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Assessment of Noise-Induced Hearing Loss among Staff and Students of Ignatius Ajuru University of Education, Port Harcourt

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Abstract
This study assessed noise induced hearing loss at Ignatius Ajuru University of Education in Port Harcourt, Rivers State, Nigeria. The noise levels were measured using BENETECH Model: GN1352 noise meter. The sound meter was held at a height of 1.2 meters and 3 meters away from the source of noise, the instantaneous A-weighting noise value was computed. Measurement was carried out thrice per day at 8.00am-10.0am, 12.00-2.00pm and 4.00-6.00pm respectively. Measurement was conducted at different locations within the tertiary institution which includes: administrative buildings, hostels, lecture halls, library, park and business centers. The data was recorded quarterly for a period of twelve months. The mean value was obtained and used in computing the noise pollution level (LNP) and day time average noise level (LD). Also, three hundred subjects were drawn from the tertiary institution and screened for noise induced hearing loss. Hearing loss was assessed using the audiometry method. The data obtained were subjected to ANOVA and T-Test statistical package. The result revealed a noise pollution level for lecture halls (94dbA), libraries (79.1dbA), administrative building(80dbA), hostels(83.4dbA), business areas(83.6dBA), daytime average noise level (LD) for lecture halls (89.7dbA), libraries (70.4dbA), hostels (72.9dbA), business areas (80.7dbA) and and administrative building (71.6dBA) for all the locations . These values exceeded the maximum permissible limits for various locations when compared to the set standards of World Health Organization (WHO) and Federal Environmental Protection Agency (FEPA). Also, for hearing test, 26% had normal hearing level of (0-25DB), 31% had mild hearing loss (25-40 DB), 20.3% had moderate hearing loss (40-70 DB) and 23% had severe hearing loss (> 70 DB), those within the age bracket of 50-59 years were more in number of those with hearing loss. This study is an eye opener to the authorities of Ignatius Ajuru University of Education of the abnormal high noise level and the associated health impacts within its environs. Therefore, measures such as noise abatement and hearing conservation programmes, purchase and installation of such equipments which include earplugs, earmuffs, sound enclosures, acoustic doors and window sound walls, fences and barriers, acoustic baffles, banners, curtains and sound diffusers is advocated for.

Keywords: Noise Pollution, Noise - Induced Hearing Loss, Audiometry, Abatement measures

Introduction

Sound can be said to be a wave in air and does not accumulate in the environment. loud sound affects humans and these effects do not disappear so easily. (Bob-Manuel, 2009). The human ear has the attribute of being sensitive to a wild range of sound intensities. The loudest sound that can be heard such as rocket taking off or the noise of battle are billions of times more powerful than the softest sounds such as the pattern of rain drops on soft earth or a child' s whisper .sound intensity is measured on a scale of values called decibel (db) scale. Noise is largely viewed as a form of sound, though sound of every inharmonious or irregular note. Noise is a part of sound which is not pleasurable. It may be perceived as an unwanted or extraneous sound. Noise is derived from the Latin word " nausea" implying ' unwanted sound' or ' sound that is loud, unpleasant or unexpected' . According to Garg (2004), noise can be transmitted through a material medium like air, this noise on reaching the ear, may be perceived as desirable or undesirable. Okoro (2014) opined that it is the undesirable sound that is commonly referred to as noise. Anomohanran (2013) referred to noise as an environmental pollutant that is increasing very rapidly due to a corresponding increase in commercial, industrial and social activities. Noise can be described as sound without agreeable musical quality or as an unwanted or undesired sound (Abolarin, 2012).

Noise is the sound that is high enough, that adversely affects our level of tolerant (Orbak et al., 2022). Granting that noise is a global issue, there are several studies in this subject. In an attempt to control noise pollution, the World Health Organization (WHO, 2018) has set a standard for the permissible level of noise at 90 dBA, which is the highest allowable level of noise human beings can be exposed to. However, many countries, including Brazil, Japan, Spain, Sweden, Switzerland, Denmark and India have adopted higher standards of permissible noise levels, such as 55 dB (A) for daytime, and 45 dB(A) for night-time, while Ireland (Dublin) has set 55 dB(A) for daytime and 35 to 45 dB(A) for nigh time, Australia set her standard at 45 dB (A), the Netherland has different threshold values, namely 75 dB to 70 dB(A) for the industrial area, 65 dB to 55 dB(A) for the commercial area, 55 dB to 45 dB(A) for the residential area and 50 dB to 42 dB or 46 dB(A) for the silent zone for day and nighttime. The noise standards for low density areas in Malaysia are of 50 dB (A) and 40 dB (A) and for high density mixed-use areas, the noise standards are higher than 60 dB (A) and 50 dB (A) for daytime and nighttime.

