



# **The silent killer: an assessment of level of industrial noise and associated health effects on workers**

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## **Abstract**

The aim of this study is to assess the level of industrial noise and associated health effects on workers within the Tema Industrial Area, Ghana. A calibrated noise meter, Integrated Average Sound Level Meter, was used to measure noise emanating from each operating machine from plastic, can, food, and cutlass manufacturing industries within the study area. A structured questionnaire was administered to 98 workers to assess the socio-economic and health related characteristics. The results showed that mean noise levels from all 4 industries was 90.0 dB which exceeded the allowable level of 70 dB recommended for heavy industrial area. The noise levels ranged from 78.0 dB recorded at the food processing to 108.5 dB also from the same place. The results of the survey showed that most workers were aged >30 years. Though most of the workers were aware of the effects of noise on human health, few workers used ear-protecting devices during work period. More than half (63.3%) of workers cannot hear words clearly at normal conversation. It is clear from the study that workers were exposed to noise levels beyond recommended and they were likely to experienced auditory and non-auditory effects of such exposure.

**Keywords:** *auditory effects, non-auditory effects, industrial noise, health-related, ear-protecting device.*

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## **1 Introduction**

The renowned German bacteriologist, Robert Koch, noted that in future, harsh noise would become the most dangerous enemy to threaten the health of humankind [1]. Noise is an unwanted sound that has become a prominent factor in the urban environment that deteriorates the quality of life [2]. Major cities of the world are facing problems associated with rise in noise pollution due to very high population, transportation, congestion, and associated commercial and industrial activities [3, 4].

Many reports have associated noise with physiological and psychological damages. Exposure to continuous noise of 85–90 dBA, particularly over a lifetime in industrial settings, can lead to a progressive loss of hearing, with an increase in the threshold of hearing sensitivity [5]. The mechanism of noise-trauma and the damaging effects of loud sounds on the mammalian inner ear strongly are said to depend on the parameters of exposure, such as the intensity and the frequency spectrum of noise, the duration of exposure and the meaning of exposure [6, 5].

In 2004 alone, over 275 million people globally were reported to have had moderate-to-profound hearing impairment, 80% of them in low- and middle-income countries [7]. Chronic noise exposure is also associated with adverse pathophysiological effects and may contribute to the progression of cardiovascular disease [8, 9, 10]. There is a positive correlation between noise exposure and high blood pressure [11]. Noise, even at relatively low levels, can disrupt sleep and/or hinder cognitive development in children [12].

In fact, Ghana is not insulated from the effects of noise pollution. The noise levels in many areas in the country has, in recent times, assumed alarming rate such that the Environmental Protection Agency of Ghana has instituted April 14<sup>th</sup> of every year as “National Noise Awareness Day” to sensitise the public about the harmful effects of noise. Dr. E. D. Kitcher (a leading ENT Specialist Korle-Bu Teaching Hospital, Accra), speaking at the 2011 National Noise Awareness Day, described noise as a silent killer since it slowly but surely damages ones hearing. He noted that there is no medication, which can revive a dead organ of hearing or a dying organ of hearing, and therefore, efforts must be directed at creating awareness on health hazard of noise pollution [13].

The motivation for this study was envisaged due to insufficient information on the level of noise and associated effects industrial workers in Ghana. This study aimed at assessing the level of industrial noise and its effects on the health of workers.

## 2 Materials and methods

The study was carried out in Tema, which serves as the administrative capital of the Tema Metropolitan Assembly of Ghana. Tema is the nation's largest seaport, and the home to an oil refinery and many manufacturing centres. It is a coastal city situated 25 kilometres east of Accra, the national capital. The Greenwich Meridian (00 Longitude) passes through the city of Tema.

The noise measurements were taken in four (4) manufacturing companies: a can manufacturing, a plastic manufacturing, food and beverage manufacturing, and a cutlass manufacturing. The noise from each operating machines from the selected companies was measured using Integrated Average Sound Level Meter (CR:812B). According to a previous study, the noise meter was first calibrated and brought near the ears of the each worker operating the machine in the industries [14].

A structured questionnaire was first pretested, and then administered to 98 workers in the industries where the noise levels were measured. The questionnaire sought to know the socio-economic and noise-health related characteristics of the workers.

## 3 Results

Table 1 shows noise level recorded from machines in 4 selected manufacturing industries in Tema. Altogether, the 4 industries had mean noise level above 90 dB. The lowest noise level of 78.0 dB was recorded in a food processing company from the big bag discharging system. This is a system designed for discharging a large variety of products from different types of big bags. This system is designed to eliminate dust emissions, product loss and product contamination. The same company recorded the highest noise level of 108.5 dB from the hammermill, which is used to aggregate materials into smaller pieces. The result shows that the noise levels recorded from all the machines used by the manufacturing companies were above the recommended level of 70 dB for predominantly heavy industrial areas set by the EPA-Ghana. Clearly all workers from the selected companies were exposed to these noise levels for an average of 8 hours per day.

Table 1: Noise levels recorded from selected manufacturing industries in Tema

Manufacturing company	Noise level (dB)		Machine type	maxi.	Mean $\pm$ SD	Exposure (hrs/day)	Time
	Machine type	mini.					
Plastic	Compressor	90.2	Injection m/c	97.2	94.0 $\pm$ 3.1	8	
Can	Smag tester	85.6	DRD draw	107.0	94.4 $\pm$ 7.2	8	
Food	Big bag discharging	78.0	Hammermill	108.5	93.1 $\pm$ 9.2	8	
Cutlass	Heat treatment	87.5	Polishing section	101.4	93.2 $\pm$ 4.5	8	

Table 2 records the profile of the 98 industrial workers who responded to the questionnaire. The result shows that there are more men working as industrial workers than women and also majority of the workers were more than 30 years old. In addition, while most workers were married, less than a third (32.7%) were single. Very few (8.2%) of industrial workers had had basic education. Majority of the workers (91.8%) had had at least secondary school education. Furthermore, most workers (62.2%) responded to having been working with their present companies of more than 5 years while 38.8% for less than the same number of years. While more than half (61.2%) of the workers earned less than 500 Ghana cedis per month, the rest earned more than that amount every month. Majority (69.4%) of the workers had registered with either company's own health insurance or the National Health Insurance Scheme (NHIS) and hence access free health delivery.

