Noise Pollution in Teshie-Nungua Schools

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Abstract
Schools located in the Teshie-Nungua area a suburb of Accra, have their background noise levels above 55 dB, the Environmental Protection Agency (EPA) recommended noise level in educational facility. A maximum noise level (L_{max}) value of 95.8 dB and a minimum noise level (L_{min}) value of 51.6 dB were recorded. In this paper, a Quest Technologies 210 Model sound level meter equipped with a microphone had been used to measure noise levels in schools around the Teshie-Nungua area. It has been shown that about 90 % of the measured schools presented equivalent noise levels (L_{eq}) above 72.5 dB. Pupils were exposed to a high noise pollution level (L_{NP}) value of 95.8 dB and the day and night noise levels (L_{dn}) in and around the target schools were all above 72 dB. About 98% of schools in the Teshie-Nungua area do not have acoustic materials to minimize noise levels has been established. It was observed that schools in the study area are located in mixed commercial and semi-commercial areas. Nearly 80 % of survey respondents ranked Constant Traffic as number one source of noise. These measured noise levels have the potential to adversely affect the hearing of the pupils in these schools if the required sound proof mechanism is not put in place.
Keywords: Equivalent noise level, Noise level, Noise pollution, Teshie-Nungua.

1.0 Background

School children in Ghana and indeed Accra are often subjected to high levels of noise because their schools are close to places such as markets, chop bars, quarry sites, milling machines, lorry stations etc. Some schools in are located close to drinking bars, churches, highways, social centers etc. Setting up of schools is a major problem in Ghana, there are guidelines regarding the setting up of schools but people are flouting these guidelines with impunity because the enforcement is generally weak (EPA, 2013). Noise is an unwanted sound that may cause some psychological and physical stress to the living as well as non-living objects exposed to it. The problem of noise pollution in Ghana, and in particular Accra is that, as at 2013, the complaint desk of Ghana's Environmental Protection Agency (EPA) showed an escalation of noise nuisance in the suburbs of Greater Accra metropolis. Out of the total of 78 complaints received, 40 % was on noise alone (EPA, 2013). Some of the complaints had to do with loud music from churches and music vendors, milling/grinding machine shops, drinking bars, etc. The situation has not changed and is not likely to change any sooner. EPA has developed ambient noise levels guidelines for seven zones in the country. The seven zones are (i) education and health facilities, (ii) areas with some commercial or light industry, (iii) places of entertainment or public assembly, (iv) commercial areas, (v) light industrial areas, (vi) heavy industrial areas and (vii) residential areas. The permissible noise levels for each zone prescribed by the EPA are well spelt out, as shown in Table 9. Surprisingly, these guidelines are flouted with impunity (EPA, 2013). It appears that in Ghana, it is not even enough to have only ambient noise levels without the necessary enforcement mechanism to check noise pollution. EPA has also set aside April of every year as noise pollution awareness month. During the awareness month, the public is educated on the need to minimizing noise levels in the country and the effects of noise pollution. However, it is not enough to do all these without investigating the effects of noise pollution on the people, particularly children, in order to use more scientific approach to deal with the problem. Schools are located in business environment, near lorry stations, markets, etc. Some schools are housed in makeshift wooden structures, some have been built without proper ceilings and floors. Classrooms acoustics in developing countries such as Ghana, are very poor and highly populated (Wetheril, 1999). There have been several studies carried out of classroom acoustics internationally (Coddington 1984, Blake & Bushy 1994, and Harper 1995). Previous noise level researchers have measured community's noise levels but have not done schools noise background measurement. For these reasons, acceptance of this paper would contribute to the knowledge of the impacts of noise pollution on students' performance.

1.1 AIM of Study

This study seeks to assess the levels of noise around schools in Teshie-Nungua to generate data to enable authorities to access the impacts of noise pollution on learning.

