Noise Pollution and its Impacts in Selected Secondary Schools in Ikorodu Division Area of Lagos, South-Western Nigeria

[1]Atilade, Adesanya Oluwafemi, [2]Okedeyi, Sakiru Abiodun, [3]Akinyemi, Joseph Adekunle and

[3]Idowu, Ibikunle Albert

[1]Department of Physical Science, Lagos State University of Science and Technology, Ikorodu, Lagos State, Nigeria
[2]Department of Physics, Lagos State University of Education, Oto-Ijanikin, Lagos State, Nigeria
[3]Department of Mathematics and Statistics, Lagos State University of Science and Technology, Ikorodu, Lagos State, Nigeria

*Corresponding author's email: atilade.ao@lasustech.edu.ng; atiladeadesanya@gmail.com Phone: +2347011250504

Keywords:
Academic Performance,
Humidity,
Statistical analysis,
Temperature,
WHO.

ABSTRACT

Noise pollution has been a major challenge in schools which is adjudged to affect the health of the students. The noise levels of twelve selected secondary schools in Ikorodu division of Lagos were measured with the aid of a smart sensor sound level meter AS844+. Noise level, humidity and temperature of the schools were measured at three points within the school premises between 9 am – 10 am, 11 am – 12 Noon and 1 pm to 2 pm. The measurements were taken at 1-minute intervals for 1 hour at each period. 120 questionnaires were distributed to students to determine the effects of noise on their well-being. The Results revealed that the Duncan PostHoc mean noise levels of the classrooms of the schools selected for this study were in the range of 57.84 ± 2.74 dBA to 86.68 ± 4.12 dBA, mean humidity ranges from 54.33 ± 6.10 % to 74.72 ± 2.42 % and temperature ranges from 30.45 ± 0.67 ^{0}C to 37.29 ± 2.43 ^{0}C. This noise level was significantly above the World Health Organization (WHO) recommended classroom and outdoor noise level. Statistical analysis of the responses from the questionnaires distributed shows that headache and stress are the major effects of noise on the respondents with 84.17% and 63.33% agreement respectively. It is recommended that effects and ways of reducing noise in schools should be introduced into the curriculum of secondary schools for optimum academic performance and improved well-being.

INTRODUCTION

Classroom noise is becoming unbearable in most secondary schools in Lagos State due to the experiences of teachers' inability to disseminate information in a noise-free environment. Noise is unwanted sound considered unpleasant, intrusive, loud or disruptive to hearing. It is an unexpected and loud sound that is greater than threshold limits adjudged to be annoying and distracting (Ryherd, 2016; Farina, 2017; Farooqi *et al*., 2020; Atilade *et al*., 2021; Okedeyi *et al*., 2023). Noise pollution is an unwanted or excessive sound that can have damaging effects on human health, wildlife, and environmental quality (Ana *et al*., 2009).

Noise and sound are not distinct in the sense that sound is a sensory perception evoked by physiological processes from the outer ear to the brain. Noise cannot be exclusively defined based on the physical parameters of sound. Developing countries and Nigeria in particular have some factors responsible for most noise experienced today. These include automobiles, commercial motorcycles, electricity generators, commercial activities, etc. These are in addition to population growth and vehicular traffic (Gbimadee, 2017; Ugbebor, 2018).

Noise harms the physical, social and psychological wellbeing which makes high noise levels in the school environment pose a real public health problem. The school is an important place for the social, creative and cognitive development of children and it is expected that the best possible conditions for a child's physical and intellectual development which include control of excess environmental noise are ensured. Exposure for more than six hours a day to sound more than 85 dB(A) is potentially hazardous to health (Ana *et al*, 2009; Ochiabuto *et al*., 2021).

World Health Organization (WHO) hasestablished that children exposed to continuous disruptive noise can perform below average in reading ability, memory and academic feat. The National Institute of Health study of classroom acoustics and school teachers' noise exposure also assert that excessive noise has an impact on teachers who are forced to raise their voices to be heard. Eventually, this can lead to increased fatigue and stress. The researcher Nermin (2014) studied noise pollution levels in two elementary schools. Questionnaires, sound meter observations, and the reflections of the student teachers participating in the study were used for collecting data. The findings showed that noise levels measured in both schools were much higher than national and international upper limits. It was concluded that teachers and administrators must display sensitive behaviours concerning the noise in particular, this issue should be emphasized during lessons and the training in schools should be given to students at early ages.

