Assessment Of The Hearing Sensitivity Of People Exposed To Noise Generated From Welding Workshops In Calabar, Cross River State.

E. O. Onoyom-Ita., S. A. Ojomu., A. O. Ezugwu

ABSTRACT: A comparative study to determine whether noise generated by Welding workshops could affect the hearing sensitivity of people within their vicinity was conducted. One hundred and thirty (130) people were selected at random. Among those selected were thirty five (35) operators and Ninety five (95) people living or working within the premise, which is 5meters away from the source, for a minimum of one year. The control subjects were one hundred (100) members of staff and students of the State College of Health Technology Calabar. Noise and audiometric measurements were obtained using MS6700 digital sound level meter and Proton DX 5 digital audiometer. A structured questionnaire was administered to each participant. Noise level measurements at the test sites ranged from 85dB to 110dB with a mean Noise Level of 99.88 ± 0.68(dB). They were higher than the control Sound Pressure Level 58.85 ± 0.631 (dB) at ($P < 0.005$). At tested frequencies, the mean hearing threshold of the test subjects were higher at 2 KHz, 4 KHz and 8 KHz ($p < 0.0005$). Sensorineural hearing loss was prevalent among the exposed subjects (73%) compared to the control (27%; $p < 0.01$) sample. Tinnitus and headache were prevalent on the exposed subjects (67% and 65%) compared to the control sample; 30% had tinnitus ($p<0.01$) and 6% complained of headache ($p<0.0001$). The hearing thresholds at 2 KHz, 4 KHz and 8 KHz for both ears of the exposed subject correlated positively with duration of exposure. The correlation coefficient (r) obtained for the right-ear (RE) are 0.517, 0.594, and 0.582 they were all significant at 0.01. The correlation coefficient (r) obtained for the left ear (LE) was 0.497, 0.375 and 0.394 they were all significant at 0.01 for two-tail test. The correlation coefficient (r) obtained for the hearing thresholds at 2 KHz, 4 KHz and 8 KHz and age for the left ear are 0.189, 0.255, and 0.175. The correlation coefficient (r) obtained for the hearing thresholds at 2 KHz, 4 KHz and 8 KHz and age for the right-ear are 0.139, 0.181 and 0.121. Exposure to noise from these workshops for long durations could reduce human hearing sensitivity and increase the probability of the incidence of tinnitus and headache.

Keywords: Pure-tone Air Conduction, Pure-tone Bone Conduction, Hearing Threshold, Hearing Sensitivity, Welding Workshop, Noise levels, Duration Of Exposure.

1. INTRODUCTION

Noise is prevalent in our urban areas, the availability of quiet places within Calabar metropolis is decreasing due to a boom in the tourism industry. Prolonged exposure to noise leads to a range of physiological and psychological effects on man, which are difficult to diagnose early because they have long latency period. Thus most individuals keep treating incident symptoms like headaches, ear pains, tinnitus, and insomnia without tacking the underlying cause which could be due to Noise exposure. Hence, these symptoms keep reoccurring and lead to other diseases. The hearing acuity of individuals can be affected by aging, disease, ototoxic drugs, or exposure to noise [7].

Physiological effects from noise exposure could be harmless, painful or physically damaging [1]. Earlier studies as stated by Basner et al. [9] show that, health effects due to noise were first recognized in occupational settings such as weaving mills, where high noise levels were associated with noise induced hearing loss (NIHL). NIHL is a permanent impairment in hearing, is probably the most obvious and easily quantified effect of excessive exposure to noise [2],[6],[8],[13],[11],[17].

In Nigeria small scale factories are common in residential areas and are situated side by side in non-residential areas such as the market place, mechanic and computer villages. Noise pollution arising from these factories has become worrisome owing to the proximity of living houses and shops to these factories, where children, the elderly, and adults with varying health conditions are exposed [12].

