Review Article

HEALTH EFFECTS CAUSED BY NOISE - THE CASE OF AFRICA: EVIDENCE IN LITERATURE FROM THE PAST 25 YEARS.

ABSTRACT

This narrative review paper is centred on researches conducted in Africa from the past Twenty-Five (25) years which reveals the health effects caused by noise pollution. Noise pollution has become a global menace. The various areas of noise reception, the health effects reported, sources, noise and exposure levels identified are described. Consistencies and discrepancies between results of various researches are elaborated. Finally, the implications of findings and any new research fields spotted are spelt out.

Keywords: *Noise pollution; public health; noise levels; health effects; Africa.*

1. INTRODUCTION

Africa, the second-largest continent, is bounded by the Mediterranean Sea, the Red Sea, the Indian Ocean, and the Atlantic Ocean. It is divided in half almost equally by the Equator with population density of 87 people per square kilometre [1].

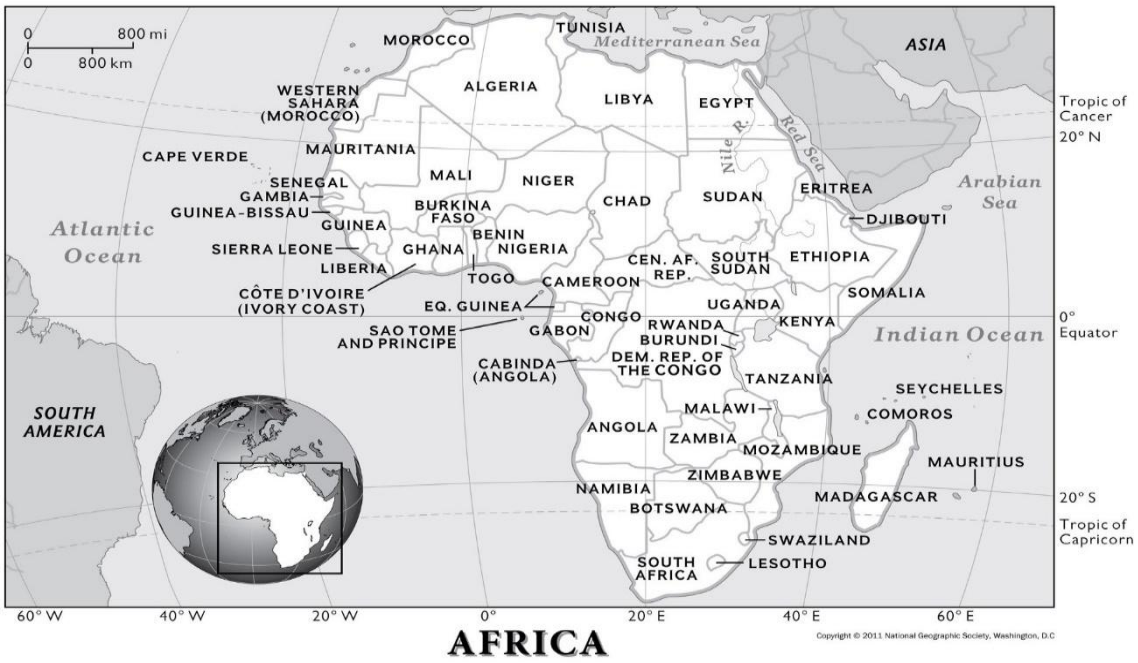

Figure 1: A pictorial view of the African Continent

About 40% of residents in industrialized nations suffer from noise of which a third are exposed to level of noise detrimental to their health.The population exposure to noise tends to be severe in large cities [2]. Urbanization, civilization or industrialization is majorly characterized with noise pollution.

Noise is one of the major environmental pollutants that has direct effects on human performance. The survival and healthy existence of man depend largely on the enabling environment where he resides, as disruption in the conducive environment may lead to dysfunction in health status [3]. According to Baffoe *et al* (2022), noise level of over 60 dBA can affect the physical and psychological health of humans. Moreover, some studies also predict that noise levels in some areas, especially in the developing countries, could go as high as 90 dBA and even to 110 dBA. It was found out that traffic noise levels ranges from 65.00 dBA to 98 dBA, while that of churches ranged from 73.10 dBA to 107.00 dBA. Noise level of working sites ranged from 74.4 dBA to 115.2 dBA. And these could probably lead to hypertension, ear problems and sleep disturbances [4].