2.0 LITERATURE SURVEY

2.1 Definition and Types of Noise

Sound is a form of energy which results from periodic disturbances of the air and at room temperature is propagated in air at a speed of approximately 340 m/s. In water and steel for example the speed is much greater, being about 1500 m/s and 5000 m/s respectively. As the disturbance spreads geometrically its effect will decrease with distance from the sound source but the diminution in sound intensity will also be affected by the damping of the sound waves by the transmitting medium. This effect may arise in the atmosphere and is influenced by the degree of humidity and the frequency of the sound. It is of particular importance in a closed space, such as a concert hall, where the geometrical spreading is almost eliminated. Here it becomes desirable from the musical and speech intelligibility points of view to introduce sound absorbing material or resonator devices at the walls or ceiling to reduce the propagation of a given sound, i.e. to control the reverberation of the sound. These absorbing materials are usually of a porous nature and their particular absorbing powers range between 50 to 90 per cent of the sound energy incident upon their surfaces. The sounds we are concerned with in industry generally emanate from the vibrating surfaces of machines, etc. these vibrations are transmitted through the body of a machine and the vibrational energy is partly transformed into sound vibrations in the air, i.e. structure-borne sound in the environment.

Noise is any annoying or unwanted sound (Noise Pollution, Effects and Control, 1986). It has also been defined as “sound that interferes with other sounds that are being listened to” (McGraw-Hill Encyclopedia, 1980). It is also “any signal that does not convey useful information”. The judiciary defines noise pollution as any level of noise that exceeds the noise limits set by legislation (Noise Pollution, Effects and Control, 1986).

2.2 Sources of noise

There are several sources of noise in and around school compounds. In purely residential areas, high noise levels are generated by school children during playtime and after school, but in an area where commercial activities and residential accommodation exist, high levels of noise are generated by music shops, lorry stations, drinking spots and markets, etc.

2.3 Community Noise

In community noise we are concerned about the intrusion of noise into our daily lives that would reduce the quality of our environment. Noise limits set by legislation would influence the construction and location of new building and highways and the regulation of aircraft flight paths. Noise levels are rated for easy identification and analysis. For example, a noise level A-weighted provides a basic measurement of community noise but for defining time-varying noise and for predicting its human reaction other measurement parameters are employed. For example, the so-called ambient noise which includes all the sounds which occur in an environment is expressed by L_{Aeq}, which is the equivalent continuous A-weighted level over the whole time period.

2.4 Traffic Noise

This nuisance appears to be the dominant world-wide problem and it is the focus of greatest concern. The most significant control is to reduce the noise emission from the vehicles but complementary procedures are the use of noise barriers, planned routing of traffic, etc. It is always expensive and generally not possible to obtain complete satisfaction in reducing existing noise. Hence regional and town planners have a key role to play in the task of minimizing noise in future developments and today they are helped by the fact that noise levels from sources such as road and air traffic can often be predicted.

2.5 Railway Noise

The noise from railways is quite complex and comprises that emanating from the motive power, i.e. diesel or electric motor, that from wheel-track interactions, which effectively constitute a sequence of point-sources, and the overall combination of the various noise contributions yielding and effective line-source. However, although the overall train-noise is high, which is perhaps not so surprising as might be thought initially. People living near a railway may do so by choice with the confidence that in general the density of traffic is unlikely to be heavily increased. Also the time interval between trains will still appreciably segregate their individual noises and the intrusion of their sound at the listener will be gradual and hence less objectionable. Also in the developed world, to the urban commuter his closeness to a railway, and hence a station, is a boon for his workday travel, and these factors tend to make a moderate noise level socially acceptable.

2.6 Effects of classroom noise on children

In recent years, the rapid increase of noise level in the environment has become a public health hazard. Noise affects man's state of mental, physical, and social well-being (Noise Pollution, Effects and Control, 1986). The problem forms a special type of air pollution. Noise study is a rather new subject among other branches of science. The transition from art to near-science started before World War II.

