Awareness and Implications of Aircraft Noise on the Airport Staff of Mallam Aminu Kano International Airport Kano, Nigeria

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Abstract. Noise pollution, operationally defined as 'unwanted sound', has become an environmental contaminant of massive proportions. Noise causes annoyance, frustration, impediment to learning, and general stress. Of all present-day sources of noise, the noise from surface transportation, above all that from road vehicles, is the most diffused and difficult to control. Aircraft, industrial noise, noisy neighbours, and their pets are other familiar sources of noise aggravation. Noise pollution is a harmful environmental impact of sound, which, by its nature, volume, or duration, is likely to have health effects.

This research aims to measure the noise level within the Mallam Aminu Kano International Airport, examine the effects of aircraft noise on employees, assess the awareness level of workers on the impact of aircraft noise, and determine the level of compliance with safety standards.

This study examined the implications and awareness of aircraft noise at the Mallam Aminu Kano International Airport (MAKIA). The noise level within the five selected locations was measured. A noise meter was used to measure the noise at the new fire station, old fire station, international terminal building, domestic terminal building, and main apron. Primary and secondary data were used; fifty questionnaires were randomly distributed to staff from the fire department, aviation security, ground handlers of the Nigerian Aviation Handling Company (NAHCO) and Skyway Aviation Handling Company Plc (SAHCO), airfield staff of the operations department, and airliners. The data obtained from the noise meter were analysed using the mean noise level, whereas descriptive statistics and simple percentages were used to analyse the data obtained from the questionnaire.

The level of staff awareness of aircraft noise implications due to prolonged exposure and safety regulations was determined. The noise produced within the study area is between 65 and 98 decibels. Seventy-four percent of the responders think that aircraft noise is a nuisance, with more than 50% aware of the implications of noise exposure. In contrast, only 24% have experienced some of the effects of aircraft noise, such as headache, cardiovascular loss, and hearing loss. It was discovered that employers are not providing enough safety

kits for their employees, and most staff do not undergo safety training and are not aware of any laws regulating noise. In conclusion, staff need training on noise pollution, its effects, and ways to reduce health implications.

Keywords: health; airport; aircraft; decibels; noise pollution; implications; regulations; effect.

INTRODUCTION

Noise pollution, operationally defined as 'unwanted sound', has become an environmental contaminant of massive proportions. Noise causes annoyance, frustration, impediment to learning, and general stress. Of all present-day sources of noise, the noise from surface transportation, above all that from road vehicles, is the most diffused and difficult to control. Aircraft, industrial noise, and noisy neighbours and their pets are other familiar sources of noise aggravation. Noise pollution is a harmful environmental impact of sound, which, by its nature, volume, or duration, is likely to have health effects. Noise pollution can be defined as unwanted or offensive sounds that unreasonably intrude into our daily activities. It has many sources, most of which are associated with urban development.

Several variables define noise situations, such as the intensity of a continuous sound level measured as an average level over a particular period, such as day and night. This entails the extent and number of peak levels, the frequency of the noise, and the interval between the noise occurrences.

Aircraft noise is defined as noise produced by aircraft in flight that causes numerous stress-mediated health challenges, such as sleep disorders and cardiovascular illnesses. Governments across nations have enacted comprehensive laws to regulate aircraft designers, operators, and manufacturers, resulting in better procedures and reductions in noise emissions.

Sound production can be divided into three classes:

1. Aerodynamic noise from the airflow around the surfaces of the aircraft, especially when flying at low speeds.

2. Noise from aircraft systems, cockpit and cabin pressurisation and conditioning systems, and auxiliary power units.

3. Mechanical noise: the engine parts' rotation is most noticeable when the fan blades reach supersonic speeds.

Aircraft noise emanates from an aircraft or its components, whether parked and running on Auxilliary Power Units, while taxiing or run-up from jet exhaust or propeller, during take-off, lateral to arrival or departure paths, or over-flying while landing or en route. Aircraft engines are the primary noise source and can exceed 140 decibels (dB) during take-off. During airborne operations, the primary noise sources are high-speed turbulence over the fuselage and engine. High sound levels have health consequences. These consequences include hypertension, ischemic heart disease, hearing impairment, sleep disturbance, and decreased academic performance. High noise levels can lead to stress, increase workplace accident rates, and stimulate aggression, anger, and other antisocial tendencies. Airport noise has been linked to an increased risk of heart attack and high blood pressure.

