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Study of Occupational Noise Level: A Case Study from a Developing Country, Nigeria

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Case Study

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ABSTRACT

Levels of noise generated from mechanic villages within Kaduna metropolis, (Nigeria) were measured in the present study. Existing noise generation sources and analysis were carried out. Noise level (maximum of 120dB) was measured at these sites. Noise dose of 104.30% and hearing deterioration index of 55.15 were obtained. It is observed that the noise generated at these sites is a mixture of low and high frequencies. This is capable of causing temporary and permanent deafness in addition to inflict high level of interference of speech as well as capable of causing increase in the rate of heartbeat. It is also observed that the noise generated by these sources is aperiodic, that is, not sinusoidal, they are cumulative and can lead to step waves.

Keywords: Decibels; frequency; amplitude; panel beating workshop; pressure.

1. INTRODUCTION

The risks of noise at workplace cannot be considered in isolation from that person's social or recreational environment. Noise occurs throughout the day and has a damage-dose effect on hearing. Industrial noise exposure standards are set for an average 8-hour working day and assume that noise exposure throughout the rest of the 24 hours will not cause the total noise exposure for that day to exceed the exposure standard (NPC Library).

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The extent of damage caused to hearing is dependent on the amount of noise energy that the ear has been exposed to over a period of a day. This total noise energy for the day can be determined by adding up all the separate exposures of different levels for various periods of time. There is a great variability in the amount of Noise Induced Hearing Loss (NIHL) suffered between people exposed to the same levels of noise. This may be due to a number of different mechanisms but two people doing the same work in the same environment can have quite different degrees of hearing loss from their exposures. Noise exposure is normally expressed in terms of an Equivalent Level of sound over a period of 8 hours, called the Leq (8hrs), and can be directly compared with an exposure standard to determine whether the noise is likely to be damaging to a person's hearing. When we are exposed to intense noise levels some or all of the hair cells in the organ of corti may be damaged temporarily or permanently (NPC library). Exposure to excessive industrial noise for a short period of time may produce a loss of heavy sensitivity. Temporary damage means that our hearing threshold level has shifted temporarily due to the noise exposure. Given adequate time for recovery in quieter environments, our hearing threshold returns to its original threshold level. Thus, a noise induced temporary threshold shift (NITTS) occurs.

When insufficient time is allowed for the TTS to recover, and further excess noise levels are encountered, this threshold shift can become permanent and is called a Permanent Threshold Shift (PTS). The extent of PTS for a given set of conditions varies significantly from one subject to another and is unpredictable. An exposed person does not have to have suffered a TTS to develop PTS. If TTS occurs frequently, then PTS can develop and become PTS.

Hearing loss is among the most tragic of all sensory defects because of the far-reaching social, economic and psychological consequences involved. Intensively loud noise such as that from explosion can lead to immediate or permanent loss of hearing due to damage to the tympanic membrane. However, in the majority of cases, noise induced hearing deafness is not sudden; rather it deteriorates gradually as both the noise level and time of exposure increase.

2. MATERIALS AND METHODS

The most widely used method for the determination of sound power is the method made in the vicinity of the noise source. Here, it is assumed that any reverberant sound is negligible, (Morse, 1990). The machine and its acoustic images may be thought of source of noise whose sound pressure is being measured.

The measurements were performed using digital sound level meter, testo 860, mounted on a tripod stand 3m away from the source and 1.2m high above the ground level in accordance to Occupational Safety Health Acts (OSHA). The measurements were carried out in Kaduna metropolis, Nigeria, between the hours of 0800 and 1800. In addition, physical identification of the existing noise sources and interaction with some of the people in charge of these sources were carried out.

3. RESULTS AND DISCUSSION

From table 1, the minimum and maximum noise levels with the corresponding frequencies are 70dB at the frequencies of 500Hz, 4,400Hz and2, 400Hz; and 109dB at the frequency of 800Hz, respectively. The noise dose obtained from equation (2) to be 85.18%, 104.30% and 86.33% at Kurmi Mashi, New Panteka and Kakuri, respectively are shown in figure 1

together with the hearing deterioration index obtained from equation (3) to be 54.42, 55.15 and 54.49 at Kurmi Mashi, New Panteka and Kakuri, respectively.

