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Research Paper

Effects of industrial noise pollution on the auditory performance and health status of industrial workers in Oluyole Industrial Estate, Ibadan, Nigeria

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ABSTRACT

Exposure to excessive noise level is capable of producing destruction of the hair cells due to vasoconstriction of the cochlea blood vessels and over stimulation of the hair cells as a response to the noise exposure, which in turn may reduce the nutrient and oxygen to the cells as well as, placing a great impingement on the occupational performances of the Industrial workers. The study examined the potential effect of excessive noise exposure on the auditory performance and health status of some industrial workers in Ibadan. A total of hundred (100) industrial workers consisting of seventy-five (75) males and twenty-five (25) females were purposively selected to participate in the ex post facto research. Instruments used included a TENMA RS-232 Sound Level Meter (SLM) to measure the noise level of the bakery firm, Maico 53 audiometer to test the hearing levels of the participants, OMRON M2 Basic blood pressure monitor to assess the systolic, diastolic pressure and pulse rate of the participants and a self designed questionnaire to assess the participants' daily health status. SLM readings of the firm revealed three different results of 85dB, 87dB and 91dB. 80% of the participants were affected by hearing loss on either right, left or both ears measured; 71% had high systolic blood pressure, 68% had abnormal pulse rate while 75% after exposure to excessive noise at work and 75% were not aware of the effects of excessive noise to their hearing organs as they were not informed at work. The Federal Government of Nigeria should enforce hearing conservation programme and health and safety regulations on every industry where noise is a by–product. In general, the health and safety of industrial workers should be placed on a high priority by government, employees and industrial employers.

Keywords: Auditory performance, excessive noise exposure, health effects, industrial noise, noise-pollution.

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INTRODUCTION

Noise is a common phenomenon in the modern society and a deleterious element present in every human activity; and when assessing its impact on human well-being, it is usually classified either as occupational noise (that is, noise in the workplace), or as environmental noise and this includes noise in all other settings, whether at the community, residential or domestic places.

According to OSHA 3074 (2002), noise, or unwanted sound is one of the most pervasive occupational health problems. It is a by-product of many industrial processes. Exposure to high levels of noise leads to hearing loss and may further cause other harmful health effects as well.

The extent of damage depends primarily on the intensity of the noise and the duration of the exposure. Noise-

induced hearing loss can be temporary or permanent. Temporary hearing loss results from short-term exposures to noise with normal hearing returning after a period of rest. Generally, prolonged exposure to high noise levels over a period of time gradually causes permanent damage.

Noise is capable of causing a general rise in blood pressure, increase in the pressure inside the head, increase in perspiration and heartbeat, changes in breathing patterns and general muscular contradictions (Tafalla and Evans, 1997). Similarly, Regecova and Kellerova (1995) reported that noise exposure causes some vascular problems such as increase in blood pressure and heartbeat – hypertension, metabolic and biochemical disorders.

Noise-induced cardiovascular effects have been extensively studied in occupational settings. The Health Council of the Netherlands (1996) concluded that prolonged exposure to occupational noise may contribute to increased blood pressure and hypertension. These effects were shown to occur at sound levels of 85 dB(A). Other noise-induced cardiovascular effects include: abnormalities in the electrocardiogram, more heart beat irregularities, faster pulse rate and slower recovery of vascular constriction. There have serious difficulty in determining the effects of noise in the urban environment.

Most studies focused on the effects of air and road traffic noise on people in their own homes. A complicating factor was made to distinguish exposure to traffic noise versus other often louder noises from other sources. Housing features, as well as, personal habits and proximity of sleep areas to the noise source (for example, road) affect the actual noise exposure. There is some evidence that suggests an increased risk of hypertension and ischemic heart disease for people living in road areas or air traffic noise at outdoor equivalent sound levels above 70 dB(A) based on exposure between 6:00 a.m. and 10:00 p.m. The study of Thompson (1996) revealed that kindergarten children had significantly higher systolic and diastolic blood pressures when exposed to noisy or very noisy environments (kindergarten and home) as compared to quiet environments. However, these effects appear to be of temporary nature (Health Council of the Netherlands, 1996; Thompson, 1996).

Blood pressure in humans is subject to movement variation. Also, it is generally agreed that for hypertension in the young adult and early middle age, the systolic pressure must be consistently above 140 mmHg and the diastolic pressure consistently above 90 mmHg (Wilson et al., 1991). It was observed that the mean BP of urban subjects is generally higher than that of their rural counterparts and that in the rural labourers (individuals engaged in vigorous physical activities) BP is lower than that of rural clerks (individuals engaged in vigorous physical activities).