In Nigeria, the National Environmental (Noise Standards and Control) Regulations 2009, set the maximum noise level permitted in residential buildings for daytime (6:00 am– 10:00 pm) to be of 43 dB and for night(10:00 pm– 6:00 am) of 35 dB, whereas for higher education institutions to be 60 dB for day and 50 dB for night (Federal Republic of Nigeria Offical Gazette, 2009).These standards are comparable to what are obtained in other countries. Based on these, a combination of the WHO' s16-hour day and night limit standard of 55 dB and National the Environmental (Noise Standards and Control) Regulations 2009 for residential areas of 50 dB was adopted for this study as a control.

Budiman (2014) reiterated that those who feel the main impact of noise in urban area are students, whose schools are located near busy roads because of their exposure to vehicular noise pollution. The negative impact of noise is worse at school with an open classroom design and those located nearer to external sources of noise (Connolly et al., 2015). Noise pollution may bring physiological impact on students in form of dizziness, emotional and uncomfortable feeling as well as communication process (Buchari & Matondang, 2017).The consequences are the decline in performance achievement due to noise disturbance as most students do not hear the voice of teachers clearly during teaching and discussions. The prevalence of noise pollution especially in urban areas, Thattai et al. (2017) argued that is due to increase in population and urbanization in urban areas. Wen et al. (2019) investigated the impact of urban traffic on the acoustic comfort of roadside six secondary schools in Taiyuan, in the northern China. The schools are situated near different categories of roads. Noise data were obtained at three different locations (front of school, schoolyard, and classrooms). The results showed that noise level in these schools were quite high and a strong correlation with road traffic noise. The maximum measured ' ' equivalent A-weighted sound level (LAeq,20min, LAeq) was 74.2 dB (A) near an expressway, which is 35% higher than the exterior threshold value (55.0 dB(A) recommended by the World Health Organization' '

Hamad and Hussen (2021) found that noise has health and psychological effects on schools in the city of Ramadi. The sources of the noise are nearness of the' ' traffic, generators, markets and industrial workshops. The study identified adverse health effects of noise as' ' fatigue, headache, lack of focus, tension, nervousness and psychological discomfort.' ' These adverse effects on health may compel the pupils and staff to move to other schools with less effects of noise pollution. The study by Amakom et al. (2019) inferred that noise exposure could greatly reduce the students' academic performance. Reductions in student' s academic performance induced by noise pollution include loss of memory, increase aggression, distraction, and concentration (Ntui, 2009). Teachers too experienced adverse effects of noise pollution as it affects their deliverability of lectures. For instance, Bulunuz et al. (2021) found in school teachers' noise sensitivity in Turkey. Teachers showed hypersensitivity, migraine and prolonged severe headache, difficulty in communicating, tinnitus, and difficulty in focusing on lessons, communication and interaction. These adverse effects also include excessive tiredness and getting distracted, and a reduced tolerance limit, as well as feeling tired and angry. The finding of this study suggests that teachers would be in continued search of a quiet environment to get away from the noise in the schools.