Table 1: Description of noise spectra

S/N	Site	Noise source	Noise dose, %	Hearing deterioration index	Amplitude/frequency range
1	Kurmi Mashi mechanic village	Panel beating workshop	85.18	54.42	70dB at 800Hz to 82dB at 3,300Hz
		spraying workshop			79dB at 500Hz to 82dB at 3,800Hz
		welding workshop			75dB at 500Hz to 91dB at 3,300Hz
2	New Panteka Mechanic village	Panel beating workshop	104.30	55.15	82dB at 500Hz to 100dB at 1,800Hz
		spraying workshop			78dB at 500Hz to 82dB at 1,300Hz
		welding workshop			70dB at 4,400Hz to 109dB at 8,000Hz
3	Kakuri mechanic village	Panel beating workshop	86.33	54.49	70dB at 2,400Hz to 108dB at 800Hz
		spraying workshop			88dB at 500Hz to 99dB at 3,800Hz
		welding workshop			88dB at 500Hz to 99dB at 3,800Hz

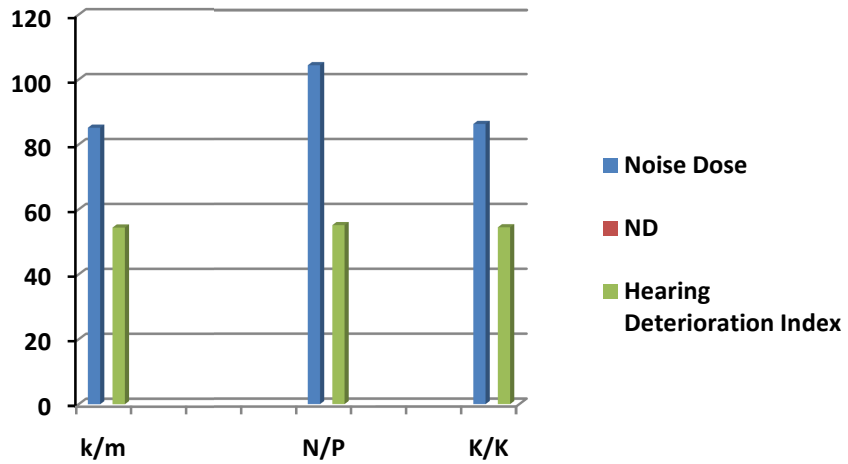

Figure 1: Bar Chart of noise dose and hearing deterioration index of mechanic villages

In addition, figures 2 to 4 show that the noise generated at the mechanic villages are mixture of low and high frequencies. Noise induced hearing loss can begin in frequencies other than

the frequencies 3Hz to 3 kHz. The greatest loss usually occurs at 400 kHz. The lower and higher frequencies take longer to be affected than 3 Hz to 6 kHz range.

The maximum noise level of 120dB recorded in this work indicates that noise generated in mechanic villages is very high above the recommended standard value of 90dB (FEPA, 1991). This high level of noise corresponds to the high noise dose and hearing deterioration index. The recommended noise dose and hearing deterioration index are 100% and 45 respectively.

