

A STUDY OF THE RISK OF EXPOSURE TO NOISE IN A TEXTILE INDUSTRY

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ABSTRACT

Seven hundred and fifty-one workers in a textile industry were examined to assess the permanent change in their hearing threshold. Air audiometry in the 4000 Hz frequency, a clinical survey and a measurement of the existing noise level were performed. It was found that 78% of the workers were exposed to noise, 41% of the total showed a threshold hearing loss of more than 35%, being 35 dB the normal hearing threshold in the 4000 Hz frequency. Better hearing in female subjects than in males is corroborated.

Occupational health is more and more concerned with the effect of industrial noise on workers. The levels of noise have increased since the early days of the industrial revolution. The textile industry, as well as some other industries, has been considered as a noisy industry².

Investigations of the noise levels affecting the workers health have been conducted in many countries. During the last years the increased number of studies of this physical risk allowed us to gain a better knowledge on this problem as well as to establish standards in different countries and organizations. However, due to differences in human sensitivity there are no standard criteria about the noise intensity threshold. Currently, the accepted criterion is 85 dB during 8 hours of exposure⁵.

Noise exerts a pathologic action on the nervous system, and specially on the hearing system; it also disturbs oral communication and induces behavioral changes, etc. Of all aspects the most intensively studied is the hearing pathology on which are based the established standards. The man himself constitutes a noise measuring system and the technology of noise measurement tries to measure it the same way as it is measured by the human ear. For this reason, our study will describe only the relation between the exposure levels and time and the hearing pathology.

Our country lacks the necessary studies to determine the incidence of the effect of this physical factor on workers' health; these data are essential for the establishment of national control programme for the control of this risk, as well as for the implementation of personal protective measures so important within this occupational environment.

SUBJECTS AND METHOD

The study was carried out in 46 workshops of a textile industry which comprised every job representing this production branch. All 751 workers were taken in the study.

The investigation comprised an interview with every worker to obtain the information about name, age and sex, years of work, years of exposure to noise, daily exposure time, pathologic background, use of personal protective devices.

A 2209 type Bruel-Kjaer sonometer provided with a calipter gauge was employed to make 5 determinations of noise level in dB in each workplace in the different areas. This balance filter was used because it has proved to be useful in determining the disturbance and the damage associated with the noise. In order to know noise characteristics, simultaneous frequency analyses within the 63 to 8000 Hz range were made. The areas were classified at the following levels: $NPS < 85$, $86 \leq NPS < 90$, and $NPS > 90$.

Each worker was subjected to an audiometric test in both ears. The tests were performed with a Claman and Grahnert, Dresden MA-10 audiometer. The test consisted in a screening for the 4000 Hz frequency, and the individuals were given a 14 hours minimal rest period. At the end of the workshift another audiometry was performed to determine the threshold temporary displacement (TTD). For the mean individual after ten years of exposure to intense noise during 8 hours, displacement runs parallel to permanent loss⁶.

Audiometric tests were performed in a room with the 37 dB background level established by other authors⁴. The technique employed consisted in giving the 4000 Hz signal to the individual so that he could identify it. Later, the sound stimulus was increased, starting from 0 in 5 dB ranges until the individual heard the sound; then the test was performed in the other ear.

RESULTS

Five of the 751 workers were dismissed due to disturbances in the hearing threshold produced by other causes of no interest to our study. Subsequently, only 746 workers present at the time the investigation was carried out were examined. The mean age of the workers was 30.5 years with a maximum of 68 years and a minimum of 17 years. The average exposure to risk of these workers was 7.7 years, with a maximum of 45 years and a minimum of 1 year. None of the workers used protective devices.

Noise measurements made in 25 different workshops showed noise levels under 85 dB. The maximum threshold of 8-hour daily exposure was accepted as not causing a pathological effect on hearing. In the remaining work areas, however, the workers were exposed to levels which may damage their health. Thirteen of the 21 workers worked at noise level between 86 and 90 dB, and 8 workers worked at levels over 90 dB.

The frequency analysis showed the most important range was between 500 and 8000 Hz. Besides, the levels found in the roving frame areas in the 4000 Hz frequency were similar to those found in the loom areas. We should emphasize

that the areas showing higher sound levels are those with a greater number of workers. As shown in Table 1, 71% of the workers (533) were exposed to the sound exposure risk.

TABLE 1
Workshops with risk levels and workers exposed.

		Noise level (dB)		
		< 85	86-90	> 90
Workshops (46)	N	25	13	8
Workers (746)	N	213	241	292
	%	28.5	32.2	39.1

The 10 workshops with the highest percentage of workers with a temporary threshold sound (TTS) over 6 dB were determined by carrying out audiometric tests on the workers at the end of their 8-hour shift to determine the temporary hearing threshold displacement. The workshops are listed according to their degree of risk in Table 2. There are 176 workers within these 10 working areas with a TTS over 6 dB. This implies a noise exposure which produces a subsequent progressive decrease in the hearing ability. These workers represent 41% of the total.