In Nigeria, high noise levels have been attributed to traffic characteristics, especially traffic volume, vehicle horns, vehicle-mounted loudspeakers, unmuffled vehicles, record players and hawking. Average daily noise exposure level (LAeq) in Ilorin metropolis varies from 46 dBA to 86 dBA. The result of this study shows that the major source of noise in Ilorin metropolis can be attributed to traffic noise. The noise map developed reveals high noise exposure at the nucleus of the metropolis where commercial activities, high traffic volume and clustered buildings with high population exist [5]. Research conducted in Ghana by Clark *et al* (2021) also showed that commercial, business, industrial and areas near major roads had highest daily sound levels. The sources of noise were mixtures of sound from animals, human speech, and outdoor music which dominated in various locations and at different times of the day [6].

There has been a great deal of research in the past 25 years into the health effects of noise globally. But this review has been done to ascertain the case of Africa when it comes to health effects caused by noise. The prevailing health effect of noise at the different areas of noise reception would be spelt out as necessary recommendations will be given for future studies.

2. AREAS OF NOISE RECEPTION STUDIED

2.1 Residential Areas

A cross-sectional community-based study of environmental equivalent noise levels within Abuja municipal was conducted by Ibekwe et al (2016). Results from the study showed high noise levels at day time sourced from human and vehicular activities. Daily exposure over five (5) hours resulted in conditions like cardiovascular disorders and inhibition of full intelligibility in normal listeners [7].

Residents in a metropolitan city in South-South Nigeria indicated noise-induced hearing loss(NIHL) as a major public health issue which was similar to that revealed in Lagos Metropolis. The sources of noise were generators, music, music concerts, sports and children's toys, traffic. The traffic— both human and vehicular—was high in noise level even up to 90.3 dB(A). NIHL resulted due to long exposure to noise from these sources. Tinnitus and hyperacusis were some symptoms experienced by residents [8,13]. Researchers found out that Eight (8) hours and beyond daily exposure to noise level ranging from 64.8 dBA to 98.0 dBA caused hearing impairments. Traffic was the major source of noise identified with others like music studios, night clubs, generators, construction sites and religious activities [9,12].

Oyedepo *et al* (2010) analysed noise pollution in Illorin metropolis, Nigeria and showed that at 56 to 98 dBA, discomfort and irritation were experienced by inhabitants which also reduced productivity. Sleep disturbance, pains and loss of hearing were also recorded over daily exposure to traffic noise. Traffic noise was the main source of pollution. Other sources were human conversation and radio players [11]. Parallel to this study was that of Oguntunde *et al* who identified that noise level in Ota Metropolis in Nigeria was

averagely 90.8 dBA which was far from World Health Organization (WHO) recommendation. Activities such as pupils going to school, workers going to office, traffic at junctions and major bus stops served as sources of the elevated noise levels [14].

Halls of residence in the University of Cape Coast, Ghana experience noise levels ranging from 30dB to 70dB daily. The sources of the noise had been linked to various arguments that went on among residents and music. These caused irritation and sleep interference which were non-auditory noise effects [15]. Building occupants in Lagos, Nigeria experienced mean noise values of 53dB,68.4dB and 68.3dB for the three residential neighbourhood groups ie. low density (LD), medium density (MD), and high density (HD), with the medium density neighbourhoods having the highest mean value. Occupants were exposed to noise levels over duration exceeding 8hours.About 35% of occupants in the three residential neighbourhoods reported that the major source of noise pollution was vehicular followed by generator sets and music system. Headache, lack of concentration and irritability were the major health effects reported [16]. Similar research conducted in Lagos State by Adekunle *et al* indicated average sound levels of 85.9dB, 84.7dB, and 83.1dB respectively in event centers, markets, and religious centers. The following health effects were recorded: headache, muscle tension, anxiety, insomnia, fatigue, resentment, distraction, hearing impairment, interference with communication, interference with relaxation [18].

In Ogun State of Nigeria, common auditory ailments found across the metropolis included impaired hearing, tinnitus and otitis. Significant correlation was found between diagnosed cases of auditory ailments and noise levels measured which ranged from 75.0 – 88.2 dBA [17]. Joubert and Ellis (2012) found out that toys used by children between the ages of birth and 3 years in South Africa produced the largest amount of continuous noise outside of the natural frequency range for young children. This is associated with Noise Induced Hearing Loss (NIHL) [10].

