

Noise Pollution in Port Harcourt Metropolis: Sources, Effects, and Control.

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ABSTRACT

This paper reports the problem of noise pollution within the Port Harcourt metropolis. A good percentage of the inhabitants reveal that the main sources of noise pollution come from generators, road traffic, and the use of loudspeakers mainly in religious and social activities. The potential health effects of noise pollution are numerous, pervasive, persistent, and are medically and socially significant. Noise produces direct and cumulative adverse effects that impair health and that degrade residential, social, working, and learning environments with corresponding real (economic) and intangible (well-being) impacts. Major effects of noise include interference with communication, sleeplessness and reduction in efficiency. Public education seems to be the best method as suggested by the respondents in solving this menace. However, government and NGO's can play a significant role in this process.

(Keywords: noise pollution, generators, loudspeakers, impaired hearing, hearing loss, Port Harcourt, social-economic impacts, health hazard)

INTRODUCTION

The word noise is derived from the Latin word "nausea" implying 'unwanted sound'. Noise can originate from human activities, especially urbanization and the development of transport systems. Though the urban population is much more affected by such pollution, small towns/villages along side roads or industrial areas are also subjected to this problem. Noise is becoming an increasingly omnipresent, yet unnoticed form of pollution even in developed countries.

Many researchers have studied the effects of noise on man and his environment. Onuu (1999) concluded that the environmental noise climate

due to road traffic in urban areas has shown strong dependence on the number of heavy vehicles in particular and of course vehicle speed and other parameters such as ground cover. It is worthy of note that prolonged exposure to low frequency noise can cause either permanent or temporal damage to hearing. The effect of noise on human emotions ranges from negligible through annoyance and anger to psychologically disruptive. Physiologically, noise can range from harmless to painful and physically damaging, (Akpan *et al.*, 2003). Murray and Lewis (1995) studied environmental noise correction factors for typical industrial work rooms using field measurement techniques and found the result to be more accurate than the calculated value which was incorrect by as much as 4dB.

Industrial plant noise is considered a principal source of noise in our communities. Numerous industrial plant workers and communities are affected continuously by such noise. Onuu *et al.* (1996) studied the sound levels and spectra of industrial noise of nine industrial layouts in Calabar, Cross Rivers State of Nigeria and found the octave band pressure levels to be well above 85 dB (A) which is the starting point where damage risk is thought to be imminent. From the survey, they also found that the deafening level produced by the machinery noise was as high as 115 dB (A). High noise levels in industry may reduce productivity and the efficiency of workers. Additionally, a lot of industrial accidents are caused by excessive noise. Furthermore, industrial noise in plants, depending on the spectral distribution and amplitude, may annoy, interfere with speech and hearing, accelerate presbycusis, or cause irreversible hearing damage. It also has pathological danger.

Alaminokuma *et al.* (2008) studied the frequency-dependent noise characteristic in a gas-to-liquid plant in the swamp area of the Niger Delta and

concluded that the noise condition within the gas plant is such that the high level of discomfort and annoyance were produced by discrete noise masked by broadband noise in the zones where machines with rotating parts operate.

Omubo-Pepple *et al.* (2009), investigated the effect of noise-induced hearing loss within Port Harcourt metropolis, Nigeria at two locations and concluded that the noise pollution within Port Harcourt International Airport has adverse effect on the environment and recommended that if certain protective measures were not taken that it will result to induced hearing loss and other psychological and pathological effects.

Noise pollution is not a unique problem for developing countries like Nigeria. In China, until the third century B.C., instead of hanging men for dangerous crimes, noise was used for their torturing. The worrisome effects of noise are dangerous enough that the noise problem can be considered a crime by certain countries (Kapoor and Singh, 1995). Bond (1996) reports that 16% of people in Europe are exposed to 40 dB or more of traffic noise in their bedrooms at night and compared it with WHO's average estimates of 30 to 35 dB for undisturbed sleep.

Several initiatives have been taken by various countries to check noise levels. For example, the USA has taken initiatives to create sites where human-caused noise pollution will not be tolerated (Geary, 1996). Laws in the Netherlands do not permit the building of houses in areas where 24-hour average noise levels exceed 50dB. In Great Britain, the Noise Act empowers local authorities to confiscate noisy equipment and fine people who create excess noise at night. In Nigeria, as far back as 1990, while forming the Federal Environment Protection Agency (FEPA), the Federal government entrusted it with the responsibility of formulating laws to regulate and control the levels and impact of noise in the country. However, the impact of FEPA has not been felt. Despite the fact that much has been written about the health effects of noise, it seems that much of the following information is not appreciated by the medical community and even less so by the general public.

