

# Chapter 6

## Assessment and Evaluation of the Effects of Hazardous Noise Produced by the Manufacturing Industry on the Workers



Tushar Kanta Mahapatra and Suchismita Satapathy

**Abstract** People are becoming more aware of this problem as noise pollution has increased significantly in recent decades owing to the expanding industry. The manufacturing sector provides employment opportunities for workers and produces annoying noise from various sources, particularly machinery. This study aims to pinpoint dangerous loudness in the manufacturing sector, where employees work eight hours daily under sweltering conditions. In addition, a follow-up study may provide a clear image of many noisy situations, such as an auto shop, the textile industry, or a small industrial worker, enabling them to evaluate the effects of noise on their hearing conditions. A quick study of various industries was conducted at the site to categorize the health issues caused by noise pollution in the Bhubaneswar, Odisha area. In this survey, 120 workers were examined by a health expert to determine whether they had health issues owing to high noise. This study used three questionnaires to examine labor-related health issues at clinical and workplace levels. The findings suggest that a significant proportion of the population experiences problems with hearing impairment (26%), acoustic fatigue (18%), and sleep problems (16%). Other problems include a change in behavior towards others, annoyance, decreased success in carrying out routine tasks for industrial workers, and increased hypertension with other cardiovascular conditions. To reduce the detrimental impacts of noise pollution, industries must follow specific suggestions and take preventative measures such as using personal protective equipment (PPE), particle boards, soundproofing barriers, and vibration-proof foundations. Therefore, hearing preservation techniques should be used under noisy conditions.

**Keywords** Noise pollution · Hearing loss · Decibels · Health problems · Sleeping problem

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## 6.1 Introduction

An essential element of human existence is sound. Humans cannot communicate their needs and feelings to others without sounds. Nevertheless, when sound turns into noise, it affects society and daily life (Subramaniam et al. 2019). The Latin word for “nausea” is the root of the English term “noise”. Noise is a wrong, unpleasant, and distracting sound at the wrong time or place. However, this form of pollution carries risks that cannot be observed. This cannot be observed, even though it exists on land or water. Any undesirable or annoying sound affecting people’s health and well-being and other living things is called noise pollution (Goswami et al. 2019). Noise pollution is no longer a new issue for typical people, particularly in most industrial and metropolitan areas. Noise is the most common workplace environmental hazard.

Human activities produce two types of noise, occupational noise and environmental noise, which include noise from traffic, music, and other sources (Khajenasiri et al. 2016). Unwanted or excessive noise can harm the environment and human health, and noise pollution is what this means. Prolonged or recurrent exposure to loud noises that harm the spiral organs can result in high-frequency deafness. In addition, hypertension, is more prevalent due to noise.

Some studies draw on this area of research to learn more about how noise and loud music impact human performance and how music, an everyday activity that frequently incorporates background music, impacts driving (Dalton and Behm, 2007). In addition to adversely affecting a person’s capacity for comprehension, attention, and alertness, background noise also affects public health (Oguntunde et al. 2019). Hearing loss, sleep disturbance, heart disease, social impairments, poor productivity, rebellious public behavior, irritable responses, absenteeism, and accidents are all severe public health issues that can be caused by noise.

Numerous studies have shown that 30 million American employees are routinely subjected to loud noise. Noise exposure is one of the most common environmental risks in industrial settings, although its effects vary depending on job and location (Gurjar et al. 2016). Numerous studies have shown that noise pollution negatively affects workers’ productivity and effectiveness. One of the major environmental stressors is noise pollution, and contemporary life demands that the noises produced will not disappear overnight.

### 6.1.1 *The Source of Noise Pollution*

#### 6.1.1.1 Industrialization

A unit of measurement for sound is “decibels.” Most industries employ machines that generate a significant amount of noise. Different equipment contributes to the production of loud noise, such as grinding mills (134 dB), milling machines (104 dB), lathe machines (101 dB), weaving mills (94–99 dB), compressors (95–104 dB),

sawmills (95–105 dB), and steam turbines (91 dB). These factors contribute to the excessive noise (Bhosale et al. 2010; Caciari et al. 2013).

### **6.1.1.2 Bad Urban Planning**

Large families living in cramped quarters, disputes over parking, and frequent alterations in necessities contribute to noise pollution, which disturbs the social environment (Pantawane et al. 2017).

### **6.1.1.3 Public Transport**

Many cars are on the road, planes pass over residences, and underground trains generate much noise, making it difficult for people to get used to them. Regular individuals lose hearing capacity because of extreme noise levels.

### **6.1.1.4 Constructions Work**

Construction activities, including mining, building bridges, dams, buildings, stations, highways, and flyovers, are ongoing worldwide. These building and bridge construction activities occur daily because new structures must be created to accommodate more people and ease traffic congestion. However, the negative aspect is the noise of these construction tools (Pantawane et al. 2017).

### **6.1.1.5 Other Sources**

Primary noise sources currently include traffic, building sites, industrial regions, shoddy urban design, social gatherings, housework, and air traffic (Bhosale et al. 2010). There are many different sounds in the environment, such as thunderclaps (120 dB), rustling leaves (20–30 dB), and siren calls (120–140 dB). Loud rock concerts, subway trains, and powerful lawnmowers are sound sources that are louder than this level, between 90 and 115 dB and 110–120 dB (Jóźwik et al. 2018).

## ***6.1.2 Impact of Noise Pollution***

Humans are affected by sound frequency. It is widely known that the human ear can detect frequencies within the range of 0–180 dB. A critical issue is that insufficient number of individuals know how noise pollution at work affects and causes serious health issues (Aluko and Nna 2015). The World Health Organization (WHO) claims that noise pollution is the most significant environmental threat to human health.