2.2 Educational Facilities

Three schools reported tiredness, and one school lack of concentration, as the most prevalent noise-related health problems according to Godson R. E. E. Ana *et al*. Respondents were exposed to daily noise levels that ranged from 68.3–84.7 dBA from sources such as vehicular traffic and religious activities. The noise also caused disturbance to respondents [19]. Otutu 2011 investigated noise levels on Campus 2 of Delta State University, Nigeria and found average noise level of 87 dB. Power plants and generators were the major sources of noise [23]. This high levels caused critical health effects such as speech interference, disturbance of information extraction, message communication and annoyance [24].

In Tanzania, students' learning and productivity has been interfered by noise pollution. Also annoyance, cognitive impairment and stress were recorded as health issues related to noise pollution. Sources were from motor vehicles, construction and welding machines and other activities related to music sounds, promotions adverts and people's movements [20]. Learning spaces of basic schools in Kumasi, Ghana was chosen for a study on noise pollution. The study showed that mean outdoor and indoor noise levels exceed the World Health Organisation permissible limits by 30 - 40 percent and 90 - 107 percent respectively for schools in the commercial zones and schools that are located near highways. Vehicles and commercial activities within the vicinity were the major sources of noise. Exposure to the noise levels caused these problems: Speech interference, disturbance of information comprehension and message communication. Students' performance was affected as well [21].

Similar to this, was a study of noise pollution in Teshie-Nungua schools. Sowah *et al* revealed that the schools had their background noise levels above 55 dB, the Environmental Protection Agency (EPA) recommended noise level in educational facility. Constant traffic was the main source of noise which adversely affected the hearing of

students. Others were church activities, corn milling shops construction sites, large trucks, fitting shops and music shops. Students' performance was affected [22].

2.3 Health Facilities

Nathan *et al* (2008) assessed noise levels in a neonatal intensive care unit(NICU) in the Cape metropole, South Africa and discovered that noise levels ranged from 62.3 to 66. dBA which exceeded American and British NICU standards of 50 - 60 dBA [27]. Staff conversations were the largest single contributor to the number of noise events. The largest single non-human contributor was monitor alarm noise. Noise affected optimal care for new-borns, caused acoustic trauma risks and caused some physiological instability in the NICU. Hearing problems were caused by daily exposure to noise levels [25].

Four public hospitals in Kigali City, Rwanda were assessed for noise levels. Sound levels recorded in all the NICUs were high ranging from 61.8 decibel (dB) to 77.0 dB, greater than the 45 dB recommended by the American Association of Paediatrics (AAP). High noise levels in NICU affected heart rate, respiratory rate, blood pressure, oxygen saturation, and intracranial pressure [26].

2.4 Industries

In 2019, Burns *et al* studied and found out that electronic waste recycling workers in Ghana were exposed to average noise level of 78.8 dBA frequently in their activities. The vast majority of workers (87%) reported frequent exposure to high noise on the job, and also reported being frequently bothered by this noise which affected their mental health and also caused stress. A major source of the noise was from dismantling activities [29]. Cardiovascular disorders like hypertension, myocardial infarction and stroke have been linked to exposure to frequent loud noise [30]. According to Elechi and Chibuzor (2021), aircraft noise poses major health effects on workers in Port Harcourt International Airport. The following conditions were associated with frequent exposure to noise: cardiovascular diseases like hypertension, sleep disturbance, annoyance, noise-Induced hearing loss. Noise also affected psychological health and cognitive impairment in children [31].

In Zimbabwe, noise induced hearing loss (NIHL) was within the top five occupational illnesses among employees at a mining industry. Workers were exposed to noise over long time on daily basis. The range was from 94 -103 dBA which exceeded the recommended World Health Organization (WHO) standard [32]. A similar outcome emanated from Malawi. Light and heavy industries showed high levels of noise above standard level of 85. 0dB.This caused hearing loss among workers. The highest measurement was found in the fertilizer industry with a reading of 102 dBA. The lowest measurement was observed in plastic industry with reading of 81 dBA [37]. Mgbe *et al (*2017) researched and discovered that Forty-one (41) of the noise exposed workers in flour mill had mild hearing loss and ten had moderate loss. In Wartsilla, twenty-six (26) of the noise exposed workers had mild hearing loss and six (6) had moderate loss [38].