A recent meta-analysis reviewed the effects of occupational and environmental noise on a variety of cardiovascular risks, including hypertension, use of anti-hypertension drugs, consultation with a general practitioner or specialist, use of cardiovascular medicines, angina pectoris, myocardial infarction and prevalence of ischemic heart disease (van Kempen et al., 2002). The analysis showed an association with hypertension, but only limited evidence for an association with the other health outcomes.

Epidemiological and laboratory studies involving workers exposed to occupational noise and general populations (including children) living in noisy areas around airports, industries and noisy streets indicated that noise may have both temporary and permanent impacts on physiological functions in humans (Passchier-Vermeer, 1993; Berglund and Lindvall, 1995). It was postulated that noise acts as an environmental stressor (Passchier-Vermeer, 1993; Berglund and Lindvall, 1995).

Acute noise exposures activate the autonomic and hormonal systems, thereby leading to temporary changes such as increased blood pressure and heart rate and vasoconstriction. After prolonged exposure, susceptible individuals in the general population may develop permanent effects such as hypertension and ischemic heart disease associated with exposures to high sound pressure levels (Passchier-Vermeer, 1993; Berglund and Lindvall, 1995). The magnitude and duration of the effects are determined in part by individual characteristics, lifestyle behaviours and environmental conditions. Sounds also evoke reflex responses, particularly when they are unfamiliar and have a sudden onset.

Exposure to excessive noise is the major avoidable cause of permanent hearing impairment worldwide (Smith, 1998). However, the situation is improving in developed countries as more widespread appreciation of the hazard led to the introduction of protective measures (Concha-Barrientos, 2004). The average noise levels in developing countries may be increasing because industrialization is not always accompanied by total adherence to safety hearing conservation regulations. Effective legislation against noise and NIHL preventive programmes lack well established structures in Nigeria and many other developing countries (Akande and Ologe, 2003).

Although, several initiatives were taken by various countries to reduce noise-pollution, for example, the United States of America took the initiative to create sites where human-caused noise pollution will not be tolerated (Geary, 1996). Laws in the Netherlands do not permit the building of houses in areas where 24 h average noise levels exceed 50dB. In Great Britain, the noise Act empowers the local authorities to confiscate noisy equipment and punish people who create excess noise at night, whereas, the absence of the effective legislation and safety practices expose Nigerian societies to the penetration of this assiduous noise influence.

Therefore, the rate of noise in the society is getting alarming especially in industrial areas. Heavy machines are used in such industries and yet precautions to prevent hazards caused by the noise emitted by these machines are not taken into consideration, thereby, putting the auditory

performance and health of workers exposed to noise pollution at risk. It is evident that workers who are exposed to industrial noise at their places of work over time do experience some health problems. The hazardous effects of industrial noise pollution on workers make these workers vulnerable and susceptible to auditory disorders, fatigue, annoyance, cardiovascular disorders, sleep disorder, performance effect, immune effect and biochemical effects. Therefore, a study to determine the effects of excessive noise exposure on the auditory and health status of workers as well as, creating awareness on ways of educating industrial workers on the health and auditory risk when exposed to excessive noise from their workplace is necessary.

The major essence of this study was to examine the effects of industrial noise pollution on auditory performances and health status of workers in Ibadan. The study also purposed to determine the sound level in which the workers are exposed to at their place of work, determine if excessive exposure to noise contributes to cardiovascular diseases and health, affects the work performance of the industrial workers and if industrial workers are aware of the dangerous effects noise has on them and also to suggest ways of educating industrial workers on the potential health risks and auditory performance on exposure to noise at their workplace.

In order to achieve these aims, we sought to know the sound level of noise the participants are exposed to at their place of work and if excessive noise exposures affects their work performance, what the effects of excessive noise pollution on the auditory performances are, if industrial workers experience high blood pressure and headache as a result of excessive noise exposure, as well as, the awareness of the workers on the effect of industrial noise pollution on their auditory performance and health status.

MATERIALS AND METHODS

One hundred 100 (and) industrial workers consisting of seventy-five (75) males and twenty-five (25) females from Oluyole Industrial Estate were purposively selected to form the participants for the study. The participants were between 21 and 60 years of age and were majorly casual workers exposed to noise without any means of protection.

The study adopted a descriptive survey research design through the use of a purposive sampling technique. This method was chosen because it helps to describe, record, analyze and interpret the conditions that naturally exist.