Aircraft noise pollution is considered an important environmental problem at airports and a significant issue affecting the operation and development of airports and, hence, the capacity of airports around the globe. It is an essential factor considered a substantial barrier to airport development, expansion, or construction worldwide. Therefore, stakeholders in the air transport industry face the challenge of balancing air traffic growth with local and international concerns.

Aircraft noise causes more annoyance than road and railway traffic noise because of its intermittent and unpredictable nature. Aircraft noise modifies social behaviour, hinders complex task performance, and causes pain. Short-term noise exposure may cause neuronal endocrine arousal because noise is a stressor that results in different hemodynamic and metabolic changes. Aircraft such as Boeing 727 and Boeing 747–200 have noise levels above 100 decibels. The noise level of Airbus A320 and Boeing 737–800 aircraft is around 93-94 decibels. The noise level decreased to approximately 90 decibels in Airbus A350, Boeing 787, Airbus A320neo, and Boeing 737 MAX aircraft. However, it is still above the average ambient sound level of 55 decibels for

residential areas, 65 decibels for commercial areas, and 70 decibels for industrialised zones.

A study on the effects of aircraft noise on residents near a Malaysian airport by [1] revealed that noise pollution affects the health of nearby residents. Many studies have been conducted around the globe on the health effects of aircraft noise. Most of the studies in Nigeria look at the implications of aircraft noise; in Port-Harcourt International Airport, the author [2] researched the impact of aircraft noise on workers and established that aircraft noise has health-related implications for workers. Authors [3] evaluate the extent and consequences of noise and air pollution in the Kano metropolis's three major commercial areas: Kwari, Sabon Gari, and Kofar Na'isa Market. Most of these studies conducted on noise implications in airports make less assessment of airport workers' awareness of its impact or ways of mitigation through International Civil Aviation Organization (ICAO) Annex 16 spells clear regulations on aircraft environmental noise.

Some questions this research would attempt to answer are:

1. What are the noise level variations within the study area?

2. Does aircraft noise have any effects on workers?

3. Are the workers aware of any related products due to aircraft noise exposure?

4. Are there any safety regulations for aircraft noise pollution?

This research aims to measure the noise level within the Mallam Aminu Kano International Airport, examine the effects of aircraft noise on employees, assess the awareness level of workers on the impact of aircraft noise, and determine the level of compliance with safety standards.

The study is significant in looking at the nuisance aircraft noise can cause to those exposed to it; it will create awareness among the staff on the effects of the noise and suggest ways to minimise exposure.

Literature review

Environmental noise is an undesired or harmful outdoor sound created by human activities. Recently, it has become a crucial deliberation, especially in urban areas, because of several factors, such as the growing population coupled with industrialisation and the necessity for transportation systems such as rail and air transport. As a measure of growing concern related to these issues, problems with noise are rated at the highest level, with global warming in some states. Furthermore, research suggests that prolonged exposure to high noise levels leads to sleep deprivation and reduces productivity and cognitive performance in children. Moreover, noise exposure may negatively impact psychological health, damage hearing, and annoy [5].

Noise is an unwanted sound produced by a source causing vibration in the medium sounding it. Vibration can also be termed sound waves if they fall within the range capable of affecting the sense of hearing. Noise is also commonly defined as any unwelcome sound; it has many sources attributed to urban development, such as road, air, rail transport, industries, and recreational activities. Noise pollution in a city is a big problem, and necessary measures must be taken to reduce or control it. The noise produced by musical instruments, aircraft, motor vehicle rail systems, and other human activities is rapidly becoming more than a nuisance. It is beginning to assume a proportion of significant health hazards.

The European Union introduced a program to stop noise's adverse effects on humans. The objectives are "preventing and reducing environmental noise where necessary and particularly where the exposure level can induce harmful effects on human health and preserving environmental noise quality where it is good." The primary action required by this directive concerns monitoring the problem and alerting the public, whereas the secondary measures to be taken because of the information gained are left to the judgment of the local authority. Measurements must be collected, and noise maps must represent this measurement for the day -evening, night (den) and nighttime.

Noise control policies in Nigeria have not received much attention because Nigeria does not have specific legislation on noise pollution, as is the case in countries such as the United States and the United Kingdom. The relevant policies on noise pollution are:

1) The National Environmental Standards and Regulations Enforcement Agency (Establishment) Act. The National Environmental Standards and Regulations Enforcement Agency (Es-

tablishment) Act of 2007 is Nigeria's primary law on noise pollution [6]. The law provides that:

1.1. The Agency shall, at the initiation of this Act and in consultation with appropriate authorities

- identify significant noise sources, noise criteria, and noise control technology;

- making noise regulations, emission control, and abatement necessary to preserve and maintain public health and welfare.