Children who are repeatedly exposed to loud environmental noises learn to read more slowly than their peers, a German study of kids living near airports finds. The research is the best direct evidence yet that noise pollution has a negative impact on learning and long-term memory (Noise Pollution, Effects and Control, 1986).

Researchers analyzed data on children in Munich who either lived near the city's old airport, which was scheduled to close, or near the site of its new airport. They assessed reading and other learning skills prior to and after the airport switch and found that reading scores improved for children who went from the noisy to the quiet environment, while they declined for those who went from the quiet to noisy one.

Another research, published in the journal of Psychological Science, joins about two dozen studies linking environmental noise to impaired learning in children. The evidence is so strong that a Federal Committee of Chicago in the U.S.A. in 1978 issued a report assessing the impact of aircraft noise on classroom learning. The Committee concluded that repeated exposure not only interferes with reading, but with motivation, memory, language and speech acquisition (Johnson, 1980). But researcher Arline Bronzaft, thinks that there is still a great deal of denial among government officials about the impact of environmental noise on learning (Noise Pollution, Effects and Control, 1986).In a landmark research published in the 1970s, Bronzaft studied children in a New York school in which some of the classrooms faced a loud, aboveground subway rail and others did not. She found that by the sixth grade, children in the noisy rooms were a year behind their peers in reading skills. After acoustical tiles were installed to lower noise levels she did the research again and found no difference in reading skills among children in the different classrooms (Noise Pollution, Effects and Control, 1986).Even after series of research works, some people still believe that noise pollution has little effects on humans. In addition to impairment of cognitive development in children, there is also some evidence that excessive noise affects kids physically. In a study published in 1998, it was found out that children living near busy airports had elevated blood pressure and stress hormone levels, compared with kids living in quieter areas (Evans et al., 1998). Blomberg (La Breche, 1974) pointed out that humans are evolutionarily hardwired to become stressed when they hear loud noises. And since stress plays a role in most human illnesses, it only makes sense that noise pollution can make us sick. Other research on the nonauditory effects of noise on children has been on cognitive effects. These studies have looked at memory, attention/perception, and academic achievement (Evans et al., 1974).

2.7 PHYSICS OF NOISE

2.7.1 Introduction

Noise as a sound sensation has its origin in the mechanical vibration of matter, either in a solid or fluid state. The ring of a bell or the escape of a gas in a pressurized system are two simple examples of the mechanical vibration of matter. The transmission of these vibrations through the air are received at the ear to become interpreted as sound by the human sensory system.

3.0 Materials and Method

The methodology employed in this study included site visit to the various schools in the study area to conduct a visual survey of the schools and their premises including possible noise sources, administer questionnaire to elicit information on noise levels and level of annoyance, measurement of noise level in and around the schools

3.1 Materials

A Quest Technologies 210 Model Sound Level Meter equipped with a microphone was employed.

3.2 Survey

The initial part of the study consisted in carrying out internal and external noise surveys of Teshie-Nungua schools. For the survey a questionnaire was designed to find out people's perception of noise sources and were asked to ranked noise sources. The questionnaire was distributed to 600 respondents (380 women, 220 men). In addition, people were interviewed and their oral responses taken down. The questionnaire is shown in APPENDIX Y. The study area was zoned into two: (1) areas of residential and little commercial activity with relatively low level of noise and (2) areas with lots of commercial activities and relatively high noise levels.

3.3 Study Sites

The study area is located in Nungua in the Greater Accra region of Ghana. Nungua is a typical mixed settlement with commercial facilities and residential facilities coexisting.