The European Environment Agency (EEA) estimates that noise causes more than 72,000 hospital admissions annually and 16,600 premature deaths in Europe (Parma Declaration on Environment and Health 2010).

Loud noise can also cause hearing issues (physical effects), high blood pressure, heart disease, insomnia, stress (physiological effects), a weak nervous system, sleeping issues (psychological effects), and low productivity (effects on work performance). In 1972 Shapiro and Baland were the first to measure the intensity of noise pollution and then describe it as the “third pollution” after air and water pollution (Shapiro and Berland 1972; Panhwar et al. 2018).

The World Health Organization (WHO) defines noise pollution as louder than 65 decibels (dB). Noise levels greater than 75 dB (in decibels) are harmful and painful. As a result, it is suggested that daytime sound levels are kept under 65 dB and that it is difficult to have a good night’s sleep when ambient noise levels at night are higher than 30 dB. Millions of people are affected by daily noise pollution. All of these noise sources impact our daily lives without our knowledge because it is impossible to intentionally close our ears while sleeping to block unwanted aural input (Babisch 2005).

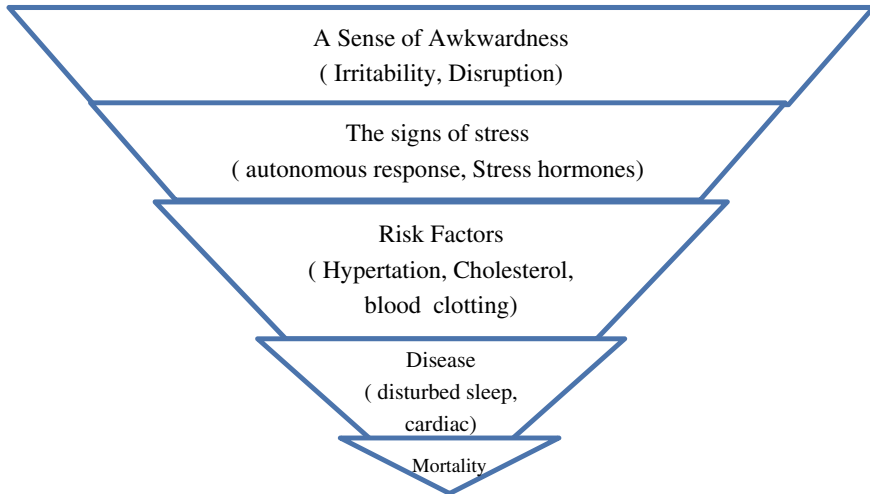
Moreover, noise harms health and can cause auditory issues, such as nerve fatigue, partial hearing loss, and other issues, such as decreased productivity, aggravation, cardiac issues, and high blood pressure. Noise is a stress-mediating factor that reduces mental clarity, interferes with communication, disturbs sleep, alters psychosocial behavior, and generally degrades performance in daily tasks (Kpang and Dollah 2021). Noise-related symptoms include increased heart rate, severe hypertension, physiological disturbances, and peripheral vascular resistance.

The impact of the physical work environment on employee performance was investigated using a theoretical framework. Temperature, sound, air, light, color, and physical workplace space are the five primary elements that affect employee performance. According to industrial safety and health, noise is hazardous to worker health and safety (Kahya 2007), even though hearing is one of the basic senses and is crucial to our ability to comprehend our surroundings.

### ***6.1.3 Health Problems Due to Noise***

Excessive noise pollution can harm mental health in public areas, workplaces, construction sites, bars, and homes. Studies have shown a connection between loud environments and aggressive behavior, annoyance, chronic stress, fatigue, sleep problems, and hypertension. Continuous loud noise may cause headaches, upset, and emotional equilibrium (Firdaus and Ahmad 2010).

Figure 6.1 describes the diseases caused by noise pollution, such as hypertension, high cholesterol, and disturbed sleep.



**Fig. 6.1** Various forms of diseases have occurred due to the impact of noise pollution

### 6.1.3.1 Cardiovascular Problems

Numerous studies have shown that noise pollution has both temporary and long-term effects on the autonomic nervous system of humans and other species (Hahad et al. 2019). According to one theory, noise acts as a general biological stressor, activating processes in the body that prepare for a fight-or-flight response (Aluko and Nna 2015). As noise can cause reactions in the hormonal and autonomic nervous systems that affect the circulatory system, it may increase the risk of cardiovascular disease. Long-term repeated exposure to noise levels above 65 dB and quick access to noise levels above 80–85 dB can cause these effects. According to previous studies, high-intensity noise causes high blood pressure and increases the heart rate by disrupting regular blood flow (Berglund and Lindvall 1995).

### 6.1.3.2 Sleeping Disorder

Adequate sleep is necessary for the proper physiological and psychological performance of healthy individuals. Environmental noise contributes significantly to sleep disruptions (Singh and Davar 2004). Repeated sleep disturbances can lead to changes in mood, poor performance, and other long-term adverse effects on health and wellness. For instance, it is widely recognized that consistent noise levels exceeding 30 dB make sleep challenging.

Sleep deprivation and disrupted sleep cycles have also been linked to decreased attentiveness, which results in mishaps, injuries, and fatalities. This loud noise may make it difficult to sleep, annoy, and create uncomfortable situations. People feel fatigued and perform worse at work and home if they do not sleep well.