1.2. The Agency shall enforce compliance with existing regulations and recommend programs to control noise from industrial, commercial, domestic sports, recreational, transportation, or other similar activities.

2. National Policy on Environment and Noise Pollution. The National Policy on the Environment of 1988 provided that programs would be established to:

2.1. Set up standards, including acoustic guarantees;

2.2. Prescribe guidelines for controlling neighbourhood noise, especially concerning construction sites, markets, and meeting places.

2.3. Prescribe permissible noise levels in noise-prone industries and construction sites and ensure the installation of noise dampers on noise equipment;

2.4. Establish quiet zones, especially within game parks, reserves, and recreational centres;

2.5. Ensure compliance with stipulated standards by conducting periodic audit checks.

3. National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations and Noise Pollution. The National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulation of 1991 enjoined designated industrial layouts to be separate from residential areas and to create buffer zones separating industrial areas from residential areas – National Guideline and Standards for Environmental Pollution Control in Nigeria. The National Guidelines and Standards for Environmental Pollution Control in Nigeria of 1991 were intended to monitor and control industrial and urban pollution.

Aircraft noise is the most significant cause of adverse community reactions related to the operation and expansion of airports [7]. This is expected to remain the case in most regions of the world for the foreseeable future. Therefore, limiting or reducing the number of people affected by significant aircraft noise is a critical environmental goal of ICAO. The central overarching ICAO policy on aircraft noise is the Balanced Approach to Aircraft Noise Management, adopted by the ICAO Assembly in its 33 Session (2001) and reaffirmed in all subsequent Assembly Sessions (ICAO Resolution A39-1 appendix C). The Balanced Approach consists of identifying the noise problem at a specific airport and analysing various measures available to reduce noise through the exploration of multiple steps; the activities include Reduction of Noise at Source (Technology Standards), Land-use Planning and Management, Noise Abatement Operational Procedures, and Operating Restrictions. As part of the ICAO Global Environmental Trends, the ICAO has been assessing trends in global exposure to aircraft noise, which provides a basis for sound discussion and decision-making on aircraft noise policies. In addition, noise technology goals have been developed to give stretch yet reasonable targets for the industry.

Authors [8] concluded that there was a marginally significant association between aircraft noise and high blood pressure when he studied two random groups: one with exposure to aircraft noise and the other without. It is also concluded that residents who are more likely to complain of sleep difficulties and to have poor health are those who were bothered by aircraft noise. Studies of occupational and environmental noise exposure have concluded that there is an association between noise and cardiovascular systems and blood pressure. These studies have found that workers exposed to noise levels exceeding 80 dBA have a higher risk of hypertension or other factors associated with hypertension than those who are not exposed to noise. These epidemiological studies explain the biological mechanism between noise exposure and hypertension based on the assumption that noise activates the sympathetic and endocrine systems to induce the release of stress hormones, producing a transient elevation of blood pressure. Chronic and repetitive noise stimuli result in baroreceptors and lead to hypertension. Research [5] showed that those performing complex but not simple jobs with noise levels are more vulnerable to a higher possibility of rising systolic and diastolic pressure and an increase in mortality risk. Several studies have shown that adverse health out-

comes can be observed if chronic exposure to noise in occupational places exceeds certain levels.

The study [2] also examines the effects of aircraft noise and research showing an association between aircraft noise and cardiovascular disease. Emerging evidence suggests cardiovascular effects are more strongly linked with nighttime noise exposure than daytime or total (24-hour) noise exposure. About night noise and sleep disturbance, there is growing recognition that average indicators such as Lnight are insufficient to predict sleep disturbance and sleep quality fully and that using some noise events (LAmax) will help understand noise-induced sleep disturbance. Regarding aircraft noise and its impact on health, further explorations of past studies have considered confounding factors, such as air pollution, and concluded that these did alter the associations once found. While reporting associations with the impact of aircraft, several studies discovered that the effects persist on workers exposed to the noise.