Nungua town is locked between Teshie and Sakumono and bounded by the Gulf of Guinea. According to the 2010 population and census (Ghana Statistical Service), Nungua has a population distribution of 100 women to 95.2 men based on the national percentage distributions. Children form about 38.3 % of the population based on the national figures. As at the 2012-2013 academic year there were about 30 public schools and 74 private schools in Nungua (Ghana Education Service). Most of the private schools are housed in makeshift structures with no proper partitioning of classrooms. Classrooms that are partitioned have been done with plywood or aluminium sheets, in general. These classrooms have no acoustic materials and those who have at all are poor. For these reasons, the study focused on the private schools. Majority of the public schools are housed in decent cement block structures, though acoustically poor. The microphone was mounted on top of the roofs of all the schools; the purpose was to capture the various noise levels from the surroundings. Some of the schools are sited along the busy Teshie-Nungua road, so background noise levels were measured. Climatic condition during the measurement was relatively low breezy and conducive for the survey.

3.4 Noise measurement

Physical noise measurements were carried out in 20 schools selected in the Nungua area with relatively high population densities. A Quest Technologies 210 Model Sound Level Meter equipped with a microphone was employed. The microphone was mounted on top of the roofs of the schools and sound measurement conducted over a 24h period. The hourly values of L_{peak}, L_{10}, L_{90}, and L_{eq}, were obtained through 24 hour periods for each school. The physical measurements were repeated for each school and average noise found.

4.0 Results and Discussion

A useful way of presenting noise data is the cumulative level distributions, known as percentile level and referred to as Ln, n being the percentage of time for a particular noise level during a total period T. The most common percentiles are L_{90} (background level), L_{50} (approximate average), L_{10} (intense level periods), L_1 (peak levels), L_{NP} (noise pollution level), L_{eq} (equivalent continuous sound level).

Table 1: Monitored schools in areas of relatively high level of noise and their noise sources.

Monitoring Schools Codes		Noise Sources
1.	01-AQ	1. Taxi Station, Audio shop, Drinking & Chop Bar and Salon.
2.	02-AQ	2. Mechanic shop and a church.
3.	03-AQ	3. Traffic, drinking bar and provision store.
4.	04-AQ	4. Construction site and traffic.
5.	05-AQ	5. Traffic, church and a drinking bar.
6.	06-AQ	6. Corn mill, fitting shop and playing field.
7.	07-AQ	7. Traffic, church, drinking bar and chop bar.
8.	08-AQ	8. Traffic, drinking bar and provision store.
9.	09-AQ	9. Construction site, railway line and traffic.
10.	010-AQ	10. Construction site, railway line and traffic.

Table 1 represents data of noise sources generated around the schools (represented with codes) with relatively high level of background noise. These noise sources are the various noise sources ranked by the six hundred respondents.

Table 2: Monitored schools in areas of relatively low level of noise and their noise sources.

Monitoring Schools Codes		Noise Sources
1.	011-AQ	1. Residential facilities and a construction site
2.	012-AQ	2. corn milling machine, a drinking bar and a restaurant
3.	013-AQ	3. Residential and little commercial activities
4.	014-AQ	4. Residential and little commercial activities
5.	015-AQ	5. Traffic
6.	016-AQ	6. Traffic
7.	017-AQ	7. Fitting shop and a cold store
8.	018-AQ	8. Residential area
9.	019-AQ	9. Traffic
10.	020-AQ	10. Railway line

Descriptions of the various noise sources for schools sited in relatively low noise areas are presented in Table 2. From the data, it suggests that about a third of the noise sources were traffic noise, ranked as number one source of noise by the respondents.

Table 3: Monitored schools in areas of relatively high level of noise and their building structure.

Monitoring Schools Codes		Structure
1.	01-AQ	1. Wawa board and zinc roofing sheets
2.	02-AQ	2. Wawa board and zinc roofing sheets
3.	03-AQ	3. Cement blocks, Wawa board and zinc roofing sheets
4.	04-AQ	4. Cement block with good ceilings
5.	05-AQ	5. Wawa boards and zinc roofing sheets
6.	06-AQ	6. Cement blocks and zinc roofing sheets
7.	07-AQ	7. Cement blocks and zinc roofing sheets
8.	08-AQ	8. Cement blocks and zinc roofing sheets
9.	09-AQ	9. Cement blocks and zinc roofing sheets
10.	010-AQ	10. Wawa board and zinc roofing sheets

A representation of the school structures in areas with relatively high noise levels are presented in Table 3. About 70 percent of the sampled schools were built with cement block and only one out of ten had good acoustic ceilings, and the remaining had no ceilings and the floors were bare, made of hard concrete.