**Table 6.1** Effects on hearing due to noise

Sound level (dB)	Effects due to noise
10	There is no hearing loss at these volumes
30	
40	
60	
80–85	Hearing the damage after two hours
95	Hearing damage after 50 min
100–105	After 15 min, possible hearing loss
110	Possible hearing loss after 2 min
120	Pain and ear injury
140–150	Pain and ear injury

### 6.1.3.3 Hearing Issue

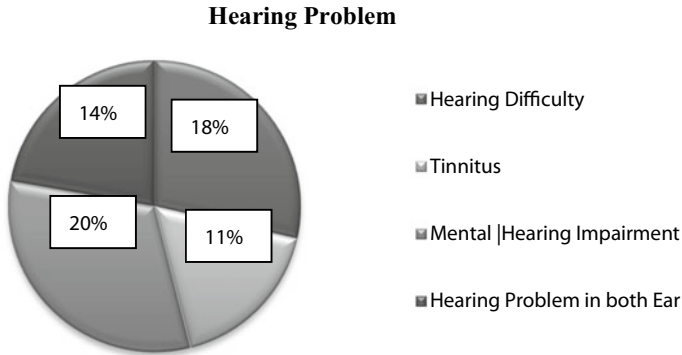
Any uncomfortable sounds that our ears are not designed to filter harms our health, and our ears can only handle noise before they are damaged. Constant exposure to loud noises can quickly damage the eardrums and cause hearing loss (Anees et al. 2017). Table 6.1 clearly shows that sound levels above 80 dB begin to damage our ears after continuous exposure to that noise level (Dunne et al. 2017) and shows how our ears respond to different noise levels (in decibels) (Qutubuddin et al. 2012). Below are the data collected from different sources, such as literature, doctor consultations, and informed responses.

According to a report from the National Institute for Occupational Safety and Health (2021), in Fig. 6.2, people are affected by different types of health issues due to the high noise collected and categorized under Employees are at risk of hearing loss, mental health problems, hearing difficulty, and tinnitus. There is no solution for these injuries yet, which means those who are hurt will have to live with the effects for the rest of their lives.

To address this issue, some countries passed different laws, such as Japan in 1972, the United Kingdom enacted the Health and Safety at Work Act in 1974, and the United States of America implemented the Occupational Health and Safety Act in 1970. The Occupational Safety and Health Act (OSHA) was revised in 1994 to address the need for an extensive employee base and dangerous workplace acts. According to the Occupational Safety and Health Act (OSHA), industrial workers should not work for more than eight hours in an environment with noise levels greater than 90 dBA.

### 6.1.3.4 Disappointment and Negative Human Behavior

Any action or circumstance that a person believes will harm them can irritate them, causing them to feel annoyed. Noise has been utilized as a noxious stimulus in



**Fig. 6.2** Hearing problems of workers working in a noisy environment

numerous studies because its effects are similar to those of other stressors. Irritation and noise considerably increase when vibration or low-frequency components are present. Noise pollution can evoke many negative emotions, including anger, displeasure, dissatisfaction, helplessness, worry, distraction, agitation, and tiredness.

#### 6.1.3.5 Mental Health Problems

Noise pollution is believed to expedite and aggravate hidden mental problems, although it is not recognized as a primary cause of psychological disease. Noise pollution causes tension, nervousness, headaches, emotional instability, anger, hormonal disorders, poor concentration, increased social conflicts, neurosis, and psychosis, to name a few adverse effects. News media often covers aggressive behavior owing to disagreements over noise, and in several cases, these disagreements result in harm or death.

#### 6.1.3.6 Verbal Communication Interruption

In addition to making it difficult to understand spoken language, noise pollution can cause psychological problems, physical impairments, and behavioral changes. These include difficulty concentrating, doubt, annoyance, misunderstanding, reduced working capacity, harmed interpersonal interactions, and stressful reactions. These consequences could result in more accidents, a breakdown in classroom communication, and poor academic achievement. Children, the elderly, and those who do not speak the language fluently are among the most disadvantaged groups.

### **6.1.3.7 Working Performance**

Laboratory and field research has demonstrated that occupational noise exposure negatively affects workers' ability to complete mental tasks. The results of field research on the impact of noise on safety and performance revealed that noise might cause task impairment and increase the frequency of errors, depending on the activity being performed and the type of noise.

### **6.1.3.8 Effects on Other Animals or Living Things**

Animals, including birds, rats, fish, and domestic pets, are sensitive to various impacts from exposure to high noise levels and can experience the effects of factories, railways, crackers, explosions, and bustles in cities and aircraft. During migration, birds avoided areas with noise levels greater than 100 dB. Fish miscarriages and birds ceasing to lay eggs due to noise emissions from supersonic aircraft, trains, and other sources have been documented. In conclusion, it may be said that animals and other living creatures are directly responsible for the ecological balance and experience more distress than humans do.

### **6.1.3.9 Effect on Non-living Objects**

Nonliving creatures are also affected by loud noise levels. Deafening noise levels and booms induce fissures in hills and national and archaeological sites. High-intensity explosions can cause building vibrations and broken glass. Research is being conducted in India and internationally to determine its impact on non-living creatures so that preventative measures can be adopted (Mushtaq 2009).

## **6.1.4 Objective**

Moreover, sound generates headaches, impatience, anxiousness, and a sense of exhaustion, which could lead to more severe and persistent health problems combined with the other variables described above. Therefore, our study assessed the impact of noise pollution on workers' health in the S.I.T.E. area of Bhubaneswar, Odisha. Furthermore, a few recommendations are made based on the results of this study to investigate the adverse effects on workers in the industrial area working for 5–10 years, such that acoustic materials can be suggested, which can reduce pollution and its adverse effects on human health.



## 6.2 Literature Review

Any audible sound in an environment that causes concern is considered noise. It comprises background music, driving cars, and domestic and industrial noise (Dalton and Behm 2007).

