THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Impact of Noise on Human Health from Oba and Lagos Street Markets in Benin City, Nigeria

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Abstract:
This study investigates the noise levels in three unregulated industries in Benin Metropolis, Nigeria. Thirty (30) industries chosen through stratified sampling ten (10) each from metal (Aluminum), wood and furniture (Sawmill) and grain and tomatoes millers' industries were assessed. The noise climate; the exceedance levels LN (L10, L50, and L90), LEQ and Noise pollution level were measured using a sound level meter. The results obtained showed that both the L10 and NPL values estimated were higher than the 85 dBA limits. The health impact of the environmental noise was evaluated through questionnaire. The results indict 50% of the sampled participants in the tomatoes grinding machine, 27.5% of the aluminum cutting factory and 40% of the sawmill workers experience annoyance. While 60% of tomatoes grinding machine workers, 17.5% Aluminum cutting workers and 20% sawmill workers experience sleep disturbance. Other factors evaluated shows 85%, 75% and 73% had headache, 70%, 40% and 13.3% experience anxiety, 35%, 32.5% and 53.3% had increased blood pressure. Furthermore, 90%, 57.7% and 46.7% had irregular heartbeat in the Aluminum, Sawmill and tomatoes grinding industries respectively.

Keywords: *Noise pollution, Noise climate, Excellence level, Unregulated industries, health effects.*

1. Introduction

Noise pollution is any undesirable, exasperating, or destructive sound that disables or meddles with hearing, causes pains, hampers concentration and work proficiency (N. Singh & Davar, 2004). Noise pollution is now recognized worldwide as a major problem for the quality of life in any urban area (Hunashal & Patil, 2012). Noise is among the physical factors of the environment that affects the human health in todays' world (Mndeme & Mkoma, 2012). It has assumed alarming proportions and has become even more dangerous than water and air pollution (Oyedepo, 2012). The sources of industrial noise include riveting guns, stamping presses, power saws, pumps and compressors; machine tools, conveyor systems, lift-trucks, steam and air relief valves; signal or alarm systems, and many others mixed into an unidentifiable loud noise source (Gongi, 2018). Mithanga, Gatebe, & Gichuhi, (2013) expressed that appreciably high levels of work-related noise are still an issue in all most workplace around the world and there is prove of its expanding predominance within the work environment. According to the National Institute of Occupational Security and Health (NIOSH), 14% of workers are exposed to noise higher than the allowable limit (Lee, Kang, Yaang, Choy, & Lee, 2009). Mbuligwe, (2004) examined two destinations for wood and metal-works businesses (small-scale businesses) in Dar es Salaam City of Tanzania for noise pollution levels. Both displayed disproportionate noise levels that is higher than the standard 85 dBA, the allowable exposure level restrain for occupational noise (Concha-Barrientos et al., 2004). Noise-induced impacts incorporate hearing losses, changes in heart rate, heart infections, an increment in gastrointestinal portability, diastolic weight, respiratory rates, and heart maladies (Berglund & Lindvall, 1995). Atmaca, Peker, & Altin, (2005) assessed noise level and its physiological impact on laborers of a few business enterprise in Turkey, counting cement, steel, and material industries. They found out that the noise levels in all these businesses sphere were higher than 80 dBA. Effects of exposure to noise on laborers within businesses have been isolated into sound-related or non-auditory effects (Attarchi, Ashouri, Labbafinejad, & Mohammadi, 2012). The sound-related impacts incorporate hearing impedance and lasting hearing loss due to highly intemperate noise exposure. The non-auditory impacts incorporate stretch, related physiological and behavioral impacts (Ismaila & Odusote, 2014). Fada & Osisanya, (2017) expressed that noise can cause common rise in blood weight and increment in sweat and pulse. It has moreover been detailed that noise exposure causes a few vascular issues such as an increment in blood weight and heartbeat– hypertension, metabolic and biochemical clutters (Regecová & Kellerová, 1995). Noise is becoming more severe and widespread than ever before, and it will continue to increase in magnitude and severity because of population growth, urbanization, and the associated growth in the use of increasingly powerful, varied, and highly mobile sources of noise. In most developed countries, standards for air pollution and noise exposures are important part of environmental policy to improve local environmental quality including Nigeria (Gupta & Ghatak, 2011).

