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Impact of Aircraft Noise Generation on Residential Neighbourhoods near Port- Harcourt International Airport Omuagwa, Ikwerre Local Government Area, Rivers State, Nigeria.

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Abstract- This study examined Aircraft noise impact on residential neighborhoods near Port Harcourt International Airport Omuagwa, Nigeria. Medical health record data for the acoustic report was obtained from the Omuagwa health center. Field noise measurement was taken from sensitive noise receptors in the airport and the host community using a précised sound level meter model 2310 SL, IEC 651. Seven years' acoustic health records from 2013, 2014, 2015, 2016, 2017, 2018, and 2019 were obtained and calculated. Field noise data was sample within and outside the Airport terminal. The points include terminal1(95.6 dBA), terminal 2(94.0 dBA), Airport junction (94.4 dBA), Igwuruta Stadium (88.0 dBA), Omuagwa Village1(92.7 dBA), Omuagwa Village (91.7 dBA), and Omuagwa village market (92.3dBA). The result shows two health diseases such as hypertension and hearing impairment caused by aircraft noise, with 2,990 cases. Hearing impairment is prevalent among adults above 18 years, with 2,248 disease cases and 742 cases of hypertension in the study area. The relationship between aircraft noise and residents' health was determined using regression analysis, and the statistical result revealed a significant relationship. To mitigate the effect of noise on people residing around airports, the Aviation Industry should ensure noise metrics measurement are deployed to ascertain noise level of different aircrafts on daytime, nighttime, and frequencies of takeoff and landing within and outside the airport terminal. The Federal Ministry of Aviation should monitor and restrict the host communities' land development encroachment near airport, to help curb the risk of noise pollution.

Keywords- noise, aircraft, diseases, terminal, hypertension, hospital.

I. INTRODUCTION

The ear is one of the main essential parts of human sensory organs that send messages to the brain for interpretation through the nerve receptors. Human hearing is limited to a range of between 20 to 20,000 cycles per second [William, 1997].

Sound waves surpass the tympanic membrane and create mechanical vibrations in the auditory ossicles to the inner ear. Though, people with an auditory deficiency are less sensitive to noise and are prone to more stress. Excessive noise accumulations without containment or curbing annoyance cause ear infections. The degree of annoyance to noise depends on the individual attitude and mood to noise and the quality and magnitude of the sound [Ogobiri et al., 2013]. Noise from neighbors could be enjoyed and appreciated by some individuals like laughter and birds chirping, but barking dogs, children crying or screaming, neighbors arguing, or even domestic violence may result in an adverse reaction [Grimwood, 1993]. Epidemiological studies have found neighbor noise annoyance to be negatively associated with indicators of both physical [Nitschke et al., 2014; Shepherd et al., 2013; Niemann et al., 2006] and mental health [Beutel et al., 2016; Nitschke et al., 2014]. Noise as a musical play, result in psychological, physiological, and physical effects on people exposed to it.

Noise annoyance as a form of psychological stress is by the extent to which a person perceives threats, disturbance, and the possibilities or resources that a person has with which to face this threat perceived and control [Charlotte, 2015]. About 8-12% of the world population has suffered the impact of noise in various forms in 2011, an estimation of 360 million population experienced hearing impairment [WHO, 2013].
Airport operation is identified as a source of noise emissions and is a community concern. Aircraft noise production is high during takeoff, landings, and

overflights. The noise increases when one or more aircraft about landing discovered one is on the runway. Noise such as physiological/medical and induced hearing loss associated with occupational noise exposure is common in Nigerian airports.

The effects of aircraft noise on human health are more severe to people working at the airports and the host communities. Goldschag [2007] opines that noise around airports causes problems for the aircraft operators, local authorities, airport operators, and residents. Therefore, it becomes necessary to consider the impacts on host communities and require management practice during the site location, designing, and/or expansion.

Research has it that aircraft noise exposure leads to increased risk of cardiovascular health after long-term exposure. Cardiovascular outcomes such as high blood pressure (hypertension), heart attack, and stroke, increase by 7 to 17% for a 10dB increase in aircraft or road traffic noise exposure [Basner et al., 2014]. The perceived disturbance is either a short-term or immediate annoyance, and the perceived threat is equal [Stallen, 1999]. Some health problem(s) are assumed to have either a positive or negative effect on noise sensitivity factors [Deborah et al., 2005].