To be able to hear and understand spoken messages in classrooms, the World Health Organization (WHO) recommends that in school classrooms and pre-schools, the background sound level should not exceed 35 dB(A) during teaching sessions. Also, school outdoor/playground noise level should not exceed 55 dB(A), the same value given for outdoor residential areas in the daytime (Berglund *et al*., 1999; Ochiabuto *et al*., 2021; Okedeyi*et al*., 2023).

The National Environmental Standards and Regulations Enforcement Agency (NESREA) in Nigeria sets the maximum permissible noise for the general environment such as buildings used as hospitals, convalescence homes, homes for the aged, sanatorium, institutes of higher learning, conference rooms, public library, environmental or recreational sites at 45 dB(A) (NESREA, 2009; Ochiabuto *et al*., 2021; Okedeyi *et al*., 2023). Despite these provisions, many children in Nigeria do not have access to ideal or tranquil learning environments (Ana *et al*., 2009; Ochiabuto *et al*., 2021; Okedeyi *et al*., 2023). Therefore, this study was conducted basically to know the noise level and its effects on students in some selected secondary schools in Ikorodu Local Government Area, Lagos State, Nigeria.Sound level intensity is measured in decibels (dB). When the intensity of sound (*I*) increases by a factor of $10^{0.1}$, the increase in intensity level in decibel is given by equation 1 (Onanuga and Atilade, 2012)

$$dB = 10 \log_{10}\left(\frac{I}{I_0}\right) \qquad (1)$$

Where I_0= Threshold of audibility

MATERIALS AND METHODS
Materials used for the project include: Noise Level Meter (Fig. 1), Tape Rule (Fig. 2) and Stop Watch (Fig. 3).

Figure 1: Noise level meterAS844+
(Source: SLT Physics Lab)

Figure 2: Tape rule
(Source: SLT Physics Lab)

Figure 3: Stop watch
(Source: SLT Physics Lab)

Study Location
Ikorodu division (Fig. 4) lies approximately 36 km north of Lagos. The Division consists of Ikorodu Local Government, and five Local Council Development

Areas which include Igbogbo-Baiyeku, Ikorodu North, Ikorodu West, Imota and Ijede. The Division serves as the entrance to the country's hinterland (Lagos State Government, 2021; Okedeyi *et al*., 2023).
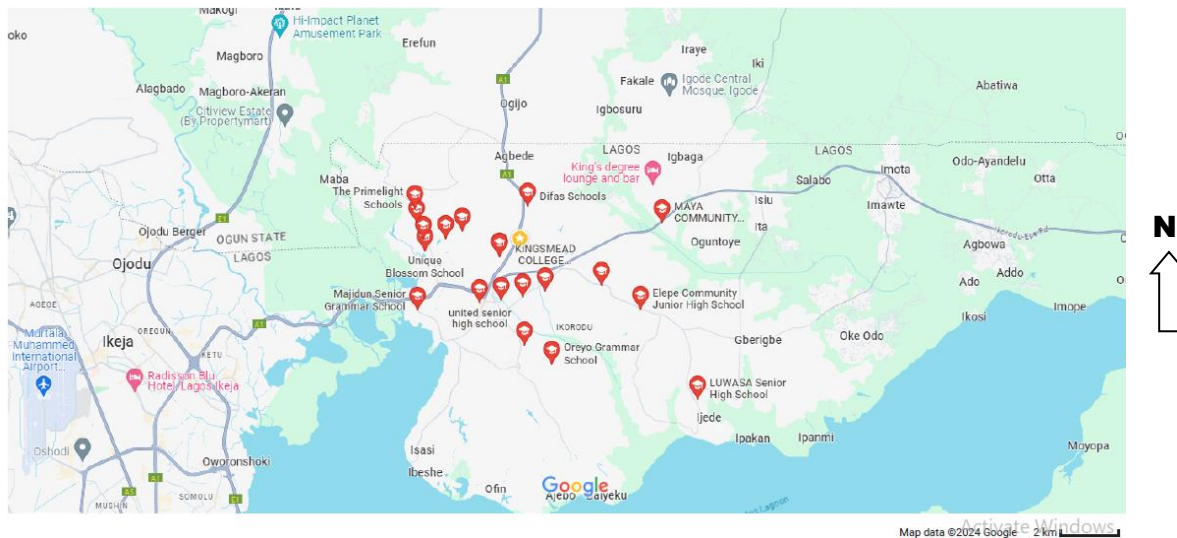
Figure 4: Map of Ikorodu showing the study area (Source: GoogleMap, 2024)

