



Impacts of Aircraft Noise on Psychosocial Health of Man: A Study in Sam Mbakwe International Cargo Airport, Imo State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Noise can be seen as unwanted sound which is unpleasant to man and the Environment. One of the sources of noise pollution which has effect on man is aircraft noise. Noise assessment level data were obtained at three stages of aircraft operation; Standby, Take-off and Landing for a period

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of five days. Two airlines within the same age limit were assessed for the study. The sound meter utilized in this study is sound meter android application. It has the measurement range of 30 to 130 dB(A) with an accuracy of ± 2 dB(A) and resolution 0.1 dB(A). 100 copies of structured questionnaire were used to solicit information within the airport environment from workers on the perceived effects of aircraft noise on their health and daily activities within the airport. Data were collected and compared with World Health Organization (W.H.O) standard. Findings of the study revealed that the recorded noise levels were above the W.H.O permissible limit. Although, there were variation in noise level between the two airlines and the different stages assessed. Findings from the questionnaire survey also revealed that 80% of the population admitted that the noise levels had impact on their health ranging from annoyance, stress, deprivation of sleep, hearing problems amongst others. The study confirmed that aircraft noise had an impact on health and well-being of people. The study therefore, recommends that there is need to reduce the aviation noise impacts in other to promote human and environmental health.

Keywords: Aircraft noise; Cargo airport; psychosocial; health; Sam Mbakwe.

1. INTRODUCTION

One of the factors contributing to environmental harm and negative health effects is noise pollution. According to [1], noise is described as a "sound in the wrong place at the wrong time" that results in a general feeling of displeasure and aggravation, weariness, and harm to the auditory processes. In other words, noise can be thought of as unwanted sound that is bad for both the environment and people. Aircraft noise is one of the sources of noise pollution that affects people. Any increase in aircraft activity has a detrimental effect on the environment, notably in terms of noise pollution [2]. People exposed to aircraft noise may experience severe effects on their emotional health. Research has shown a variety of negative effects, including irritation, stress, sleep disturbance, cardiovascular illness, hearing impairment, and impaired early learning [3-7]. Of these, noise from ubiquitous aircraft is a main and rising source of concern globally, with more severe health consequences than other forms of transportation noise [8-10]. The most relevant evidence of the influence of noise on human health is likely found in the WHO study of 2021, which examined the relationship between environmental noise and illnesses (such as cardiovascular disease, sleep disruption, and tinnitus, among others) [11,12].

A person's mental health, quality of life, and social relationships are all included in what is referred to as their psychosocial health. Chronic tension and anxiety might develop after repeated exposure to loud aircraft noise. The physiological repercussions of noise, such as elevated heart rate and blood pressure, can exacerbate unease and anxiety, which has a negative influence on psychosocial wellbeing. The persistent noise

interferes with sleep cycles and may cause the body to go into a stress reaction, which raises levels of stress chemicals like cortisol. Anxiety, irritation, and a drop in general wellbeing may follow from this. Additionally, aircraft noise, particularly at night, can disturb sleep and cause sleep disorders. Reduced cognitive ability, emotional issues, and generalized mental illness can all be caused by poor sleep. Communication and social connections can be hampered by aircraft noise pollution. It may be difficult for people to carry on discussions, which can result in social isolation and a lower quality of life. Chronic exposure to airplane noise has been associated with cognitive deficits, such as poorer memory and concentration. This may affect a person's capacity for success at job or in a learning environment, adding to their stress and dissatisfaction. Similar to this, is the fact that noise from aircraft can greatly lower people's general quality of life in the vicinity. The constant loudness can make it difficult to relax at home, take part in hobbies, or enjoy outdoor activities, which can lower one's sense of wellbeing. While prolonged exposure to loud airplane noise has been linked to a higher risk of mental health conditions like depression. These diseases may develop as a result of the ongoing stress and sleep difficulties brought on by noise pollution. Numerous studies over the years have demonstrated that living near airports can have negative health effects on those who are exposed to aircraft noise, including irritation [13], sleep disturbance [14,15], cardiovascular disease, including hypertension [16-19]. Another possibility for adverse effects of exposure to aircraft noise is psychological illnesses. Noise is a psychosocial stressor since it has been shown to activate the sympathetic and endocrine systems. The relationship between noise

