

## **Industrial noise pollution and its effects on the hearing capabilities of workers: A study from saw mills, printing presses and corn mills**

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### **Summary**

The purpose of this study was to ascertain industrial noise pollution and its effects on the hearing capabilities of workers. The procedure adopted included noise measurements, otoscopy, audiometric evaluation and assessment of medical history. The results showed that noise levels in corn mills and saw mills exceed 85dBA. The average noise level measured in the printing industry was 85dBA. It was also found that 23%, 20% and 7.9% of workers in corn mills, saw mills and the printing industry have evidence of noise-induced hearing loss (NIHL). A highly significant correlation was found between noise exposure level, duration of exposure and the development of NIHL in corn mills and saw mills but not in the printers. Hearing - impairment was also observed at the speech frequencies among some of the workers exposed to hazardous noise. These findings suggest that more specific intervention is required to protect workers exposed to such hazards at the work places employed in this study.

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### **Introduction**

Like the home and the school, the place of work is also an important part of man's environment. The protection of the health and safety of the workforce from hazards related to work activities is an imperative that underpins a healthy and a vibrant economy of any country. Exposure to loud and distracting and possibly hazardous noise is a common experience for everyone, but whether to allow such exposure to be hazardous to one's hearing is often a personal choice. Reports from studies indicate that for the 90<sup>th</sup> percentile of noise-exposed population, the risk of presumed noise-induced hearing loss (NIHL) increases exponentially for noise

levels beyond 85dBA and over prolonged period [1]. NIHL manifests irreversible subtle change in the sensory cells and other structures in the organ of corti in the cochlea. Consequently, the hair cells and supporting cells disintegrate and ultimately the nerve fibres that enervate the hair cells disappear resulting in permanent threshold shift and hence irreversible hearing loss at the higher frequencies [ 2,3]. The adverse effects of noise on hearing may be classified into three categories namely, temporary threshold shift (TTS), permanent threshold shift (PTS) and a acoustic trauma [4]. In addition, noise interferes with verbal communications leading to errors and failures to respond to warning signals. In Ghana, there is a paucity of information on the effect of noise exposure on industrial

workers. Thus, no study has focused specially on hearing loss among workers in saw mills, printing presses and corn mills; even though the effect of noise pollution in mining companies have been studied [5,6]. There is the need to conduct such investigation since several workers work in these work settings in Ghana. Thus in this paper, the results are presented of a study to determine noise levels in saw mills, printing presses and saw mills and their impact on the hearing capabilities of workers.

## Materials and Methods

### *Instrumentation and Noise Survey*

The experimental apparatus employed in the recording of noise levels in the saw mills, printing presses and corn mills was Quest sound level meter (SLM) type 2 model 2700. The desired response of the SLM was set at "slow". When measurements were made, the microphone was located in such a way as not to be in the acoustic shadow of any obstacle in appreciable field of reflected waves. Noise levels were measured at the position of the employees head while they kept their work posture. For each of the selected machines in the study, five measurements were taken for a period of 20-30 seconds [7]. The experimental apparatus used was Kamplex audiometer (model 27) calibrated previously to the ANSI standard (S.3.6 -1969) [8]

### *Subjects*

Participants in the study were drawn from six sawmills, seventeen printing houses and twenty groups of corn millers operating at different locations in the Kumasi metropolis. In all, a total of 818 employees were recruited consisting of 463 saw millers, 193 Corn millers and 163 printers.

Selection of subject was by lottery (simple random sampling). In addition, 516 subjects and traders within the age range 20 to 50+ were used as control groups. Hearing acuity was measured at 5dB intervals over a range of octave band frequency from 500 though 8000Hz. Hearing was considered

normal if the threshold level was less than or equal to 25dB individuals with a characteristic notch at 4 K Hz depicting the classical sign of noise - induced hearing loss (NIHL) were analysed. The degree and type of hearing loss were determined using Goodman's [ 9 ] and Cahart's approaches [10 ] respectively. All subjects were tested at the beginning of each work shift. This was done to ensure that those whose hearing had been "fatigued" might have gained some recovery after being away from the noise exposure. An otoscopic examination was done to exclude wax, or any discharge in the ear canal or perforation of the eardrum to rule out possibility of conductive hearing loss.

