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Noise Induced Hearing Loss Among Cotton Textile and Carpet Mill Workers

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Abstract: In industry increased mechanisation results in increased noise levels. Operation of textile machines carries a high risk of hearing loss. In this study the evaluation of textile worker's noise induced hearing loss was reviewed cross sectionally. The hearing of 260 textile workers exposed to noise levels between 85-95 dB(A) in carpet and cotton textile factories was assessed by means of air and bone conductance audiograms obtained. The subjects were grouped into five hearing categories according to hearing thresholds at 125 to 8000 Hz with Klockhoffs classification. The prevalence of the grade-3 hearing loss was 47.92% and grade 4-5 was 9.21% on exposed subjects in both factories. There was significant differance between exposed and unexposed control subjects working in the same factories ($p<0.001$). Also age and working section factors were evaluated.

Key Words: Noise Induced Hearing Loss, Textile Workers

Introduction

One of the major stresses with which industrial workers must cope is excessive noise exposure. The occupations that carry a particularly high risk of hearing loss include: mining, tunelling, quarring, heavy engineering, operation of textile machines (1). Noise induced hearing loss is an irreversible and incurable disease. Prevention is of primary importance. Since the disease develops slowly over the years and since the firs signs areeadily detected by simple audiometric examinations, it can be said that the basic principle for medical prevention is the periodic audiometric examinations (2). Clearly, this basic medical practice should be followed up by a series of environmental and organisational preventive measures required to remove the affected worker from the hazardous working environment. Assuming workers in Diyarbakır Sümerbank Cotton Textile and Carpet Mill are exposed to high levels of noise there should be high prevalence of noise induced hearing loss. Determining whether there is hazardous level of noise exists at the working area and prevalence of affected workers this study was performed.

Materials and Methods

Diyarbakır Sümerbank Cotton Textile and Carpet Mills were the place where the study was conducted employed 321 (190 in cotton textile, and 131 in carpet mill) subjects. All of the 264 production workers and 57 nonproduction subjects were invited for the study. Of the production workers 217 (78.40%) and nonproduction workers 43 (75.43%) were assessed in the study. A questionare was administered to elicit information about medical history, particularly of disease that could impair hearing.

Noise Assessment: The noise levels in the workplaces were assessed during production period using Cel-231 Type 2A sound level meter. Six measurements were taken for each production unit, these were at the middle and end of each workshift at the begining, middle and end the work week. The locations where readings were taken were at the entrance, in the middle of the production area and at the end of the production floor.

Audiograms: All the audiograms were obtained by a certified audiometricians. The audiograms were taken before the workers entered the work area, in a room with background noise level of 30dB(A). Thus the workers had been away from noise more than 16 hours. This should help us to show the distinction between PTS (permanent threshold shift) and TTS (temporary threshold shift). Becouse TTS usually disappeares less than 16 hours after exposure. Both air and bone

Table 1. Distrisution of the subjects by age groups.

Age	n	mean hearing at 4000 Hz
26-34	68	30.07±14.33
35-34	64	32.26±15.42
40-44	53	34.90±16.12
45+	31	38.00±15.57

F=2.22, p>0.05

conductance audiograms were obtained to rule out the posibility of conductive deafness. The audiograms were obtained over a range of octaveband frequency from 125-8000 Hz.

The subjects were grouped into five hearing categories according to hearing thresholds at 125 to 8000 Hz with Klockhoffs following classification criteria (3):

1. No hearing loss exceeding 20 dB in either ear at all test frequencies

2. Hearing loss in the range of 20-30 dB in at least one ear at one or more frequencies

Table 2. Noise Measurements at Different Sections

SECTİONS	dB(A)
Carpet Factory	
Wahsing section	55
Dye section	55
Couldren section	80-85
Sewing section	90-95
Weaving	95-100
Finishing	80-85
Quality Control	55
Cotton Textile	
Openning, Scutching, Carding	80-85
Spinning, winding	95

3. Hearing loss larger than 30 dB in at least one ear at one or more frequencies, but the impairment does not fulfill the criteria for 4 or 5

4. A mean hearing loss in at least one ear greater than 35 dB at 500 to 2000 combined with a mean hearing loss larger than 40 dB at 4000 and 8000 Hz, but the impairment does not fulfill the criteria for category 5.