2. Materials and Methods

This study investigated noise pollution level on unregulated industries in selected areas within the Benin Metropolitan City, Nigeria. The city has an estimated population of 1.2 million and characterized by high commercial and industrial activity (NPOPC, 2006). Data were collected from various identified unregulated industry such as metal (aluminum cutting), wood processing, grains and tomatoes mills as indicated in **Error! Reference source not found.**. These industries were identified because of their increasing numbers and the relative noise produced in the city center. A total of 110 workers were surveyed. This comprised operators of machine, the general laborers and administrative staff.

Sampled Industry	No of Industries In The Area	Total Number of Employees	Number of Industries Sampled	Workers Sampled
Metals (aluminium Cutting)	47	480	10	39
Wood (Sawmill)	15	32	10	12
Grain/Tomatoes Mill	60	120	10	59
Total	122	632	30	110

Table 1: Industries Sample for Noise Pollution

Sampling procedure involved a total of thirty industries, ten each from metal (Aluminum), wood and furniture (Sawmill), grain and tomatoes millers industries. In each industry, respondents were chosen by simple random selection from among the workers working within the generation area. This was in agreement with the study done by (Mithanga et al., 2013) and (Gongi, 2018) in which the generation area was found to be the noisiest portion of the industries. Sound level measurements were carried by employing a computerized integrating sound level meter, MSA (IEC651). The meter was calibrated following the manufacturer's instructions using a sound source and an amplifier system which shows an LCD flag for a known sound level.

2.1. Data Collection Procedure

Measurements were taken at ten different locations within the noise generation segment of the industries; Aluminium cutting, Tomatoes grinding and Sawmill at the operator's station. The sound meter was held at 1.5 m above ground level and at 3 m from reflecting surfaces during measurement. Hourly readings were recorded between 9am and 9pm for each of the five-observation carried out.

2.2. Data Analysis and Presentation

Noise measurement readings taken at the different locations were then used to calculate the environmental noise indices using Microsoft Excel tool pack 365. The following were subsequently calculated;

Exceedance Level (L_n): The percentile exceedance of the data was calculated after it has been ranked using the Weibull's ranking formula shown in Equation 1, **Error! Reference source not found.**then the Noise level that is equal or exceeded 10% of the time (L_{10}), also called Peak/maximum noise, L_{50} and L_{90} were calculated using interpolation of the percentile exceedances.

$$L_n = \frac{m}{n+1} * 100 \qquad \text{Equation 1}$$

Where m= Rank no

n=No of data (outcome)

Equivalent Noise Level (L_{EQ}): A single value representative of the fluctuations of sound level, bearing the same energy as the fluctuating noise. This was calculated using the formula shown in Equation 2.

Where T= Total duration of sampling

$$L_{EQ} = 10\ log_{10}\frac{1}{T}\left(\sum 10^{0.1+L_I} * t_i\right) \qquad \text{Equation 3}$$

Li = Instantaneous sound level in dBA

Noise Pollution Level (NPL): This parameter explains the fluctuations in environmental noise, and it was calculated using the formula in Equation 4.

$$NPL = L_{50} + D + \frac{D^2}{60} \qquad \text{Equation 5}$$

Where D= difference between L_{10} and L_{90}, i.e. D = (L_{10}-L_{90})

The environmental noise indices estimated at the various locations were compared with allowable noise levels and the related dangers to public health evaluated.