Researchers in Nairobi, Kenya found out that industrial noise pollution could cause serious health problems like loss of hearing, headaches, ringing sound in the ears, irritability, and sleeplessness. The study found that millers, non-formal metal sheds and metal industries were the leading noise polluters within the workplaces at 94.4, 92.2 and 90.2 dB(A) respectively. In addition, the noise emission into the environment from these industries was beyond the recommended transmission level of 60 dB(A). Headache was predominant health condition experienced [33]. Offices in Ghana were exposed to high

levels of noise. As described by Koranteng *et al* (2016), these offices exposed occupants to noise that emanated from indoor and outdoor sources which interfered with and impeded work performance. Aside that, interference in speech intelligibility and annoyance were experienced by occupants in these offices [34]. Quarry workers experienced frequent noise levels from 85.5 to 102.7 dBA which emanated from machines used at work. This led to hearing loss among the workers [35,43].

Again, the level of industrial noise was assessed by Omari et al (2013). The major source was operating machines from plastic, can, food, and cutlass manufacturing industries. Workers developed problems with hearing. More than half (63.3%) of workers could not hear words clearly at normal conversation. Mean noise level from all four (4) industries was 90.0 dB which exceeded the allowable level of 70 dB recommended for heavy industrial areas [39]. Textile workers in Ethiopia suffered from Noise-induced hearing loss due to frequent exposure to noise at 99.5 dBA [40]. In Calabar-Nigeria, operators of food grinding machines suffered health effects like hearing loss and symptoms such as tinnitus, insomnia and headache. Operators were exposed to noise for at least six (6) months at 105.8 dB [41]. Furthermore, researchers in Tanzania found out that the power plant section of a cement factory produced noise level of 104.8 dBA which exceeded the allowed limit value of 85 dBA as recommended by Tanzania Bureau of Standards (TBS). The sources of noise in the factory were compressor room, raw mill, cement mill and power plant. Health effects that most complained among workers were headache (20.5%), hearing problem during conversation (53.8%), and irritability (17.9%) [42].

Again, Wheat processing operations generated noise levels ranging from 56 dBA to 100.9 dBA which posed a lot of physiological and psychological disorders to workers. speech interference, reduction in hearing, tinnitus, heaviness in ear, diplacusis, nervousness and annoyance, blurred hearing were some of the health effects encountered [45]. Another study of noise pollution from Sawmilling in Nigeria revealed noise level ranging from 58.1-64.8 dBA. The effect of noise included tinnitus (96.6%), headache (86.6%) and hearing impairment (71. 9%).The machines were the sources of noise [46]. Manufacturing sectors in Thika District, Kenya were polluted by noise which could cause interference in speech intelligibility, ear infection and trauma [47].

2.5 Commercial Areas

In Mongoro Municipality of Tanzania, restaurants were affected by noise levels ranging from 61dBA to 64dBA which put customers at the risk of developing hearing loss. The noise sources were from customers, outside (the street), and music systems [44]. Motorcyclists in Southwestern Nigeria were affected by noise-induced hearing loss and ear discharge when they were long exposed to noise in a day. Aremu *et al* (2020) indicated that an important source of noise was “wind noise” produced by wind rushing past a rider’s ears [36]. Over a year exposure to noise from industries and music had caused noise-induced hearing impairment among traders. The average ambient noise level in Sawmills, Electro-acoustic markets, and food processing industrial areas was determined to be above 90dB [48]. Main commercial areas of Cape Coast, Ghana revealed noise level high above the standard set by the Environmental Protection Agency (EPA). The major sources of noise were from generators, plants, record players, street dancers, open parties, human conversation, noise from religious worship. Frequent exposure resulted in discomfort, irritation, pains, hearing loss and interference with speech intelligibility [49]. The mean ambient noise for motor bike riders was 90 dB, a level significantly higher than the International Standard Organization (ISO) standard of 60dB.This caused noise-induced hearing loss(NIHL) among commercial motor bike riders [50].

2.6 Social Gatherings

Abankwa et al (2017) observed that social gatherings like church services, funeral gatherings were contributors to noise pollution in Ghana. People were exposed to noise levels that ranged from 78.3-82.8 dBA which exceeded EPA prescribed limits. Sources of noise were musical instruments, praises, worship and preaching using microphones, noise from a number of loud speakers from intense praise. Irritations, interference in speech intelligibility and hearing problems were some effects associated [51].

