EFFECTS OF EXPOSURE TO LOUD NOISE ON THE HEARING OF THE RESIDENTS OF CALABAR, NIGERIA

Ubon Asuquo[1], Michael Onuu[2] and Affiong Asuquo[3]

[1]Department of Mathematics, Trinity Western University, Langley, BC, Canada. (2011/2012 Session)
[2]Department of Physics, University of Calabar, Calabar, Nigeria.
[3] Department of Anaesthesiology, University of Calabar Teaching Hospital, Calabar, Nigeria

1. INTRODUCTION

As the society develops technologically, more and more people are exposed in one way or the other to noise exceeding 65 dB(A). In some countries, more than half of the population is exposed. When one realizes that at 65 dB(A) sleeping becomes seriously disturbed and most people become annoyed, it is clear that noise is a genuine environmental health problem.

Problems associated with noise – induced hearing loss are not new. In the middle ages, workers in certain profession such as blacksmithing, mining, and church bell ringing were known to become deaf, or partially deaf, after years of work [1]. However, with technological development, the number of workers exposed to excessive noise increased significantly as has the number of people exposed to other sources of noise, such as transportation noise and loud music [2]

The risk of much increased rates of occupationally acquired hearing loss must be met by strong preventive measures in engineering and medicine in both developed and developing countries

1.1 Hypotheses

The following null hypotheses were used for the research;

i. There is no relationship between objective measure of noise using sound level meter and the subjective measure of noise using questionnaires.
ii. There is no relationship between exposure to loud noise and noise – induced hearing loss.

2. MATERIALS AND METHODS

The materials used for this study are the sound level meter for measuring the sound level of the zones, an audiometer for testing hearing acuity and a 39-item questionnaire for subjective assessment of the respondents.

2.1 Site description

Guided by our preliminary measurements, sixteen sites were selected. Measurements were taken in these sixteen zones-eight high noise zones and eight low noise zones. The high noise zones had average A-weighted noise levels of 80 dB or above, a level which may be hazardous to the hearing of most people. The low noise zones had average A- weighted noise levels of 50 dB or below, a level above which most people complain

2.2 Measurements

Noise levels at schools and their surroundings were measured objectively using a precision sound level meter (Bruel and Kjaer) type 2203 with octave band filter (B&K) type 1613 by an accredited Acoustician from the Department of Physics, University of Calabar, Nigeria.
Measurements were taken between 7 am and 9 am, and 2 pm and 4 pm on working days (Monday to Fridays). About fifty random readings were taken at different locations within each zone and the sound level of each zone was calculated.

Hearing assessment of the respondents was done by a trained Technician using a pure tone audiometer in the Department of Otolaryngology, University of Calabar Teaching Hospital, Calabar using the audiometer. The frequency of the audiometer was varied from 64 Hz to over 8000 Hz. Amplitude was varied by 5 dB increments. The oscillator was used to change pitch so that a range of sounds can be tested. Hearing threshold measurements were carried out separately for both the right and left ears of the 2000 subjects using the Hughson-Westlake (ascending/descending) procedure. Each audiometric test was preceded by an auriscopic examination in order that any coexistence significant aural pathological conditions such as wax impaction, tympanic membrane perforation, etc., could be detected.

Subjective measurement was done using questionnaires. A total of 1300 questionnaires were distributed in the high noise zones while 1200 were distributed in the low noise zones. 1100 (85.6%) were collected back from the high noise zones while 1050 (87.5%) were collected back from the low noise zones. However, 1000 questionnaires were accepted for analysis from both the low and the high noise zones. This is because 100 and 50 questionnaires were rejected from the high noise zones and the low noise zones, respectively because the respondents did not stayed or worked/schooled in the area for up to three years.

3. RESULTS

The effects of exposure to loud noise on hearing of people in Calabar were assessed by comparing the hearing acuity and subjective responses of respondents in the high noise zones with that of respondents in the low noise zones. The respondents taken were those that have resided or done business in these areas for at least three years, a period believed to be enough for the respondents to be adapted to the noise environment of the zone. Results of physical measurements are presented in Tables 1, 2, 3 and 4.

Table 1. Noise levels in the high noise zones.