Noise pollution was defined as a sound pressure level (dB) above 65. Noise is dangerous when it exceeds 75 dB, and it is advised to maintain noise levels in the environment below 65 dB during the day and below 30 dB at night to promote healthy sleep.

Developing a manufacturing work system that reduces safety risks while maximizing worker productivity and improving worker happiness is vital. Using ergonomic principles can help employers provide employees with a pleasant, secure, and comfortable work environment. The suggested work focused on the important components of industrial noise and analyzed its causes and consequences, particularly on productivity and human performance. 2012. established a computer-assisted ergonomics system to improve the application of ergonomics principles in industrial industries.

According to author noise is constant daily and can cause various auditory and nonauditory health problems. Social noise exposure is primarily influenced by loud noises that harm hearing in industrial environments. To reduce the detrimental consequences of noise pollution, this study discusses the need for businesses to use PPE, soundproof buildings, and vibration-resistant foundations (Panhwar et al. 2018).

The author (Oguntunde et al. 2019) developed a probability model for predicting noise pollution. Based on the survey findings by another author (Melamed et al. 2001), the physiological, auditory, and sleep-related noise impacts are statistically significant at a significance level of  $\alpha = 0.05$ .

Following Hashim et al. (2012), this study compared the evaluation of postural analysis using physical assessment methods and a self-report questionnaire for students between 13 and 15 years of age in a school workshop. Using both physical assessment techniques and questionnaire analysis, it was determined that the 13-year-old children were exposed to greater danger.

The study is to determine how electromagnetic fields and noise at a power plant in Shiraz affect people's psychological well-being. Humans are exposed to various physical and chemical components owing to substantial industrial and scientific breakthroughs. Some of these substances, such as electromagnetism, are called constant elements of the environment (Zamanian et al. 2010).

According to the author (Subramaniam et al. 2019), today's need is to minimize and eradicate noise at its source by utilizing various effective solutions. This study aims to understand how noise is produced and how to stop and control it.

The risk of noise exposure and its consequences on technical operators of tobacco processing machines in Nigerian cigarette firms are evaluated in this research by Hsu et al. The noise generated by various pieces of equipment used in the primary, secondary, and utility production departments was evaluated and examined in three different tobacco factories in Nigeria. This study found that high decibel noise levels

harmed the health and productivity of technicians who spent an average of 12 h/day working on the manufacturing floor.

As a result, the term “noise” describes a sound that lacks an excellent musical quality or is unwanted or undesirable. Noise is just as dangerous a chemical as many pollutants. Noise is becoming a more pervasive and major source of discomfort and risk owing to increased mechanization, the use of more complex and extensive machinery and equipment, and a ramping up in the pace of production.

This study assessed the amount of noise exposure and the potential adverse effects on wheat processing workers. It is suggested that workers in the processing sections wear WHO Class-5 hearing protectors. According to Khaiwal et al. (2016), room acoustics are altered to lessen some sounds transmitted to offices in light of these findings.

This study aimed to determine how electromagnetic fields and noise at a power plant in Shiraz impact people’s psychological health. As a result of substantial industrial and scientific advancements, humans are being exposed to various physical and chemical components. Some of these substances, such as electromagnetism, are known as constant components of the environment (Zamanian et al. 2010).

This study assessed workers from several industrial enterprises in Hyderabad for occupational exposure. It was found that Hyderabad’s manufacturing industry employees were exposed to significant noise ( $p > 0.05$ ) (Panwar et al. 2018).

This result suggests that the tractor driver’s ear equivalent sound pressure level (Leq) was measured during the tillage operations. Six different tractor models with five different tillage implements (moldboard plow, disc plow, rotator, disc harrow, and duck foot cultivator) were evaluated at three different forward speeds. According to Lalremruata et al. (2019), noise control standards should be closely adhered to and supported by the required personal protection equipment, training, and procedures.

According to Mithanga et al., this study aimed to determine the maximum working hours allowed by excessive industrial exposure to noise hazards. Noise exposure was initially measured using a dosimeter, and the results demonstrated that noise-induced hearing loss (NIHL) was significantly more likely to occur in workers exposed to noise. The critical areas were the CAM and CNC departments, which must adhere to the NIOSH and OSHA rules at less than 0.125 and 1.33 h, respectively.

Farooqi et al. state that one of Pakistan’s largest industrial cities, Faisalabad, may experience noise pollution due to the developing robust industrial and transportation infrastructures. This study aimed to map the noise pollution levels in different parts of Faisalabad, compare the levels of noise pollution for each source in the morning, afternoon, and late afternoon, and determine how noise negatively affects human hearing.

## 6.3 Research Procedures

### 6.3.1 Research Design and Sampling

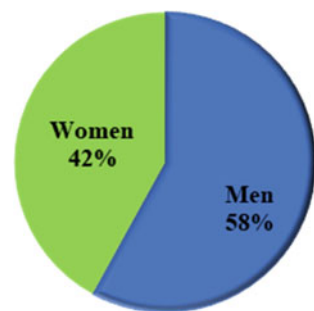
This study was conducted in the Bhubaneswar region and outside of the city. Bhubaneswar is the capital of Odisha, India. The population of this city was 8.37 lakhs (according to the 2011 census), with an area of 422 km<sup>2</sup>. Many small, medium, and micro companies and automobile workshops operate in this city, including the textile industry, automobile workshops, pipe manufacturing companies, and utensil manufacturing companies. Ergo-Fellow (Considering Background Noise Zero) has discovered that the length of sound hits inside and outside the room may be used to quantify the sound effect when a single machine measures noise inside a 3600-square-foot region. This implies that both the inside and outside residents are affected by noise. According to Panhwar et al. (2018) noise pollution causes annoyance and health issues and has become a severe environmental hazard. This essay aims to investigate and assess the degree of noise pollution in Ota's significant neighborhoods.