Four instruments were used for the study, namely a sound level meter, a screening audiometer, an automatic blood pressure monitor and a self-developed noise questionnaire. Sound level meter was a calibrated TENMA RS-232, while Sound Level Meter 72-860 which has both low and high set mode enables it to measure low and high intensity sounds was used to measure the level of sounds the workers are exposed to at their place of work. Screening Audiometer used was a MAICO 53 model and was used to conduct a Pure Tone Audiometric test in Air Conduction (PTA - AC) in order to find the hearing threshold of the industrial workers. The blood pressure monitor was an OMRON M2 Basic and was used to measure the blood pressure of the industrial workers. It read the systolic, diastolic pressure and also the pulse rate. The noise research questionnaire used for the study was a self – designed scale which covered both the objective of the study and the research questions. The twenty – five (25) structured items in the questionnaire measured the actual variables. The questionnaire was divided into three sections. Section A involved some demographic information, while section B involved some sets of questions that required responses on the effects of noise to hearing function and Section C involved some sets of statements that require responses to health related issues.

The researchers initially used the Sound Level Meter to take readings of sound intensity at various points and location in the industry, after which 100 workers were randomly selected to form the participants for the study from the workforce. After the selection, a PTA air conduction test was conducted on each participant in order to determine the hearing threshold. Afterwards, each participant was presented with the Noise Research Questionnaire appropriately filled in order to determine the effect on noise on their health status. The data collected was then analyzed with the use of descriptive statistics of frequency count and percentage.

RESULTS

Figure 1 revealed that those having good hearing represented 50%, while those who perceived having little trouble with their hearing represented 29%. The sampled participants who admitted they had hearing difficulty from less to total were 8 and 13%, respectively.

Figure 2 showed that 20% of the participants had normal hearing at the right ear while, those with mild hearing loss were 43% participants. 16% represented those with moderate hearing loss; those with moderately severe hearing loss were 15% while those with severe hearing loss were 5% and 1% represents profound hearing loss. Thus, 80% of the participants were presented with evidence of hearing loss at the right ear.

Figure 3 revealed the degree of hearing loss on the left ear; 17% had normal hearing, 33% represented mild hearing loss, 21% had moderate hearing loss, 19% had moderately severe hearing loss, 7% had severe hearing loss and 3% had profound hearing loss on the left ear, respectively. By implication, 83% of participants had hearing loss on the left ear while 17% had a normal hearing.

Figure 4 shows that 68% of the participants had at one point or the other experienced tinnitus (ringing in the