Table 4: Monitored schools in areas of relatively low level of noise and their building structure.

Monitoring Schools Codes	Structure
1. 011-AQ	1. Wawa board and zinc roofing sheets
2. 012-AQ	2. Cement blocks, and zinc roofing sheets
3. 013-AQ	3. Wawa board and zinc roofing sheets
4. 014-AQ	4. Cement block with good ceilings
5. 015-AQ	5. Cement blocks and zinc roofing sheets
6. 016-AQ	6. Cement blocks and zinc roofing sheets
7. 017-AQ	7. Cement blocks and zinc roofing sheets
8. 018-AQ	8. Cement blocks and zinc roofing sheets
9. 019-AQ	9. Wawa board and zinc roofing sheets
10. 020-AQ	10.Cement blocks and zinc roofing sheets

A representation of the school structures in areas with relatively low noise levels are presented in Table 4. About 70 percent of the sampled schools were built with cement block and only one percent had good acoustic ceilings, and the remaining had no ceilings and the floors were bare, made of hard concrete.

Table 5: Noise levels of monitored schools in areas of relatively high level of noise measured for 24 hours.

Monitoring Schools Codes	Minimum sound level L_{mim} (dB)	Maximum sound level L_{max} (dB)	Peak sound level L_1 (dB)
1. 01-AQ	53.3	97.8	123.6
2. 02-AQ	51.6	94.5	111.4
3. 03-AQ	51.6	96.2	126.0
4. 04-AQ	51.4	93.8	130.4
5. 05-AQ	52.2	95.6	108.2
6. 06-AQ	53.1	94.8	123.4
7. 07-AQ	54.8	96.9	115.3
8. 08-AQ	52.4	93.2	104.2
9. 09-AQ	51.9	91.6	110.3
10. 010-AQ	54.6	95.9	127.4

Table 5 presents a summarized data of the minimum, maximum and peak noise levels for schools in relatively high noise areas. From Table 5, the minimum sound level correlated with the maximum sound level with a correlation coefficient of ($r = 0.5$) and a determination coefficient of 0.29. This indicates that about 29 % of the sampled schools had noise levels above the EPAs permissible noise levels. In the same Table 5, the correlation coefficient between the maximum sound level and the peak sound level is 0.39, with a coefficient of determination of 0.16. This indicates that, 16 % of the schools sample had peak levels far above ambient values.

Table 6: Noise levels of monitored schools in areas of relatively low level of noise measured for 24 hours.

Monitoring Schools Codes	Minimum sound level L_{mim} (dB)	Maximum sound level L_{max} (dB)	Peak sound level L_1 (dB)
1. 011-AQ	55.6	94.7	113.9
2. 012-AQ	57.8	98.1	121.5
3. 013-AQ	50.2	94.1	128.2
4. 014-AQ	52.6	95.1	127.1
5. 015-AQ	51.3	94.6	118.4
6. 016-AQ	52.3	93.9	125.7
7. 017-AQ	52.1	94.1	118.3
8. 018-AQ	51.9	91.7	101.6
9. 019-AQ	50.4	92.3	115.8
10. 020-AQ	53.8	97.2	112.2

Table 7: Percentile levels of monitored schools in areas of relatively high level of noise measured for 24 hours.

