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PARAMETERS AFFECTING NOISE INDUCED HEARING LOSS IN INDUSTRY*

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ABSTRACT

The paper is based on a study conducted in three different industries on 844 of their employees to determine the effect of over all noise intensity, length of employment and rest periods among them.

It was found that the mentioned factors have direct effect on the induced hearing loss among the exposed workers. High noise level and long period of employment adversely affecting the hearing ability while the breaks taken during daily working hours have prevented the expected defect.

INTRODUCTION

Hearing loss due to exposure to excessive industrial noise has been known for sometimes. In his book "De Morbis Artificum Diatriba", Ramazzini described way back in 1713 the loss of hearing which Copper-Smiths suffered from due to the noise made when hammering the metal. In the late 19th century a high proportion of workers making steam boilers were found to be the victims of severe occupational deafness. In 1927 Legge and Mcklive showed that 24.3 percent of cotton weavers in Lancashire, England were suffering from some

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degree of deafness. (1) The aim of this investigation was to explore how some factors as over all noise intensity, rest periods and length of employment affect the noise induced hearing loss of the workers.

METHODS AND MATERIALS

In all, 844 male workers in three working conditions were studied. Of these workers 267 were employed in an industry (No. 1) where the mean noise level was less than 85 dBA, standard recommended for 8 hours continuous work per day, 5 days per week (2), 296 in another industry (No. II) where the mean noise level was more than 85 dBA but the workers were allowed a 15 and 40 minutes rest per working day in a quiet room, without exposure to machinery noise, and 281 in a third industry (No. III) with a mean noise level more than 85 dBA. The workers were selected into the study on the basis of medical examination, completing a special questionair and considering the following criteria: (3)

a) external ear free from cerumen.
b) normal ear drum on otological examination.
c) no history of congenital or acquired conditions associated with sensorineural hearing loss.
d) no history of previous exposure to excessive noise.
e) no upper respiratory tract infection at the time of examination
f) Rinne test positive.

Hearing acuity was determined using a silent room and a manually operated pure tone Rion audiometer (model AA-271) calibrated to the ANSI - 1969 standard and checked frequently during the study. (4,5) Each ear of each worker was tested in the morning (rested ear) before the work-shift at the frequencies of 250, 500, 1000, 2000, 4000 and 8000 cycles per second (HZ). The noise level were measured 3 times in a day and 3 different days in a week in each of 24 positions distributed evenly over the shop floors. The noise level in a work shop was characterized in a single mean level obtained from averaging all measurements through out the floor. The noise levels in excess of 85 dBA were analyzed. The measurements were done by using Rion sound level meter (model NA-07A) and Rion ----$\frac{1}{3}$--- octave band analyser (model SA-56A). (6, 7).

RESULTS

The mean and standard diviation of noise level in the above industries are as follows:

Industry No. I, mean noise level 75.92 dBA, sd., 4.5

Industry No. II, mean noise level 94.15 dBA, sd., 1.35

Industry No. III, mean noise level 95.91 dBA, sd., 1.44

The analysis of noise in industries II and III where the mean level exceed 85 dBA are shown in figure I.

Table I reflects the age categories with the length of employment of the samples studied in all three industries. It is shown that the subjects in age group 20-29 were almost double the subjects in other groups and maximum length of service of most workers did not exceed 19 years. Hearing loss adjusted for age varied with different frequency, length of employment and work place (Table II), (8). In general hearing loss at all frequencies was related to the length of employment and the noisiness of the work place. (9)

DISCUSSION

Statistical analysis of the data obtained in the noise measurements in the work shops shows that noise levels in industry No. I were significantly lower than in industries No. II and III ($P < 0.001$). Whereas noise levels in the other two industries were almost the same considering their over-all intensity and spectra.

Comparing the findings reflected in table II it is realized that:

1. The hearing loss among the workers in industries number (I) and (II) is almost the same and the difference observed is not statistically significant.
2. But when both groups are compared with the workers of industry number (III) it is noticed that the loss is markedly different being much higher among the latter group and the difference is statistically significant, ($P < 0.01$ or $P < 0.05$). These differences can be explained as follows:
   It was pointed out that the overall noise intensity measured at industry number (I) was even less than the standard of threshold limit set for 8 hours continuous work per day, 5 days per week. On the other hand, it was found that the over all noise intensity at industry number (II) is higher than that

of industry (I) but inspite of that, the hearing impairments induced remains the same among the two groups. This discrepancy can be explained by the fact that the two daily breaks taken by the workers of industry number (II) have prevented the hearing loss that the mentioned workers otherwise had to suffer from. (10, 11, 12).