sensitivity and harmful effects of noise has also received little research, but the findings are consistent: noise sensitivity has been linked to higher blood pressure [20], health complaints, including cardiac complaints [21], hypertension, psychological distress, and the use of psychotropic drugs (sleeping pills, tranquilizers), among other things [22-23] Hypertension, psychological distress, and the use of psychotropic medicines (sedatives, tranquilizers, and analgesics) are all risk factors for heart disease [24-26]. Therefore, looking at several impact that can be created by noise from aircraft, it has become necessary to carry out this study to ascertain the adherence to guidelines as well as the perception of residents living in the vicinity of the airport.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The Sam Mbakwe International Cargo Airport is located in Owerri, Imo State and lies between latitude $5^{\circ}25'35''$ N and longitude $7^{\circ}12'20''$ E. It is located in Ngor-Okpala Local Government Area, Imo State. Other cities served by the airport are, the commercial city of Onitsha, automobile and manufacturing city of Nnewi in Anambra State, the industrial hub of Aba, Umuahia and

Arochukwu in Abia State. Others are Okigwe, Oguta, and Orlu business districts in Imo State. The airport also serves some parts of Akwa-Ibom and Cross River States in the South-South part of Nigeria. It is located in the humid tropics and has a high surface air temperature regime throughout year [27]. The area has two distinctive seasons: wet and dry. The rainy season lasts from April to October, while the dry season lasts from November to March [27].

2.2 Methods of Data Collection and Analysis

The study carried out assessment on resident living within a 50 km radius of the Sam Mbakwe International cargo airport. The research design used for this study is the survey research. A survey research is one in which a group of people or items is studied by collecting and analyzing data from only a few people or items considered to be representative of the entire group. The research utilizes two separate well-structured sets of questionnaires to obtain relevant personal information on the conditions, noise level and impacts on health from residents within the airport. Further, the use of GPS and Noise Meter was used in the collection of locations and noise levels of different strategic



Fig. 1. The study area

locations within the airport. The sound meter utilized in this study is sound meter android application. It has the measurement range of 30 to 130 dB(A) with an accuracy of ± 2 dB(A) and resolution 0.1 dB(A). It is commonly used in noise pollution studies for the quantification of different kinds of sound levels, especially for industrial, environmental and commercial. The procedure was carried out for 5 days. The flight time for each day was taken in other to keep track of aircraft arrivals and departures so as to take the aircraft noise levels and make assessments within these periods in other to achieve the aim of this study. The data obtained were analyzed to show tables, trends and charts to further depict a pictorial view of the noise levels. The results were further compared with W.H.O acceptable limits to give recommendations and reduction levels for improved environmental Health. The tables were arranged according to each day of the assessment carried out for takeoff, standby and landing of both aircraft (United Nigerian and Air Peace Airlines). According to [28] the W.H.O acceptable aircraft environmental noise is 95 dB(A) for 20-hour exposure.

3. RESULTS AND DISCUSSION

Assessment was carried out on two air craft (Air peace and United Nigeria airline) acquired within the same age limit for noise levels at the Sam Mbakwe International Cargo Airport. Point coordinates of location where the noise levels were taken were recorded, the elevation of the point were also recorded for reference. The noise levels were accessed at three stages of the aircraft operation namely; *Takeoff point, Stand by and Landing*. From the Noise level dB(A) reading taken between the two aircrafts, it was observed that Air Peace has a higher

noise level when compared to United Nigerian Airline.

Table 1 shows the data recorded for the noise level assessment at Sam Mbakwe International Cargo Airport on the first day of the assessment for takeoff, standby and landing. The table shows that United Nigeria airlines were little above the permissible limit while Air Peace recorded higher noise levels above 100 dB(A) with takeoff noise recorded the highest at 106.2 dB(A).