The study involved the collection of data on temperature, humidity and noise levels from twelve secondary schools in the Ikorodu Local Government Area of Lagos State using smart sensor noise level meter AS844+ (Okedeyi et al., 2023). The noise level, humidity and temperature data were collected when students are active (9 am – 10 am, 11 am – 12 pm and 1 pm – 2 pm). Questionnaires were administered to 120 students in selected schools and their response analysed. The analysis was carried out using Statistical Package for Social Science (SPSS) version 23, and a Two-way Analysis of Variance was used to compare the means of the indicators (temperature, humidity, and noise level) across the schools.

RESULTS AND DISCUSSION

Table 1: ANOVA Summary for the difference in Temperature, Humidity and Noise Level by School

		Sum of Squares	Df	Mean Square	F	P-value
Temp	Between Groups	110.766	11	10.070	2.264	0.046
	Within Groups	106.730	24	4.447		
	Total	217.496	35			
Humidity	Between Groups	911.071	11	82.825	2.469	0.031
	Within Groups	805.209	24	33.550		
	Total	1716.281	35			
Noise	Between Groups	2188.504	11	198.955	5.882	0.000
	Within Groups	811.761	24	33.823		
	Total	3000.264	35			

The results indicated a significant difference in noise levels among the schools (P = 0.000), while temperature and humidity also showed significant variations from school to school (P = 0.046 and P= 0.031, respectively).

Table 2: ANOVA Summary for the difference in Temperature, Humidity and Noise Level by Time

		Sum of Squares	Df	Mean Square	F	P-value
Temp	Between Groups	21.167	2	10.583	1.779	0.185
	Within Groups	196.330	33	5.949		
	Total	217.496	35			
Humidity	Between Groups	118.339	2	59.169	1.222	0.308
	Within Groups	1597.942	33	48.422		
	Total	1716.281	35			
Noise	Between Groups	289.670	2	144.835	1.763	0.187
	Within Groups	2710.595	33	82.139		
	Total	3000.264	35			

Additionally, the analysis revealed that there was no significant difference in the indicators across the different times (P=0.185, P= 0.308 and P= 0.187 for temperature, humidity, and noise level, respectively), indicating that these factors did not vary significantly by time in all the schools.

Table 3: Duncan PostHoc Test for Temperature (°C)

School	9am to 10am	11am to 12pm	1pm to 2pm	Mean±SD
Majidun	29.50	34.84	32.55	32.30±2.68[b]
Community	33.16	33.46	31.87	32.83±0.85[b]
Maya	28.20	32.96	39.61	33.59±5.73[b]
United	34.98	37.07	39.83	37.29±2.43[a]
Ogolonto	30.05	30.08	31.23	30.45±0.67[b]
Elepe	32.21	34.23	31.27	32.57±1.51[b]
Ijede	31.74	30.28	30.50	30.84±0.79[b]
Odogunyan	31.96	33.39	32.51	32.62±0.71[b]
Civil Service	29.96	30.95	32.67	31.19±1.37[b]
Imota	30.91	31.00	30.40	30.77±0.32[b]
Oriwu	32.29	32.23	33.31	32.61±0.61[b]
Maya Community	31.09	31.00	32.24	31.44±0.69[b]
Mean±SD	31.34±1.80[a]	32.62±2.11[a]	33.17±3.19[a]	

Analysis also showed that United Anglican schools had a significant difference in temperature, while other schools did not.

Table 4: Duncan Posthoc Test for Humidity (%)

School	9am to 10am	11am to 12pm	1pm to 2pm	Mean±SD
Majidun	74.16	61.08	68.02	67.75±6.55[ab]
Community	64.41	65.84	68.46	66.24±2.05[ab]
Maya	77.36	66.53	45.68	63.19±16.11[bc]
United	60.43	54.34	48.22	54.33±6.10[c]
Ogolonto	72.60	77.36	74.20	74.72±2.42[a]
Elepe	69.90	64.14	69.28	67.77±3.16[ab]
Ijede	67.04	70.19	73.22	70.15±3.09[ab]
Odogunyan	69.21	62.69	65.61	65.84±3.26[ab]
Civil Service	74.83	72.46	67.01	71.43±4.01[ab]
Imota	71.04	69.75	72.03	70.94±1.15[ab]
Oriwu	68.32	66.09	67.95	67.45±1.20[ab]
Maya Community	72.15	74.08	70.02	72.08±2.03[ab]
Mean±SD	70.12±4.69[a]	67.05±6.25[a]	65.81±9.18[a]	

Posthoc tests for humidity revealed that the United Anglican School had the lowest average humidity, while Ogolonto secondary school had the highest.

