A PILOT SURVEY OF NOISE AND HEARING ACUITY OF WORKERS ENGAGED IN SAWMILL OPERATIONS IN SOUTHEASTERN NIGERIA

B. Dickson

Department of Wood and Paper Technology, The Polytechnic, Calabar, Nigeria

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DICKSON, B. 1991. A pilot survey of noise and hearing acuity of workers engaged in sawmill operations in southeastern Nigeria. Noise measurements were carried out at seven workplaces in a Calabar based sawmill (Seromwood Industries Limited) to evaluate the noise situation in the factory, which employed 24 workers. The production line consisted of a Headrig, one Resaw, an Edger, a Frame Saw and a Circular Cross-cutting Saw. The ears of 14 workers who had been engaged in the sawmill for lengths of time ranging from 5 to 20 *y* with work schedules that exposed each to noise for 8 *h* daily were otoscopically and audiometrically examined. Sound level measurements and the subsequent calculated A-weighted Equivalent Noise Levels to which workers were exposed daily (dose) showed that the probability of hearing-loss occurring was high. Audiometric assessment of hearing acuity showed a lowering of hearing threshold in 71% of the workers sampled. This averaged 30 *dB*. Fifty per cent of the workers showed the classical steep dip (acoustic notch) at 4000 *Hz* on both ears, characteristic of noise induced hearing loss and this was associated with the high noise levels workers in the various sawmill workplaces were exposed to daily. The percentage incidence of hearing impairment increased progressively with age.

Key words: Dose - acoustic notch - noise induced hearing loss

Introduction

Acoustic noise is defined as an unwanted sound, an undesirable by-product of society's normal day to day activities (Hassel & Zaveri 1979). According to UNIDO (1983), all wood working machinery with high speed cutting tools, such as saws, planners, *et cetera* produce a considerable amount of high pitched noise. Noise by its nature is sound and the rate at which noise is emitted per second is equal to sound power which is defined as the rate of propagation of sound energy per second (Nelkon & Parker 1977). The intensity of the emitted noise simply expressed as the sound power per m^2 normal to the surface, in the direction of sound propagation varies from one machine to another.

Noise measurements are necessary to evaluate the noise situation in workplaces in order to prevent the occurrence of noise induced hearing loss. Standardized methods are used for such measurements. The limit for the noise load on the human ear at different frequencies is stipulated in ISO (1974).

A number of research works have been carried out on the subject of noise in sawmills (Dost 1973, Thunell 1973, Staudt 1985, Kumugisha - Ruhombe 1985).

Dost (1973), while studying the effect of noise level variation on noise exposure, carried out separate noise level measurements on various machines under "cutting" and "idling" conditions in order to update an existing mill survey data and found by examining the additional data that some machines were noisier while idling than while working. Noise emission measurements to show which machine in that mill produced the loudest noise at all machine centres were also made under "no load" conditions (measurements taken when each separately switched subsystem can be operated by itself). Dost concluded that the data from these additional measurements can be useful in planning control measures.

Thunell (1973) carried out studies to establish which machines produce the worst noise, the circumstances affecting noise and also the noises produced when pieces of lumber fall down or bump into an end. Measurements of noise levels and frequency spectra at different sawmills for each of similar machine centres and in respect of the operator's or his assistant's working position (fixed and varied) were taken. The Octave-band spectrograms of the noise of each source in respect to the working position of the operator showed not only that the dangerous noise emitted by some machines (*e.g.* the circular saws) was mostly in the higher frequency range but also the difference between idling and sawing of, for example, frame saws, implied a considerably increased noise level in the higher frequency register.

Staudt (1985) in his study measured in the first instance the range in noise levels for various workplaces in two separate sawmills, after which the total amount of noise exposure was measured for selected workers (those who were exposed to the highest levels of noise in the mills) as Equivalent Continuous Noise Level - Leq in *dB*(A). Measurements for circular saw and power engines were taken at a measuring distance of 0.5 *m*. All workers studied were found to be exposed to unacceptable noise levels.

In none of the above mentioned studies was any audiometric test carried out to confirm whether the exposed workers had suffered any hearing impairment. Hearing impairment is particularly severe in the higher frequency range of sound, between 3000 and 6000 *Hz*, and the clinical characteristics of occupational deafness tend to be bilaterial and to show in the audiogram atypical dip at the frequency of 4000 *Hz* (Ballantyne 1977).

In this study attempt was made to confirm the results obtained from noise level measurements through audiometric tests conducted on workers exposed to high noise levels for periods of time ranging from 10 *y* and above.