As presented in Table 3, more than half (55.1%) of the workers regularly undergo medical check-up and of these majority (85.2% were not told of any damage to any of their ears. Of those who have had damages of an ear, half (50%) of them reportedly pay for treatments while the other half had their medical bills paid for by their employers. Though a greater number (83.7%) of the workers were aware of the effects of noise on human health, less than half (42.9%) of the workers used ear-protecting devices during work period. Furthermore, more (59.2%) workers were either unaware of or did not know of routine noise monitoring at their workplaces. While 36.7% of the workers said they can hear words spoken at normal voice or conversation, more than half (63.3%) reported otherwise.

The result showed that while more than half (57.1%) of workers were aware of maintenance works being carried on the machinery used at the factories, less than a 28.6% were unaware of such exercise. Less than a fifth (14.3%) said that no maintenance works had been carried out at the workplace.

Table 2: Summary of Socio-economic profile of selected industrial workers in Tema (N = 98)

Selected characteristics	Categories	Number (%)
Sex	Male	56 (57.1)
	Female	42 (42.9)
Age category (years)	15- 30	8 (8.2)
	31 - 60	78 (79.6)
	> 60	12 (12.2)
Marital status	Married	66 (67.3)
	Single	32 (32.7)
Education level	Up to basic school	8 (8.2)
	Up to secondary school	28 (28.6)
	Up to tertiary	62 (63.2)
Monthly salary (Ghana cedis)	< 500	60 (61.2)
	501-1000	19 (19.4)
	> 1000	19 (19.4)
No. of working years in the industry	≤ 5	38 (38.8)
	6-10	26 (26.5)
	> 10	34 (34.7)
Having health insurance?	YES	68 (69.4)
	NO	30 (30.6)

Table 3: Industrial workers response to selected noise related variables (N = 98)

Selected characteristics	Responses	Number (%)
Routine medical check-up?	YES	54 (55.1)
	NO	44 (44.9)
Detection of any damage to your ear? *	YES	8 (14.8)
	NO	46 (85.2)
Payment of treatment? **	Self	4 (50.0)
	Company	4 (50.0)
Awareness of effects of noise on health?	YES	82 (83.7)
	NO	16 (16.3)
Able to hear better at normal conversation.	YES	36 (36.7)
	NO	62 (63.3)
Routine noise survey at workplace?	YES	40 (40.8)
	NO	38 (38.8)
	Unaware	20 (20.4)
Provision of ear protector?	YES	42 (42.9)
	NO	56 (57.1)
Routine maintenance of machinery at workplace within a year?	YES	56 (57.1)
	NO	14 (14.3)
	Unaware	28 (28.6)

\*n = 54, from those who responded YES to medical check-up

\*\*n = 8, from those having ear problems

## 4 Discussion

The study revealed that workers of heavy industrial companies were exposed to noise levels exceeding the maximum allowable limit of 70 dB for light and predominantly heavy industrial areas which confirms the findings of other researchers and EPA Ghana [15, 16]. These workers were likely to exhibit symptoms of long-term exposure to noise in the workplace. Several studies have examined the correlation between exposure to noise and health.

Noise pollution has undeniable effects on worker's auditory and non-auditory functions [17]. The auditory effects include tinnitus, acoustic trauma, temporary hearing loss, permanent hearing loss, etc [17]. The non-auditory effects include cardiovascular, gastric, nervous, endocrine, psychological, autonomic, etc. It also causes both hearing loss and oxidative stress among workers exposed to high levels of noise [18]. Oxidative stress, defined as a disturbance in the balance between the production of reactive oxygen species (free radicals) and antioxidant defences [19]. It is known to cause colon cancer, cardiovascular disease, Alzheimer disease and 200 other diseases [20]. There is a positive correlation between long-term exposure to noise and the brain organization of speech processing and attention control [21, 22].

The inability of most of the workers to hear words spoken to at normal conversation may be a symptom of noise exposure. People who are unable to hear and repeat words at normal voice ( $\leq 40$  dB) may be suffering from moderate, severe, or profound hearing impairment [23]. Education plays a major role in people's understanding of noise and their possible effects on human health. A study has shown that many workers with low education had poor perception about noise and were unaware of its effects [24].

The use of noise or hearing protection devices will go a long way in reducing the health burden associated with occupational noise. It has been recommended that in order to reduce hearing loss, hearing loss prevention and intervention programmes should be tailored for workers at industries and occupations with high noise exposure [25]. Comfort, requirement to wear hearing protection and enforcement of this requirement were reasons why most workers do not use hearing protection [26].

This study has shown that workers of heavy industrial companies within the Tema Metropolitan Assembly of Ghana are exposed to noise levels above the maximum allowable and this could present negative health effects on them. Though, a greater majority of them were abreast with the harmful health effects of noise, the provision of noise protection devices by employers was not encouraging. There is the need for employers to provide and enforce the use of such devices at the workplaces. Again, all stakeholders must enforce maintenance or replacement of outmoded machines.

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