Table 5: Duncan Posthoc Test for Noise Level (dBA)

School	9am to 10am	11am to 12pm	1pm to 2pm	Mean±SD
Majidun	67.67	75.25	75.44	72.79±4.43[bc]
Community	66.66	75.25	76.48	72.80±5.35[bc]
Maya	61.62	83.92	77.98	74.51±11.54[ab]
United	70.95	79.91	69.20	73.35±5.75[bc]
Ogolonto	66.78	71.61	77.44	71.95±5.34[bc]
Elepe	82.16	90.20	87.68	86.68±4.12[a]
Ijede	68.70	81.65	73.72	74.69±6.53[bc]
Odogunyan	92.49	92.89	80.97	88.78±6.77[a]
Civil Service	58.32	60.31	54.89	57.84±2.74[d]
Imota	71.48	78.34	66.62	72.15±5.89[bc]
Oriwu	74.27	72.46	67.84	71.52±3.31[c]
Maya Community	81.15	83.03	85.24	83.14±2.05[bc]
Mean±SD	71.86±9.50[a]	78.74±8.75[a]	74.46±8.92[a]	

Similarly, post hoc tests for noise level showed that several schools had relatively the same noise level, while Odogunyan and Elepe secondary schools had the highest noise levels, possibly due to their proximity to bus stops. Civil Service Model School generated the lowest noise level.
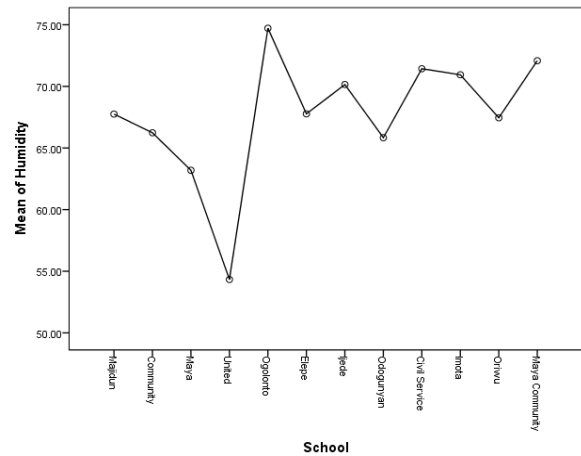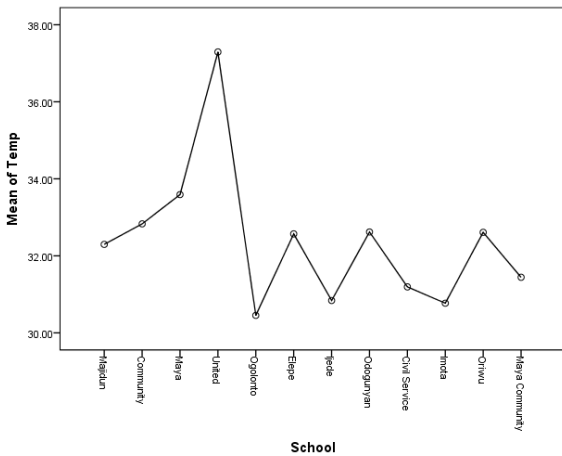

Figure 5: Mean plot for different temperature (ºC) by schools locations

Figure 6: Mean plot for different humidity (%) by schools locations
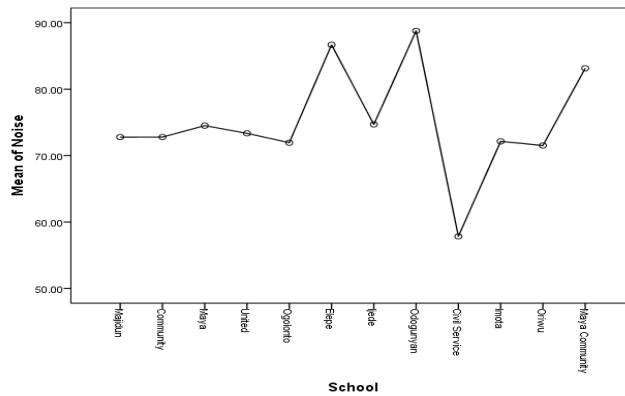

