVN 5964-1995.
Fig. 1. Hearing threshold levels (HTL) by duration of employment

*D Dunn’s multiple comparison statistically significant at p<0.05 for measurements done at 1,000 Hz. mean HTL (>10 years) > (≤5 years) and (>5 ≤10 years). *b Dunn’s multiple comparison statistically significant at p<0.05 for measurements done at 4,000 Hz. mean HTL (>10 years) > (≤5 years) and (>5 to ≤10 years).

Fig. 2. Hearing threshold levels by age

*a Dunn’s multiple comparison statistically significant at p<0.05 for measurements done at 1,000 Hz. mean HTL (>35 years) > (≤25 years old); (26–30 years old) and (31–35 years old). *b Dunn’s multiple comparison statistically significant at p<0.05 for measurements done at 4,000 Hz. mean HTL (>35 years) > (≤25 years old); (26–30 years old) and (31–35 years old).
The audiograms were also evaluated for characteristics suggestive of changes due to noise. The typical notch at the 4,000 Hz was noted in 26 subjects. The mean duration of employment was longer among those with the notch than those not exhibiting the feature but the difference was not statistically significant (with the notch: 11.5 ± 7.4 years; without the notch: 9.6 ± 7.1 years; p=0.21).

Based on the results of this study, it can be gathered that noise is a serious health hazard in this textile factory. The noise mapping performed at the area of the 4 groups of weaving machines showed that, for most part of the 8-hr work day, the noise levels always exceeded the permissible levels set by the Vietnamese standard by as much as 9 dBA. Daily exposure of the subjects to these levels of continuous noise put them at risk of developing noise-induced hearing loss.

The profile of the hearing ability of the workers revealed that the length of employment is an important factor in the development of hearing loss. The hearing threshold levels of workers employed for more than 10 years were worse than for those employed for a shorter period of time. This finding conforms to the results of other studies that showed the relationship between progression of hearing loss with continuous exposure8, 9).

Contribution of aging on the deterioration of hearing among the workers cannot be totally ruled out despite the age-adjustment performed. The trends in the results where hearing levels were related to exposure duration and age were the same. Helmkamp et al.10 have also indicated that the interaction between presbycusis and noise-induced hearing loss is not clear and that their effects are not additive.

The methodology employed in this study is also a limiting factor in the definitive diagnosis of permanent threshold shift among the subjects. Some subjects were away from noise for just over 6 hr. Recovery from temporary threshold shift may, most likely, not have been complete.

The role of non-occupational or past occupational exposures to factors that may produce hearing loss cannot also be totally eliminated. The inability to collect the pertinent information on these variables was another limitation.

The definitive diagnosis of NIHL lies in the difference between the baseline and subsequent audiograms8, 11). In this study, comparison of the audiometric test results to a previous measurement cannot be done because this was the first time an audiometric examination was conducted among the workers. It is also hard to ascertain the type of hearing loss (whether conductive, sensorineural or mixed) present in some of the subjects because no bone conduction tests were done12. Nonetheless, the presence of the characteristic notch at 4,000 Hz in about 38% of the subjects is a good indication that indeed noise may be a primary cause of the hearing loss among these cases.

From the viewpoint of disease prevention, this study will be most useful as a situationer in drawing up an appropriate hearing conservation program in the factory. The noise mapping has provided adequate information on the source and intensity of noise. The audiometric examinations have identified workers with some degree of hearing impairment whose hearing ability should be guarded from further insult. Likewise, these results have also identified workers whose auditory faculties may be prevented from deteriorating because of the hazard in the workplace.

### Annex

Classification of hearing loss according to Busquet and Motier9 and Nguyen Thi Thoan9).

Calculation of hearing loss in dB is done using the formula below:

\[
\text{Hearing threshold levels (HTL) at } \left(\frac{500 \text{ Hz} + 1,000 \text{ Hz} + 2,000 \text{ Hz}}{3}\right) \\
\]

The results are classified into degree of hearing impairment based on the table below:

<table>
<thead>
<tr>
<th>Degree of hearing impairment</th>
<th>Hearing loss in dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt;20</td>
</tr>
<tr>
<td>Slight</td>
<td>20 – &lt;40</td>
</tr>
<tr>
<td>Moderate</td>
<td>40 – &lt;70</td>
</tr>
<tr>
<td>Severe</td>
<td>70 – &lt;90</td>
</tr>
<tr>
<td>Profound</td>
<td>≥90</td>
</tr>
</tbody>
</table>

Note:
1. For all degrees of hearing impairment, if the difference between the HTL at 500 and 2,000 Hz is 40dB,
calculations will be done using the following formula.

\[
\text{Hearing threshold levels at } \frac{(500 \text{ Hz} + 1,000 \text{ Hz} + 2,000 \text{ Hz} + 4,000 \text{ Hz})}{4}
\]

2. For severe and profound hearing impairment, if the HTL at 4,000 Hz is lower than that at 2,000 Hz, the value for 2,000 Hz will be replaced by the value for 4,000 Hz in the computation.

References