3 .Results and Discussion

The measured environmental noise index levels recorded for the different locations are shown Figure 3*: Health Effect of noise pollution*

. The equivalent continuous levels L_{EQ} for the ten locations for the Tomato grinding machines ranged between 92.61 ± 0.05 to 99.84 ± 0.01 dBA and between 95.70 ± 0.03 to 106.26 ± 0.01 dBA for Aluminum Cutting Factory while for the Sawmill it ranged from 101.37 ± 0.02 to 107.40 ± 0.04 dBA.

Figure *1* shows the mean average L_{EQ} results compared to the WHO and NESRA Limits.

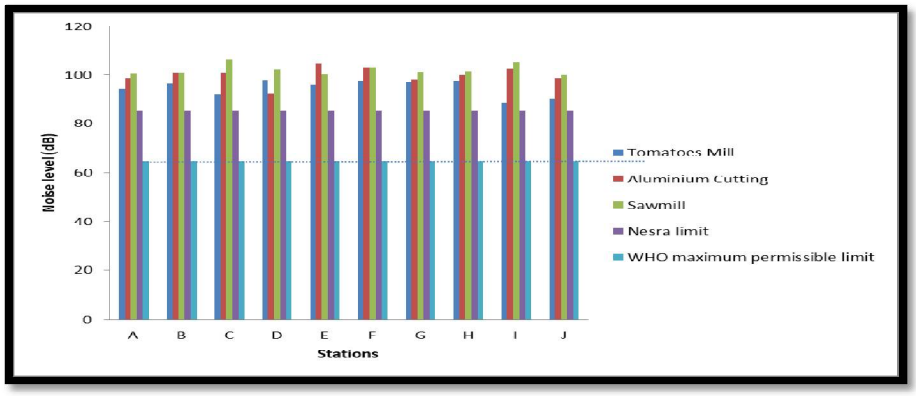

Figure 1 : Measured Noise Level in Different Industries

Figure *2* shows the noise levels produced by the various industries. Results indicates that noise levels from tomatoes grinding machines around Benin metropolis were above that recommended noise level limit (WHO, 2001, NESREA, 2009). Thus, workers and customers who patronize these sites for service were exposed to noise levels well above the threshold limit of 85Dba (NESREA, 2009). The results of levels of noise recorded in the tomatoes grinding machine area in this study agrees with the report of Boateng & Amedofu, (2004) in Ghana, where locally made corn milling machines were compared to imported corn milling machines. In their report the locally milling machines made more noise than the imported corn mills, although both corn mill machines produced noise levels far above the NESREA standard of 85 dB. Similarly, the study by Ampofo, (2012), on the noise levels of corn mill in Ablekuma, North sub metro, Ghana was not different from the report from this study. The imported and locally made corn mills produced noise levels ranging from 90 dBA to 106 dBA. The results also showed that the noise levels of new and old grinding plates of corn mills ranged from 98 dBA to 103 dBA. Comparing the results from this study to the report on chili pepper grinders shows that the noise levels were similar. The report of Omokhodion, et al., (2007) on hearing impairment among mill workers in small scale enterprises in southwest Nigeria, shows that the workers were exposed to noise levels at workstations ranged from 88 – 90 dBA for small mills and 101-105 dBA for larger mills. Furthermore, this study agrees with the report of Umar, (2007) on grinding machine operator's noise exposure levels at refinery road market, Effurun Delta State, Nigeria. The result shows that the operators of the grinding machine are exposed to about 97 dBA of noise. Analysis of results obtained from the aluminum cutting machines shows that the average noise level produce from the machines exceeded the permissible limit of 85 dBA (NESREA, 2009). The noise levels form the different machines did not show any significant difference. The noise generating machines found in the studied aluminum cutting area were similar to the other metals cutting machines that have been studied. The result from this study were similar to the findings of Nyarubeli et al., (2018) where workers in four iron and steel factories were exposed to an average noise of 92 dBA, with 90% of the personal measurements exceeding the OEL of 85 dB A Singh et al., (2013) reported a noise level similar to this present study. The study showed that Indian steel industrial workers were exposed to high mean noise levels for both personal 83 – 130 dBA and area 89–105 dBA measurements respectively.