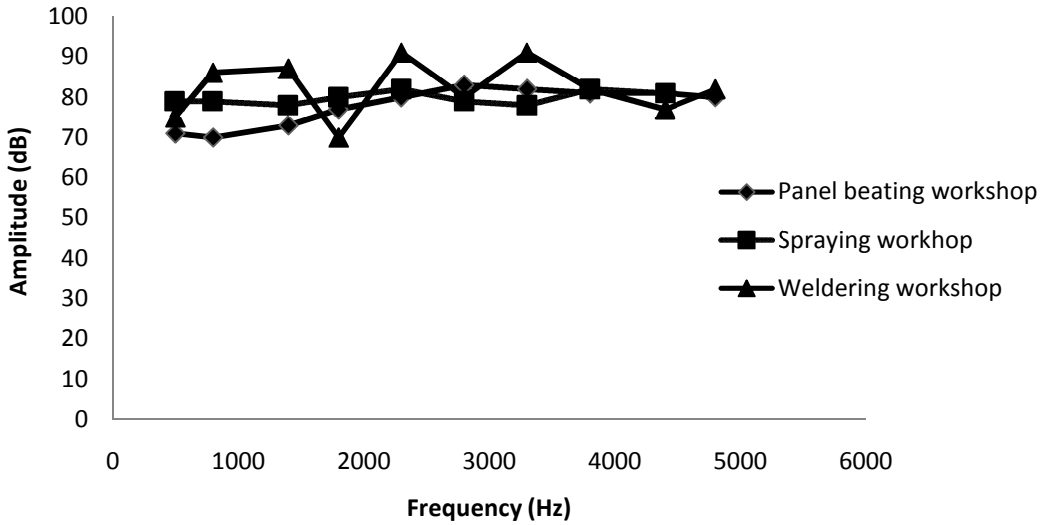

Fig. 2: Kurmi Mashi mechanic village noise spectra

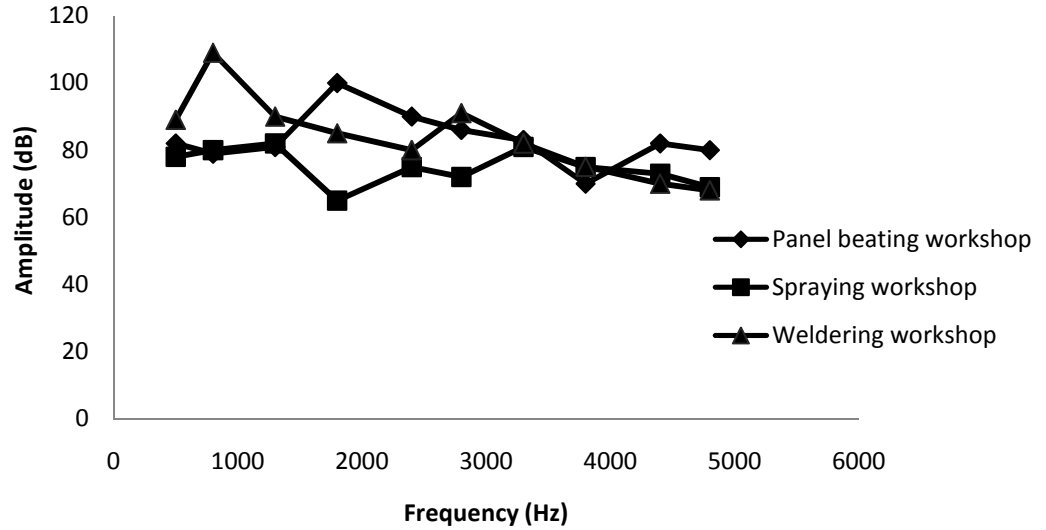

Fig.3: New Panteka mechanic village noise spectra

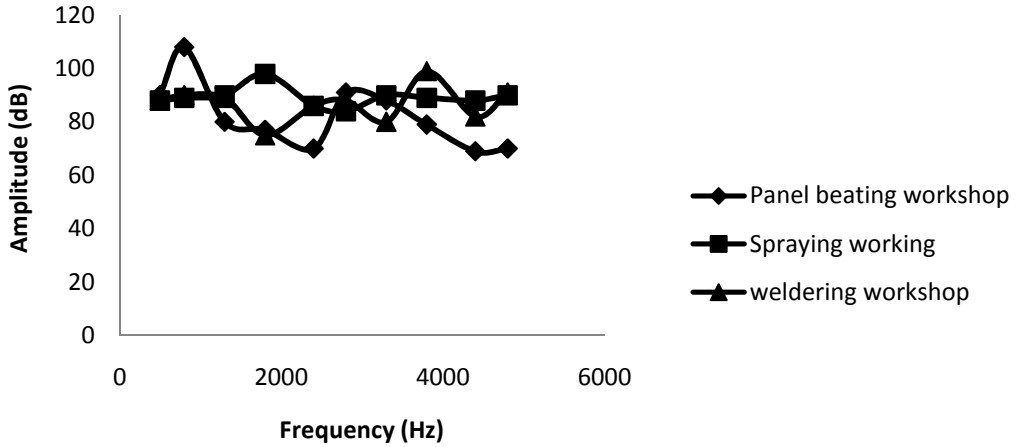

Fig. 4: Kakuri mechanic village noise spectra

The general implication of these levels of noise is that the mechanics and the owners of vehicles under repairs, as well as the nearby community are liable to have hearing impairing. These noise levels can rapture the eardrum, which may result to temporary or permanent deafness. Similar report and analysis was made (Onuu, 2001). Long exposure to these noise levels can cause non-auditory effects to human body. These include cardiovascular effects, stress, neuro-physiological and psychological effects (Ola, 1988). These can result to increase in the rate of respiration and heartbeat that may eventually cause high blood pressure.

It is good to note that continuous noise exposure over the years is more damaging than interrupted exposure to noise, which permits the ear to have a rest period (Onuu and Menkiti, 1997). Hinchcliffe (1999) studies the effects of impulse noise from military weapons on long serving soldiers. He found out that the continued strain led from temporary threshold shift to permanent threshold shift. The mechanics worked through the day not minding the Occupational Health Acts, which allows for 90dB, as the maximum noise exposure for only 8-hours working period per day. From these results, mechanics at these study sites are liable to have hearing impairment, either temporary or permanent. Also, the frequency ranges at these sites are high above the frequency of speech intelligibility of 1,000Hz, 2,500Hz (Toynbee 1968). It therefore means that communication is very difficult and it requires one to shout aloud. Experimental studies have shown the effects of hearing loss produced by impact and impulsive noise is more dependent on the peak sound level of the impulse than the total energy level of the noise exposure. This further stressed that it is associated with substantial greater loss of hair cells in the cochlea.

The noise generated by these sources is aperiodic, that is, not sinusoidal, they are cumulative and lead to step waves. This type of wave always suffers severe waveform distortion through cumulative action of nonlinearities, in its propagation over large time or distance.

4. CONCLUSION

From the Foregoing, It is deduced that

- The noise level of 120dB recorded is very high and is above the threshold of hearing (90dB) as well as above the international recommended standard.
- The noise dose of 104.30% is above the international standard of 100%.
- This noise level is in no doubt will have negative effects on the mechanics as well affect the owners of vehicles under repairs.
- The environmental noise may therefore affect sleep, conversation, and cause annoyance, psychological as well as affect task performance.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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