Egunsola (2014) observed that pupils in senior secondary students in Adamawa state, but from different homes, located in a noisy environment caused by traffic, market and industrial machine, were affected negatively in their performance in school. The pupils complained that their environment is noisy and prevent them from concentrating

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while reading and studying at home and even while listening to educative radio programs. Noise affects the quality of information delivered by the teacher as well as the message received by the students. Ali et al. (2017) noted that acoustic discomfort causes fatigue, headaches, annoyance, changes in behavior and attitude leading to a decrease in intellectual working ability and sleep disorders. In a similar study done in Benin City, Nigeria, Oviasogie and Ikhudayisi (2019) revealed that the prominent sources of noise pollution in two residential neighborhoods were portable electricity generators and commercial activities. They also noted that other sources of noise pollution were the loudspeakers used by churches and mosques, highly amplified music from record shops, bells used by peddlers, hawkers, and salesmen of items to who advertise their wares and grinding machines. Sources of Noise pollution in the Nigerian institutions of higher learning could be identified as electricity generating plants, road traffic, religious activities and classroom internally generated noise by the students themselves. Wekpe (2020) evaluated the problem of noise pollution around the communities of the University of Port Harcourt using both cross-sectional and experimental design. They found that noise values across the study area were beyond threshold limits for acceptable noise levels. The noise pollution was attributed to rapid urbanization and industrialization associated with high number of automobiles, generating plants, industries, and marketing strategies using mobile advertisement vans and mobile vendors, and conversion of residential areas to business and artisanal outfit.

Ighoroje et al. (2004) carried out a research on noise-induced hearing impairment as an occupational risk factor among Nigerian traders. The objective of the study was to assess the effects of occupational noise on hearing among selected industrial workers in Benin City, Nigeria. Male and female workers (n=150) in sawmills, Food Processing industries and Marketers of recorded music who had been exposed to high levels of occupational noise for between 1-14years were evaluated. the ambient noise levels in their workplaces was over 90dB.The air and bone conduction defects for both left and right ears were analysed. The results showed that noise-induced hearing impairment was present in 100% of the workers exposed for a period of 14 years. By 4-8 years, 100% of sawmill workers had developed hearing impairment. In addition, air-conduction pathway in the right ear was affected more than the left ear. In general, male workers were more susceptible to noise induced hearing impairment. In a situation of low level of awareness and dearth of enforced noise control laws in many developing countries, noise pollution can pose severe hearing impairment and other health risks.

Zerina et al. (2021) carried out a research to determine the prevalence of hearing impairment caused by noise among workers in two companies in Bosnia and Herzegovina, to correlate hearing loss with age and years of specific work experience, and to indicate the occurrence mechanisms for these impairments.: The study included 60 respondents who were divided into two groups: one group consisted of respondents with hearing impairment, and the second group respondents whose hearing was not impaired. Data were collected over a period of 5 years, by testing with sounds in frequency range 250-8000 Hz, which were graphically represented by audiograms.

Israel et al. (2019) conducted a research on the prevalence of NIHL among iron and steel workers and compared hearing thresholds at different frequencies with a control group. A cross-sectional study among 221 iron and steel workers exposed to average noise level of 92 dB(A), compared with 107 primary school teachers recruited as controls and exposed to average noise level of 79.7 dB(A).The prevalence of hearing loss was significantly higher among the exposed group than among the controls, i.e. 48% and 31%, respectively. There were significant differences in hearing thresholds between the exposed and control groups at 3000, 4000, 6000, and 8000 Hz. Hearing loss was more frequent among workers exposed to higher noise levels than among the controls suggesting that iron and steel workers run a higher risk of developing hearing loss.

Due to the rapid industrial revolution in Port Harcourt which have led to a corresponding increase in urban migration of people to the city for greener pasture. Against this background, the tertiary institutions within Port Harcourt metropolis have been impacted with tremendous increase in activities such as academic, industrial, and commercial activities respectively. With the rapid increase in the number of students on campus, increase in vehicular movement, car horns ,constructions sites, increase due to infrastructural demands, increase in commercial activities and use of automobile generating sets and others. A lot of research has been carried out on traffic noise levels in the major cities within Port Harcourt metropolis. However, much attention has not been given to tertiary institution noise in Port Harcourt metropolis as well as the risk associated or posed by noise on the members of the academic community within the metropolis. This problem and others prompted an attempt to close the gap in knowledge. Therefore, this study assessed noise induced hearing loss at Ignatius Ajuru University of Education with a focus on assessing the noise pollution level (LNP), the daytime average noise levels (LD) and the impact of noise on hearing level of the members of the academic community.