A study identified hospital admitted with patients and mortality for stroke, coronary heart disease, and cardiovascular disease for around 3.6 million people living near London Heathrow airport [Hansell et al., 2013]. Longitudinal evidence for an association between aircraft noise exposure and mortality from heart attacks comes from a large-scale Swiss study of 4.6 million residents over 30 years of age [Huss et al., 2010]. A recent study of long-term exposure to aircraft noise in Sweden found that exposure was associated with a larger waist circumference but less clearly with Type II diabetes and body mass index [Eriksson et al., 2014].

Adults, children, and unhealthy people are suspected to be prone to the risk for sleep disturbance by noise [Muzet, 2007]. Priority to noise reduction at the source (e.g., engine noise, aerodynamic noise) and reducing noise by adjusting takeoff and landing procedures, but measures are not always sufficient or feasible [Mathias et al., 2017].

One of the more common ways of mitigating aircraft noise impacts is to insulate residential properties and noise-sensitive buildings, e.g., schools and hospitals. Noise transmission from outside to inside be a complex process, being dependent on the wall, window frame, and window glass construction [CAA, 2014]. The study was to ascertain the impacts of aircraft noise on the residents near the International Airport.

II. STUDY AREA

Port Harcourt International Airport is in the Omuagwa Community in Ikwerre Local Government Area of Rivers State. Geographically, Port Harcourt International Airport lies between latitude 05000'55" N and longitude 006056'58" E. The airport has two terminals for both international and domestic flights. The new international terminal started operation in 2018.

The two terminals are owned and operated by the Federal Airport's Authority of Nigeria (FAAN), and the third busiest airport in the country by passengers' traffic, with single asphalt, surfaced runway at the airport has a length of 9,846ft (3,000lm) and a width of 197ft (60m). The terminal served about 1,081,587 passengers in 29 after it reopened in late 2007. The study area is bounded in the Igwuruta by south/ southwest, Ipo by East, Omuagwa by North/Northwest, with a mean sea level of 87feet (27m).

The area occupies a landmass of 655km2 with a density of 405.2/km2, with 265,400 population as projected by the 2006 Nigeria population census. The airport is surrounded by thick vegetation covers that serve as natural and partial noise barriers. It falls within the coastal belt on the sedimentary environment of Agbada, Akata, and Benin formations from the earliest to recent modern Niger Delta [Weli and Ogbonna, 2015; Short and Stauble, 1967].

The surface topography is fluvial deposits, Mud, sand, peat, and sediment rock conveyed by the Niger River distributaries are deposited to wind up enormous mainland sandstones overlaying a variation of sandstones and clay of imperceptibly marine source [Weli, Eludoyin, and Agaviezor, 2021].

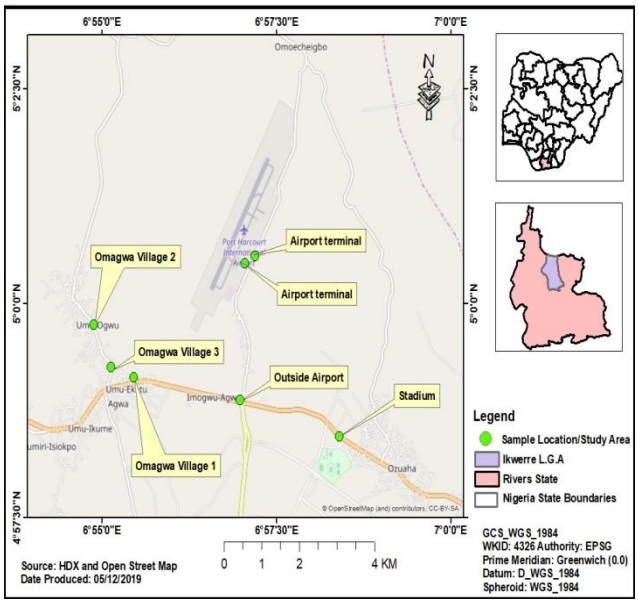

Fig 1. Study Area locating sampled points.