Environmental Noise. Noise pollution, also known as environmental noise or sound pollution, is the propagation of noise with a range of impacts on human or animal life activity, most of which are harmful to a certain degree. Machines, transport, and propagation systems are the primary sources of outdoor noise worldwide [8]. Poor urban planning may produce noise disintegration or pollution; side-by-side industrial and residential buildings can result in noise pollution in residential areas. Some primary noise sources in residential spaces include loud music, transportation (traffic, rail, aeroplanes, etc.), lawn care maintenance, construction, electrical generators, explosions, and people. Documented noise-related problems in urban environments date back to ancient Rome [9]. Today, the average noise level of 98 decibels (dB) exceeds the WHO value of 50 dB allowed for residential areas [10]. Research suggests that noise pollution in the United States is the highest in low-income and racial minority neighbourhoods [11], and noise pollution associated with household electricity generators is an emerging environmental degradation in many developing nations.

High noise levels can contribute to cardiovascular effects in humans and an increased incidence of coronary artery disease [12]. In animals, noise can increase the risk of death by altering predator or prey detection and avoidance, interfering with reproduction and navigation, and contributing to permanent hearing loss [13]. A substantial amount of the noise that humans produce occurs in the ocean. Until recently, most research on noise impacts has focused on marine mammals and, to a lesser degree, fish [14]. In the past few years, scientists have shifted their focus to studies on invertebrates and their responses to anthropogenic sounds in the marine environment. This research is essential, especially considering that invertebrates makeup 75% of marine species and thus comprise a large percentage of ocean food webs [14]. Of the studies conducted, a sizable variety of families of invertebrates have been represented in the research. Variations in the complexity of their sensory systems exist, which allows scientists to study a range of characteristics and develop a better understanding of the impacts of anthropogenic noise on living organisms.

Measurement of Noise. External noise exposure metrics are generally used to study noise effects on children's health. These measures the average sound pressure over a specific period using dBA as the unit (dBA is the unit of A-weighted good pressure level in decibels where A-weighted means that the proper pressure levels in various frequency bands across the audible range have been weighted by differences in human hearing sensitivity at different frequencies) [3]. L Aeq16 and L day, indicating noise exposure over a 16-h daytime period, are most often used. The daytime period is most often defined as 7 am–11 pm; L night means nighttime noise exposure (11 pm–7 am); and Ldn is a combination of daytime and nighttime noise exposure averaged over 24 h. This includes a 10 dB penalty added to the nighttime indicator. The 10 dB penalty reflects people's greater sensitivity to noise exposure at night. It assumes that the effects of noise at night are equivalent to 10 dB more than the same level of exposure during the daytime. In recent studies, noise modelling employs geographical information systems, whereas older studies and some contemporary studies measure community noise exposure. Direct measurements over brief periods can be less reliable because noise levels often vary by time of day, and short-term measures may not accurately capture long-term average exposure. More recently, a trend has been toward measuring exposure to maximum noise levels (e.g. L Amax). It is still uncertain whether the 'dose' of overall sound energy, the number of events or the peak good pressure level of critical

events is most important for human health effects [3]; these are relevant distinctions as the number of aircraft overflights and cars on the road are increasing, whilst individual noise emission levels for each event are declining.

Effects of aircraft noise on human health. *Hearing lost*. Hearing loss is mainly associated with exposure to noise for a more extended period for people who work in a noisy environment or live near a noise source. Loud noise further damages the ear drums or destroys the ossicles so severely that they cannot be healed. Continuous exposure to loud sounds for an extended period results in noise-induced hearing loss.

Sound is measured in units called decibels. Even after prolonged exposure, sounds at or below 70 A-weighted decibels (dBA) are unlikely to cause hearing loss. However, prolonged or repeated exposure to sounds at or above 85 dBA can cause hearing loss. The louder the sound, the shorter the time it takes for NIHL to occur. According to reports, the noise level of aircraft such as the Boeing 727 and Boeing 747-200, now few in the skies, is above 100 decibels. The noise level of Airbus A320 and Boeing 737–800 type aircraft, which are widely used in the medium category worldwide, is around 93-94 decibels.

The noise level decreased to approximately 90 decibels in Airbus A350, Boeing 787, Airbus A320neo, and Boeing 737 MAX aircraft, which are today's most modern passenger aircraft. All these aircraft produce noise above the average sound level of approximately 70 decibels for industrialised areas and can cause noise-induced hearing loss if exposed for extended periods. Hearing loss may be a temporary threshold shift (TTS) if the exposure is for a short period or a permanent threshold shift (NIPTS), which causes permanent damage.