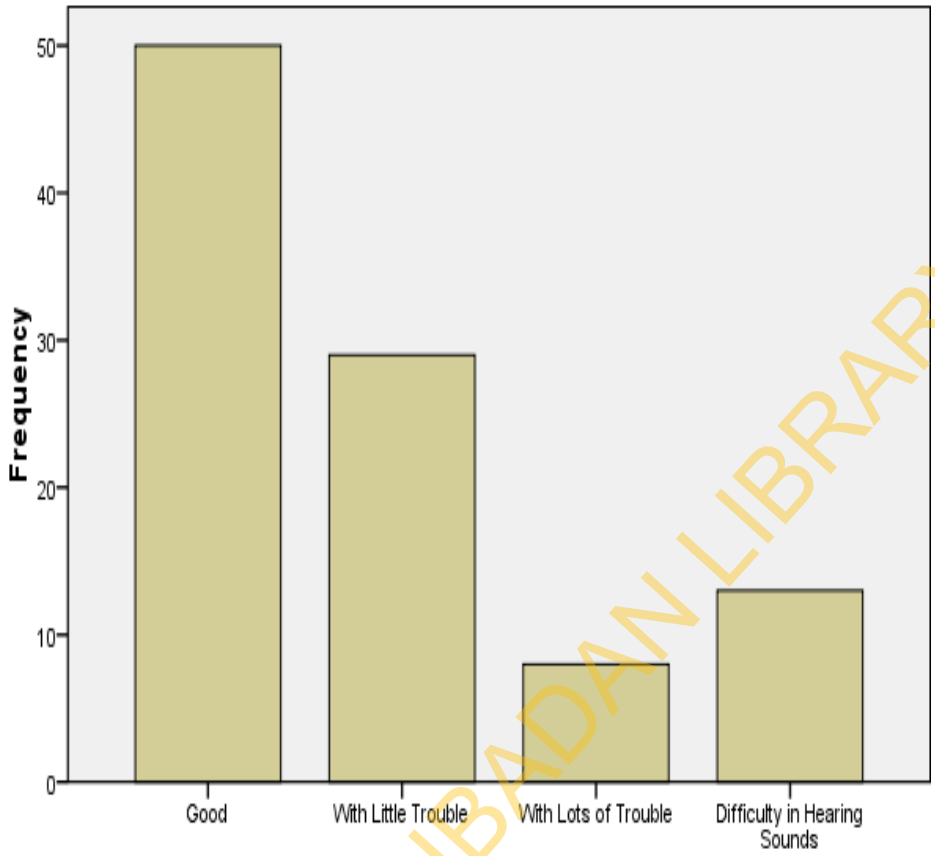

Figure 1: General hearing perception of the participants.

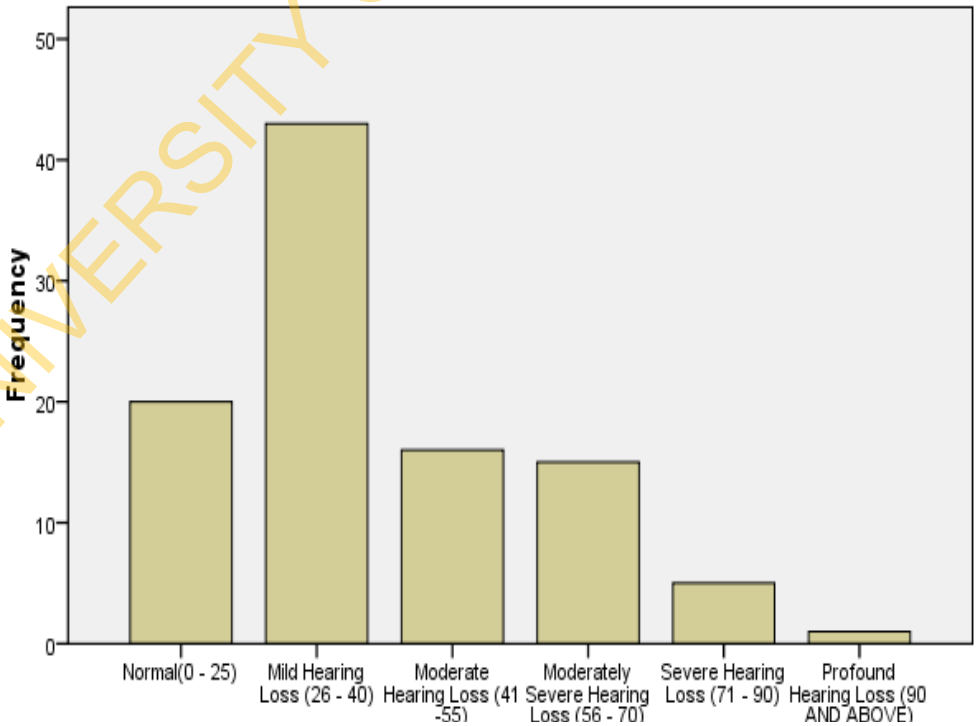

Figure 2: Degree of hearing loss (Right ear).