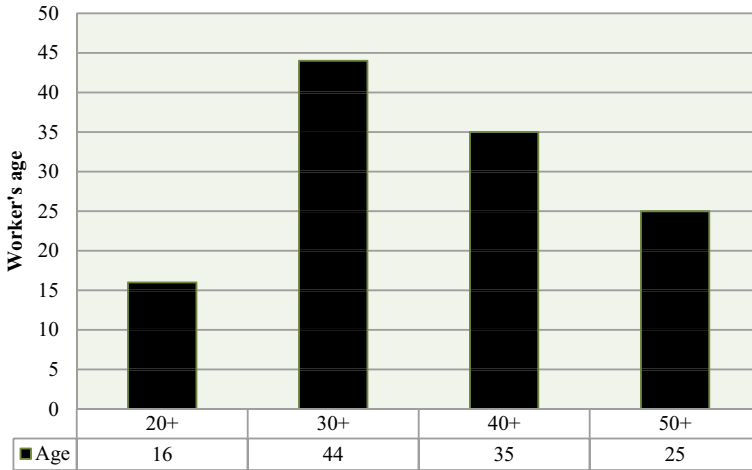
One hundred twenty workers from various workshops of automakers and small businesses in Odisha participated in the study. Seventy men (58% of the total workers) and 50 women (42%) were assessed for hearing problems in a noisy environment in Odisha, India. Workers' ages ranged from 18 to 60 years (Fig. 6.3). Figure 6.4 shows the workers' age distribution from 18 to 60 years, selected for evaluation. The maximum age of the workers was selected to be more than 30.

Figure 6.4 shows the number of workers of various ages who participated in the survey.

In Fig. 6.5, workers are unaware of the impact of the noise produced in industry and automobile workshops after continuous exposure to high noise during work hours, which affects health.

**Fig. 6.3** Number of workers for the study





**Fig. 6.4** Different age groups of workers participated in that study

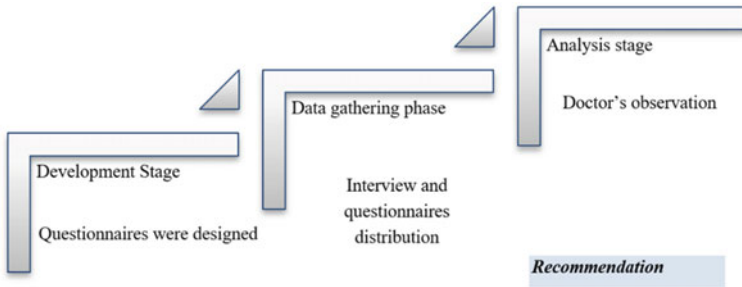


**Fig. 6.5** **a** Worker doing machine maintenance in a utensil manufacturing company, **b** Worker working in the automobile company workshop near Bhubaneswar

### 6.3.2 Health Impact Assessment Methodology

A questionnaire was designed to receive responses from industrial and medical doctors. Doctors were exclusively interviewed to examine illnesses in affected areas linked to noise pollution. Following data collection, the questionnaires were combined using information gathered from respondents during the consultation process. The questionnaire is available as a supplementary file. It was ensured that the respondents had no head injury or hearing loss. The flowchart of the study approach is presented in Fig. 6.6.

A survey was conducted to assess the impact of noise on workers in the noisy areas. A brief question was posed to the company’s workers, residents, and staff in the company’s working area, and they were asked to respond in the open field.



**Fig. 6.6** Survey method for evaluation of the hearing impact

The questionnaire survey list was developed and filled out by posing various questions to residents in that region. Table 6.2 contains data from brief surveys on the characteristics of noise pollution, as per the questionnaire.

## 6.4 Results and Discussion

This is the doctor's survey report, which includes information on the effects of noise pollution on the auditory and nonauditory collected from KIMS Bhubaneswar from June 2022 to January 2023 (within six months). Data were collected for workers working for more than five years in the industry within the age range (18–50). Then statistical software Minitab 16 was used to determine the percentage of workers with hearing problems.

As per Table 6.3, the data were collected from the doctor team through a survey and categorized under nine factors (i.e., deafness, auditory fatigue, disturbance in sleeping, blood pressure rise, disease related to stress, heart rate rise, irritation, rise in breath, and nausea) for 120 patients (workers).

The main contributing factors include long-term noise exposure and continuous work for months or years. The effects of production rates that are not audible include a 14% increase in blood pressure and a 19% disturbance in sleep. The other nonauditory problems listed in Table 6.3 have lower values and fall within manageable ranges; therefore, their effects on blood pressure and sleep quality would not be as detrimental. Aneurysms, heart failure, memory loss, and cognitive challenges primarily result in nonauditory illnesses.

Table 6.4 details the awareness, practices, issues, infections, and awareness of the consequences of noise pollution for workers. As per Panhwar et al. (2018), the same 120 workers were questioned regarding their knowledge of noise pollution. Factor analysis was conducted using Minitab 16 on the data collected by 120 workers on questions (yes = 1 and no = 0) under the six dimensions of awareness, practices, issues, disease, consciousness, and custom effect).