Figure 7: Mean plot for different noise level (dBA) by schools locations

The mean plot in Figure 5 depicted that United Anglican had the highest average temperature, while Ogolonto secondary school had the lowest. Figure 6 showed an indirect relationship between temperature and humidity, and Figure 7 revealed that Odogunyan secondary school had the highest average noise level, while Civil Service Model school had the lowest.
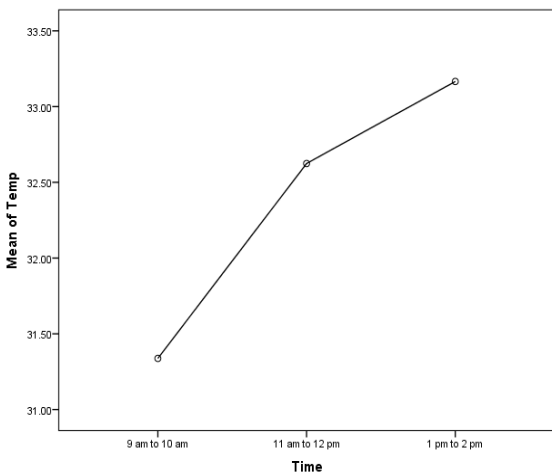
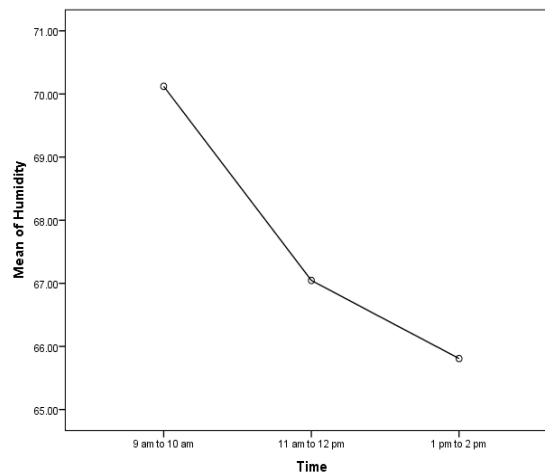Figure 8: Mean plot for different temperature (°C) by time difference

Figure 9: Mean plot for different humidity (dBA) by time difference
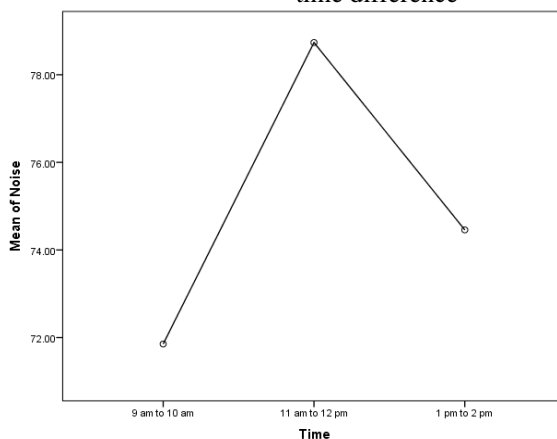

Figure 10: Mean plot for different noise level (dBA) by time difference

Figures 8, 9, and 10 displayed the mean plots for temperature, humidity, and noise level across different times, indicating that the highest noise level occurred at 11 am-12 pm across the schools.

Questionnaire
Table 6: Responses to questions on questionnaires administered to 120 students

Question	A	SA	D	SD	UD	Total
Teachers, Pupils, Vehicle, are sources of noise in your school environment	55.00	23.33	15.83	5.00	0.83	100
Noise prevents you from performing tasks in school	32.50	25.00	35.00	5.83	1.67	100
You make noise capable of disturbing your colleagues in school	34.17	18.33	35.00	11.67	0.83	100
Noise can cause damage to health	35.00	54.17	6.67	3.33	0.83	100
You can prevent harm from hearing noise	36.67	22.5	25.83	13.33	1.67	100
Environmental Education should be addressed in the school curriculum	45.00	47.5	5.00	0.83	1.67	100
Environmental Education should be included in the subject of Physics	37.50	30.00	20.83	10.00	1.67	100
Environmental Education should be included in other subject	50.00	24.17	18.33	3.33	4.17	100
Noise is experienced mostly in your classroom, corridor	40.83	42.50	11.67	4.17	0.83	100