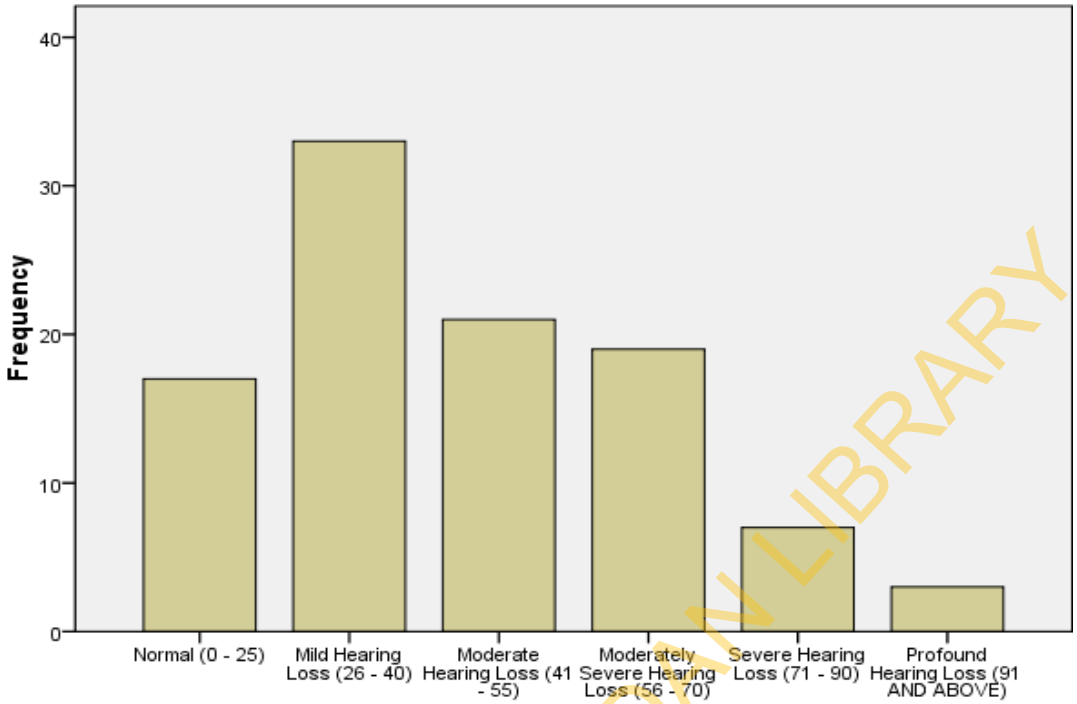

Figure 3: Degree of hearing loss (Left ear).

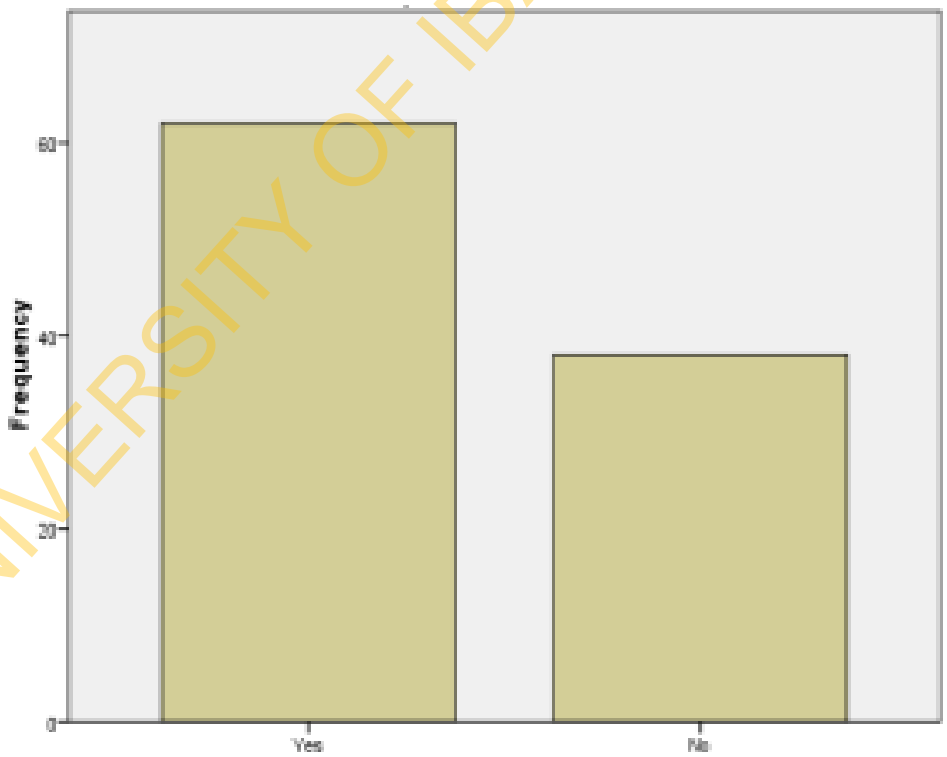

Figure 4: Participants with tinnitus.

ear/head) in one ear or at both ears while 32% participants had no evidence of tinnitus. Figure 5 indicated that 29% of the participants had a normal systolic blood pressure level as against 71% who had blood pressure level higher than normal. 45% of the participants were found pre - hypertensive crisis, 16% had stage I