III. MATERIALS AND METHOD

Noise level is a measure of sound energy expressed in units of decibels (dBA). Field noise measurement was taken from sensitive noise receptors in the airport and the host community using a precision sound level meter, model 2310 SL, IEC 651. The abduction of seven years' acoustic health records from 2013, 2014, 2015, 2016, 2017, 2018, and 2019.

A Cross-sectional research design took place in PortHarcourt International Airport Omuagwa and its environment in Ikwerre Local Government Area. The study applied a random sampling technique at sensitive receptors points in the study area. Sample collection took place at Airport Terminal 1, Terminal 2, Airport junction, Igwuruta Ali, Omuagwa village 1, village 2, and village market 3 using a Geographic positioning system (GPS). The study abducted multiple regression coefficient techniques to identify the relationship between aircraft noise and human health conditions. The equation is of the form:

$$Y = a + bX1 + cX2$$

Where
Y = Dependent variable (Aircraft Noise)
X1 and X2 = Independent variables (hypertention and hearing impairement)
a, b and c= Regression coefficients.

IV. RESULTS AND DISCUSSION

The study identified two diseases such as hypertension and hearing impairment. Table1 shows that 2013 has the highest occurrence of diseases (146 and 288) cases seconded by 2014 (130 and 365) Cases with a slight decrease in 2015 (104 and 320) Cases.

In 2016, hypertension decreased by 99, increased to 121 in 2017, and declined in 2018 (65) and 2019 (77) cases, showing aircraft noise reduction by either takeoff or landing adjustment procedures. While hearing impairment maintained 281, 211, 222, and 271cases in 2016, 2017, 2018, and 2019 respectively. Patients between 18 to 39 years had low hypertension and hearing impairment diseases, and 40 to 70years old had a high degree of infection.

The result shows 100% cases of which hearing impairment is prevalent with 75.2%, and hypertension is 24.8% among male and female adults between the ages of 18 to 100, with total visits of 2,990 from 2013 to 2019.

Table 1. The Distribution of Observed Noise related Diseases, Frequency of Visits, and Infected Age in Omuagwa.

S/N	Years	Diseases Description	No. of hospital Visit	Gender Patients Between 18 to 100 years/ visit	
				18 - 39	40-100
1	2013	Hypertension	146	54	92
		Hearing impairment	388	121	267
2	2014	Hypertension	130	36	94
		Hearing impairment	365	101	264
3	2015	Hypertension	104	33	71
		Hearing impairment	310	57	310
4	2016	Hypertension	99	29	70
		Hearing impairment	281	104	177
5	2017	Hypertension	121	41	80
		Hearing impairment	211	67	144
6	2018	Hypertension	65	12	53
		Hearing impairment	222	79	143
7	2019	Hypertension	77	31	46
		Hearing impairment	271	88	183

Source: Medical Record Office Omuagwa Health Center, 2019.

Table 2. Distribution of Disease and frequency of Hospital visit.

S/N	Disease description	No. of Frequency	Percentage (%)	18-39 yrs	40-100 yrs
1	Hypertension	742	24.8	236	506
2	Hearing impairment	2,248	75.2	619	1,224
	Total	2,990	100	855	1,730

Source: Medical Record Office Omuagwa Health Center, 2019.

Table 3 shows Noise measurement reading in the Airport terminal1(95.6dBA), terminal 2 (94.4dBA), and Airport junction (94.0 dBA) recorded high-frequency values due to the short distance from the terminal. Igwuruta Stadium recorded a low value of 88.0 dBA because of some distance away from the terminal.

Omuagwa Village 1, Omuagwa Village 2, and Village market3 range between 92.7dBA, 91.7dBA, and 92.3 dBA, and all the values exceeded World Health Organization (WHO) permissible Limit. Aircraft have a very high noise frequency above WHO and European standard levels of 50dBA and 55dBA. It can deduce that the residents in the airport terminal and the communities are exposed or infected with long-term noise pollution generated by aircraft.

Table 3. Noise Sampled Locations and Standard Levels.