Materials and Methods

Description of study area

This study was carried out in Ignatius Ajuru University of Education located at Rumuolumeni, Port Harcourt, with GPS coordinates of 4.80531N and 6.93233E. The University enjoys six faculties with an estimated total population of about 25,000 including staff and students. Rumuolumeni where Ignatius University is located is a prominent town in Port Harcourt City. The town features a tropical monsoon climate with lengthy and heavy rainy seasons and very short dry seasons. Only the months of December and January truly qualifies as dry season months in the town. The harmattan, which climatically influences many cities in West Africa, is less pronounced in Rumuolumeni. Rumuolumeni heaviest precipitation occurs during September with an average of 367 mm of rain. December on average is the driest month of the year; with an average rainfall of 20 mm. Temperatures throughout the year in the city is relatively constant, showing little variation throughout the course of the year. Average temperatures are typically between 25 °C - 28 °C in the city.

Sampling area

The sampling areas includes library, lecture Halls, Administrative buildings, Business Areas and Hostels.

Determination of noise pollution levels

The ambient noise monitoring was carried out using an EXTECH 407732 sound level meter.

The monitoring of noise around the schools in the respective study area was carried out. The noise level meter was set at the slow response mode with A-weighting (A-weighted decibels (dBA)). The measurement was carried out thrice per day,

8.00 A.M. – 10:00 A.M.

1:00 P.M. – 3:00 P.M.

6:00 P.M. – 8:00P.M.

The noise meter was held at a position of 45° in the midst of the students or members of staff of the Tertiary institution at a height of 1.2 meters which correspond to the average ear height of the students and members of staff sound level measurements was taken.

Noise pollution level

This gives vibration in sound signal with a fluctuating noise.

From the data obtained above, the Noise pollution level was computed thus;

Noise Pollution Level: $LNP = LAeq + K\sigma$

Where

K = Constant with a value of 2.56

σ = the standard deviation of the acquired Leqvalues. (Alao & Avwiri, 2010).

OR

$LNP = LAeq. + (L10 - L90)$ dB

Where

L10 = sound level exceeded 10% of observed time

L90 = sound level exceeded 90% of observed time. (Obisung et al., 2013).

Assessment of daytime average sound level (LD)

This is computed using this expression for daytime noise average

$LD = 10\log10[1/2(\text{antilog } LAeq1uM/10 + \text{antilog } LequA/10)$

(Essandoh & Armah, 2011).

Ascertaining the impact of noise on hearing level

The hearing test was assessed through an automated mobile audiometer, a non-invasive and painless procedure to measure hearing sensitivity of individuals. It was performed using sounds of single frequency to determine the lowest loudness level the individual is able to hear at each frequency.

Procedure

Three hundred (300) subjects were drawn across the five tertiary institutions within Port Harcourt metropolis with respect to age range such as 20-29years, 30-39years, 40-49 years and 50-59years respectively. Medical history of the subjects were taken prior to the noise induced hearing test to ensure they are not previously experiencing hearing problems, all factors that are associated with hearing problems such as ontological pathology: ear disease, head injuries and positive family history of hearing loss were all ruled out. Subjects were made to sit in a sound treated room for testing. Standard head phones/ ear phones were fixed; the subject was required to give a response or hearing a tone, by lifting hands or fingers or pressing a button. The lowest loudness level heard by the subject in each frequency was recorded and is called threshold. This was read from the audiogram. The pure tone average was calculated as the average thresholds (softest sound heard) the 500Hz, 1000Hz and 2000Hz respectively to determine the type and severity of hearing loss in the ear.

Statistical analysis

The results were analyzed using the SPSS packages of ANOVA and T- Test respectively. **Results**

Result showing noise pollution level (LNP) for all the stations

Location	**LNP**
LH	94.0
LB	79.1
ADM	80.6
HS	83.4
BA	83.6

Key
LH- lecture Hall
LB- Library
ADM- Administrative Building
HS - Hostel
BA - Business Area

Result showing daytime average noise level (LD) for station all the stations

Location	LD
LH	89.7
LB	70.4
ADM	71.6
HS	72.9
BA	80.7

Key LH- lecture Hall
LB- Library
ADM- Administrative Building
HS - Hostel
BA - Business Area