Also, Ackah *et al* (2021) found out that noise levels from churches and mosques exceeded the acceptable limit set by EPA. Noise was described as a nuisance to those affected. The range was 66.2 -98.5dBA. The majority of sample respondents exposed to noise pollution reported occurrence of annoyance, deafness, mental breakdown. Depression and sleeplessness as effects of noise pollution [52]. Instrumentalists in Pentecost Churches in Porthacourt City, Nigeria suffered from Noise-Induced Hearing Loss(NIHL) and tinnitus due to noise pollution [53].

3. FINDINGS AND DISCUSSIONS

A total number of Fifty-One (51) published manuscripts were sourced from reputable journals to represent the studies conducted in Africa only on noise pollution and its health effects. The sample sizes related to the areas of noise reception studied are depicted in table 1 below. Much research had been conducted in both residential and Industrial areas than in educational facilities, health facilities, commercial areas and social gatherings.

Table 1. Descriptive statistics of Literature Review

Areas of Noise Reception	Number of Literature	Percentage (%)
Residential Areas	15	29.4
Educational Facilities	6	11.8
Health facilities	4	7.8
Industries	15	29.4
Commercial Area	7	13.8
Social Gatherings	4	7.8
Total	**51**	**100**

Table 2. Findings On Health Effects Associated with Noise Pollution in Study Areas.

Areas of Noise Reception	Health Effects
Residential Areas	Hypertension, Inhibition of speech intelligibility, Noise-induced hearing loss,Tinnitus,Acusis, discomfort, Irritations, Sleeplessness, Pains, Headache, Lack of concentration, Muscle tension, Anxiety, Tiredness and Otitis.
Educational Facilities	Tiredness, lack of concentration, Disturbances, inhibition of speech intelligibility, Annoyance, Stress, hearing problems, Cognitive impairment, Poor performance, irritations.

Health Facilities	Trauma, Hearing impairment, increased heart rate, High respiratory rate, Hypertension, High Oxygen saturation and Intracranial pressure, Inhibition of speech intelligibility, Irritations.
Industries	Hypertension, myocardial Infarctions, Stroke, Sleeplessness, Annoyance, Noise-induced hearing loss, mental breakdown, headaches, Tinnitus, Irritations, Poor performance, inhibition of speech intelligibility, Acusis, nervousness, Trauma, Otitis, cognitive impairment.
Commercial Areas	Noise-induced hearing loss, ear discharge,discomfort,irritation,Pains, Inhibition of speech intelligibility.
Social Gatherings	Inhibition of speech intelligibility, Irritations, Annoyance, Tinnitus, Noise-induced hearing loss, mental breakdown, depression, sleeplessness.

3.1 Consistencies in results

Noise-induced hearing loss(NIHL), Irritations and Inhibition of Speech intelligibility were three (3) main health effects associated with noise pollution and these affected people found in all Six (6) areas of study followed by Hypertension, Tinnitus, Sleeplessness(Insomnia) and Annoyance which identified with at least three (3) areas of study. Acusis, Discomfort, Pains, Headaches, Lack of Concentration, Tiredness, Otitis, Cognitive Impairment, Mental Breakdown and Trauma were consistent in at least two (2) study areas. Anxiety, Muscle Tensions and stress identified with a particular study area. Most of the health effects prevailed in the residential and industrial areas. Pains and Discomfort were consistent with residential and commercial areas. Acusis, Headaches and otitis were consistent with residential and industrial areas

3.2 Discrepancies in results

Despite the uneven size of literature reviewed under each study area, people suffered varying health conditions which were inconsistent among the study areas. Sleepness, Hypertension, Tinnitus and Annoyance identified with three (3) varying studying areas. For example, Hypertension identified with residential, health facilities and industries. Tinnitus identified with Social gatherings, residential and industrial areas. Annoyance identified with education facilities, social gatherings and industries while sleeplessness identified with residential areas, social gatherings and industries. Furthermore, Acusis, Discomfort, Pains, Headaches, Lack of Concentration, Tiredness, Otitis, Cognitive Impairment, Mental Breakdown and Trauma identified with two (2) varying study areas. For example, Acusis identified with residential and industrial areas. Discomfort identified with commercial and residential areas etc.