and playgrounds						
Students should be interested in the topic of noise	32.50	43.33	10.83	12.5	0.83	100
Teachers should be interested in the topic of noise	41.67	35.83	9.17	12.5	0.83	100
There is sufficient time to address this topic	46.67	25.83	18.33	6.67	2.50	100
Male gender makes the loudest noise in the classroom	36.67	30.83	23.33	8.33	0.83	100
Female gender makes the loudest noise in the classroom	32.50	22.50	31.67	12.50	0.83	100

The results obtained through questionnaires administered to students in the twelve schools (table 6) revealed that noise is generated from teachers, pupils, and vehicles with 78.33% acceptance (Agreed and Strongly Agreed). 89.17% of respondents also agreed that noise has negative effects on health. There is a high percentage of respondents who believed that environmental noise should be introduced into the curriculum (92.50% agreed and strongly agreed).

Table 7: Response of respondents to the effects of noise on their health (Source: Questionnaire)

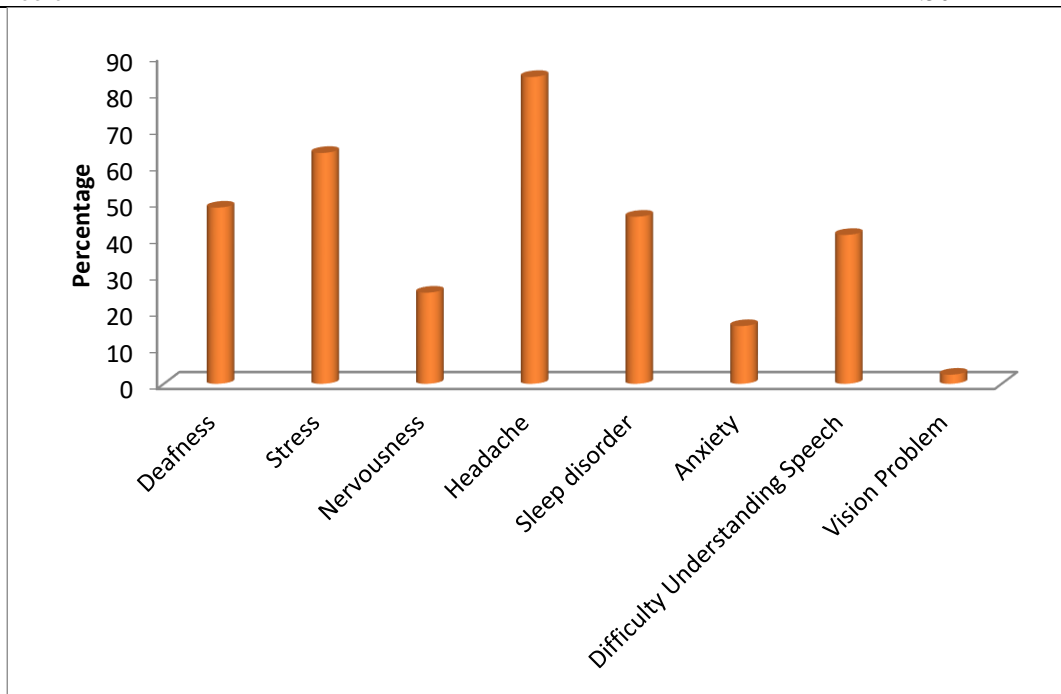| Possible Effect of Noise on Health	Percentage
Deafness	48.33
Stress	63.33
Nervousness	25.00
Headache	84.17
Sleep disorder	45.83
Anxiety	15.83
Difficulty Understanding Speech	40.83
Vision Problem	2.50

Figure 11: Plot of the effect of noise on health as perceived by respondents

Table 7 and Figure 11 are obtained from the questionnaires which show that noise can affect health as it causes headaches and stress (84.17% and 63.33% respectively). Deafness, sleep disorder and difficulty in understanding speech have 48.33%, 45.83% and 40.83% responses respectively which implies that a sizeable number of students experience these effects as a result of noise in their school environment.

The respondents largely believed that there is little or insignificant effect of noise on nervousness, anxiety and vision problems (25.00%, 15.83% and 2.5% respectively).