**Table 6.2** Questionnaire for research on noise pollution

Sl. no.	Questions
<i>A</i>	<i>Do you realize the impact noise has on you and others around you?</i>
1	You know it harms your ears, brain, and overall health
2	No, we're not looking for sounds
3	It certainly irritates us
4	We are used to noise
<i>B</i>	<i>Have you ever had a visitor inquire about noise pollution?</i>
1	No, we never witness someone posing such queries
2	Yes, a few times, people came to inquire about it, but nothing further transpired
3	A brief survey was conducted in a few places in the region, but the outcomes were not particularly promising
4	Due to ignorance, we disregard the advice provided by some particular industries
<i>C</i>	<i>Do you have a favorite time of day when there is much noise?</i>
1	Yes, due to excessive noise, the first eight to ten hours of the morning are the most bothersome
2	The evenings are better in the late hours
<i>D</i>	<i>Are you aware of the harm that noise may do to your health?</i>
1	In no way
2	I definitely, understand, like Deafness, irritability, and interrupted sleep
3	Increasing blood pressure, hypertension, etc.
<i>E</i>	<i>Do loud sounds affect you when you're at work?</i>
1	Undoubtedly, we are irritated
2	Sometimes, yes
3	My thinking has changed
4	Undoubtedly, excessive noise irritates us and harms our health, causing us to visit an ENT specialist frequently
<i>F</i>	<i>Are there any other diseases that frequently run in families among your people?</i>
1	No, our family is not affected by a particular disease or problem
2	Yes, because of their noisy workplaces, some members of our family experience stress

According to the results of the structured questionnaires, most workers became familiar with noise pollution and ignored the safety instructions provided by relevant departments. Because almost all organizations operate continuously throughout the day without regard for noise pollution regulations, a higher proportion of employees (94%) complained about noise pollution during the first 18 working hours. As many industries lacked a safety department and insufficient safety equipment, a sizable portion of the workforce (91%) was unaware of noise pollution safety guidelines, leading to bad habits (83%). This study aimed to determine whether excessive noise pollution experienced by workers has adverse health effects on spouses, and 92% of family members reported no health issues.

**Table 6.3** Disease number

Disease name	Percentage (%)
Deafness	30
Auditory fatigue	20
Disturbance in sleeping	19
Blood pressure rise	14
Disease-related to stress	8
Heart rate rise	7
Irritation	7
Rise in breath	4
Nausea	2

The findings of the clinical survey conducted in this study are presented in Table 6.5. Most of the labor force (approximately 90%) comprised men (80%) and adult workers (78%). Most of them (75%) had recently contacted clinics when the situation became problematic (78%), since it was previously acknowledged that there were insufficient labor safety precautions or awareness campaigns. Because the workforce is seen as the foundation of the country's economy, the health consequences of noise pollution on that population are concerning and could directly affect these industries.

Table 6.6 reports the ergonomic effects of noise exposure (OSHA). NIOSH (The National Institute for Occupational Safety and Health) states that sound levels up to 60 dB can be managed. Consequently, they become hazardous. Therefore, managers need protective equipment such as earmuffs or earplugs. Acoustic walls are critical steps that may be used to lower sound levels.

Duration T is computed by  $T = \frac{8}{2^{L-90/5}}$ , where L denotes the sound level.

## 6.5 Conclusions

According to our research, there is a connection between a higher health risk, a problem with noise pollution, and not following the rules and regulations that are already in place. Nonetheless, the companies and residents chosen for this study recognized that the amount of noise enterprises generated in the environment was above the permitted levels, which might lead to several health problems. The studies we evaluated showed a direct correlation between increased health risk and noise pollution. Because most industries are unconcerned about this issue and do not adhere to the norms and current regulatory requirements, noise pollution has numerous adverse effects on health, including auditory fatigue, hearing loss, and discomfort.

Explaining the severe effects of noise pollution and the considerable health effects discussed in this work is critical, as they include hearing impairment (26%), acoustic fatigue (18%), and sleep problems (16%). These side effects can lead to hearing loss,

**Table 6.4** Questionnaire survey results on the impact of noise on the human

Characters	Serial no.	Questions	Percentage of workers (%)
Awareness	A	Do you realize the impact noise has on you and others around you?	
	1	You know it harms your ears, brain, and overall health	05
	2	No, we're not looking for sounds	20
	3	It certainly irritates us	30
	4	We are used to noise	40
Practices	B	Have you ever had a visitor inquire about noise pollution?	
	1	No, we never witness someone posing such queries	04
	2	Yes, a few times, people came to inquire about it, but nothing further transpired	04
	3	Yes, a brief survey was conducted in a few places in the region, but the outcomes were not particularly promising	18
	4	Due to ignorance, we disregard the advice provided by some particular industries	66
Issues	C	Do you have a favorite time of day when there is a lot of noise?	
	1	Yes, due to excessive noise, the first eight to ten hours of the morning are the most bothersome	94
	2	The evenings are better in the late hours	06
Disease	D	Are you aware of the harm that noise may do to your health?	
	1	In no way	91
	2	Definitely, understand, like Deafness, irritability, interrupted sleep	04
	3	Increasing blood pressure, hypertension, etc	5
Consciousness	E	Do loud sounds affect you when you're at work?	
	1	Undoubtedly, we are irritated	10
	2	Sometimes, yes	3
	3	My thinking has changed	83

(continued)



**Table 6.4** (continued)

Characters	Serial no.	Questions	Percentage of workers (%)
	4	Undoubtedly, excessive noise irritates us and harms our health, causing us to visit an ENT specialist frequently	4
Custom effects	F	Are there any other diseases that frequently run in families among your people?	
	1	No, our family is not affected by a particular disease or problem	92
	2	Yes, because of their noisy workplaces, some members of our family experience stress	8