Table 2 shows the data obtained on the second day varied from day one. This was evident in the noise levels recorded. Only takeoff for both airlines exceeded the W.H.O permissible standard set for aircraft noise, with United Nigeria at 95.7 dB(A) and Air Peace at 101.7 dB(A). Other stages of the aircraft accessed were below the W.H.O permissible noise level standard with United Nigeria recording the least at 85.8 dB(A) on landing.

Table 3 shows that there were also variations in data obtained from the previous two days of the field assessment, except with United Nigeria at takeoff which maintained noise level at 95.7 dB(A) from the previous day. Unlike the previous day, most of the noise level recorded exceeded the W.H.O, with some slightly exceeding this limit, except for United Nigeria airlines on landing which recorded noise level of 92.9 dB(A) and on standby at 94.3 dB(A).

Table 4 also shows variations in data obtained from the previous three days of the field assessment. Air Peace recorded the least Noise level since the field assessment at 85.6 dB(A), which was also the same with United Nigeria on standby stage. Only these two stages were below the W.H.O permissible limit. AP accounted for the highest noise level recorded for this day at 100.4 dB(A).

Table 1. Aircraft Noise level results at Sam Mbakwe Airport – Day One

SN	DAY 1	UN dB(A)	LEVEL	AP dB(A)	LEVEL	W.H.O LIMIT dB(A)
1	takeoff	98.5	Above Limit	106.2	Above Limit	95
2	Standby	96.8	Above Limit	101.8	Above Limit	95
3	Landing	96.6	Above Limit	102.5	Above Limit	95

Source: Authors fieldwork, 2021.

Table 2. Air craft Noise Assessment results at Sam Mbakwe Airport – Day Two

SN	DAY 2	UN dB(A)	LEVEL	AP dB(A)	LEVEL	W.H.O LIMIT dB(A)
1	takeoff	95.7	Above Limit	101.7	Above Limit	95
2	Standby	86.3	Below Limit	92.7	Below Limit	95
3	Landing	85.8	Below Limit	89.3	Below Limit	95

Source: Authors fieldwork, 2021.

Table 3. Air craft Noise Assessment results at Sam Mbakwe Airport – Day Three

SN	DAY 3	UN dB(A)	LEVEL	AP dB(A)	LEVEL	W.H.O LIMIT dB(A)
1	takeoff	95.7	Above Limit	104.6	Above Limit	95
2	Standby	94.3	Below Limit	98.4	Above Limit	95
3	Landing	92.9	Below Limit	95.4	Above Limit	95

Source: Authors fieldwork, 2021

Table 4. Air craft Noise Assessment results at Sam Mbakwe Airport – Day Four

SN	DAY 4	UN dB(A)	LEVEL	AP dB(A)	LEVEL	W.H.O LIMIT dB(A)
1	Takeoff	97.7	Above Limit	100.4	Above Limit	95
2	Standby	85.6	Below Limit	96.6	Above Limit	95
3	Landing	78.6	Below Limit	85.6	Below Limit	95

Source: Authors fieldwork, 2021.

Table 5. Air craft Noise Assessment results at Sam Mbakwe Airport – Day Five

SN	DAY 5	UN dB(A)	LEVEL	AP dB(A)	LEVEL	W.H.O LIMIT dB(A)
1	takeoff	90.6	Above Limit	108.5	Above Limit	95
2	Standby	92.6	Below Limit	94.4	Above Limit	95
3	Landing	90.9	Below Limit	109.5	Above Limit	95

Source: Authors fieldwork, 2021.

Table 5 shows that the highest recorded noise level was Air Peace on landing at 109.5 dB(A), this is also the highest recorded noise level of this field assessment. Only two noise levels were above the WHO standard, these were both Air Peace on takeoff and landing which recorded 108.5 dB(A) and 109.5dB(A) respectively.

It was further observed throughout the course of the data collection, Air Peace recorded higher noise levels compared to United Nigeria. It was further inferred that Air peace airlines was older than United Nigerian Airlines. Thus, it was understood that the older the aircraft, the higher the noise, and the newer the plane the lesser the noise. This is in line with the investigation of [29], who stated that older aircrafts tend to give off louder, annoying environmental noise. They also outlined that most of the aircraft noise emanate from old and over used aircrafts.