4. CONCLUSION

All study areas and subjects of noise reception revealed health conditions which needs the attention of public health departments and agencies across Africa and globally for the purpose of education and remediation. From this review, it has been concluded that Noise-

induced hearing loss(NIHL), Irritations and Inhibition of Speech intelligibility are three (3) main health effects associated with noise pollution in Africa. Noise Induced Hearing Loss is auditory while Irritations and Inhibition of Speech intelligibility are non-auditory.

Limited literature was identified as a gap for further and continuous research to be conducted on the health effects of noise pollutions in the following areas of reception: educational, health facilities and social gatherings. Especially in African countries which presented no results for literature search.

REFERENCES

1**.** Dunn MG. Exploring Your World: The Adventure of Geography. Washington, D.C.: National Geographic Society. 1993.

2.ASTM.Community noise. Special Technical Publication No.692. American Society for Testing and Materials. 1979.

3. Awosusi AO, Akindutire IO. Perceived Health Effects of Environmental Noise Pollution on the Inhabitants of Ado-Ekiti Metropolis Ekiti State, Nigeria. Journal of Biology, Agriculture and Healthcare. 2014. Vol.4, No.26.

4. Baffoe PE, Duker AA, Senkyire-Kwarteng EV. Assessment of health impacts of noise pollution in the Tarkwa Mining Community of Ghana using noise mapping techniques. Global Health Journal. 2022.

5. Oyedepo SO. Environmental Noise Pollution in Ilorin Metropolis, Nigeria. Nature Environment and Pollution. 2021.11(4): 553-67.

6. Clark SN, Alli AS, Nathvani R. *et al.* Space-time characterization of community noise and sound sources in Accra, Ghana. *Sci Rep*. 2021.**11,** 11113.

7. Ibekwe T, Folorunso D, Ebuta A, Amodu J, Nwegbu M, Mairami Z, Liman I, Okebaram C, Chimdi C, Durogbola B, Suleiman H, Mamven H, Baamlong N, Dahilo E, Gbujie I, Ibekwe P, Nwaorgu O. Evaluation of the environmental noise levels in Abuja Municipality using mobile phones. *Annals of Ibadan postgraduate medicine*. 2016. *14*(2), 58–64.

8. Adekanye AG, Nja GM, Ojo MO, Mgbe RB, Offiong ME, Umana AN. Awareness of noise-induced hearing loss among residents in a metropolitan city in South-south Nigeria. Niger J Med. 2020; 29:407-14.

9. Afolabi MT, Salamat A. Environmental Noise Pollution and its Impacts on the Hearing Ability of Men and Women in Ilorin, Kwara State, Nigeria. Tanzania Journal of Science. 2021. 47(5): 1517-29.

10. Joubert K*,* Ellis M. Noise levels of toys for children between the ages of birth and 3 years in South Africa. SAJCH. 2012. Vol. 6 No. 1,12-16.

11. Olayinka SO, Abdullahi AS. Evaluation and analysis of noise levels in Ilorin metropolis, Nigeria. Environ Monit Assess. 2010. 160:563–77.

12. Akinkuade ST, Fasae KP. A Survey of Noise Pollution in Ado-Ekiti Metropolis Using Mobile Phone. *Natural Science*. 2015. **7,475**-82.

13. Ibitoye ZA, Aweda MA, Ofojebe CP. Assessment of Noise Level Distributions in Lagos Metropolis and the Potential for Adverse Health Effects. Journal of Environmental Health. 2017. Vol. 79 No. 10, E1-5.

14.Oguntunde PE, Okagbue HI, Oguntunde OA, Odetunmibi OO. A Study of Noise Pollution Measurements and Possible Effects on Public Health in Ota Metropolis, Nigeria. Open Access Maced J Med Sci. 2019. 7(8):1391-95.

15.Armah FA, Afrifa EKA, Pappoe ANM. Determination of Ambient Noise Levels and Perception of Residents in Halls at the University of Cape Coast, Ghana. Environment and Natural Resources Research.2011. 1(1);181-88.

16.Oloruntoba EO, Ademola RA, Sridhar MKC, Agbola SA, Omokhodion FO, Ana GREE, Alabi RT. *Urban* Environmental Noise Pollution and Perceived Health Effects in Ibadan, Nigeria. *Afr. J. Biomed. Res.* 2012.*Vol 15; 77 – 84.*

17.Oguntoke O, Tijani YA, Adetunji OR, Obayagbona ON. Spatial Analysis of Environmental Noise and Auditory Health of Abeokuta Residents, Ogun State, Nigeria. J. Appl. Sci. Environ. Manage. 2019. 23 (9) 1699-707.