**Table 6.5** Collects the health checkup data from hospitals and clinics

Sl no.		Questionnaire	Age (%)
A		How often do you go to the doctor?	
	1	Annually	3
	2	Six month	75
	3	3 month	10
	4	30 days	7
	5	15 days	5
B		Which age group suffers the most?	
	1	Children	2
	2	Young	80
	3	Aged	18
C		What was the patient's condition when they arrived at the hospital?	
	1	Patient reports are troublesome at this point	78
	2	When symptoms are vague, patients describe	11
	3	Preliminary patient reports	9
	4	Early on, patients arrived, but they disregarded medical advice	12
D		What kind of work does the patient do?	
	1	Office worker	10
	2	Labor	90
E		The most impacted gender is?	
	1	Male	80
	2	Female	20

**Table 6.6** Ergonomic analysis of noise effects on workers in a specific machine based on noise exposure (OSHA)

Machines	Decibel (inside room)	Sound effects in hrs (h)	Outside the room	Sound effects in hrs (h)
Lathe machine	101	1.7	95	4
Grinding machine	134	0.031	120	0.125
Milling/ Drilling machine	104	1.1	99	2.3
Metal cutting saws	115	0.25	107	0.76
Automobile machinery	108	0.66	103	1.3
Weaving mills	94–99 (max)	2.3	90	8
Sawmills	95–105 (max)	1	89	9.2
Air Compressor	95–104 (max)	1.1	89	9.2
Oxy acetylene cutting	96	3.5	92	6.1
Steam turbine (12,500 KW)	91	7	89	9.2
Pulveriser	92	6.1 h	83	21.1 h
Riveting	95	4 h	86	13.9 h
Computer rooms	55–60	38 h	37	43.3 h
Ticking clock	30	47 h	23	49.1 h

annoyance, loss of efficiency, and performance. The current study suggests that new safety rules must be developed, and existing rules must be strengthened to ensure workers' fitness and safety.

### **6.5.1 Recommendations**

Based on the results, the following recommendations were made:

- The present National Environmental (Noise Control) Regulation, implemented in 1996, should be reevaluated and amended according to current control, mitigation, and management needs to preserve the quality of our environment below the standard level.
- In addition to the Environmental Impact Assessment (EIA) given to companies to determine the risk to both human health and the environment, the Central

Environmental Authority (CEA) is requested to perform a Health Impact Risk Assessment (HIRA) with the support of the health authority.

- Every industry must have a system to measure its average noise level electronically. These records must be available for review by internal audits or appropriate law enforcement agencies.
- Industries should construct soundproofing, silent buildings, and storage facilities to reduce noise pollution.
- When installing heavy machinery, vibration dampers should be installed to minimize noise.
- Governmental and non-governmental NGOs should take proper action to control noise pollution in these locations.

## References

- Aluko E O, & Nna V (2015) Impact of noise pollution on human cardiovascular system. *International Journal of Tropical Disease & Health*, 6(2): 35–43. <https://doi.org/10.9734/IJTDDH/2015/13791>
- Anees M M, Qasim M, & Bashir A (2017) Physiological and physical impact of noise pollution on the environment. *Earth Science Pakistan*, 1(1), 08–11. Clark WW, Bohn BA. Effect of noise in hearing. *J Am Med Assoc* 1999; 281 (17):1658–1659. <https://doi.org/10.1001/jama.281.17.1658>.
- Babisch W. Noise and Health. *Environmental health perspectives*. 2005, 113:A14–15. <https://doi.org/10.1289/ehp.113-a14>. PMID: 15631951 PMCID: PMC1253720
- Berglund B, Lindvall T. (eds.) *Community Noise*. Archives of the Center for Sensory Research. 1995;2:1–195. This document is an updated version of the document published by the World Health Organization in 1995, (January 6, 2007). [https://doi.org/10.1016/0160-4120\(97\)81268-8](https://doi.org/10.1016/0160-4120(97)81268-8)
- Bhosale B J, Late A, Nalawade P M, Chavan S P, & Mule M B (2010) Studies on assessment of traffic noise level in Aurangabad city, India. *Noise and Health*, 12(48): 195. <https://doi.org/10.4103/1463-1741.64971>
- Caciari T, Rosati M V, Casale T, Loreti B, Sancini A, Riservato R, ... & Tomei G (2013) Noise-induced hearing loss in workers exposed to urban stressors. *Science of the total environment*, 463: 302–308. <https://doi.org/10.1016/j.scitotenv.2013.06.009>
- Dalton B H, & Behm D G (2007) Effects of noise and music on human and task performance: A systematic review. *Occupational ergonomics*, 7(3): 143-152. <https://doi.org/10.3233/oer-2007-7301>
- Dunne R K, Desai D A, & Sadiku R (2017) A review of porous automotive sound absorbers, their environmental impact and the factors that influence sound absorption. *International Journal of Vehicle Noise and Vibration*, 13(2): 137-163. <https://doi.org/10.1504/ijvvnv.2017.087910>
- Environmental noise-induced effects on stress hormones, oxidative stress, and vascular dysfunction: key factors in the relationship between cerebrovascular and psychological disorders. *Oxidative Medicine and Cellular Longevity*, 2019. <https://doi.org/10.1155/2019/4623109>
- Firdaus G and Ahmad A 2010 Noise pollution and human health: a case study of municipal corporation of Delhi. *Indoor and built environment*, 19(6): 648-656. <https://doi.org/10.1177/1420326x10370532>
- Goswami B, Dutta S, & Pathak T K (2019) Peculiarities in noises to pollute. *International Journal of Prevention and Control of Industrial Pollution*, 5(2): 31-37. <https://doi.org/10.37628/ijpcip>
- Gurjar B R, Ravindra K, & Nagpure A S (2016) Air pollution trends over Indian megacities and their local-to-global implications. *Atmospheric Environment*, 142: 475-495. <https://doi.org/10.1016/j.atmosenv.2016.06.030>