## Results

A total of 818 workers aged 20 -50 + years from sawmills (463), corn mills (193) and printing presses (163) were seen after noise measurements were taken. Table 1.1 displays the noise level obtained from the machines in the saw- mill. Observe that the measured values ranged between 87-112dBA; demonstrating that the noise levels produced by these machines exceed the limiting threshold level of 85dBA. The average noise level measure in the printing industry was 85dB (Table 1.2) while that at the corn mills exceed 90dBA (Table 1.3). The locally made corn mills produced more noise than the imported one ( $t=2.183$  and  $0.05$ ). We also observed in Tables 2.1 and 2.2 that more than 20% of subjects exposed to noise levels greater than 85dBA in the saw mills and corn mills had the classical NIHL at 4KHz as compared to 10% of printers. The proportion of workers with NIHL at 4KHz increased as function of duration of exposure. The relationships were ( $\chi^2= 21.24$ ,  $df=4$ ,  $p< 0.005$  for those in saw mills,  $p<0.01$  for those in corn mills. The chi-square indicated significant difference between the age groups with regard to hearing loss at 4KHz (saw mills  $\chi^2 = 14.23$   $df = 3$ , corn mills:  $\chi^2 = 17.31$ ,  $df = 3$ , but for control group,  $1.27$ ,  $df = 3$  at  $p= 0.05$ ).

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A total of 49 subjects (10.6%) of workers in saw mills (463) had hearing loss at the speech frequencies (> 25 dB HI at 500, 1,000 and 2,000 Hz) in one or both ears. Out of this number (49), 38 (77.6%) had a mild hearing loss and 18.4%, moderate hearing loss. With regard to workers in the corn mills, out of a total of 27 workers 14.1% of 193 had hearing loss. From this number, 22 (82%) had mild hearing loss,

11% moderate loss and 5% 5 moderate severe loss. On the contrary, only (3.0%) of the 193 workers in the printing press had hearing loss at one or both ears. Finally 5.8% of loss at the 516 subjects in the control group had hearing loss. 24 (86.7%) had mild hearing loss and 4 (13.3%) moderate hearing loss.

**Table 1.1 Noise levels measured on selected sawmill machines in six factories**

Factory	I	II	III	IV	V	VI	Total average noise level (dBA)
<b>Type of Machine</b>							
Band saw	87-207	94-107	100-108	92-103	93-105	98-105	99
Cross cut saw	96-104	89-105	95-103	92-106	95-110	89-99	97
Chain saw	100-133	100-117	98-107	100-118	98-107	105-112	108
Edger saw	91-100	87-105	91-99	90-95	88-108	87-104	96
Moulding	88-98	87-100	88-103				95
Planning	96-100		103-108			99-103	101
Peeler	86-97				89-100	84-97	92
Re-saw	966-102	96-105	98-105	85-94	92-100	87-92	97
Silc	87-92				86-94	85-97	90

**Table 1.2: Noise levels measured on selected printing machines in six factories**

Factory	I	II	III	IV	V	VI	Total average noise level (dBA)
<b>Type of Machine</b>							
Papèr cutting guillotine	84-88	84-90	82-89	85-86	84-86	85-89	86
Kord 64 offset	84-87	80-85	79-87	82-88	86-89	80-85	85
Letterpress	80-86	86-90	84-87	80-85	85-88	84-88	85

**Table 1.3: Noise levels measured on Corn mills at six different locations.**

Factory	I	II	III	IV	V	VI	Total average noise level (dBA)
<b>Type of Machine</b>							
Import corn mill	90-103	95-99	96-100	94-105	85-98	89-98	97
Locally made corn mill	100-104	98-103	98-109	103-107	94-106	89-102	101

**Table 2.1: Audiometric Tests – Sawmills Workers**

Duration/Exposure Time (years)	Audiometric tests results at 4kHz			
	Total No. Tested	No. with HTL $\leq 25$ dB	No. with HTL $\geq 25$ dB	%NIHL
5	114	103	11	9.60
6-10	164	135	29	17.68
11-15	89	65	24	26.97
16-20	72	51	21	29.17
21	24	14	10	41.67
All years	463	368	95	20.50