Two major effects of noise are interruption of sleep and the interference with work that requires concentration. It is interesting that noises emanating from the various types of roadways of today are still among the most important sources

of environmental noise, even though the types of noise are not those that existed in Rome, Medieval Europe, or 18th century Philadelphia. Our modern transportation-ways (including road, rail, and air) and the products of modern technology produce increasing levels of unwanted noise of varying types and intensities throughout the day and night that disturb sleep, concentration, and other functions (Ising and Kruppa, 2004 and Bluhm *et al.* 2004).

This noise affects us without our being consciously aware of it. Unlike our eyes, which we can shut to exclude unwanted visual input, we cannot voluntarily shut our ears to exclude unwanted auditory input. Our hearing mechanisms are always 'on' even when we are asleep (Babisch *et al.*, 2005).

The noise problems of the past are significant when compared with those experienced by modern city dwellers; noise pollution continues to grow in extent, frequency, and severity as a result of population growth, urbanization, and technological development (Berglund and Lindvall, 1995). Our society is beset by noise, which is intrusive, pervasive, and ubiquitous; most important of all, it is unhealthy. Most reasonable people would agree that much of the environmental noise to which we are subjected serves no useful purpose and is therefore undesirable. The variety of noise polluting devices and activities is large and seems to be growing on a daily basis, although there is no consensus about what items are useful and desirable or noise polluting and unnecessary.

Adverse Health Effects of Noise

The World Health Organization (WHO) has documented seven categories of adverse health effects of noise pollution on humans. Much of the following comes from the WHO Guideline on Community Noise and follows its format, (Berglund and Lindvall, 1995). The guideline provides an excellent, reasonably up-to-date, and comprehensive overview of noise-related issues, as do the other recent reviews on this subject.

Hearing Impairment

Hearing is essential for well-being and safety. Hearing impairment is typically defined as an increase in the threshold of hearing as clinically

assessed by audiometry. Impaired hearing may come from the workplace, from the community, and from a variety of other causes (e.g., trauma, ototoxic drugs, infection, and heredity).

There is general agreement that exposure to sound levels less than 70dB does not produce hearing damage, regardless of the duration of exposure and also exposure for more than eight hours to sound levels in excess of 85 dB is potentially hazardous. To place this in context, 85 dB is roughly equivalent to the noise of heavy truck traffic on a busy road. With sound levels above 85 dB, damage is related to sound pressure (measured in dB) and to time of exposure. The major cause of hearing loss is occupational exposure, although other sources of noise, particularly recreational noise, may produce significant deficits. Studies suggest that children seem to be more vulnerable than adults to noise induced hearing impairment.

Noise induced hearing impairment may be accompanied by abnormal loudness perception, loudness recruitment, distortion (paracusis), and tinnitus. Tinnitus may be temporary or permanent after prolonged exposure. The eventual results of hearing losses are loneliness, depression, impaired speech discrimination, impaired school and job performance, and a sense of isolation, (Brookhouser, 1996).

In the young, hearing loss affects communication, cognition, behavior, social emotional development, academic outcomes, and later vocational opportunities (Karchmer and Allen, 1999). Those working in clubs, bars, and other places of entertainment are also at risk. It is well known that rock musicians frequently have noise-induced hearing loss.

Interference with Spoken Communication

Noise pollution interferes with the ability to comprehend normal speech and may lead to a number of personal disabilities, handicaps, and behavioral changes. These include problems with concentration, fatigue, uncertainty, lack of self confidence, irritation, misunderstandings, decreased working capacity, disturbed interpersonal relationships, and stress reactions. Some of these effects may lead to increased accidents, disruption of communication in the classroom, and impaired academic performance, (Evans and Lepore, 1993).