3.1 Mean and Maximum Value

The mean noise levels were calculated for each stages of the two airlines accessed for this research. Air Peace recorded the highest mean value at takeoff for all the stages accessed. The maximum value of the investigation was also calculated and presented on the Table 6. It can be observed that United Nigeria airlines at standby and landing were below the W.H.O permissible limit, notably United Nigeria on landing which accounted for the lowest at 88.96

dB(A). The mean values of all the stages for Air Peace airlines were above the W.H.O permissible limit. Most notable is Air Peace on takeoff which recorded the highest mean value at 104.28 dB(A). The tables and charts are presented in Table 6.

3.2 Perception of Residents on the Impact of Aircraft Noise

To statistically represent the Table 7, a chi-square was carried out to test for hypothesis and further explain the effect of aircraft noise on the health of the population accessed within the area of research.

The Chi-square was to test for the hypothesis:

H_0 = Aircraft Noise Pollution does not affect human health

H_1 = Aircraft Noise Affects human health.

The statistical test if as follows:

$$X^2 = \frac{(O - E)^2}{E}$$

Where:

1. O = Observed values
2. E = Expected values

The level of significance test used is 95%, = 0.05

Table 6. Noise data showing the coordinates, Elevation, Mean Values, and the Maximum Value

S/N	Elevation (m)	113 Takeoff Point		121 Stand by		117 Landing	
		N	E	N	E	N	E
	Coordinate	05° 25' 24.9"	007° 12' 21.0"	05°25' 40.3"	007° 12' 09.1"	05° 25' 47.2"	007° 12' 16.0"
		UN dB(A)	AP dB(A)	UN dB(A)	AP dB(A)	UN dB(A)	AP dB(A)
1		98.5	106.2	96.8	101.8	96.6	102.5
2		95.7	101.7	86.3	92.7	85.8	89.3
3		95.7	104.6	94.3	98.4	92.9	95.4
4		97.7	100.4	85.6	96.6	78.6	85.6
5		90.6	108.5	92.6	94.4	90.9	109.5
	Mean	95.64	104.28	91.12	96.78	88.96	96.46
	Max Value	109.5					

Source: Authors work, 2021.

Table 7. Health Impact Response from Aircraft Noise

SN	Response	Frequency	Percentage
1	Yes	40	80
2	Neutral	3	6
3	No	7	14
		50	100

Table 8. Chi-Square Noise response table

SN	Response	Frequency	Percentage	O	E	(O-E) ²	(O-E) ² /E
1	Yes	40	80	40	16.67	544.2889	32.6508
2	Neutral	3	6	3	16.67	186.8689	11.20989
3	No	7	14	7	16.67	93.5089	5.609412
		50	100	50	50.01	824.6667	49.47011

The degree of freedom (df) is given by (n-1), where n = number of categories minus one

$$Df = (3-1) = 2$$

$$X^2 = 49.47011 \text{ calculated}$$

Critical value = 5.991 at 0.05, df = 2

Decision: since the calculated chi-square statistics $X^2 = 49.47011$ is greater than the critical value on the chi-square table, 5.991, the null hypothesis will be rejected and the alternate hypothesis will be accepted which states that aircraft noise pollution has negative impact on human health.

4. CONCLUSION

Review and analysis have shown that Aircraft is becoming one of the most prevalent sources of noise pollution worldwide. Aircraft noise is also observed as the most irritating noise. The effects are mostly observed in sick, pregnant women, convalescents, children, the elderly, and the low social/economic class. According to WHO's report to the United Nations conference on the environment, of all the environmental problems noise is the easiest to control. Thus, government effort to control noise (air craft) has not been effective due to negligence and lack of monitoring and control strategies. Aircraft Noise pollution assessment can be helpful in Environmental decision-making process and in Urban and Regional planning as a way of protecting human health and the environment.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models, (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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