$X^2=21.25$ ,  $df=4$ ,  $p < 0.005$

**Table 2.2: Audiometric Tests - Corn-mills operators**

Duration/Exposure time (years)	Audiometric tests results at 4kHz			
	Total No. Tested	No. with HTL $\leq 25$ dB	No. with HTL $\geq 25$ dB	%NIHL
5	58	51	7	12.07
6-10	54	44	10	18.52
11-15	35	24	10	28.57
16-20	38	25	13	34.21
21	7	3	4	57.14
All years	192	148	44	22.92

$X^2=12.53$ ,  $df=4$ ,  $0.025 < p < 0.01$

**Table 2.3: Audiometric Tests – Printing Press Workers**

Duration//Exposure time (years))	Audiometric tests results at 4kHz			
	Total No. Tested	No. with HTL $\leq 25$ dB	No. with HTL $\geq 25$ dB	%NIHL
5	28	28	0	0.00
6-10	48	46	2	4.17
11-15	39	36	3	7.69
16-20	18	15	3	16.67
21	30	25	5	16.67
All years	163	150	13	7.98

$X^2=8.3$ ,  $df=4$ ,  $0.100 < p < 0.050$

## Discussion

This study assessed noise pollution levels and its impact on hearing capabilities of workers in saw mills, corn mills and printing houses. It was found that workers in saw mills are exposed to noise levels well above the threshold limit of 85 dBA. This is in agreement with the finding of Rafalski et al [11] who in a case study on wood cutters

found hazardous noise levels among the exposed workers. The results further demonstrated that workers in the corn mill industry are equally at risk as their counter parts in the saw mills. On the contrary, this study seems to suggest that noise is not a serious problem in the printing industry (mean value = 85dBA). The present study

was also at variance with the report of McMahon and McManus [ 12 ] who noted that about 43% of the printing production workers in 64 establishments, in New York were exposed to 8 - hour time average (TWA) noise of 85dBA or greater and that 14% were exposed to TWA 90dBA or greater. The results of the present study is not surprising since most of the printing houses surveyed in this study were low capacity printing machines which produced relatively low noise levels.

With regard to the impact of hazardous noise on hearing capability of workers, the data obtained in this study indicate that 22.9% workers in corn mills and 20.5% of workers in saw mills and 8% of workers printing houses had high frequency hearing loss at 4KHz. In another vain, the prevalence of high frequency sensorineural hearing loss was significantly higher among noise exposed workers (saw mills, corn mills and printing houses) than those in the control group (22% versus 6% {<0.05}). The pattern of noise induced hearing loss noted in this study is consistent with the findings of other researchers [13,14 ]. Intensity, spectral content and duration of noise exposure are known to be important variables in determining the pattern of NIHL. Additionally, cochlea processing of intense acoustic signals play a critical role. Clarke and Bolin [15] reported that hearing loss might occur in the high frequency regions of the cochlea partition even when the peak spectral energy of the noise exposure is limited to low frequency stimuli without a concomitant loss of sensory cells in the basal turn of the cochlea. They reasoned that metabolic events and cochlea micro-mechanics significantly influence the magnitude of ear damage emanating in NIHL. It must be remembered that the interaction of noise and other agents contribute to the large variability observed in a population's response of noise exposure and if overlooked may undermine the success of traditional hearing conservation programmes [16]

## Conclusion

The purpose of this study was to survey noise levels in saw mills, corn mills and printing houses and to determine the impact of noise levels on the hearing capabilities of workers in such work settings. Our data has shown that noise levels in corn mills exceed the limiting value of 85dBA. Again, the results showed that 23% of workers in corn mill, 20% of workers in saw mills and to a lesser degree 7% of workers in printing houses exhibit the classical noise induced hearing loss. Significant relationships were found between the two independent variables (age and duration of exposure) and the threshold at 4KHz for workers in saw mills and corn mills. However, the positive relationship between hearing loss at 4KHz and the independent variables are not significant in the case of workers in the printing industry. Considering the important role that hearing plays in our lives, it becomes necessary for governments to protect those at risk from industrial hearing loss through enactment of laws to compel companies to develop hearing conservation programmes and see to its enforcement. This is necessarily so, especially in small scale enterprises such as corn mills which are overlooked by governmental agencies responsible for the enforcement of health and safety measures at the work place.

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