Sleep Disturbances

Uninterrupted sleep is known to be a prerequisite for good physiological and mental functioning in healthy individuals. Environmental noise is one of the major causes of disturbed sleep (Stansfeld and Matheson, 2003). When sleep disruption becomes chronic, the results are mood changes, decrements in performance, and other long-term effects on health and well-being. It is known that continuous noise in excess of 30 dB disturb sleep. For intermittent noise, the probability of being awakened increases with the number of noise events per night. Noise during sleep causes increased blood pressure, increased heart rate, increased pulse amplitude, vasoconstriction, changes in respiration, cardiac arrhythmias, and increased body movement. Secondary effects (so-called after effects) measured the following day include fatigue, depressed mood and well-being, and decreased performance (Carter, 1996). Decreased alertness and disrupted circadian rhythms, which lead to accidents, injuries, and death, have also been attributed to lack of sleep (Coren, 1996).

Cardiovascular Disturbances

A growing body of evidence confirms that noise pollution has both temporary and permanent effects on humans (and other mammals) by way of the endocrine and autonomic nervous systems. It has been postulated that noise acts as a nonspecific biologic stressor eliciting reactions that prepare the body for a 'fight' response (Babisch et al, 2005). For this reason, noise can trigger both endocrine and autonomic nervous system responses that affect the cardiovascular system and thus may be a risk factor for cardiovascular disease. Acute exposure to noise activates nervous and hormonal responses, leading to temporary increases in blood pressure, heart rate, and vasoconstriction.

Disturbance in Mental Health

Noise pollution is not believed to be a cause of mental illness, but it is assumed to accelerate and intensify the development of latent mental disorders. Noise pollution may cause or contribute to the following adverse effects: anxiety, stress, nervousness, nausea, headache, emotional instability, argumentativeness, sexual impotence, changes in mood, increase in social

conflicts, neurosis, hysteria, and psychosis. Noise levels above 80 dB are associated with both an increase in aggressive behavior and a decrease in behavior helpful to others (Konenci, 1975 and Mathews and Cannon, 1975).

Impaired Task Performance

The effects of noise pollution on cognitive task performance have been well-studied. Noise pollution impairs task performance at school and at work, increases errors, and decreases motivation. Reading attention, problem solving, and memory are most strongly affected by noise. Two types of memory deficits have been identified under experimental conditions: recall of subject content and recall of incidental details. Both are adversely influenced by noise.

Cognitive and language development and reading achievement are diminished in noisy homes, even though the children's schools may be noisier than average. Cognitive development is impaired when homes or schools are near sources of noise such as highways and airports (Lee and Fleming, 2002). Noise produces negative after-effects on performance, particularly in children. Children from noisy areas have been found to have heightened sympathetic arousal indicated by increased levels of stress-related hormones and elevated resting and blood pressure (Bronzaft, 2000).

Negative Social Behavior and Annoyance Reactions

Annoyance is defined as a feeling of displeasure associated with any agent or condition believed by an individual to adversely affect him or her. Annoyance increases significantly when noise is accompanied by vibrations or by low frequency components. The term annoyance does not begin to cover the wide range of negative reactions associated with noise pollution; these include anger, disappointment, dissatisfaction, withdrawal, helplessness, depression, anxiety, distraction, agitation, or exhaustion. The degree of annoyance produced by noise may vary with time of the day, the unpleasant characteristics of the noise, the duration and intensity of the noise, the meaning associated with it, and the nature of activity that the noise interrupted (Berglund and Lindvall, 1995). Greater annoyance has been observed when noise is of low frequency, is accompanied

by vibrations that contain low-frequency components, or when it contains impulses such as the noise of gun shots. Annoyance is greater when noise progressively increases.

METHODOLOGY

The research presented here is based on a survey carried out within the Port Harcourt metropolis. More than 200 hundred respondents were interviewed personally. The study represents a cross-section of different age groups, sex, geography, educational levels, and income levels across the residents of the metropolis.

Port Harcourt city was chosen for the study because of its population, and reflects both the modern and traditional infrastructure (roads, localities, buildings, etc.). Moreover the residents represent a cross-section of the Nigerian culture. The data was collected by using a structured questionnaire blended with suitable open-ended questions. The analysis has been carried out with help of percentages and cross-classifications on sources of noise, effects of noise, reaction to noise, and suggestions to control noise in terms age as well as sex.

RESULTS AND ANALYSIS

Sources of Noise

The source of most outdoor noise worldwide is transportation systems, including roads, flyways, and rail traffic. Poor urban planning may give rise to noise pollution, since side-by-side industrial and residential buildings can result in noise pollution in the residential area. Other sources of indoor and outdoor noise pollution are generators, car alarms, emergency service sirens, office equipment, factory machinery, grounds keeping equipment, barking dogs, appliances, power tools, lighting hum, audio entertainment systems, loudspeakers, and neighborhood sounds.