- Hashim AM, Dawal SZM and Yusoff N, 2012 Ergonomic evaluation of postural stress in school workshop. *Work*, 41(Supplement 1): 827-831. <https://doi.org/10.3233/wor-2012-0249-827>  
<https://qwenu.com/2020/07/01/a-noisy-look-into-noise-pollution-and-its-back-wash-by-ogungb-ile-emmanuel-oludotun>  
<https://www.nationalgeographic.org/encyclopedia>
- Józwik J, Wac-Włodarczyk A, Michałowska J, & Kłoczko M (2018). Monitoring of the noise emitted by machine tools in industrial conditions. *Journal of Ecological Engineering*, 19(1): 83-93. <https://doi.org/10.12911/22998993/79447>
- Kahya E The effects of job characteristics and working conditions on job performance. *Int J IndErgonom*2007; 37:515–523. <https://doi.org/10.1016/j.ergon.2007.02.006>
- Khaiwal R, Singh T, Tripathy JP, Mor S, Munjal S, Patro B, & Panda N (2016) Assessment of noise pollution in and around a sensitive zone in North India and its non-auditory impacts. *Science of the Total Environment*, 566: 981-987. <https://doi.org/10.1016/j.scitotenv.2016.05.070>
- Khajenasiri F, Zamanian A, & Zamanian Z (2016). The effect of exposure to high noise levels on the performance and rate of error in manual activities. *Electronic physician*, 8(3): 2088. <https://doi.org/10.19082/2088>
- Kpang MB T, & Dollah O C (2021) Monitoring noise levels in cities: A step towards urban environmental quality management in Nigeria. *World Journal of Advanced Research and Reviews*, 10(3): 348-357. <https://doi.org/10.30574/wjarr.2021.10.3.0194>
- Lalremruata Dewangan K N, & Patel T (2019) Noise exposure to tractor drivers in field operations. *International Journal of Vehicle Performance*, 5(4): 430-442. <https://doi.org/10.1504/ijvp.2019>
- Melamed S, Fried Y, Froom P. The interactive effect of chronic exposure to noise and job complexity on changes in blood pressure and job satisfaction: A longitudinal study of industrial employees. *J Occup Health Psychol*2001; 6:182-195. 11482631. <https://doi.org/10.1037/1076-8998.6.3.182>
- Mushtaq M U (2009) Public health in British India: A brief account of the history of medical services and disease prevention in colonial India. *Indian journal of community medicine: official publication of Indian Association of Preventive & Social Medicine*, 34(1): 6. <https://doi.org/10.4103/0970-0218.45369>
- Oguntunde PE, Okagbue HI, Oguntunde OA and Odetunmbi OO, 2019 A study of noise pollution measurements and possible effects on public health in ota metropolis, Nigeria. *Open Access Macedonian Journal of Medical Sciences*, 7(8): 1391. <https://doi.org/10.3889/oamjms.2019.234>
- Panhwar MA., Memon DA, Bhutto AA and Jamali QB, 2018. Impact of noise pollution on human health at industrial site in Hyderabad. *Indian J. Sci. Technol*, 11: 1-6. <https://doi.org/10.17485/ijst/2018/v11i31/130436>
- Pantawane P B, Dhanze H, Verma M R, Singh G, Kapdi A, Chauhan J, & Bhilegaonkar K N (2017) Seasonal occurrence of Japanese encephalitis vectors in Bareilly district, Uttar Pradesh, India. *Journal of Vector Borne Diseases*, 54(3): 270-276. <https://doi.org/10.4103/0972-9062.217619>
- Panwar A, Jain R, Rathore A P S, Nepal B, & Lyons A C (2018) The impact of lean practices on operational performance—an empirical investigation of Indian process industries. *Production Planning & Control*, 29(2): 158-169. doi:<https://doi.org/10.1080/09537287.2017.1397788>
- Parma Declaration on Environment and Health, the Fifth Ministerial Conference on Environment and Health, Parma, Italy, 10–12 March 2010 ([http://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0011/78608/E93618.pdf](http://www.euro.who.int/__data/assets/pdf_file/0011/78608/E93618.pdf), accessed 7 October 2010)
- Qutubuddin S M, Hebbal SS, & Kumar A C S (2012) A review on effect of industrial noise on the performance of worker and productivity. *International Review of Applied Engineering Research*, 2(1): 43-54.
- Shapiro RA, Berland T. Noise in the operating room. *The New England Journal of Medicine*. 1972 Dec; 287(24): 1236–8. <https://doi.org/10.1056/NEJM1972121242872407>. PMID:5084988
- Singh N, Davar S, Noise Pollution- Sources, effects & Control, *Journal of Human ecology*, 16(3):181187(2004). <https://doi.org/10.1080/09709274.2004.11905735>

- Subramaniam M, Hassan MZ, Sadali MF, Ibrahim I, Daud MY, Aziz SA., ... & Sarip S (2019). Evaluation and analysis of noise pollution in the manufacturing industry. In *Journal of Physics: Conference Series*, 1150(1): 012019. IOP Publishing. <https://doi.org/10.1088/1742-6596/1150/1/012019>
- Zamanian Z, Gharepoor S, Dehghani M. Effects of electromagnetic fields on mental health of the staff employed in gas power plants, Shiraz, 2009. *Pak J Biol Sci* 2010; 13(19): 956-960. <https://doi.org/10.3923/pjbs.2010.956.960>