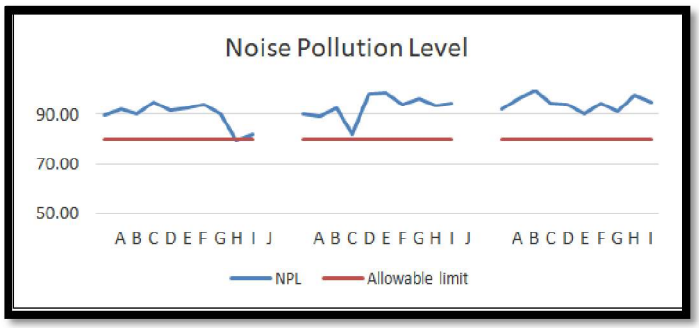

Figure 2 : Noise Pollution Level in the Different Industries

The mean noise levels produced by the sawmill machines in the studied areas also exceeded the permissible level dBA for industrial and commercial area at day time (WHO, 2001, NESREA, 2009). Noise levels generated by sawmill in operation have been reported to vary from 80 dBA up to 120 dBA. Not only can the cutting noise be extreme, there is also the additional factor that, even when idling, sawmills can produce noise levels up to 95 dBA (Choudhari et al., (2011). This study agrees with the findings of Agbalagba el al., (2013) on noise pollution levels in four selected sawmill factories in Delta State and recorded mean level of machine noise pollution and background noise level of 103.77 ± 4.71 dBA and 78.25 dBA; 96.55 ± 1.48 dBA and 72.08 dBA; 99.02 ± 3.20 dBA and 72.54 dBA; 99.97 ± 3.66 dBA and 79.89 dBA for Ozoro, Ughelli, Warri and Sapele areas, respectively.

3.1. Health Effect of Noise from Unregulated Industries

In order to access the effect of noise on health, a total of 110 out of 240 administered questionnaires which were completed and returned were analysed, **Error! Reference source not found.**. Results obtained indicates that 50% of the sampled participants in the tomatoes grinding machine area admitted they had annoyance as a health challenge, 27.50% of the Aluminum cutting factory workers had same issue, while 40% of the sawmill workers admitted too. Within the tomatoes grinding machine areas, 60% of workers indicated sleep disturbance, 17.5% in Aluminum cutting area and 20% in the case of sawmill workers. The results also indicate 85% of sampled participants admitted they had headache from the 10 sites visited, 75% in aluminum cutting areas and 73% in Sawmill area. In Tomatoes grinding area, 70% of the participants had anxiety, 40% in the aluminum cutting factories, while 13.30% of the participants in the sawmill area reported same. Increased blood pressure was reported by 35% of the workers in the tomatoes grinding machine areas, 32.5% in aluminum cutting factories while 53.3% of the participants from the sawmill had increased blood pressure. The reports also indicated 90% of participants in the tomatoes grinding area had abnormal heart beat, and a reduced percentage was observed for the aluminum cutters with 57.70% against 46.67% of the work force in sawmill having abnormal heart beat. The highest number of health effect was observed in hearing defects as 95% of the workers in tomatoes grinding area admitted they had hearing difficulty, 75% of the workers in the aluminum cutting and 80% of the sawmill workers admitted that they had similar hearing problem.