Also it is observed that though the parameters of length of employment, over all noise intensity and exposure of the workers in industries number (II) and (III) are almost the same, hearing impairment among the latter group is much higher and statistically significant. This can be another factor in support of the fact that the daily breaks or (rest periods) have been the elements in preventing hearing loss in industry number (II).

On the other hand the difference of induced hearing loss observed between workers of industries number (I) and (III) can be attributed to the higher noise level present at the latter while the other parameters are the same in both places. (13).

So it can be concluded that three factors of noise intensity, length of employment and rest periods during the work hours are important in affecting noise induced hearing loss.

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FIG. 1 SOUND PRESSURE LEVEL AND OCTAVE BAND ANALYSIS IN THE INDUSTRIES NUMBER II AND III

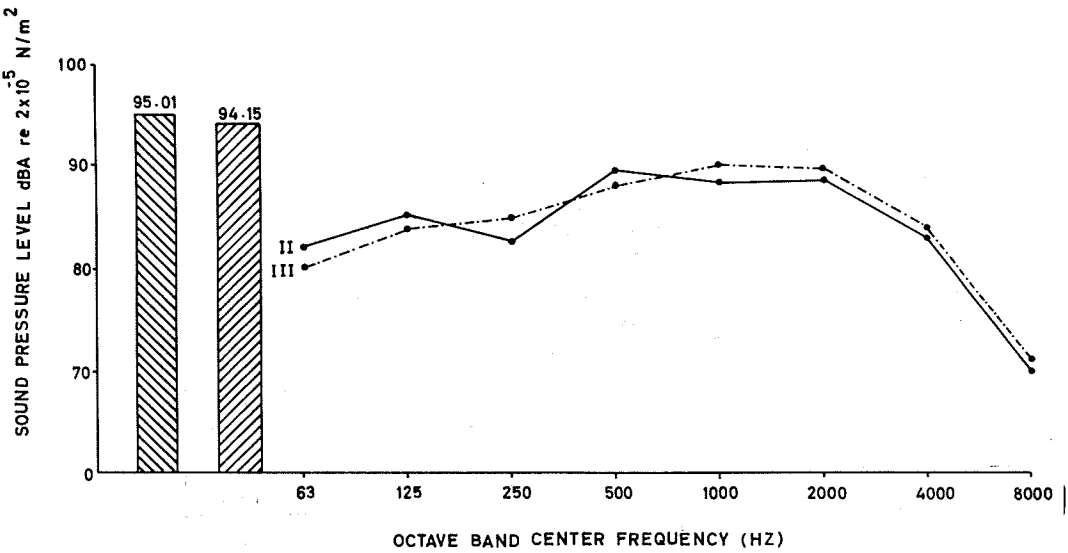

TABLE I
DISTRIBUTION OF THE WORKERS ACCORDING TO AGE, LENGTH OF EMPLOYMENT AND INDUSTRY

LENGTH OF EMPLOYMENT YEARS	INDUSTRY	AGE GROUPS YEARS					
		-19	20-29	30-39	40-49	50+	TOTAL
-9	I	41	44	1	-	-	86
	II	30	58	8	-	-	96
	III	35	54	4	-	-	93
10-19	I	-	34	39	3	-	76
	II	-	39	36	14	-	89
	III	-	33	43	10	-	86
20-29	I	-	-	14	28	8	50
	II	-	-	26	17	16	59
	III	-	-	19	22	11	52
30+	I	-	-	-	20	35	55
	II	-	-	-	24	28	52
	III	-	-	-	19	31	50
TOTAL	I	41	78	54	51	43	267
	II	30	97	70	55	44	296
	III	35	87	66	51	42	281

TABLE II
MEAN HEARING LOSS IN THE WORKERS OF DIFFERENT INDUSTRIES ACCORDING TO THE LENGTH OF EMPLOYMENT AND DIFFERENT FREQUENCIES

LENGTH OF EMPLOYMENT YEARS	INDUSTRY	FREQUENCY (Hz)					
		250	500	1000	2000	4000	8000
-9	I	5	5	5	7.50	12.64	5.80
	II	5.5	5.25	5.50	5.25	12.75	7
	III	19.02	17.80	11.73	14.11	36.92	13.97
10-19	I	9.12	8.95	6.79	11.42	18.21	10.25
	II	10.25	9.75	7.5	10.25	18.75	10.5
	III	20.80	20.28	15.43	16.90	44.56	20.43
20-29	I	12.75	13.12	13.83	14.12	21.87	14.12
	II	12.75	14.75	12.5	15.75	23.5	12.75
	III	23.62	23.52	20.04	24.41	53.33	26.37
30+	I	15.25	15	10.25	15.25	26.25	15
	II	15	15.75	15	17.25	28.75	15.25
	III	26.45	25.88	22.27	27.66	61.44	30.55