18. Adekunle A, Omange OM, Adekunle OT, Shawon MC. Estimation of noise pollution parameters and their health effects on building occupants in Lagos State, Nigeria. International Journal of Advanced Academic Research. 2021. Vol 7(1).64-86.

19. Godson REEA, Derek GS, Brown GE, Sridhar MKC. Assessment of Noise and Associated Health Impacts at Selected Secondary Schools in Ibadan, Nigeria. Journal of Environmental and Public Health. 2009.1-6.

20. Nzilano JL. Effects of Noise Pollution on Students' Learning in Selected Urban Public Secondary Schools in Dar es Salaam City, Tanzania. *African Research Journal of Education and Social Sciences.* 2018. 5 (1).

21. Quartey LNK, Amos-Abanyie S, Afram SO. Noise Exposure Levels in Basic School Environments in a City in Ghana. Open Journal of Civil Engineering.2021.11,81-95.

22. Sowah RA, Yankson AA, Carboo D, Adaboh RK. Noise Pollution in Teshie-Nungua Schools. Journal of Natural Sciences Research. 2014. Vol 4, No. 21, 90-8.

23.Otutu OJ. Investigation of environmental noise within campus 2, Delta State University, Abraka, Nigeria. 2011. IJRRAS 6 (2).

24.Ochiabuto OMTB, Abonyi IC, Ofili RN, Obiagwu OS, Ede AO, Okeke M, Eze PM. Assessment of Noise Levels in Primary and Secondary Schools in Nnewi, Anambra State. *European Journal of Environment and Public Health.*2021. 5(1), em0054.

25.Nathan LM, Tuomi SK, Müller AMU. Noise levels in a neonatal intensive care unit in the Cape metropole. SAJCH. 2008. Vol. 2 N0. 2.50-4.

26.Dusabe R, Muhayimana A, Muhayimana P, Meharry P. Noise Level and its Sources in Neonatal Intensive Care Units of Selected Public Hospitals in Kigali City Rwanda. Journal of Medicine and Health Sciences. 2020. Vol.3 No. 2,115-27.

27. Levy GD, Woolston DJ, Browne JV. Mean noise amounts in level II vs. level III neonatal intensive care units. Neonatal Netw. 2003. 22(2): 33-8.

28.Omari S, De-Veer A, Amfo-Otu R. The silent killer: an assessment of level of industrial noise and associated health effects on workers. International Journal of Basic and Applied Science. *2013.*2(2) ,165-69.

29. Katrina NB, Stephanie KS, Neitzel RL. Stress, health, noise exposures and injuries among electronic waste recycling workers in Ghana. Journal of Occupational Medicine and Toxicology.2019. 14:1.

30. Aluko EO, Nna VU. Impact of Noise Pollution on Human Cardiovascular System. *International Journal of TROPICAL DISEASE & Health. 2015. 6(2): 35-43.*

31. Elechi CE, Chika C. Implication of Aircraft Noise on Workers in Port Harcourt International Airport Omuagwa Rivers State. World Journal of Innovation and Modern Technology. *2021.* Vol. 4 No. 1, 46-69.

32.Chadambuka A, Mususa F, Muteti S. Prevalence of noise induced hearing loss among employees at a mining industry in Zimbabwe. African Health Sciences. 2013; 13(4): 899 – 906.

33.Gongi SP, Kaluli JW, Kanali CL. Industrial Noise Pollution and its Health Effects on Workers in Nairobi City International. Journal of Engineering Research & Technology. 2016. Vol. 5; 426-35.

34.Koranteng C, Amos-Abanyie S, Kwofie TE. Environmental Noise Exposure On Occupants in Naturally Ventilated Open-Plan Offices: Case of Selected Offices in Kumasi, Ghana. International Journal of Scientific and Technology Research. 2016. Vol 5, issue 10,138-46.

35.Gyamfi CKR, Amankwaa I, Owusu SF, Boateng D. Noise Exposure and Hearing Capabilities of Quarry Workers in Ghana: A Cross-Sectional Study. Journal of Environmental and Public Health. 2016.1-7.