Environmental noise could be transmitted to the fetus through the body tissues and uterine fluids, and probably within the fetus by bone conduction. Low frequency noise penetrates the fetal cochlea more effectively than the higher

frequency components. However, attenuation of about 10 to 20 dB for frequency components less than 250Hz and over 40dB at 2 KHz is observed at the cochlea [3].

2. MATERIALS AND METHODS

2.1 The study Area

The study was done in Calabar Metropolis, the capital of Cross River State in the south-south geopolitical zone of Nigeria. The State lies between Latitude 4.27^0 and 5.32^0 north of the Equator and Longitude 7.500 and 2.20^0 of the Greenish Meridian.

The Metropolis comprises of two local government areas namely; Calabar South and Calabar Municipality. Calabar, the capital of the former South-Eastern State and the first Capital of Nigeria has three ethnic groups namely; Efiks, Quas and Efuts speaking distinct languages and having different Monarchs.

The predominant religion is Christianity while some natives still cleave to the ancient traditional known as the Ekpe Society. She is known for her hospitality, rich culture and heritage that endear her to tourist from all over the world especially during the Christmas celebrations.

2.2 The study and control population

The study population comprised of one hundred and thirty (130) people made up of thirty-five (35) operators and ninety-five (95) neigbours- people working or residing close to the workshops. While the control population comprised of one hundred (100) members of staff and students of the College of Health Technology Calabar.

2.2.1 Exclusion criteria

1) People outside the age range 12 to 65 years.

2) People outside the control radius of 5 meters.

3) People exposed to noise before starting the venture.

4) People exposed to noise before residing or working close to the workshop.

5) People having the following clinical conditions

a) Defective ears (Pathogenic conditions)

b) Head Injuries

6) People with a social habit of night clubbing or listening to loud music

7) People that have been exposed to high doses of ototoxic drugs like quinine and chloramphenicol [14].

2.3 Materials

This research work was carried out with the following materials: MASTHECH digital sound level meter (MS6700), ARPHI digital screening audiometer model Proton DX 5, Personal computer equipped with MATLAB and a questionnaire.

2.4 Method

The research methods used was correlation analysis and the case-control epidemiological method

2.4.1 Objective Measurement

Noise generated from the welding workshops was measured at the place where the workshops were located. Furthermore, Consent was obtained from each participant (both control and subject) at the beginning of each study [5]. Furthermore, a thorough clinical history was taken with the aid of a questionnaire which was also used to implement the inclusion-exclusion criteria so as to exclude other factors responsible for reducing the hearing sensitivity apart from noise generated from these workshops.

Hearing assessments of the subject-participant was done using Proton D5 Digital audiometer at Group Specialist Clinic Calabar, where the ambient noise never exceeded 35dB. The control-participant hearing assessment was done in the audio-visual room within the School premises, where the ambient noise did not exceed 35dB.

Pure-tone audiograms were obtained for both air and bone conduction test for both ears. The air conduction audiogram were obtained for the conventional audiometric range 250Hz to 8KHz (250, 500, 1000, 2000, 4000, and 8000), while the bone conduction audiogram was obtained for the frequencies 250Hz to 4KHz [4].

3. RESULTS

The mean age for the noise exposed subjected was 25±0.959 years, while that of the control sample was 24±0.719 years. The mean duration of exposure was 7±1.128 years.

The mean Noise Level at a distance of 5 metres from the source was 99.88 ±0.68 (dB). This was significantly higher than the controls SPL 58.85 ±0.631 (dB) at (P < .0005). The mean Background Noise Level was 58 ±1.178 (dB). The background noise level at the control location was 55.25 ±0.617 (dB). Thus, there was no significant difference in the Background Noise Measured at various workshops and the Control location at (P<.01).