Monitoring Schools Codes	Noise level in dB						
	L_1	L_5	L_{10}	L_{50}	L_{90}	L_{eq}	L_{NP}
1. 01-AQ	123.6	75.2	74.6	70.2	65.7	72.5	81.4
2. 02-AQ	111.4	79.0	75.6	58.6	51.6	71.8	95.8
3. 03-AQ	126.0	80.9	80.5	75.7	71.9	77.1	85.7
4. 04-AQ	130.4	68.5	67.9	63.4	50.3	69.7	87.3
5. 05-AQ	108.2	74.6	72.5	66.5	50.1	71.4	93.8
6. 06-AQ	123.4	73.1	70.8	67.7	66.5	70.4	74.7
7. 07-AQ	115.3	69.7	67.8	58.1	52.3	69.9	85.4
8. 08-AQ	104.2	80.1	78.1	63.2	50.5	75.7	103.3
9. 09-AQ	110.3	74.1	70.3	64.8	50.6	69.5	89.2
10. 010-AQ	127.4	76.4	72.1	64.1	67.4	70.1	74.8

Table 8: Percentile levels of monitored schools in areas of relatively low level of noise measured for 24 hours.

Monitoring Schools Codes	Noise level in dB						
	L_1	L_5	L_{10}	L_{50}	L_{90}	L_{eq}	L_{NP}
1. 011-AQ	113.9	72.1	68.7	65.7	61.2	70.4	77.9
2. 012-AQ	121.5	74.3	70.3	68.9	64.3	72.3	78.3
3. 013-AQ	128.2	76.9	72.9	69.5	65.4	74.3	81.8
4. 014-AQ	127.1	68.9	65.9	61.2	56.9	69.5	78.5
5. 015-AQ	118.4	76.9	72.1	67.5	62.2	70.3	80.2
6. 016-AQ	125.7	73.4	69.5	64.6	59.4	68.9	79.0
7. 017-AQ	118.3	74.9	70.3	67.4	63.5	70.5	77.3
8. 018-AQ	101.6	67.5	61.1	59.3	55.3	66.7	72.5
9. 019-AQ	115.8	71.2	67.4	63.2	69.3	68.9	67.0
10. 020-AQ	112.2	73.2	68.4	62.4	59.4	69.7	78.7

Tables 7 & 8 presents summarized results of all the percentile values of noise levels for both high noise and low noise areas.

Almost all of the schools measured, the noise levels exceeded the EPA's guideline noise level for educational facilities. During the noise level measurements it was found out that, school's background noise came from neighbours and activities around the schools (**Tables 1 & 2**). Relatively high noise levels were recorded during the day with elevated commercial activities, and relatively low noise levels were recorded during night. Values of L_n over 75 dB imply a severe noise exposure, L_1 and L_{max} (maximum noise level) values recorded (Tables 5 & 6) were all above the recommended noise level. The minimum noise levels recorded (Tables 5 & 6) were all below that of the EPA's value, the dip in values could be attributed to low background noise during the measurements. Detailed examination of the interview data by the six hundred respondents, point to the fact that interviewees abhorred any noise source above 50 dB. Sizable correlations in the directions dictated by common sense are found among all the major variables (noise exposure, population density, annoyance, speech and sleep interference, etc.). The noise sources ranked by the respondents are presented in in Figure 1.