Result of noise induced hearing loss with respect to age

Age group in years	**Number of persons**	**Number of persons with hearing loss**	**%**
20-29	75	41	13.7
30-39	75	52	17.3
40-49	75	61	20.3
50-59	75	69	23
Total	**300**	223	74.3%

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Result showing the degree of noise induced hearing loss

Degree of hearing loss	Range	Number of persons	%
Normal	(0-25 DB)	77	25.79
Mild	(25-40 DB)	93	31
Moderate	(40-70 DB)	61	20.3
Severe	(> 70 DB)	69	23

Discussion

The result of this research revealed that the noise pollution levels(LNP) in the tertiary institution where this research was conducted all exceeded the maximum permissible limits set by various environmental and health agencies such as the World Health Organization(WHO), FEPA, as well as NESREAA(2009) guidelines for noise. The results obtained for the various locations within the institution are lecture halls (94dbA), libraries (79.1dbA), administrative building (80dbA), hostels (83.4dbA), business areas (83.6dBA) respectively. World Health Organization(WHO 1999) guidelines recommends a noise level not exceeding 35-45dbA for classrooms and libraries, 50dbA for residential areas like hostels, 65dbA for commercial areas like parks, business centres and 70dbA over 24hours for working environment like offices. Almost all the locations exceeded this limit or guideline. This result is in agreement with the results obtained by other researchers as Agbalagba et al. (2013), Usikalu & Kolawole (2018) who investigated noise pollution level (LNP) in Delta State and Covenant University Ota, Ogun State respectively and obtained results exceeding the permissible limits set by (WHO) and FEPA. Ephrampoush et al. (2011) in a similar research obtained results for LNP which exceeded the maximum permissible limits Comparing the result of this research with the results of other researchers on noise pollution level; Agbalagba et al.(2013) obtained the noise pollution level of 103.77 dba, 96.55dba ,99.02dba and 99.97dba respectively in Ozoro, Ughelli, Warri and Sapele saw mills. These values are higher than the values obtained in this research. The difference in the value could be chiefly attributed to the fact that the environment where these two researchers were carried out are different as this research was in a tertiary institution of learning whereas, the other was carried out in a saw mill. Ideally, tertiary institution ought to generate lesser noise compared to a sawmill. This research has clearly demonstrated the disparity and as such can be said to be reliable.

The Daytime average (LD) for all the locations such as lecture halls (89.7dbA), libraries (70.4dbA), hostels (72.9dbA), business areas (80.7dbA) and administrative building (71.6dBA) were all above the permissible limits of 55dbA for outdoor level at day time. Amakom et al. (2019) in a similar research reported a high daytime noise average of 71.07dbA at lecture halls taken when lecture and school activities were at its peak (12pm). Also Yu-kai (2019) reported a daytime average noise level above 55dbA. These two findings are in agreement with the results of this study carried out in the tertiary institution. The result of this research showed that 74% of those exposed to noise above 70Dba had hearing loss after exposure to noise. This result is in agreement with the result of other researchers who carried out a similar study on noise induced hearing loss. Ighoroje et al. (2004) conducted a related survey among sawmill workers and reported 100% hearing impairment among noise exposed workers. Ighorojo et al. (2004) reported hearing impairment among noise exposed subjects in their studies.

Conclusion

The research assessed noise induced hearing loss at Ignatius Ajuru University of Education. The results showed high noise pollution level (LNP) values and day time average noise levels (LD) respectively. The study also revealed that noise had an impact on the hearing level of the members of the institution.. This research serves as an eye opener to the tertiary institution authorities, students, staff and other members of the tertiary institution and also the government on the alarming high noise levels and its negative impacts within the academic community.

Recommendations

These results have revealed that a noise level in the various locations within the tertiary institution where this research was carried out is dangerously high with its impact on hearing level of the residents of the academic community. Therefore, the following recommendations are put forward;

1) That acoustic zoning method wherein some areas of the institution such as library, lecture halls, administrative buildings and hostels should be designated as silence zone.
2) That green muffler scheme which involves planting of green trees and shrubs like Ashoka, Neem and Tamarind along the road and walk ways within the institution to serve as noise repellants.
3) That noise silencers to control noise from automobiles during the daytime should be installed.
4) That staff, students and other members within the institution should wear hearing aids, earplugs and earmuffs while on campus.

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