Fig.1 and fig.2 show the mean pure-tone air conduction hearing threshold at the conventional frequencies for the left and right ears respectively. The mean pure-tone air conduction hearing threshold of the control was higher at 250Hz, 500Hz in the right ear and 1 KHz in the left ear at a significant level of 0.025. However, that of the test sample was higher at 2KHZ, 4 KHz and 8 KHz for both ears (p<0.005). But there was no significant difference in the pure-tone air conduction hearing threshold of both the test group and the control group at 1 KHz of the right ear, 250Hz and 500Hz in the left ear.

Fig.3 and fig.4 show the mean pure-tone bone conduction hearing threshold at the conventional frequencies except 8 KHz. In the test group, there was no significant difference in the mean pure-tone bone conduction hearing threshold at 250Hz, 500Hz and 1 KHz but at 2 KHz and 4 KHz there mean hearing threshold was significantly higher than that of the control for the right ear. However, the mean pure-tone bone conduction hearing threshold was significantly higher than that of the control at all frequencies in the left ear.

4 Data Analysis

The application software MATLAB was used to analyze the data, obtain descriptive statistics and generate figures. The difference between the mean hearing threshold of the test

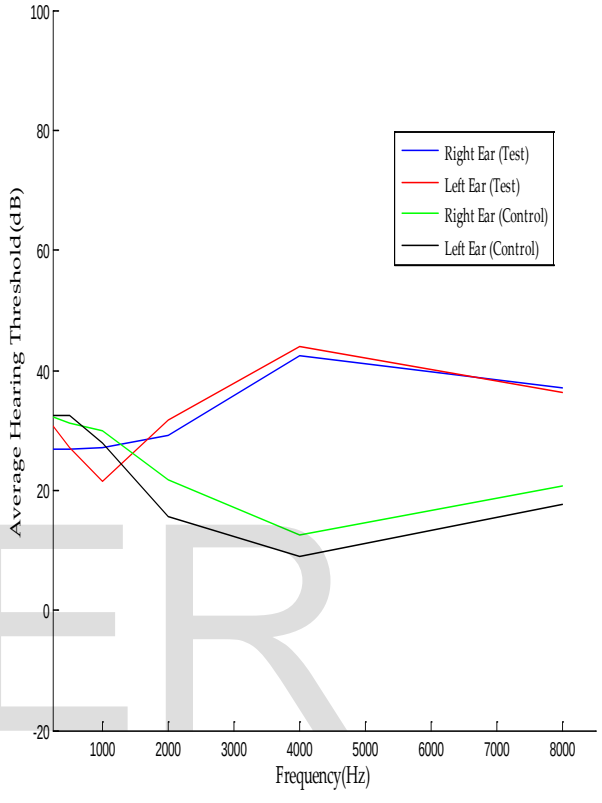

Fig.1 Plot of Average Air Conduction Hearing Threshold and Frequency

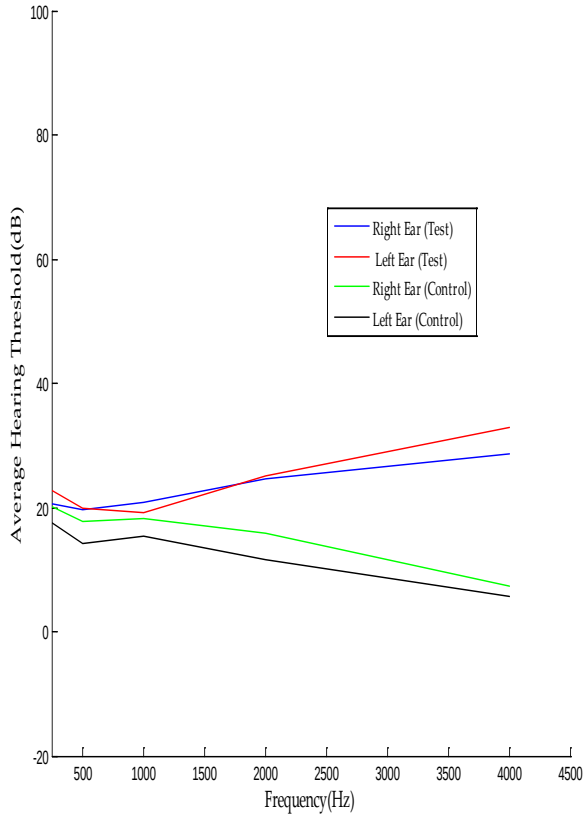

Fig.2 Plot of Average Bone Conduction Hearing Threshold and Frequency