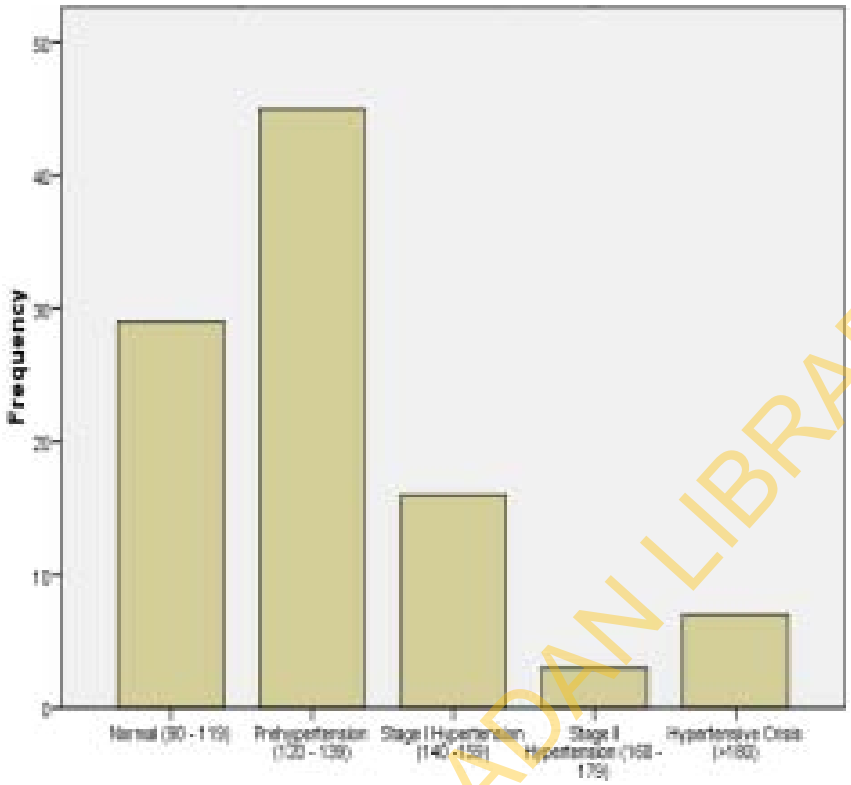

Figure 5: Systolic blood pressure of participants (mmHg).

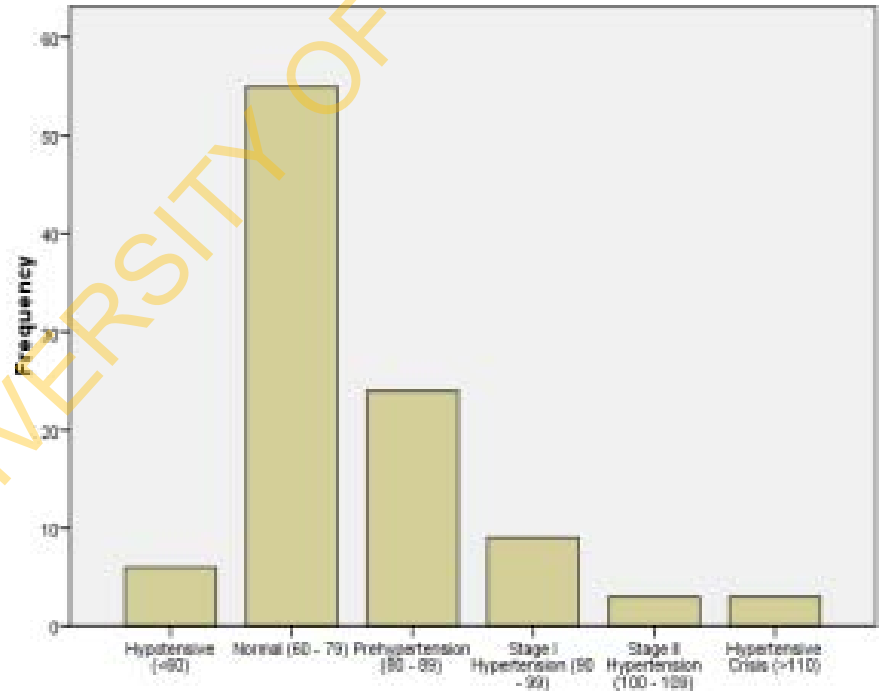

Figure 6: Diastolic blood pressure of participants (mmHg).

hypertension, 3% had stage II hypertension and 7% had hypertensive crisis, respectively.