S/N	Receptor points	Noise Frequencies	WHO Level	European Level
1	Airport Terminal 1	95.6	50dBA	55dBA
2	Airport Terminal 2	94.4	50dBA	55dBA
3	Airport Junction	94.0	50dBA	55dBA
4	Igwuruta (Stadium)	88.0	50dBA	55dBA
5	Omuagwa Village 1	92.7	50dBA	55dBA
6	Omuagwa Village 2	91.7	50dBA	55dBA
7	Ottawa Market 3	92.3	50dBA	55dBA

Source: Researcher's fieldwork, 2019

V. STATISTICAL METHOD

Table 4. ANOVA on Aircraft Noise Generation Impact on Residents Around Port.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	24.415	2	12.207	4.131	.106[b]
	Residual	11.820	4	2.955		
	Total	36.234	6			

Dependent Variable: Aircraft Noise
Predictors: (Constant), Hearing Impairment, Hypertension

Table 4 shows the analysis of variance at the 95% significant level with the Snedecor's F-value of 4.131 > the F-critical value of 0.106. The result indicates a strong relationship between aircraft noise generation and residents' health.

The r2 statistics indicates the coefficient of determination of 67.4%, revealed that the aircraft noise generation accounted for 67.4% of the impact on the health of residents in the study area. The F-calculated value of 4.131 is greater than the F-critical value of 0.106. In conclusion, aircraft noise generations determine the impact on residents' health in the study area. Table 5 below shows the relationship between the aircraft noise and the effect on residents' health.

Table 5. Coefficient Model of the Relationship between Aircraft noise and health of residents.

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	86.631	2.872		30.159	.000
	Hypertension	-.061	.030	-.715	-2.035	.112
	Hearing impairment	.043	.013	1.173	3.337	.029

Table 5 determined the relative importance of the significant predictors, the equation showing the relationship between aircraft noise generation and impact on resident's health is as;

$$Y= 86.631 - 715+ 1.173 + 2.872$$

The equation shows that hypertension disease is a non-significant coefficient of the model while hearing impairment contributes to the model with absolute standardized coefficient see figures below.

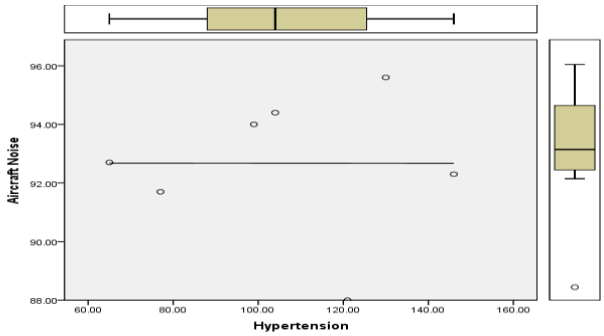

Fig 2. Aircraft Noise Versus Hypertension with negative correlation.

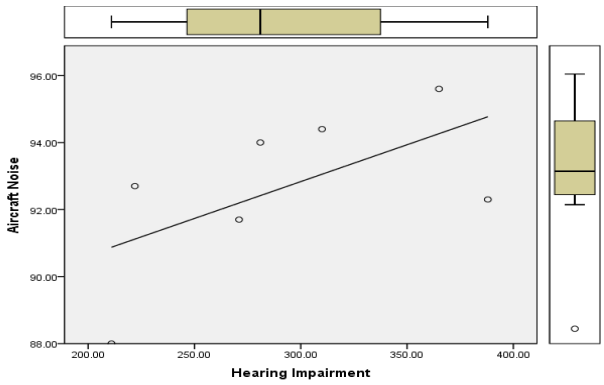

Fig 3. Aircraft Noise Versus Hearing Impairment with weak positive correlation.

VI. CONCLUSION

This study examined Aircraft noise impact on residents near Port Harcourt International Airport Omuagwa, Nigeria. Seven (7) years of medical health acoustic report record, and field noise samples were obtained for the study. The result indicates hypertension and hearing impairment diseases among residents between 18 to 100 years with 2,990 cases. The noise was severe within the airport terminal and the host Omuagwa Communities, compared to the Igwuruta stadium location. It assumed that the residents in airport terminal and the host communities have suffered for long-term annoyance of aircraft noise pollution since 1980s to date.

To mitigate the effect of noise on people residing around airports, the Aviation Industry should ensure noise metrics measurement are deployed to ascertain noise level of different aircrafts on daytime, nighttime, and frequencies of takeoff and landing within and outside the airport terminal either monthly or quarterly. The Federal Ministry of Aviation should monitor and restrict land development encroachment by the host communities to curb future risk noise effects.

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