The cardiovascular health effect. Over the past decade, evidence has considerably increased that aircraft noise exposure increases the risk of poorer cardiovascular health. A recent review suggested that the risk of cardiovascular outcomes, such as high blood pressure (hypertension), heart attack, and stroke, increases by 7%–17% for a 10-dB rise in aircraft or road traffic noise exposure [3]. A review of the evidence for children concluded that there were associations between aircraft noise and high blood pressure (Paunović et al., 2011), which may have implications for adult health [15].

The HYENA study (Hypertension and Exposure to Noise near Airports) examined noise effects on the blood pressure (hypertension) of 4,861 people aged 45–70 years who had lived for over five years near seven major European airports, including London Heathrow; Amsterdam Schiphol; Stockholm Arlanda & Bromma; Berlin Tegel, Milan Malpensa; and Athens Eleftherios Venizelos [16]. High blood pressure was assessed via measurements and medication use. The HYENA study found that a 10 dB increase in aircraft noise at night (Lnight) was associated with a 14% increase in the odds of high blood pressure, but daytime aircraft noise (LAeq 16 hours) did not increase the odds of high blood pressure [16]. The HYENA study did not find an association between daytime aircraft noise and high blood pressure, which might be because many residents work away from home during the daytime, leading to potential misclassification of their daytime aircraft noise exposure. The HYENA study also found that a 10 dB increase in nighttime aircraft noise was associated with a 34% increase in medication for high blood pressure in the UK [17]. The HYENA study is a high-quality, large-scale study of the effects of aircraft noise exposure on blood pressure, which includes a population sample around London Heathrow Airport. One shortcoming of the study is that it assesses noise and health simultaneously, meaning that we cannot be sure whether noise exposure occurred before the poorer health outcomes or whether the poorer health outcomes may have preceded the noise exposure.

A recent study of London Heathrow Airport examined the risks for hospital admission and mortality for stroke, coronary heart disease, and cardiovascular disease for approximately 3.6 million people living near the airport [18]. Both daytime (LAeq 16 hour) and nighttime (Lnight) aircraft noise exposure were associated with an increased risk of cardiovascular hospital admission. Compared with those exposed to aircraft noise levels below 51 dB in the daytime, those exposed to aircraft noise levels over 63 dB in the day had a 24% higher chance of hospital admission for stroke, a 21% higher chance of hospital admission for coronary heart disease, and a 14% higher chance of hospital admission for cardiovascular disease. These estimates considered age, sex, ethnicity, deprivation, and lung cancer mortality as proxy factors for smoking. These results were also not represented by air pollution, which

was adjusted in the analyses. Similar effects were also found between aircraft noise exposure and mortality for stroke, coronary heart disease, and cardiovascular disease. The study concluded that high levels of aircraft noise were associated with increased risks of stroke, coronary heart disease, and cardiovascular disease for both hospital admissions and mortality in areas near Heathrow Airport.

Sleep Disturbance. The WHO estimated sleep disturbance as the most adverse non-auditory effect of environmental noise exposure [3]. Undisturbed sleep of sufficient hours is required for alertness and performance during the day, quality of life, and health [3]. Humans exposed to sound while asleep still have physiological reactions to the noise that do not adapt over time, including changes in breathing, body movements, heart rate, and awakenings [3]. The elderly, shift workers, children, and those with poor health are thought to be at risk of sleep disturbance by noise [19].

The effect of nighttime aircraft noise exposure has been explored for a range of sleep outcomes ranging from subjective self-reported sleep disturbance and perceived sleep quality to more objective measures of interference with the ability to fall asleep, shortened sleep duration, awakenings, and increased bodily movements as assessed by polysomnography. Most evidence comes from studies on self-reported sleep disturbance. However, self-reported sleep disturbance outcomes are vulnerable to bias because such measures are probably influenced by noise annoyance and other demographic factors [3]. Reviews have concluded that there is evidence for an effect of nighttime aircraft noise exposure on sleep disturbance from community-based studies [20]. However, some reviews have concluded that the evidence is contradictory and inconclusive [21], which might be explained by methodological differences between studies of noise effects on sleep disturbance. A meta-analysis of 24 studies, including nearly 23,000 individuals exposed to nighttime noise levels ranging from 45 to 65 dBA, found that aircraft noise was associated with more excellent self-reported sleep disturbance than road traffic noise [20].