Code	Background Noise ± 0.5 dB(A)	A-Weighted SPL ± 0.5 dB(A)	Lmax ± 0.5 dB(A)
HNZ 1	56.0	118.0	121.5
HNZ 2	51.0	116.5	120.0
HNZ 3	54.0	109.5	112.0
HNZ 4	57.0	102.0	108.0
HNZ 5	54.5	110.0	115.0
HNZ 6	50.5	116.0	119.0
HNZ 7	60.5	129.0	131.0
HNZ 8	60.0	112.0	118.0

Table 2. Noise levels in the low noise zones.

Code	Background Noise Level ± 0.5 dB(A)
LNZ 1	47.5
LNZ 2	40.0
LNZ 3	44.5
LNZ 4	40.0
LNZ 5	43.5
LNZ 6	38.0
LNZ 7	47.0
LNZ 8	44.5

Table 3. Hearing assessment in the high noise zones

Threshold levels (dB)	Number of Respondents	
	Right ear	Left Ear
< 25	540	367
26 – 40	392	560
41 – 60	60	40
61 - 80	5	25
> 80	3	8

Table 4. Hearing assessment in the low noise zones

Threshold levels (dB)	Number of Respondents	
	Right ear	Left Ear
< 25	620	720
26 – 40	375	251
41 – 60	3	20
61 - 80	2	7
> 80	1	2

3.1 Correlation between the subjective and objective responses

To determine how related the subjective responses, assessed by the use of questionnaires as the study instrument were to the objective responses measured with the sound level meter, the coefficients of correlation[3] were calculated for the noise measurements.

The objective responses measured with the sound level meter represent x-variates and the subjection responses represented by corresponding average value per zone, as y-variates. Substituting these data into the correlation equation, we have the correlation coefficient to be 0.66 and 0.56 for the high noise zones and the low noise zones respectively. The results show that there are good correlations between the two measurements in both zones.

3.2. Effects of noise on hearings

The hearing assessment of respondents in the high and low noise zones were shown in Tables 3 and 4 respectively. Analyses of these tables were done using the Statistical Analysis Software (SAS). The results in Tables 3 and 4 show that majority of respondents had hearing loss. In the high noise zone, 1.45% had hearing loss in different degrees in the right ear while 15.82% had hearing loss in the left ear. In the low noise zones, 9.43% had hearing loss in the right ear while 6.98% had hearing loss in the left ear. The probability value is 0.0001. This is statistically significant and so we reject the null hypothesis that there is no relationship between exposure to loud noise and noise-induced hearing loss.

To further confirm our decision, we consider the chi-squares value. Here, the chi-square ($\chi 2$) value is 82.2509. The tabulated ($\chi 2$) value is 5.22. Therefore, since the calculated ($\chi 2$) is greater than the tabulated ($\chi 2$), this confirms the null hypothesis should be rejected. Therefore, we can conclude from the analysis that exposure to loud noise do cause noise-induced hearing loss, as seen in this study. This is in line with previous findings [4]

4. DISCUSSION AND CONCLUSIONS

Noise is a disturbance to the human environment that is escalating at such a high rate that it will become a major threat to the quality of human lives if nothing is done to reduce it. Noise has been a constant threat since the industrial revolution. Too much noise exposure may cause a temporary change in hearing or a temporary ringing in your ears (tinnitus). These short-term problems usually go away within a few minutes or hours after leaving the noise. However, repeated exposures to loud noise can lead to permanent, incurable hearing loss or tinnitus.

REFERENCES

1. B. Berglund and T. Lindvall, (Eds.) (1995). *Community Noise*, Centre for Sensory Research, Stockholm, Sweden.
2. U. E. Asuquo, M. U. Onuu, A. O. Akpan and A. U. Asuquo (2009). Noise and blood pressure: A cross sectional and longitudinal study of the effects of exposure to loud noise on residents in Calabar, Cross River State, Nigeria. *International Journal of Acoustics and Vibration*, 14(2), 1–15.
3. A. O. Adedayo (1998), *Understanding Statistics* JAS Publishers, Lagos.
4. O. Bethesda (1999). Noise-induced heaving loss. National Institute on deafness and other communication disorder. *Noise Induced Hearing Publication*, 97, 1433–1441.

ACKNOWLEDGEMENTS

PROF. A. I. MENKITI – PHYSICS DEPT., UNICAL., NIGERIA.