Materials and methods

Sound level meter measurements

A pilot study was conducted to identify all noise sources in the sawmill using a CRL 2.21C self-calibrating sound level meter. The sound level meter was calibrated at +94 *dB*(A). The instruments and methods used for this study fulfill the requirements of ISO (International Organisation for Standardization) and conform to standards specified by IEC (International Electrotechnical Commission).

Noise Level Measurements were carried out following the procedure laid down in the Guidelines on Ergonomic study in Forestry (Apud *et al.* 1989). Measurements were done at the level of the exposed workers' ears and facing the noise source. Readings were taken while machines were running idle as well as while sawing. The duration of measurement for each studied worker at a workplace was 30 *min* and each measurement was duplicated during two alternate days. The total amount of noise a worker at a workplace was exposed to, expressed as Equivalent Continuous Noise Level (Leq.), in *dB*(A) was calculated using the formula (Grandjean 1985);

$$\text{Leq.} = L50 + 0.43\ (L_1 - L_{50})\ dB(A)$$

where L50 = the average noise level, which is reached or exceeded during 50% of the relevant time in *dB*(A). L_1 = peak noise level, which is reached or exceeded during 1% of the relevant time.

Measurement of hearing acuity

The ears of 14 workers selected from various workplaces in the factory, who had been engaged for an average of 13 *y* and whose work schedule is such that each is exposed to noise for 8 *h* daily, were examined otoscopically and audiometrically. The Audiometer test was done using an equipment that reproduces pure tones (through ear phones) of different frequencies and intensities. Facilities at the University of Calabar Teaching Hospital, Ear, Nose and Throat Section were used for this measurement. The procedure followed is as described in the Introduction to Audiometry Manual (Naunton 1978).

Results and discussions

Table 1 shows the average and range of noise levels found in this study.

Table 1. Highest and lowest working noise levels in the *dB*(A) for various work places and measuring distances

S/N	Studied workplaces/ machines	Measuring distance (*m*)	L_{min} [*dB*(A)]	L_{max} [*dB*(A)]
1	Main bandmill operator (Headrig)	1.5	97.0	106.0
2	Frame saw operator	4.0	85.0	102.0
3	Resaw (Vertical bandsaw operator)	0.5	91.0	102.0
4	Circular ripping saw operator	1.0	81.0	104.0
5	Circular cross-cutting saw operator	0.5	92.0	106.0
6	Saw doctor workhop	0.5	84.0	112.0
7	Logyard (Caterpillar driver)	1.5	85.0	102.0

Note: S/N - Serial/Study Number

The obtained noise levels for the circular cross cutting saw compare well with that for the same machine by Staudt (1985) taken from an equal distance.

All the machines in the mill generated unacceptable noise levels which can be attributed to the state of the machines.

Table 2 shows values of the calculated A-weighted mean values of the Equivalent Levels of sustained noise (Leq.) for an eight-hour shift for seven workplaces. The highest mean Leq. [*dB*(A)] was 105.92 (circular cross-cutting saw operator) while the lowest was 92.36 for circular ripping saw operator. These noise levels are very high and expose the workers to a high degree of risk to hearing loss. According to ISO (1974), the damaging intensities are those above approximately 90 [*dB*(A)].

Table 2. Calculated mean values of the equivalent level of continuous noise at various workplaces in the mill

S/N	Workplaces/machines	First measurement Leq. [*dB*(A)]	Second measurement Leq. [*dB*(A)]	Mean Leq. [*dB*(A)]	Standard deviation
1	Bandmill operator (Headrig)	100.33	102.41	101.37	± 0.08
2	Frame saw operator	96.08	80.24	92.66	± 3.42
3	Resaw operator	94.66	98.63	96.65	± 1.99
4	Circular ripping saw operator	89.75	94.97	92.36	± 2.61
5	Circular cross-cutting saw operator	109.84	102.00	105.92	± 3.92
6	Saw doctor workshop	96.10	98.81	97.46	± 1.36
7	Logyard (Caterpillar driver)	104.25	-	104.25	± 0.00

Note: S/N - Serial/Study Number

Investigation by interview on the noise history of sampled workers revealed that of the 14 workers sampled, nine (64.3%) had been exposed to noise in sawmills for 10 to 16 *y*, and three for periods ranging from 20 to 28 *y*. One out of the remaining two had no previous exposure to noise. The other had only 5 *y* of exposure to industrial noise. The ages of the workers sampled ranged between 25 and 54 *y* (Table 3).

The audiograms of 14 sampled workers showed a lowering of hearing threshold in ten of the 14. This averaged at 30 *dB*. Seven (50%) sampled workers showed in their audiograms the characteristic V-shaped dip (Acoustic Notch) at 4000 *Hz* on both ears (Table 3, Figure 1), which confirms noise induced hearing loss (Ballantyne 1977).