Figure 7 revealed that 56% of the participants had a pulse rate higher than the normal range, while 12% had a pulse rate lower than the normal range and 32% had a normal pulse rate. Figure 6 revealed that 6% of the

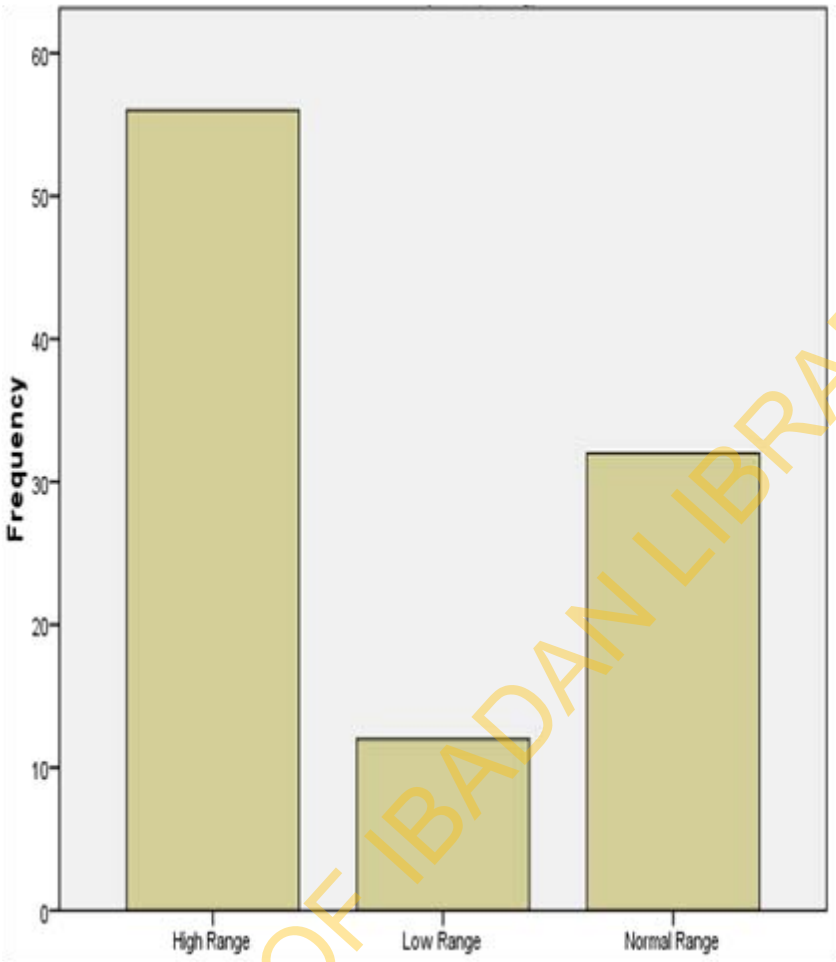

Figure 7: Pulse rate of participants.

participants were hypertensive in nature, 55% had normal diastolic blood pressure, 24% had related pre – hypertension conditions while 9% had stage I hypertension. It was also found that 3% had stage II hypertension and 3% had hypertensive crisis, respectively.

Figure 8 revealed that 75% of the participants always experience headache as a result of continuous excessive noise at work while 25% of participants admitted having stable health status.

DISCUSSION

The results of the study showed that the sound level of noise the participants are exposed to greatly surpassed the standard laid down by FEPA (1991) and OSHA (2002). This could be attested to related health challenges being experienced by the participants.

The study found majority of the participants had hearing loss in one or both ears which implied that the rate at which noise affects the hearing is high and assiduous. This therefore corroborates earlier findings that over exposure to noise leads to permanent threshold shift (PTS) or temporary threshold shift (TSS) (Plontke and Zenner, 2004). Eleweke and Owolawi (2012) further revealed that noise pollution leads to destruction of the hair cells as a result of vasoconstriction of the blood vessels in the cochlea due to oto-toxic properties of noise.

It was observed from the study that majority of the participants had tinnitus and a significant percentage with paracusis willisii which means that the participants could only hear with noise at the background. This is in line with the findings of Osisanya (1998). Additionally, it was found that majority of the participants had high systolic blood pressure, abnormal pulse rate and headache indicating that considerable exposure to noise leads to disorders. This is in agreement with the assertions of Glorig et al. (1961). The study of Glorig et al. (1961) showed that over exposure to noise pollution at work causes cardiovascular disorders such as hypertension.

However, the study further established that majority of the participants could be personally not aware of the hazardous effects of noise at their places of work. This fact was buttressed by the report of Palmer et al. (2005).