CONCLUSION
This work has unravelled the effect of noise pollution in selected public secondary schools in the Ikorodu

Division area of Lagos State. The results show that the mean noise pollution level of the schools ranges from 57.84 dB (A) to 88.78 dB (A) which is higher than the 35 dB (A) and 55 dB(A) recommended by the World Health Organization for classroom and outdoor noise respectively. It is also discovered that students exposed to these noise levels experience headaches, stress, deafness, sleep disorder and difficulty in understanding speech.

RECOMMENDATIONS
Noise pollution and its effects should be introduced into the students' curriculum through a subject or course in the schools and classes should be decongested through the construction of more and spacious classrooms for schools with large populations. Unexpected visits should be embarked on by government authorities to monitor the noise pollution level in schools.
The government should include the acceptable noise levels in schools in the list of noise level standards on its website. School authorities should be educated on the measurement of noise levels and report the same to authorities in the state for policy development.

REFERENCES
Ana, G., Shendell, D., Brown, G. and Sridhar, M. (2009). Assessment of Noise and Associated Health Impacts at Selected Secondary Schools in Ibadan, Nigeria. Journal of Environmental and Public Health. Article ID 739502. (https://doi.org/10.1155/2009/739502)

Atilade A. O., Okedeyi A. S., Idowu I. A., Akinyemi J., Ogede R. O. and Taylor J. I. (2021). Noise Level Assessments of Students' Activities Center in Lagos State University of Science and Technology, Ikorodu, Lagos, Southwestern Nigeria. Nigerian Journal of Physics 30(2), 182-186.

Berglund, B., Lindvall, T., Schwela, D. H. and World Health Organization. (1999). Guidelines for Community Noise. *World Health Organization* Geneva. Available at: https://apps.who.int/iris

Farina A. (2017). The ecological effects of noise on species and communities. In: Eco acoustics. The Ecological Role of Sounds. Wiley, Oxford, 95–108.

Farooqi Zia Ur Rahman, Sabir Muhammad, Latif Junaid, Aslam Zubair, Ahmad Hamaad Raza, Ahmad Iftikhar, Imran Muhammad and Ilić Predrag (2020). Assessment of noise pollution and its effects on human health in industrial hub of Pakistan. Environmental Science and Pollution Research. https://doi.org/10.1007/s11356-019-07105-7. *27*, 2819-2828

Google Map (2024). Public Schools in Ikorodu – Google Map. https://www.google.com/maps/search/public+schools+in+ikorodu/@6.6352313,3.5377484,12z?entry=ttu.

Gbimadee, Nubari B. P.,Ugbebor, John N. (2018). Analysis of noise associated with markets along major and minor routes in selected areas in Rivers State, Nigeria. International Journal of Novel Research in Engineering and Science Vol. 4, Issue 2, pp: (18-27).

Nermin Bulunuz (2014): Evaluation of noise pollution awareness (Google Scholar)

NESREA. (2009). National Environmental (Noise Standards and Control) Regulations. National Environmental Standards and Regulations Enforcement Agency (NESREA). Printed and Published by The Federal Government Printer, Lagos, Nigeria. FGP 1121102009/1,000 (0L60). Available at: http://extwprlegs1.fao.org/docs/pdf/nig146077.pdf. 17.

Ochiabuto, O. M. T. B., Abonyi, I. C., Ofili, R. N., Obiagwu, O. S., Ede, A. O., Okeke, M. and Eze, P. M. (2021). Assessment of Noise Levelsin Primary and Secondary Schools in Nnewi, Anambra State. European Journal of Environment and Public Health, 5(1), em0054. (https://doi.org/10.29333/ejeph/8425)

Okedeyi Abiodun Sakiru, Atilade Adesanya Oluwafemi, Akinyemi Joseph and Idowu Ibikunle Albert (2023). Evaluation of Noise Level in Selected Primary Schools in Ikorodu Division Area of Lagos State, South-Western Nigeria. International Journal of Research and Scientific Innovation (IJRSI). 10(12), 18-27. DOI: 10.51244/IJRSI

Onanuga O. K. and Atilade A. O. (2012). Acoustic Principles & Applications. Jimsalaam Limited, Lagos. ISBN: 978-978-919-855-9. 19.

Ryherd E. E. (2016). The wide world of noise. J. Acous. Soci. Am. 139(4), 2004.