TABLE 2
Temporary threshold sound (TTS) in various workshops.

Workshop	N	dB level	Temporary threshold sound						Total
			<1	%	1-5	%	>6	%	
Doubling-frame and drawing frame	13	91	1	25.0	0	-	3	75.0	4
Looms	35	98	25	16.6	34	22.5	92	60.9	151
Reeling	34	88	2	15.4	5	38.5	6	46.2	13
Reeling	18	92	8	30.8	8	38.8	10	38.5	26
Loom	24	98	16	29.1	19	34.6	20	36.4	55
Roving frames and cone winders	11	93	3	25.0	5	41.7	4	33.0	12
Roving frames and cone winders	29	96	7	31.8	8	36.4	7	31.8	22
Carding	31	88	12	35.3	14	41.2	8	23.5	34
Reeling	28	89	21	48.8	17	27.9	10	23.3	43
Spinning frames	10	87	30	43.5	23	33.3	16	23.2	69

Regarding the determination of the hearing threshold, Table 3 shows there are 309 workers (41%) suffering from a loss over 35 dB. It is also evident that the longer exposure, the higher hearing losses are determined.

TABLE 3
Number of workers with hearing loss in relation to years of exposure.

Hearing loss (dB)	Years of exposure					Total
	< 1	1-2	3-5	6-10	> 10	
> 16	51	63	29	29	14	186
16-20	10	17	13	13	15	68
21-25	13	18	13	11	14	69
26-30	8	14	8	14	15	59
31-35	6	6	7	20	16	55
36-40	7	6	9	16	12	50
> 40	16	21	25	55	142	259
Total	111	145	104	158	228	746

There are 142 workers exposed for more than 10 years suffering from a decrease of over 40 dB in their hearing ability. Hearing threshold by sex after noise exposure is shown in Table 4. Two hundred and eighty nine (50% of the 580 male) workers present a decrease over 35 dB in the hearing ability, but only 12% of the female workers belong to those groups.

TABLE 4
Base audiometry in workers exposed to different noise levels.

Hearing threshold (dB)		Noise level (dB)						Total	
		< 85		86-90		> 90		Women	Men
		Women	Men	Women	Men	Women	Men		
< 16	N	26	43	42	35	13	27	81	105
	%	59.1	25.4	51.9	21.9	31.7	10.8	48.8	18.1
16-25	N	12	35	21	28	10	31	43	94
	%	27.3	20.7	25.9	17.5	24.4	12.4	25.9	16.2
26-35	N	2	30	12	26	8	36	22	92
	%	4.5	17.8	14.8	16.3	19.5	14.3	13.3	15.9
> 36	N	4	61	6	71	10	157	20	289
	%	9.1	36.1	7.4	44.4	24.4	62.5	12.0	49.8
Total	N	44	169	81	160	41	251	166	580
	%	100	100	100	100	100	100	100	100

DISCUSSION

Considering that the normal hearing threshold is 35 dB in the 4000 Hz frequency, 309 of the 746 workers studied were found to be over this level. Regarding this figure as a hearing deficiency, 41% of the workers suffer from this impairment. When we compare Hermann's figures³ (10% of the population) and ours, we can state that this industry represents a high risk in developing

occupational deafness. Hermann estimated this loss on the basis of 500, 1 000 and 2 000 Hz frequencies. We can have the same criterion if we examine the noise levels in the workshops and make a comparison with the 1999 ISO Standard which establishes the percentages of hearing loss by exposure levels. This means a 45% hearing loss for individuals exposed during 30 years to 96 dB; in our study a part of the sample was exposed to lower levels and during shorter periods of time. Nonetheless, the percentages are very similar.

The measurement of the temporary threshold displacement 2 minutes after the noise exposure is a prognostic element for establishing the permanent loss after a 10-year exposure.

Table 2 shows 10 workshops with higher TTS percentages and with a total of 429 workers (58%). Of these workers, 176 show a 6 dB or more TTS. If we relate the TTS found with the 12 dB threshold level accepted by ISO they can be regarded as small. It may be due to the time elapsed between the end of the exposure and the moment the determination is made and to the fact that the personnel generally have an established loss. During our study we found that the white collar workers, unexposed to the noise, did not present TTS.

Women are found to show a lower change in the permanent threshold than men. This was also found by other authors¹ although significant values could not be established. Having significant values of $p < 0.01$, we can state that women have a better hearing than men.

All our results were tested by means of the statistically significant χ^2 test, which resulted in a $p < 0.01$. A study carried out in Venezuela⁷ showed that 37.5% of the workers examined in the looms had a hearing decrease, and 42.4% was generally found among all industries.

There is a direct relation between the percentage of workers with a TTS over 6 dB and the permanent loss found in them.

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