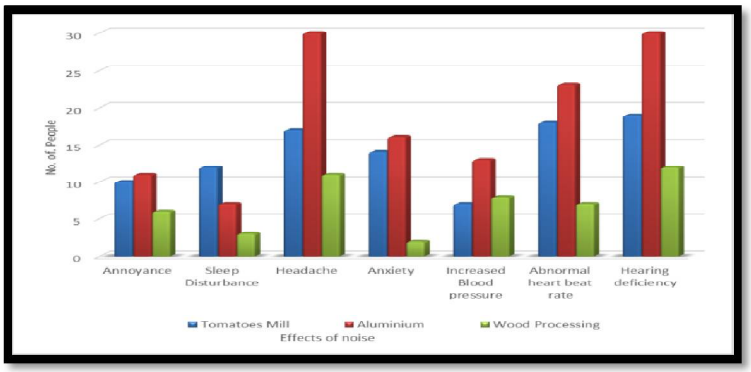

Figure 3: Health Effect of noise pollution

H	G	F	E	D	**Tomatoes/ Pepper Machine**	C	B	A	**Tomatoes/ Pepper Machine**
101.99	98.50	100.30	98.02	99.32	**L_{90}**	93.30	98.46	96.98	**L_{90}**
97.30	97.30	97.80	95.80	98.30	**L_{50}**	92.30	95.50	94.30	**L_{50}**
93.58	94.90	94.56	93.42	95.98	**L_{10}**	90.94	94.72	91.76	**L_{10}**
-8.41	-3.60	-5.74	-4.60	-3.34	**D**	-2.36	-3.74	-5.22	**D**
90.07	93.92	92.61	91.55	95.15	**NPL**	90.03	91.99	89.53	**NPL**
99.84	97.12	98.28	96.20	98.06	**L_{EQ}**	92.33	96.69	95.00	**L_{EQ}**
H	G	F	E	D	**Aluminium Cutting Factory**	C	B	A	**Aluminium Cutting Factory**
101.68	100.48	105.80	108.08	98.05	**L_{90}**	105.42	107.36	102.91	**L_{90}**
99.70	98.90	104.00	105.00	90.00	**L_{50}**	101.30	98.30	96.60	**L_{50}**
98.18	95.08	100.00	100.88	88.54	**L_{10}**	95.12	96.20	95.38	**L_{10}**
-3.50	-5.40	-5.80	-7.20	-9.51	**D**	-10.30	-11.16	-7.53	**D**
96.41	93.99	98.76	98.67	82.00	**NPL**	92.77	89.21	90.01	**NPL**
100.15	98.70	104.04	105.80	95.70	**L_{EQ}**	102.71	106.26	100.24	**L_{EQ}**
H	G	F	E	D	**Wood Processing Industry**	C	B	A	**Wood Processing Industry**
106.79	104.44	110.59	103.68	107.60	**L_{90}**	109.48	103.34	104.72	**L_{90}**
98.90	100.50	100.60	101.10	104.50	**L_{50}**	105.60	101.20	98.50	**L_{50}**
97.44	97.84	96.88	95.64	95.18	**L_{10}**	103.02	97.92	97.48	**L_{10}**
-9.35	-6.60	-13.71	-8.04	-12.42	**D**	-6.46	-5.42	-7.24	**D**
91.01	94.63	90.02	94.14	94.65	**NPL**	99.84	96.27	92.13	**NPL**
104.31	102.03	107.40	101.37	104.76	**L_{EQ}**	107.12	101.35	101.85	**L_{EQ}**

I	99.40	94.40	71.10	-28.30	79.45	96.39	I	107.37	101.00	98.52	-8.85	93.45	104.54	I	109.20	105.00	101.18	-8.02	98.05	106.50
J	94.39	88.60	86.68	-7.71	81.88	92.61	J	100.74	98.00	97.14	-3.60	94.62	99.06	J	102.60	100.20	97.12	-5.48	95.22	100.69