Annoyance. Annoyance is the most prevalent community response in a population exposed to environmental noise. Annoyance describes adverse reactions to noise, such as disturbance, irritation, dissatisfaction, and nuisance [22]. As described above, stress-related symptoms can also accompany annoyance, leading to heart rate and blood pressure changes. Acoustic factors, such as the noise source and sound level, account for only a small to moderate amount of annoyance responses; other factors, such as the fear associated with the noise source, interference with activities, ability to cope, noise sensitivity, expectations, anger, positive or negative attitudes to the head, and beliefs about whether noise could be reduced by those responsible influence annoyance responses [7].

Annoyance scales are commonly used within European policy to measure the quality of life impact of environmental noise exposure on communities around airports. An International Standard is in place governing the measurement of annoyance in community surveys, with questions typically taking the format "Thinking about the last year when you are at home, how much does the noise from aircraft bother, disturb, or annoy you?" with responses ideally given on a 10-point scale with 0 being 'not at all annoyed' and ten being "extremely annoyed". This question is often reported as the percentage of the population "highly annoyed" or "annoyed", where "highly annoyed" is 72% or more on the scale and "annoyed" is 50% or more on the scale. Exposure to aircraft noise at 60 dB Lden is estimated to be associated with 38% of the population reporting being "annoyed" and 17% being "highly annoyed" [23]. Exposure to aircraft noise at 65 dB Lden is estimated to be associated with 48% of the population reporting being "annoyed" and 26% being "highly annoyed" [23]. However, in recent years, several studies have suggested that aircraft noise annoyance around major European airports has increased [20, 24, 25]. Therefore, the percentage of the population reporting being "annoyed" or "highly annoyed" at each noise exposure level may have increased since these figures were proposed by the European Commission in 2002 [23].

Children also report annoyance responses, although it is unknown when they begin to exhibit annoyance. The Road Traffic and Aircraft Noise Exposure and Children's Cognition and Health (RANCH) study found that children aged 9–11 years living near London Heathrow, Amsterdam Schiphol, and Madrid Barajas airports reported annoyance with aircraft noise exposure at school and home [20]. For school exposure, the percentage of "highly annoyed" children increased from

approximately 5.1% at 50 dB LAeq16 h to 12.1% at 60 dB LAeq16 h. 5. Psychological health Following on from annoyance, it has been suggested that long-term noise exposure might influence psychological health. However, overall, the evidence for aircraft noise exposure being linked to poorer well-being, lower quality of life, and psychological ill-health is not as strong or consistent as for other health outcomes, such as cardiovascular disease. A recent study of 2300 residents near Frankfurt airport found that annoyance but not aircraft noise levels per se (LAeq16 hour, Lnight, Lden) was associated with self-reported lower quality of life [25]. Several studies of children around London Heathrow Airport have shown no effect of aircraft noise at school on children's psychological health or cortisol levels [26]; therefore, we would expect cortisol levels to be raised in children with depression. However, aircraft noise may have a negligible effect on hyperactivity symptoms. The West London Schools Study of 451 children around Heathrow airport, aged 8-11 years, found higher rates of hyperactivity symptoms for children attending schools exposed to aircraft noise exposure >63dB LAeq 16 compared with <57dB LAeq16 hours [26]. A similar effect was observed in the RANCH study, where a 10 dB LAeq 16-h increase in aircraft noise exposure at school was associated with a 0.13 increase in hyperactivity symptoms [23]. However, although statistically significant, these increases in hyperactivity symptoms are minimal and most likely not clinically relevant. Aircraft noise exposure does not appear to cause children to develop hyperactivity problems.

There have been fewer studies on the effects of aircraft noise on adult psychological health. The HYENA study found that a 10 dB increase in daytime (LAeq 16 hours) was associated with a 28% increase in anxiety medication use; similarly, a 10 dB increase in nighttime (Lnight) aircraft noise was associated with a 27% increase in anxiety medication use. However, daytime and nighttime aircraft noise exposure was not associated with sleep or antidepressant medication use [18]. Anxiety medication is prescribed for individuals experiencing levels of anxiety and worry that interfere with their ability to function effectively; it can also be prescribed for sleeping problems.

METHODS

The research used a quantitative research design in which a noise meter and questionnaire were used to gather the required data.