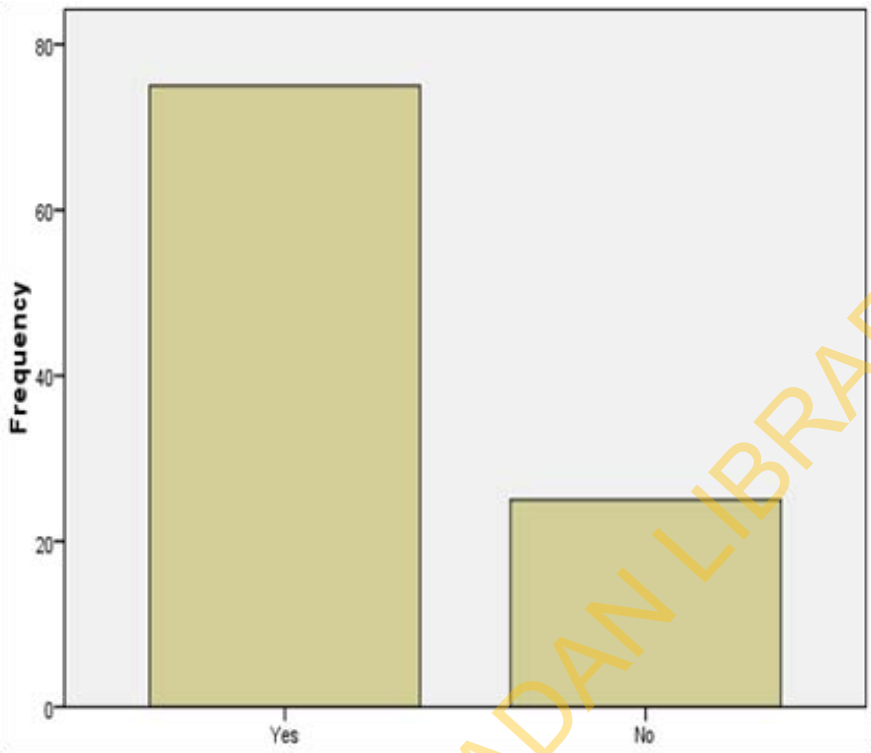

Figure 8: Percentage of participants with headache due to consistent exposure to noise at workplace.

Based on the findings of this study, it was revealed that occupational noise could lead to irreversible hearing loss, paracusis willisi, difficulty in concentration, persistent headache and cardiovascular disorders.

Conclusion

This study has served as a means of awareness about the dangerous effects of noise to industrial workers. It has also been established that occupational noise exposure remains with industrial revolution as the most pervasive occupational health problem that can prevent an individual from being healthy in every ramification of life. Exposure of unprotected ears of industrial workers over time may lead to temporary threshold shift or permanent threshold shift, tinnitus, paracusis willisii, cardiovascular diseases and other health impairments. Thus, preventive measures on the health risks caused by continued unprotected exposure to noise could reduce the productivity of the exposed workers and even cause serious health related challenges.

RECOMMENDATIONS

The following recommendations were made to suggest ways of educating industrial workers on the potential health risks and auditory performance on exposure to noise at their workplace:

1) Hearing conservation program should be encouraged in every industry where noise emitted exceeds the permissible limit;
2) Noise surveys to determine the degree of hazardous noise exposure by surveying any area in which workers are likely to be exposed to hazardous noise (>85 dBA) should be considered and appropriately effected;
3) Engineering and administrative controls must be undertaken to reduce exposures to noise generated to <90 dBA and this must include: design of equipment, its location and layout, selection of quieter machines, treatment of noisy rooms, administrative controls, proper maintenance and isolation of the workers from noise source;
4) Audiometric tests by pre-employment and periodic follow-up testing by employers to help determine employee status; employee medical history and non-workplace noise exposure should be assessed;
5) Company-sponsored education programmes should be thoroughly carried out to stress the importance of good hearing conservation practices on and off the job, as well as, other factors or diseases that may affect their hearing or general well-being;
6) Wearing of hearing protection devices to reduce the amount of sound reaching the ear must be encouraged

while, employees having noisy hobbies, or with noisy second jobs should be encouraged to use effective hearing protection devices during this noise exposure as well as, at the work-place;

7) All parties concerned - government, employers, workers and factory inspectors- should be involved in implementing noise control measures using the appropriate standardized Health and Safety guides;

8) Government should set up a monitoring committee that will inspect bi – annually, if industries are carefully following the Safety and Health Regulations;

9) Awareness programmes on the effects of noise can be introduced in the mass media so that even a layman will be aware of the dangerous effects of noise to the human health and general well-being;

10) Power supply in the country should be improved on as this will reduce the chances of industries relying on generator for power;

11) Factory workers must be encouraged to value their positive health status and go for regular Audiological / Otological and general medical checks as well as, fittings.

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