group and the control group at different frequencies was done using the student's difference in means t-test. The relationship between the hearing thresholds (hearing sensitivity) and age, hearing thresholds and duration of exposure at 2 KHz, 4 KHz and 8 KHz were determined using correlation coefficient (r) were obtained. Plots were obtained for the hearing thresholds versus age and hearing thresholds versus duration of exposure (at 2 KHz, 4 KHz and 8 KHz) and the line of best fit with the aid of MATAB. Chi square was to test for significance of the prevalence of sensorineural hearing loss (Noised induced), tinnitus and headache on the test group using the epidemiology case-control method.

4.1 Relationship between the air conduction hearing threshold at 2KHz, 4KHz and 8KHz with the age of the exposed subjects

The hearing threshold correlated positively, though weakly with the age of the exposed subjects. For the test groups the correlation coefficient (r) obtained at 2KHz, 4KHz and 8KHz are as follows: 0.139, 0.181 and 0.121 for the right ear and 0.189, 0.255, and 0.175 for the left ear.

4.2 Relationship between the air conduction hearing threshold at 2KHz, 4KHz and 8KHz with the duration of exposure

The hearing threshold correlated positively with the duration of exposure of the exposed subjects. The correlation coefficient (r) obtained are at 2KHz, 4KHz and 8KHz are as follows: 0.517, 0.594, and 0.582 for the right ear and 0.497, 0.375 and 0.394 for the left ear. They were all significant at 0.01 for a two-tail test.

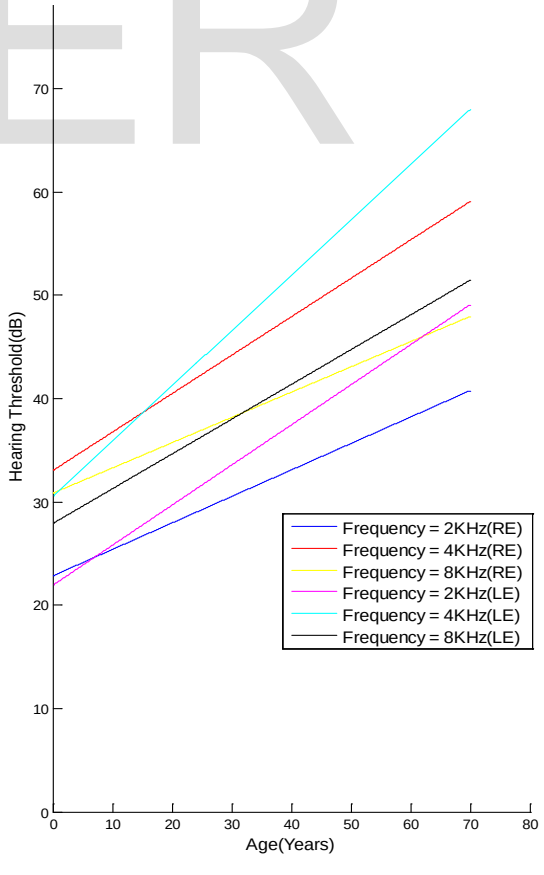

Fig.3 Plot of pure-tone air conduction hearing threshold and age(years)