The research measures the noise level using a noise meter. The noise meter is used in noise pollution studies to quantify noise levels, including aircraft noise. It can accurately convert electrical signals back to sound pressure and display the results in (decibels dB)

A questionnaire is a form of securing answers to specific questions. Structured and Likert scale questions will be used in this study. It offers a respondent choice among the options provided, 50 questionnaires to be administered (N=50) to the study population.

This research will use primary and secondary data; preliminary data refers to data collected from first-hand experience directly from the primary source. These data would constitute the data to be obtained from the measurements of noise level within the Mallam Aminu Kano International Airport and the response received from the questionnaire, while the secondary data of this research is the extensive literature review, which has established the fact that aircraft noise has implications on the exposed populace.

The noise level of aircraft on landing and take-off at both runways 06/24 was measured to determine the noise produced. Aircraft parked at the apron were measured to determine the level of exposure because this area is mainly dominated by staff that render one service to another for the helicopter—mostly ground handling team and airliners. The fire station is situated on the airside close to the parking bays of a critical aircraft, Boeing 747, and other smaller aircraft mostly parked directly opposite the fire bay. The noise will be measured at the departure hall of the domestic terminal. This measurement will give the noise level produced at each point.

The questionnaire (N=50) is to be administered based on a random selection of the staff of NAHCO and SAHCOL who are the ground handlers of baggage, fire officers whose office is mainly at the airside, aviation security personnel who are at the staff gate and Apron, Marshallers that are directing the aircraft to its parking bay or taxiway for take-off, and airfield staff of airlines operating in MAKIA.

The data obtained from the noise meter will be analysed using the mean noise level, while descriptive statistics and simple percentages will be used to analyse the data obtained from the questionnaire.

RESULTS AND DISCUSSION

From the results, the main apron has the highest noise level in the study area, and this can be attributed to the number of aircraft that have their engine or APU on while taxiing or parked.

Table 1 – Summary of noise levels in the study area

Parameters	New Fire Station	Old Fire Station	International Terminal	Domestic Terminal	Main Apron
Coordinate	120250N, 080336E	120240N 083116E	120230 N 083056E	120240N 083116E	1120240N 083116E
Mean	90.0Db	96.4 dB	65.0 dB	75.0	98.0Db
First reading	92.4Db	90.0 dB	63.9 dB	74.0	99.0Db
Second reading	87.6Db	102.8 dB	66.1 dB	77.0	97.0Db
WHO Recommend Noise Level	35dB(A) Indoor	55dB(A) Out Door	90Db(A), 8 hrs Exposure		

The old fire station, which is also very close to the apron, is noisy with a mean noise of 96.0 dB, followed by the new fire station, which is loud and has a peak noise reading when aircraft are taking off, landing, and taxiing. The terminal buildings are less noisy within the study area, with the domestic terminal having a mean reading of 75.8 dB. In comparison, the new international terminal building has the lowest noise level, with a mean noise level of 65.0 dB.

The international terminal building with modern equipment, including avio-bridges, has a noise level above WHO indoor and outdoor, with some staff working for more than 8 hours. Workers are at greater risk in fire stations and aprons than in terminal buildings.

In a previous study [26], authors assessed the aircraft noise exposure levels of people living/working near four airports in Nigeria (Ibadan, Benin City, Warri, and Owerri). Four parameters were evaluated:

1) ambient noise level (ANL);

2) sound pressure level (SPL);

3) aircraft take-off noise level (ATNL);

4) aircraft landing noise level (ALNL).

They performed 120 periodic noise sampling surveys from January to December 2017 at 30 randomly selected study locations according to the ISO 3891, ISO 1996-1, and ISO 1996–2 standards. The results showed that the SPL, ANL, ATNL, and ALNL were within the ranges of 103–115 dB(A), 52.3–64.1 dB(A), 69.6–87.7 dB(A), and 66.2–82.7 dB(A), respectively.

The values exceeded the maximum noise levels recommended by the WHO:

1) 35 dB(A) (indoor),

2) 55 dB(A) (outdoor),

3) 90 dB(A) (permissible noise limit for 8 hours of exposure).

The results revealed that the effects of aircraft noise were most pronounced near Ibadan Airport, followed by Benin Airport, Owerri Airport, and Warri Airport. Those living within proximity of Ibadan Airport were at high risk of suffering from headaches, sleep disturbance, noise annoyance, and speech intelligibility in the long term.

From the response obtained, 100% of the responders affirm that they are exposed to aircraft noise, 32 of 50, equivalent to 64% of the responders working below 8 hours a day, while 36% work above 8 hours a day. Most staff are on shift duty, per the International Civil Aviation Organization (ICAO) standards.