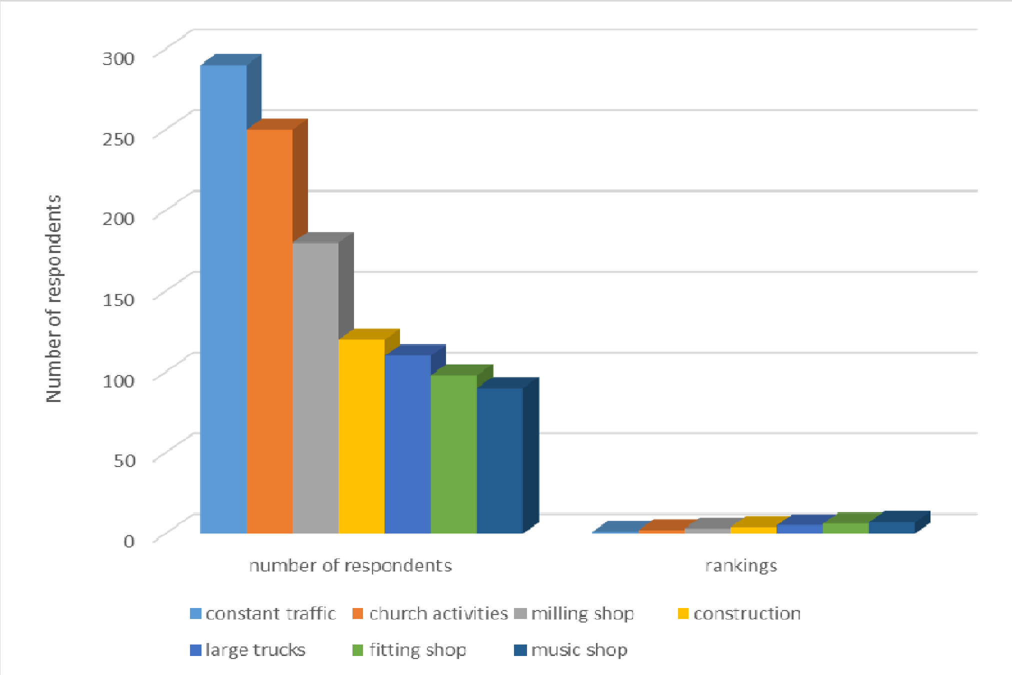

Figure 1. Noise source rankings.

Two hundred and ninety respondents ranked constant traffic as number one source of noise, two hundred and fifty ranked church activities as number two source of noise, corn milling shops were ranked as a number three noise source by one hundred and eighty respondents. Construction was ranked as number four noise source by one hundred and twenty respondents, one hundred and ten respondents ranked large trucks noise as number five. Noise generated by fitting shops was ranked number six by ninety eight respondents and rather, ninety respondents ranked music shop as number seven source of noise. About ninety percent who described their neighborhoods as quiet suffered fewer noise effects and identified fewer sources; people who had never been annoyed by noise clearly valued the quiet nature of their neighborhoods; filers of noise complaints thought they lived in less pleasant neighborhoods; people who thought they were more sensitive to noise or spent more time in their neighborhoods suffered more from noise effects and were more alert to noise sources; and so forth.

It is also apparent that respondents gave serious consideration to the questions asked them by the interviewers. Apart from the coherence and interpretability of the answers, this can be seen most clearly in responses to the dichotomous (yes/no, quiet/noisy, noise/no-noise) questions. Proportions of respondents answering these questions in the two available response categories are compared in all data tabulations with proportions that would be expected by chance alone. If respondents had answered these questions frivolously or randomly, equal numbers of respondents in each category might have been expected. In fact, enormous departures from chance responding are uniformly found in all cross-tabulations. These observations strongly suggest that meaningful inferences may be drawn from the present data.

The percentile levels are very much used in noise evaluation and are referred to as L_n, n being the percentage of time that the corresponding step of level has been attained during a total period T. These high values are not isolated figures, but rather readings that lasted for over six minutes. The impact of noise of individual events is also consistent with the findings of research into the effects of aircraft and railway noise on children's performance (Cohen et al. 1981).

Table 9: Acceptable Equivalent Sound Level- L_{eq} - at some common locations are indicated in the table below set by EPA

ZONE	LOCATION	DAY 0600 – 2200 dB(A)	NIGHT dB(A)
A	Residential areas with negligible or infrequent transportation	55	48
B1	Educational (school) and health (hospital and clinic facilities)	55	50
B2	Areas with some commercial or light industry	60	55
C1	Areas with some light industry, place of entertainment or public assembly and place of worship such as churches and mosques	65	60
C2	Predominantly commercial areas	75	65
D	Light industrial areas	70	60
E	Predominantly heavy industrial area	70	70

Source: EPA (Ghana) Noise Awareness Flier.