Table 3. The ratios of the Different NIHL Catogories in Production and Non-Production Subjects and in Different Exposed Groups

	NIHL-1	NIHL-2	NIHL-3	NIHL-4,5	Total	
Carpet Mill Production	11 (11.70)	27 (2.872)	47 (50.00)	9 (9.57)	94	χ^2_1=0.54 p>0.05
Cotton Txt. Production	18 (14.63)	37 (30.08)	57 (46.34)	11 (8.94)	123	
Total Production	29 (13.36)	64 (29.49)	104 (47.92)	20 (9.21)	217	χ^2_2=26.163 p<0.001
Control	17 (39.53)	18 (41.86)	7 (16.27)	1 (2.32)	43	
Total	46	82	111	21	260	
Group-1	11 (29.72)	10 (27.02)	12 (32.43)	4 (10.81)	37	χ^2_3=12.029 p<0.05
Group-2	10 (11.49)	16 (25.39)	32 (50.79)	8 (12.69)	63	
Group-3	11 (8.66)	38 (29.92)	60 (47.24)	8 (6.29)	117	χ^2_4=0.26 p>0.05

χ^2_1= Carpet mill versus Cotton textile, χ^2_2= Total Exposed Subjects versus control, χ^2_3=Group-1 versus Group-2 and Group-3, χ^2_4=Group-2 versus Group-3

Figure in parantesis are percentages of the subjects.

Group-1=Subjects working in units noise level below 80 dB(A), Group-2=Subjects working in units noise level between 80-85 dB(A), Group-3=Subjects working in units noise level above 85 dB(A).

Table 4. Duration of employment and hearing levels of right ear at 4000 Hz.

Years	N	Hearing at 4000 Hz
7-9	27	29.07±15.87
10-14	120	33.41±15.81
15-19	45	33.77±14.81
20+	25	34.13±14.19

F=0.68, p>0.05

5. A hearing loss in at least one ear, greater than 40 dB at 2000 Hz and with a mean hearing loss greater than 50 dB at 4000-8000 Hz.

Results

260 subjects were identified; their average age was 37.76±5.84 (minimum 26 and maximum 54). Table 1 shows the distrubition of subjects by age groups and mean hearing levels of right ear at 4000 Hz frequency for each age group. There was no statisticaly significant difference between age groups (ANOVA, F=2.22, p>0.05).

Daily duration of noise exposure was 7.5 hours for all of the workers in both factories. The noise levels of different sections was shown in table 2. In the factories there were no noise-reduction measures and beside this, workers had no addition to use protective devices.

Table 3 shows the NIHL (Noise Induced Hearing Loss) ratios of the two factories and control (non-production unit) subjects. The prevalence of the grade-3 NIHL was 46.34%, and grade 4-5 was 8.94% on exposed subjects in cotton textile mill was not different from exposed subjects working in carpet mill (grade-3 50.00% and grade-4,5 9.57%) (p>0.05). But there was a significant difference between control subjects and total exposed subjects (p<0.001).

Duration of employment is another factor effecting prevalence of noise induced hearing loss. In this study majority of the subjects' (87.56%) employment duration were more than 10 years and their hearing levels were not statistically different from each other as it shown in table 4.

Table 5 shows workers with or without NIHL at three levels of noise exposure. The analysis was stratified for four different age groups. Age adjusted odds ratios for subjects working in units noise level more than 85dB(A) was found 4.16. This ratio was not so different from subjects working in units noise level between 80-85 dB(A) (3.16). NIHL risk level of control subjects (non-production subjects and production subjects working in noise level below 80 dB(A)) was significantly different (p<0.05). The prevalence of NIHL was %66.67 (16 of 24 subjects) in exposed subjects older than 44 years was significantly different from the NIHL prevalence in unexposed subjects at the same age group (%30.76, 4 of 13 subjects) (p<0.05).