Table 2 Calculated Mean Noise Indices for Study Locations

3.2. Discussion

The results from this study shows that noise levels produced by tomatoes grinding machines around Benin metropolis were above the recommended noise level limit (WHO, 1999, NESREA, 2009). Thus, workers and customers who patronize these sites for service were exposed to noise levels well above the threshold limit of 85 dBA (NESREA, 2009). The levels of noise recorded in the tomatoes grinding machine area in this study agrees with the report of Boateng & Amedofu, (2004) in Ghana, where locally made corn milling machines were compared to imported corn milling machines. In their report the locally milling machines made more noise than the imported corn mills, although both corn mill machines produced noise levels far above the NESREA, 2009 standard of 85dBA. Similarly, study by Ampofo, (2012), on the noise levels of corn mill in Ablekuma, North sub metro, Ghana was similar to the results obtained from this study. The imported and locally made corn mills produced noise levels ranging from 90 dBA to 106 dBA. The results also showed that the noise levels of new and old grinding plates of corn mills ranged from 98 dBA to 103 dBA. Comparing the results from this study to the report on chili pepper grinders shows that the noise levels were similar. The report of Omokhodion et al., (2007) on hearing impairment among mill workers in small scale enterprises in southwest Nigeria, shows that the workers were exposed to noise levels at work stations ranging from 88 dBA -90 dBA for small mills and 101 dBA -105 dBA for larger mills. Furthermore, this study agrees with the report of Umar (2007) on grinding machine operator's noise exposure levels at refinery road market, Effurun Delta State, Nigeria. The result shows that the operators of the grinding machine are exposed to noise level of about 97.18 dBA. The result of the analysis from the aluminum cutting machines also shows that the average noise level produce from the machines exceeded the permissible limit of 85 dBA.

The noise generating machines found in the studied aluminum cutting area were similar to the other metals cutting machines that have been studied. The result from this study were similar to the findings of Nyarubeli *et al.,* (2018) where workers in the four iron and steel factories were exposed to an average noise of 92 dBA, with 90% of the personal measurements exceeding the limit of 85 dBA. Singh et al., (2013) reported a noise level similar to this present study. Their study showed that Indian steel industrial workers were exposed to high mean noise levels for both personal 83 – 130 dBA and area 89 –105 dBA noise measurements. The mean of the noise levels produced by the Sawmill machines in the studied areas also exceeded the permissible level 85 dBA as stated for industrial and commercial area. Noise levels generated by Sawmill operation have been reported to vary from 80 dBA up to 120 dBA. This study agrees with the findings of Agbalagba et al (2013) who carried out a survey on noise pollution levels in four selected sawmill factories in Delta State.

In this study, it was observed that annoyance, sleep disturbance, headache, anxiety, increased blood pressure, abnormal heartbeat and hearing deficiency were among the health challenges faced by the workers. Gupta and Ghatak (2011) had reported similar health challenges faced by people residing along major traffic areas in National Highway of Burdwan, West Bengal. Responses from the people showed that 53%, 36%, 40% of people suffered from headache, anxiety and high blood pressure whereas 36%, 15%, 67% and 61% of people suffered from hearing disability, cardiovascular diseases, irritability and insomnia respectively. Dev & Singh, (2011) had reported impacts of noise pollution on human health in Dehradun City of India. Exposure to high level of noise caused stress on human health such as auditory, nervous system, insomnia, hearing loss, reducing efficiency, sexual impotency, cardio-vascular, respiratory, neurological damages and limiting the human life. The studies of Fada & Osisanya, (2017), examined the potential effect of excessive noise exposure on the auditory performance and health status of some industrial workers in Ibadan shows that 80% of the participants were affected by hearing loss on either right, left or both ears measured; 71% had high systolic blood pressure, 68% had abnormal pulse rate while 75% after exposure to excessive noise at work and 75% were not aware of the effects of excessive noise to their hearing organs as they were not informed at work.

4 Conclusion

Noise levels in three studied industries were found to be significantly higher than the NESRA limit ranging from 83 dBA -115 dBA in Sawmill, Aluminium and Tomatoes grind mill respectively. The Noise level was found to have increased in frequency from Sawmill > Aluminium > Tomatoes Grinding machine. The equivalent continuous sound energy (L_{eq}) in three industries did not differ significantly. Noises have detrimental effects on health of the exposed workers, and as such there is urgent need to control noise to avert the accumulated health effects.

5. Acknowledgement

The authors would like to thank the Centre for Occupational Health Safety and Environment, University of Port Harcourt for their support.

6. Conflict of Interest

The author declares that there is no conflict of interests regarding the publication of this manuscript. All ethical issues have been addressed.

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