Table 4 shows that the percentage incidence of noise induced hearing loss rises progressively with age for an exposure duration ranging from 5 to 28 *y* and a noise intensity above 90 *dB*(A) which existed in all workplaces studied. This can be attributed to the fact that older workers often show the combined effects of age deafness, and noise deafness, and it is very difficult to distinguish the two (Grandjean 1985). No incidence of noise induced hearing loss was identified for the 25-*y*-old samples.

Table 3. Noise history and analysis of pure-tone audiograms of sampled workers

Serial/ study number	Workplace operator	Age of sampled worker (*y*)	Number of years spent on same job or similar workplaces	Average hearing threshold (*dB*)	Acoustic notch	Inference
1/01	Saw Doctor Workshop	43	28	30	at 50 *dB*	Noise induced hearing loss
2/03	Saw Doctor Workshop	50	28	35	at 45 *dB*	Noise induced hearing loss
3/02	Foreman since 1985	35	Headrig, 9 sawed in the forest, 4	30	-	Has hearing loss but not noise induced
4/12	Bandmill Operator	33	13	30	at 50 *dB*	Noise induced hearing loss
5/07	Bandmill Assistant Operator	25	5	20	-	-
6/14	Resaw Chief Operator	45	21	30	at 50 *dB*	Noise induced hearing loss
7/10	Resaw Assistant Operator	35	10	30	-	Hearing loss not noise induced
8/08	Frame Saw Operator	30	11 *y* + 3 *y* 08 bulldozer driving	30	at 60 *dB*	Noise induced hearing loss
9/09	Frame Saw Assistant Operator	41	11 *y* + 3 *y* 08 bulldozer driving	20	-	-
10/04	Ripping Saw Operator	30	11	50	-	Hearing loss not noise induced
11/11	Cross-cutting Saw Operator	25	11	30	-	-
12/05	Cross-cutting Saw Assistant Operator	54	11	40	at 50 *dB*	Noise induced hearing loss
13/13	Logyard Caterpillar Driver	31	16	30	at 45 *dB*	Noise induced hearing loss
14/06	Supervisor of Factory	43	7	20	-	-

Table 4. Percentage incidence of noise induced hearing loss within various age groups sampled

Age group of sample (*y*)	Number of age group in sample	Number of workers in age group with NIHL	Percentage incidence
50 - 55	2	2	100.0
40 - 45	3	2	66.7
30 - 35	6	3	50.0
25 - 29	2	-	0.0

NIHL = Noise Induced Hearing Loss

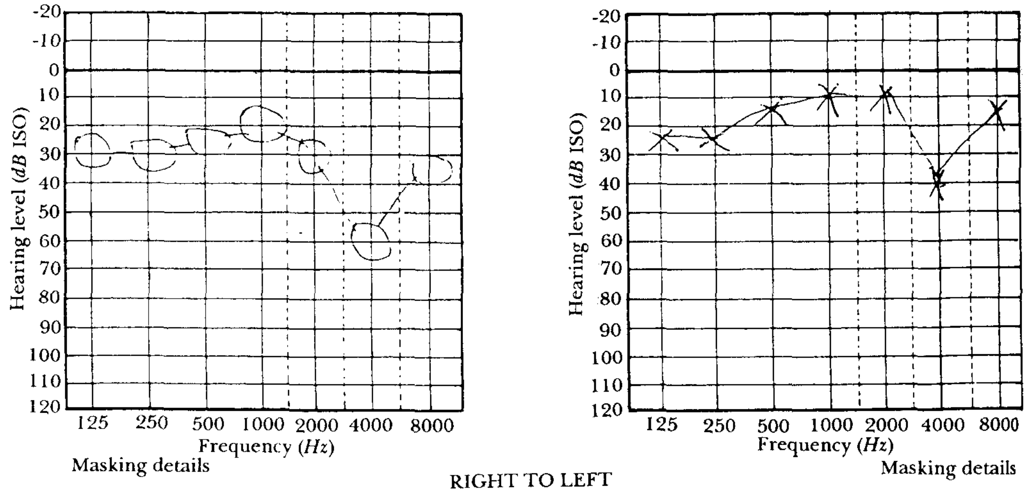

Figure 1. Pure-tone audiogram of serial/study number 8/08 showing impairment of hearing by noise

Conclusion

This study has shown that:

1. The noise levels and the noise intensities at all workplaces in the sawmill were high and 50% of the workers sampled showed noise induced hearing loss;
2. The continuous exposure of workers to potentially noise hazardous environments for periods of 11 *y* and above could result in permanent hearing loss;
3. The incidence of noise induced hearing loss increased progressively with age, although individual susceptibility was a dependent factor.

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