Table 5. Distribution of NIHL at different levels of noise exposure, at different age groups.

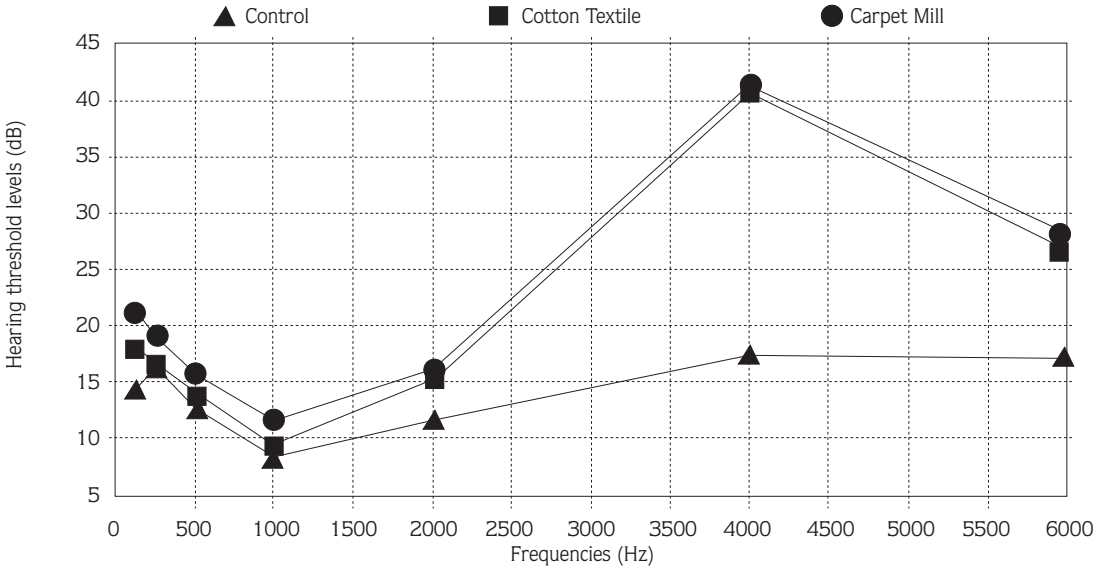
Noise level	<34 years		35-39 years		40-44 years>		44 years			
	NIHL(-)	NIHL(+)	NIHL(-)	NIHL(+)	NIHL(-)	NIHL(+)	NIHL(-)	NIHL(+)	Total	odds
<80dB(A)	22	7	12	4	13	9	9	4	80	1
80-85 dB(A)	5	9	10	7	7	11	5	9	63	3.16
>90 dB(A)	19	20	14	31	7	16	3	7	117	4.16
Total	46	36	36	42	27	36	17	20	260	

Figure 1 shows comparison of the mean hearing threshold levels (dB) of control subjects with carpet mill and cotton textile factory workers. 4000 Hz notch was plotted in carpet mill and cotton textile workers audiograms.

Discussion

This study has shown that the NIHL ratio was significantly more prevalent on the exposed subjects in

Figure 1. Mean hearing levels (dB) at different frequencies.