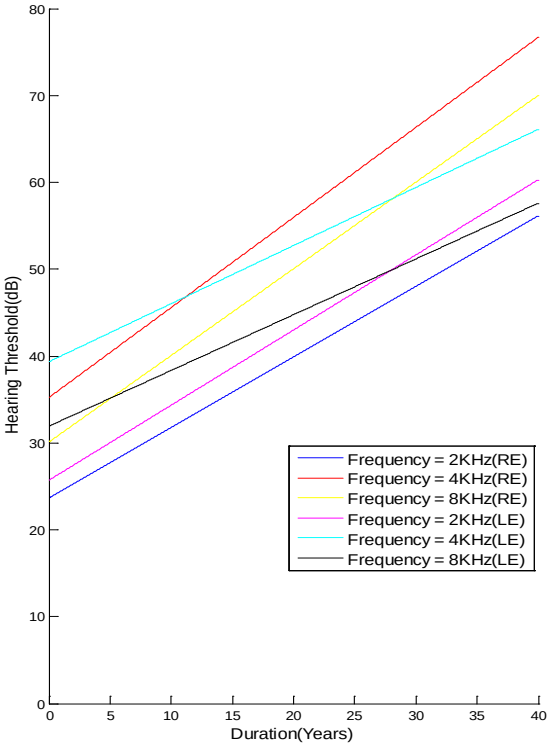

Fig.4 Plot of pure-tone air conduction hearing threshold and duration of exposure (years)

4.3 Prevalence of sensorineural hearing loss and other incidence of noise related symptoms on noise exposed subject

From the data, about 27percent (27 out of 100) of the control sample had sensorineural hearing loss, 74percent (96 out of 130) of the test group had sensorineural hearing loss on an ear. Using the epidemiology case-control method the calculated $\chi^2 = 16.4$, it is significant at $p < 0.00001$.

Approximately 67 per cent the test group (87 out of 130) complained of tinnitus compared to 33 per cent of the control sample. Thus, from the data above, the computed χ^2 for tinnitus and noise exposure is 10.35 ($p < 0.001$). 65 per cent (85 out of 130) for the test group complained of headache as compared to 9 per cent (9 out of 100) in the control group. Finally, the χ^2 for headache and noise exposure was 24 ($p<0.0001$)

5 Conclusion

This study shows that hearing loss and the occurrence of symptoms such as tinnitus and headache is significant among welders, as well as those living or working in proximity to welding workshops as compared to those not living or working in proximity to these industries. Noise levels in the study area were dangerously high and peoples' awareness of the dangers of exposure to noise was inadequate. In the industrial areas adequate steps were not taken to ensure compliance with the recommended safety regulations. This was evidenced by the non-compliance with the use of protective measures even among welders. The presence of high levels of noise coupled with inadequate awareness and use or enforcement of protective measures make the situation very grave.

NIHL is a resultant effect of persistent exposure to sound that is too loud over period of time usually years or can also occur from a single activity. To prevent NIHL from noise exposure especially in workplaces, guidelines that have been issued by various regulating agencies should be enforced. Such as, the United States Occupational Safety and Health Administration (OSHA) guidelines which advices that an exposure of 85 dB should not exceed 16 hours per day. Furthermore an increment of 5 dB in noise level requires the exposure time to be reduced by half. Implying that the exposure time could be doubled for a decrement of 5 dB in noise level. Thus, the permitted exposure time is 16 hours for 85 dB, 8 hours for 90 dB, 4 hours for 95 dB, 2 hours at 100 dB, 1 hour at 105dB (OSHA, 1983). However, the

United States National Institute for Occupational Safety and Health (NIOSH) recommends an exposure limit of 85 dB for 8 hours per day. The permitted exposure time could be doubled for any decrement of 3 dB in noise level and the reverse is the case for a 3 dB increase in noise level. Thus, the permitted exposure time is 8 hours for 85 dB, 4 hours for 88 dB, 2 hours for 91 dB, an hour for 94dB, half an hour at 97dB (NIOSH, 1998, NIOSH & CDC, 2002). These values are based on scientific studies relating noise exposure to hearing loss, and are more protective of hearing (Niquette, 2011).

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