The following statements were designed to determine the level of staff awareness of the implications of aircraft noise.

Table 2 – Noise Implications and Level of Staff Awareness

Parameters	SA	A	N	D	SD
Aircraft noise constitutes a Nuisance	32	11	0	2	0
Long exposure causes hearing loss	28	18	2	2	0
Head and Hypertension	12	17	11	6	4
Cardiovascular	10	13	14	8	5

The table above summarises the research findings on awareness of aircraft noise implications, where 74% of the responders strongly agree that aircraft noise constitutes a Nuisance. In comparison, 22% agreed with the question, meaning most workers believed that aircraft noise was a nuisance, whereas only 4% disagreed. When asked if long exposure to aircraft noise causes hearing loss, the response showed that 56% strongly agreed, with 36% of the responders agreeing and only 4% saying No, it does not cause hearing loss. From the response, 96% know that prolonged exposure to aircraft noise causes hearing loss.

Exposure to Aircraft noise leads to hypertension and headache? Of the responders, 24% strongly agreed to this, 34% only agreed, 12% and 8% disagreed and strongly disagreed, respectively, with 22% being neutral to the question. More than 50% know that prolonged exposure to aircraft noise causes high blood pressure and headaches.

Exposure to aircraft noise causes cardiovascular problems. 20% of the responders strongly viewed these, while 26% only agreed with the question, 8% did not agree that exposure to aircraft noise has a cardiovascular implication, and 28% stood neutral. It still shows that 46%, though less than half, are aware of these effects, while more than 50% are unaware that prolonged exposure to aircraft noise causes cardiovascular problems.

Staff were asked about their experience with any implications of aircraft noise. From their responses, 76% of MAKIA employees said they have not experienced any of the mentioned effects of aircraft noise, 24% has experienced headache, 10% has experienced hearing loss problem, and 2% has encountered cardiopulmonary and heart-related implications.

When asked what actions the staff takes to protect themselves, 23 responders (approximately 46%) said they wear earmuffs, and 6 of the population said they keep a maximum distance from the aircraft unless necessary. In contrast, 42% took action to protect themselves from aircraft effects.

Table 3 – Safety Regulations and Compliance

Parameters	Yes	No
Is your organisation providing you with safety kits	21	29
If yes, are you always using them	20	30
Do you undergo safety training regarding Noise pollution	15	35
Do you know any laws and bodies regulating noise pollution	13	37

From the above table, 42% of the staff confirmed that their employers provide them with safety kits. In comparison, 58%, the majority, said their organisation does not give them any safety kits, which is against the standard practice of working in a noisy environment. It shows non-compliance with safety procedures. Given the responses obtained, interns using the safety kits showed that 60% are not complying with the safety of using those kits. However, 70% of the population is not trained on safety regulations regarding noise pollution, which means that the majority are unaware of noise safety regulations, and 74% do not know bodies regulating noise pollution. In contrast, only 26% confirmed that they know of such bodies.

When asked to state the types of safety kits the employees are given, 28% specifically stated that they are given earmuffs, 32% said that they are given Personal Protective Equipment, which mostly does not come with ear-protecting equipment, and 40% are not given anything, which shows that more than one-third are not given protective equipment despite being exposed to aircraft noise.

CONCLUSIONS

Noise constitutes a severe nuisance and hazardous effect, and MAKIA workers are exposed to aircraft noise above the permissible noise level by the WHO. Most workers are aware of the adverse impact of noise on their health. However,

they do not comply with safety standards for working in a noisy environment such as MAKIA Airside. The failure of this informed majority to adhere to safety measures is partly associated with employers not providing enough safety kits to employees. Hence, by not adhering to the International Civil Aviation Authority (ICOA) standard regarding aircraft, employers and employees are not taking sufficient precautionary measures to prevent the occurrence of noise from aircraft.

Based on the findings of these studies, it is recommended that the safety department.

1. Train staff on standard and safety regulations for aircraft noise pollution.

2. The staff of MAKIA should be encouraged to comply with industrial safety regulations and standards.

3. Staff should be encouraged to check their physical and mental health related to aircraft noise exposure.

4. More awareness campaigns should be conducted on the implications of aircraft noise.

5. Regulatory bodies should conduct routine safety compliance audits.

6. Airliners should be encouraged to purchase less noisy aircraft.

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