the cotton textile and carpet factory compared with nonproduction subjects. U.G.Oleru et al also found significant difference between production and non-production subjects (4). O.Y.Chan et al reported NIHL ratio 26.3% on the subjects exposed noise level between 87 and 98 dB(A) (5). It is impossible to establish any clear cut distinction between "safe" and "unsafe" noise exposure. Generally, limits areset with the intension of protecting 90% or more of an exposed population (6). David M.Barrs et al found minimal NIHL notch at 3 to 6 kHz in approximately one third (37%) of the workers in their study even though they had no symptoms (7). It is now accepted that the risk of hearing damage is negligible at noise levels of <75 dB(A) for a daily exposure of 8 hours and even at exposure levels up to 80 dB(A) there is no detectable increase in the percentage of subjects with hearing impairment (1) we found differance between subjects working in units noise level below 80 dB(A) and other exposed groups (80-85 dB(A), above 85dB(A). In this study it was shown that NIHL prevalance on workers exposed noise level below 80 dB(A) was not negligible (grade 3: 32.43% and grade 4-5 : 10.18%). Not using of protective devices, non-existense of noise-reduction measures might explain the high prevalance of the NIHL in our study group. It was illustrated in the Swedish industries that, noise-reduction measures and the more common use of the hearing protectors had reduced hearing damage among younger workers (8).

Age is an confounding factor on hearing loss. Presbycusis is the loss of hearing that takes place with increasing age (6). The influence o fage has purely additive effect on the primary noise induced hearing loss (9). To show the effect of noisy environment, age factor must be adjusted. We calculated age adjusted odds ratio by using Mantel Haezsel Extended Chi Square Analysis and we found significant difference between production and non-production subjects (Table 2, $p<0.05$). To show the effect of noise in work place A.Ivarsson et al. compare the prevalance of NIHL in the age group >50 years exposed with unexposed group. Only 8-28% of the subjects hear normally in the exposed group, while 70% had normal hearing in the non-exposed group (8). In our study we also found difference between unexposed and exposed subjects in age group >44 years. As it shown both in our study and the others age has an little additive effect on NIHL. Moreover Donald Hendersan et al reported that age can only acount for minor amount of variability across the subjects in their susceptibility to NIHL (10).

U.G.Olero et al reported that hearing threshoulds for the exposed subjects increased with both age and duration of employment and were significantly correlated ($r=0.26$, $p>0.05$) with duration of employment (4). Günter Rösler reported compilation of 11 investigations by different authors regarding the progression of hearing deterioration during severe long-term exposure to noise. In all of this investigations it was found that the duration of employment was the most decisive cause for pronounced hearing loss increase (9). In our study we found a weak correlation between duration of

employment and hearing level. This might be explained by the long duration of employment. In our study group the majority of the subjects' employment durations were more than 10 years. It should be meaningful to compare todays hearing levels with first attending hearing levels but we had no data about the hearing levels of the subjects' before they had attended the factory years ago.

References

1. Hearing Impairment Caused by Noise. Early Detection of Occupational Disease. WHO pub., Geneva 165-70, 1986.
2. Merluzzi F: Deafness, Occupational. Encyclopedia of Occupational Health and Safety (Thir Edition), Tec. Edit. Luigi Parmeggiani Volume 1: ILO pub., Geneva, 593-96, 1983.
3. Klockhoff I, Lyttkens L, Svedberg A: Hearing Damage in Military Servise. Scandinavian Audiology. 15: 217-22, 1986.
4. Olero UG, Ijaduola GTA, Sowho E: Hearing Threshold in an Auto Assembley Plant: Perspects for Hearing Conservation in an Nigerian Factory. Int. Arch. Environ. Health. 62: 199-202, 1990.
5. Chan OY, Lee CS, Than KT: Health Problems Among Spice Grinders. Journal of Social Occupational Medicine 40: 111-15, 1990.
6. Olishifski JB: Occupational Hearing Loss, Noise and Hearing Conservation. Occupational Medicine. Second Edition, Edit by Carl Zenz. Year Book Medical pub. 1989 Chicago.
7. Barrs MB, Altthoff LK, Krueger WWO, Olsson JE: Work Related Noise Indused Hearing Loss: Evaluating Including Evoked Potential Audiometry. Otolaryngology-Head and Neck Surgery 110: 177-84, 1994.
8. Ivarsson A, Bennrup S, Toremalm NG: Models for Studying the Progression of