Road noise, especially at some distance from the road, can be described as a steady state noise that does not fluctuate much, but rail and air craft noise are acoustically characterized by high noise levels of relative short duration. The speed and exhaust systems determine the noise released by road traffic. Generators contribute to

a great extent the noise pollution within the Port Harcourt city because industries, small scale businesses, and even residential areas largely depend on generators for the supply of power.

Noise from industrial installations, construction sites, and fixed recreation facilities radiate from a point source and the shape of exposure area is generally circular (Narendra and Davar, 2004). Another major source of noise pollution are the public address systems used by religious and social organizations.

Table 1 shows that a very large proportion of the respondents in each age group are affected by noise emanating from generators. Similar results are obtained with noise from road traffic and loudspeakers. Relatively small proportions (53% across various age groups) of respondents acknowledge the effects of noise generated from neighborhoods. An almost equal proportion of respondents (54%) across different age groups agree that noise generated from religious activities affect them. Further, we examined how sources of noise affect male and female population differently.

From Table 2, it is observed that women are more affected by noise pollution from religious activities

and social activities, while in the other sources like the road traffic, air traffic and generators, there is no remarkable difference in percentage of male and female population.

Effects of Noise

There is no doubt that noise affects human health adversely. We have earlier enumerated the adverse effects of noise, as loss of hearing, stress, high blood pressure, loss of sleep, distraction affecting productivity, and in general reduction in the quality of life. The effects of noise are difficult to quantify because tolerance levels among different populace and types of noise vary considerably. Indiscriminate use of horn by cars, wide spread use of generators for business and in residential places, use of loudspeakers in religious and social activities cause different health hazards to city dwellers. It may also cause deafness, nervous breakdown, mental disorder, heart troubles, dizziness, and insomnia (Bhargawa, 2001). Exposure to noise pollution exceeding 75 dB for more than eight hours daily for a long period of time can cause loss of hearing. The hazard increases with the intensity of the noise and the period of exposure.

Table 1: Sources of in Terms of Age Groups.

Sources of Noise	Age groups				Total (%)
	Up to 18yrs (%)	19 to 35yrs (%)	36 to 50 yrs (%)	51yrs and above (%)	
Religious activities	61	51	54	55	54
Social activities	53	58	71	83	60
Loudspeakers	81	74	88	84	82
Road traffic	67	63	72	78	75
Neighborhood	44	49	45	57	53
Air traffic	32	37	33	30	29
Generators	84	80	86	88	85

Table 2: Sources of Noise in Terms of Male and Female Respondents.

Sources of Noise	Male (%)	Female (%)
Religious activities	57	61
Social activities	53	58
Loudspeakers	83	74
Road traffic	72	71
Neighborhood	47	47
Air traffic	33	31
Generators	86	86

Nagi *et al.* (1993) found that the noise level produced by household equipment and appliances sometimes reaches up to 97 dB which is more than double the acceptable (45 dB) noise level. This excessive noise may cause annoyance, speech interference, sleep disturbance, mental stress, headache, and lack of concentration. Similarly, Singh (1984) found that workers exposed to high noise levels have a high incidence of circulatory problems, cardiac diseases, hypertension, peptic ulcers, and neurosensory and motor impairments.

From Table 3, we found that noise interferes with many aspects across the age groups. A majority of the respondents exposed to noise report occurrence of sleep disturbance, annoyance, and hearing problems. Generally the growing age group bears more effect of noise pollution.

From Table 4, we observe that the perception of the effect of noise on male and female varies. A good percentage of the male population feels the adverse effect of noise pollution more than their female counterparts. The reasons for these differences may be because females are more tolerating, patient, and accommodating, and also because more men are exposed to industrial noise than women.

From Table 5, we found that people within the ages of 19 to 35 do not border on quarrelling, complaining to the police, or even requesting the source of noise to be reduced or stopped. Small proportions seek redress through legal means, while those up to 18 years quarrel and retaliation seems popular among them.

Table 3: Effect of Noise on Different Age Groups.

Effects of Noise	Age groups				
	Up to 18yrs (%)	19 to 35yrs (%)	36 to 50 yrs (%)	51yrs and above (%)	Total (%)
Effect on hearing	68	54	80	94	75
Annoyance	75	79	86	74	77
Mental stress	26	39	43	31	32
Sleep disturbance	67	90	97	93	87
Speech interference	98	95	96	83	93
Lack of concentration	41	53	57	55	49
Cardiovascular Disturbances	24	37	33	31	30

Table 4: Effect of Noise in Terms of Male and Female Respondents.