5.0 Conclusion

All the schools studied produced noise levels above 55 dBA, the EPA's recommended value for educational facility. It has been shown that about 90 % of the measured schools presented equivalent noise levels (L_{eq}) above 72.5 dB. Pupils were exposed to a high noise pollution level (L_{NP}) value of 95.8 dB and the day and night noise levels (L_{dn}) in and around the target schools were all above 72 dB. About 98% of schools in the Teshie-Nungua area do not have acoustic materials to minimize noise levels has been established. It was observed that schools in the study area are located in mixed commercial and semi-commercial areas. Nearly 80 % of survey respondents ranked Constant Traffic as number one source of noise.

APPENDIX Y

NOISE POLLUTION QUESTIONNAIRE

1. Do you know what noise pollution is?
   (a)Yes (b) No
2. Is there any problem of noise pollution in your area?
   (a)Yes (b) No
3. What are the major sources of noise in your area?
   (a)Vehicles (b) Churches (c) Venders of CD (d) Milling/Fitting shops (e) others (specify)
4. Does your daily activity generate noise?
   (a)Always (b) Sometimes (c) Never
5. Do you think that high level of noise has any effect on your health?
   (a)Yes (b) No
6. What sort of problem do you have due to high level of noise?
   (a)Headache (b) General disturbance (c) Hypertension (d) other (specify)
7. When was the last time you visited a clinic?
   (a) Less than a week (b) a month ago (c) more than six months
   (d) a year ago (e) I can't recall
8. What do you do when noise levels increase in your community?
   (a) move away from source (b) do not care (c) report to the police
   (d) report to EPA (e) you force yourself to sleep
9. Have you ever made complaint to any regulatory authority?
   (a)Yes (b) No
10. Should perpetrators of noise pollution be arrested?
    (a)Yes (b) No
11. What should the State do about noise pollution?
12. How would you describe your neighbourhood
    (a)Quiet (b) Noisy (c) neither quiet nor noisy
13. Have you ever been bothered or annoyed by noise in your neighborhood?

(a)Yes (b) No

14. How do rank these noise sources?
(a) Large Trucks (b) Corn Milling Shop (c) Constant Traffic (d)Construction (e)Fitting Shops (f) Music Shop (g) Church Activities

References

Blake, P. & Busby, S. (1994). Noise levels in New Zealand Junior Classrooms: Their impact on Hearing and Teaching. New Zealand Medical Journal.

CHABA (1978) Guidelines for Preparing Environmental Impact Statement on Noise, W.G. 69, Washington.

Coddington, K. (1980). Classroom acoustics and their relationship to children with hearing losses in normal schools. Paper presented to NZ Acoustical Society, Auckland
New Zealand.

Cohen, S. & Collacott, R. A. (1983) Cardiovascular and behavioural effects of community noise. American Scientist, 69.

Environmental Protection Agency (2014). National-Noise-Awareness day. Retrieved from http://www.epa.gov.gh/web/index.php/about-us/events-calendar/icalrepeat.detail/2014/04/16/1/-/national-noise-awareness-day 18 April 2014.

Evans, G.W. & Lepore, S.J. (1993). Nonauditory effects of noise on children: A critical review. Children's Environments, 10(1), pp.31-51.

Evans, G.W. & Lepore, S.J., (1993). Non-auditory effects of noise on children: A critical review. Children's Environments, 10(1), pp.31-51.

Evans, G.W. & Maxwell, L. (1997). Chronic noise exposure and reading deficits: The mediating effects of language acquisition. Environment and Behavior, 29(5), pp.638-656.

Harper, M. (1995). Masters Thesis Department of Audiology, University of Auckland.

La Breche, R. M. (1974) Variation in Measured Automobile Passby Noise due to Operator and Environmental Factors, G. M. Proving Ground Engl. Publ. 4587.

Wetherill, E.A. (1999). Classroom Design for Good Hearing. Better Schools for a New Century, American Institute of Architects San Francisco, April 1999.

EPA Annual Report (2013) Ghana Statistical service 2010 Population Census Report