36.Aremu SK, Adewoye RK, Adeyanju AT, Ekpo DS. Prevalence, awareness, and factors associated with noise-induced hearing loss in occupational motorcyclists in Southwestern Nigeria. Niger J Surg. 2020; 26:53-8.

37.Chirwa I, Mlatho JS, Kamunda C, Mikeka C. Assessment of noise levels in heavy and light industries in Blantyre City, Malawi. Malawi Journal of Science and Technology.2019. vol 11 issue 1.

38.Mgbe RB, Umana AN, Adekanye AG, Mbora EO. Prevalence and Awareness of Noise Induced Hearing Loss in Two Factories in Calabar, Cross River State, Nigeria. Global Journal of Pure and Applied Sciences.2017. Vol.23: 361-65.

39.Omari S, De-Veer A, Amfo-Out R. The silent killer: An Assessment of the level of industrial noise and associated health effects on workers. *International Journal of Basic and Applied Sciences.2013, 2 (2); 165-69.*

40.Belachew A, Berhane Y. Noise-induced hearing loss among textile workers. *Ethiop. J. Health Dev.* 1999;13(2):69-75.

41. Bisong SA, Umana AN, Onoyom-ita V, Osim EE. Hearing acuity loss of Operators of Food Grinding Machines in Calabar, Nigeria. Nigerian Journal of Physiological Sciences.2004. 19(1-2): 20-7.

42.Mndeme FG, Mkoma SL. Assessment of Work Zone Nose Levels at a Cement Factory in Tanga, Tanzania. Ethiopian Journal of Environmental Studies and Management.2012.5(3).

43.Adiea DB, Otunb JA, Okuofuc CA, Nasirud A. Assessment of Noise Generated by Operations within the Gunduwana Quarry in Kano State, Nigeria. Nigerian Journal of Technology.2012. Vol. 31, No. 3, 314-20.

44.Samagwa D, Stelyus LM, Tungaraza C. Investigation of Noise Pollution in Restaurants in Morogoro Municipality, Tanzania. East Africa J. Appl. Sci. Environ. Manage. 2009. Vol. 13(4);29 –33.

45. Ibrahim IB, Aremu AS, Ajao KR, Ojelab AT. Evaluation of Noise Pollution and Effects on Workers during Wheat Processing. J. Appl. Sci. Environ. Manage. 2014. Vol. 18 (4) 599 – 601.

46.Aremu AS, Aremu AO, Olukanni DO. Assessment of Noise Pollution from Sawmiill activities in Ilorin, Nigeria. Nigerian Journal of Technology2015 Vol 34(1); 72-9.

47.Mithanga J, Gatebe E, Gichuhi M. Evaluation of noise levels in Manufacturing sectors in Thika District, Kenya. JAGST.2013. Vol. 15(1).

48. Ighoroje ADA, Marchie C, Nwobodo ED. Noise-Induced Hearing Impairment as an Occupational Risk Factor among Nigerian Traders. Nigerian Journal of Physiological Sciences.2004.19(1-2): 14-9.

49. Essandoh PK, Armah FA. Determination of Ambient Noise Levels in the Main Commercial Area of Cape Coast, Ghana. Research Journal of Environmental and Earth Sciences.2011. 3(6): 637-44.

50.Ibhazehiebo K, Ighoroje ADA, Uche OK, Ogisi FO, Iyawe VI. Impact of Noise on Hearing Amongst Commercial Motor Bike Riders in Benin- City, Nigeria. JMBR: A Peer-review Journal of Biomedical Sciences. 2008 .7(1-2) .5-11.

51.Abankwa EO, Agyei-Agyemang A, Tawiah PO. Noise pollution at Ghanaian Social Gatherings: the case of the Kumasi Metropolis. *Int. Journal of Engineering Research and Application.2017.7(7) ;20-7.*

52. Ackah JY, Amankwa-Danquah P, Atianashie MA. Religious Noise Pollution in Ghana: Source, Effect and Control. A Case Study of the Bono Region in Ghana. International Journal of Multidisciplinary Studies and Innovative Research.2021. Volume 05,377-87.

53.Anyiam FE, Douglas KE. Health Effects of Noise Exposure Levels Among Instrumentalists in Pentecostal Churches in Port Harcourt City, Nigeria. Nigerian Journal of Medicine.2019.28 (1): 63 -72.