Effect of Noise	Male (%)	Female (%)
Effect on hearing	73	61
Annoyance	91	83
Mental stress	31	26
Sleep disturbance	95	80
Speech interference	92	75
Lack of concentration	87	84
Cardiovascular Disturbances	26	22

Table 5: Reactions to Noise by Different Age Groups.

Reactions	Age groups				
	Up to 18yrs (%)	19 to 35yrs (%)	36 to 50 yrs (%)	51yrs and above (%)	Total (%)
Quarrel with people	31	11	19	17	20
Complain to the Police	8	6	5	2	19
Request to stop or reduce	71	60	65	73	64
Ignore	78	81	69	88	75
Retaliate	63	55	49	41	42

Noise Control

In 1987, Nigeria took a giant leap by becoming an environmentally conscious nation following the dumping of toxic waste in Koko village, in Delta State. The country was, before this time, ill-equipped to manage such an environmental crisis, as there were no institutional capacity and legislation to address such matters. Consequently, upon the Koko toxic waste episode, there was the promulgation of Harmful Waste Decree 42 of 1988, which facilitated the establishment of the Federal Environmental Protection Agency (FEPA) through Decree 58 of 1988 and 59 (amended) of 1992. FEPA was charged with the overall responsibility for environmental management and protection but without an appropriate enabling law on enforcement issues. This vacuum in the effective enforcement of environmental laws, standards and regulations in the country, led to National Environmental Standards and Regulation (NESR) being established.

In the United States there are federal standards for highway and aircraft noise; State and Local Governments typically have very specific statutes on building codes, urban planning, and roadway development. In Canada and EU there are few national, provincial, or state laws that protect against noise. To safeguard against ill effects of noise, the laws of the Netherlands do not permit building of houses in areas where 24-hour average noise levels exceed 50 dB. In Great Britain, the Noise Act empowers the local authorities to confiscate the noisy equipment and fine people who create excess noise at night.

In Nigeria, the movement (if there is any) against noise pollution is weak. Most of the people do not consider noise as pollutant, and take it as part of routine life.

There are several methods that can be utilized for controlling the level of noise. First of all, the design and technology of machines/equipments could be altered resulting in low noise emission. Secondly, noise barriers may help us control noise. Thirdly, is to protect receptors of sound by a shield (e.g. buildings may be insulated against noise and also body and window planes may be made sound proof). Apart from technology, we may undertake various steps to modify or regulate the behavior of users of machines and equipment. Educating the public may be a good option because it is a social problem. Shear ignorance

about the adverse effects of noise pollution appear to be a key factor in laying inadequate stress on controlling or reducing its levels. Change in public attitude by programs of government, non-governmental organizations, and civil measures (fines) may reduce or prevent noise pollution. Many conflicts over noise pollution are handled by negotiation between the emitter and receiver.

CONCLUSIONS AND RECOMMENDATIONS

Generators, automobiles, and public address systems (loudspeakers) turn out to be the major sources of noise pollution in our study area. Loudspeakers and generators are frequently used for religious and social functions. As a society, our history is filled with failures to recognize the agent that cause disease; once the causes have been recognized, we have responded reluctantly, slowly, and often inadequately.

Despite the evidence about the many medical, social, and economic effects of noise, as a society, we continue to suffer from the same inertia; the reluctance to change or make appropriate action on tobacco, lead, mercury and asbestos. Now we seem unable to make the connection between noise and disease, despite the evidence, and despite the fact, which we all recognize, that our societies are becoming increasingly more polluted with noise.

Noise represents an important public health problem that can lead to hearing loss, sleep disruption, cardiovascular disease, social handicaps, reduce productivity, impaired teaching and learning, absenteeism, increased drug use, and accidents. It can impair the ability to enjoy one's property and leisure time and increases the frequency of antisocial behavior. Noise adversely affects general health and well-being in the same way as does chronic stress. It adversely affects future generations by degrading residential, social, and learning environments with corresponding economic losses.

Local control of noise has not been successful in most places. We therefore recommend improved methods of local control that should include public education, enlightened legislation, and active enforcement of noise ordinances. However, government and NGO's can play a significant role in the process.

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