

Industrial Noise Pollution and Its Impact on the Hearing Capacity of Workers: A Case Study of Gujranwala City, Pakistan

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Received: 03 June, 2019

Accepted: 24 July, 2019

Abstract: The main purpose of this study was to analyze and evaluate the impact of industrial noise pollution on hearing capacity of workers on Gujranwala City. Noise pollution levels were measured at fifty random sample locations with the help of sound level meter, which was placed at a height above 1.2 meters from the ground. Two hundred workers were interviewed through questionnaire method. Different statistical test correlation such as chi-square was applied to analyze the noise pollution level in Gujranwala city. Impact of industrial noise pollution on hearing of workers was shown through different maps using interpolation and buffer techniques. The present study concluded that noise pollution levels were exceeding the permissible limit of noise pollution at all sample locations (WHO, 2000). Workers of factories were suffering from different mental and physical setbacks like annoyance, hypertension, irritation, interference with speech communication and sleep disturbance. There is a great need of holding hearing discussion programs at various levels in factories. One of its major purposes is to impart education to the works to raise their consciousness about noise risks and techniques of prevention. Lastly, the issues of noise annoyance should be included in all future studies on the usage of hearing protection devices.

Keywords: Noise, pollution, industrial workers, hearing capacity.

Introduction

Environmental pollution such as water, air and noise are a continuous concern worldwide upsetting human health. Environmental pollution is prominently increasing and causing serious warnings to the environment. One of the main issues of environmental pollution is noise. Presences of noise-induced hearing loss have been linked with worker exposure to noisy surroundings. (Younes, 2011; Kurakula, 2007). It is a source of psychological damages for human beings (Kupchella, 1993; Younes, 2011; Sørensen et al., 2015; Atmaca, 2005; Durduran, 2008). Noise is a frustrating, irritating sound (Mokhtar et al., 2007; Srivastava, 2012) that turns into anxiety and deafness (Alrefae et al., 2013). Experience to continuous and high noise pollution more than 85(dB) was the reason for hearing loss in human beings. Sound is the physical disorder in a medium like gas, liquid and solid which can be observed by ears. Sound is an important part of our lives but the high intensity of sound is dangerous for humans. Noise is any sound that is exceeding the permissible limit do not matter it is beautiful or not (Kupchella, 1993).

Environmental pollution is continually an international concern disturbing human health. One of the major reasons of environmental pollution is noise pollution (Kurakula, 2007). High noise pollution levels are experienced in industries and their settings. Noise pollution is one of the main factors, which affects workers' health and work efficiency (Noweir, 2013). The problem of noise pollution is not new but, the noise has been known as harmful for human beings

(Rosen, 1974). After World War II, because of industrialization noise pollution increased all over the world (Celik, 1998). Now noise pollution develops major environmental problems globally. Exposure of noise pollution in industrial workers was more than 85 (dB) at their workplaces (Celik, 1998; Fernández et al., 2009; Ahmed, 2012; Khalid, 2011; Noweir, 2012). The most adverse effect of noise pollution is hearing loss, which was recognized as a main work-related health problem. Hearing loss reached about seventy-five percent (75%) of the inhabitants in western countries and twenty-one percent (21%) in developing countries (Khalid, 2011).

Globally 16% of the workers suffered from hearing impairment related to noise pollution experience at the workplace (Hanidza et al., 2013). Global Burden of Disease 2010 was estimated that 1.3 billion workers were affected by hearing loss. In Europe and USA, twenty six percent (26%) of adults had bilateral hearing loss that damages their capability to hear in a noisy environment and roughly two percent (2%) have considerable unilateral hearing loss (Basner et al., 2014). Boateng and Amedofu (2004) pointed out that industrial noise pollution and its effect on the hearing capabilities of workers in saw mills, printing presses and corn mills in Ghana indicate that workers experienced high noise level. Twenty-two-point nine percent (22.9%) workers of a corn mill, twenty-point five percent (20.5%) in saw mills and eight percent (8%) in printing presses had been suffering from hearing impairment. A study conducted the prevalence of hearing loss at the Korle-bu hospital (Nyarko, 2013). Seven hundred fifteen (715) patients

were selected who visited the hospital during the periods of January to December 2013. The result shows that 66.3% of patients had a significant hearing impairment. Highest occurrence of hearing loss was for the age group of sixty (60) and above. In Karachi, the mean noise level was over 66(dB) that causes annoyance. The maximum levels of noise pollution were about 110 (dB), which causes the hearing impairments according to WHO. Noise pollution has been rising due to huge number of industries and urbanization. Noise pollution has numerous harmful effects on human health but it is still not observed as a hazard in our society (Durduran, 2008). It has been noticed that after the industrial revolution number of factories increases and also increases the number of motor vehicles that develop a high noise level. Heavy machines are used in factories that raising noise levels in industries. Unplanned cities and industries also raise the noise levels in underdeveloped countries such as Pakistan. It has turned into severe problems in many industrial cities of Pakistan and affects the employees' health. The main objective of this study was to identify the effects of industrial noise pollution on hearing capacity of industrial workers of Gujranwala city.

Effects of Noise Pollution

Noise becomes the leading problem of noise pollution worldwide that disturbs the daily life and causes hearing loss and other diseases (Basner et al., 2014; Van Dijk, 1990; Guida, 2010; Schell, 1991). Rate of hearing loss was high in industrial setups. Noise pollution levels in industrial settings were more than 80(dB) (Basner et al., 2014; Celik, 1998; Eleftheriou, 2002). Noise-induced hearing loss was the main industrial disorder in the USA. Approximately 22 million US workers faced higher noise pollution levels at the workplace (Basner et al., 2014). Noise becomes a cause of mental disorders, variations in performance and attitude, lack of attention and concentration, anxiety, poor appetency, annoyance, tinnitus, reduced erotic effectiveness, restlessness, sadness, and rigidity (Oliveira, 2012; Basner et al., 2014, Agbalagba; 2013). Noise-induced hearing loss was a major permanent occupational hazard and it was estimated that 120 million individuals have incapacitating earshot problems (WHO, 1999). Annoyance due to noise pollution was a global phenomenon that causes feelings of anxiety. Due to annoyance people suffer from many negative emotions similar to anger, irritation, unhappiness, helplessness, sadness, nervousness, rigidity and tiredness (WHO, 1999; Mokhtar et al., 2007). Noise is also considered an issue that causes many accidents at workplaces (Fernández et al., 2009; WHO, 1999; Mokhtar et al., 2007). Hypertension and speech interference disorders were also associated with noisy surroundings.

Study Area

Gujranwala is located in the Punjab province of

Pakistan. In the northern side of the district located river Chenab and district Sheikhpura lie in the southern border of the Gujranwala. District Hafizabad located in the western border of the district and Sialkot lies at the eastern side of the Gujranwala. There are some major places in Gujranwala like Qila Didar Singh, Ladhaywala Warriach, Talwandi Rahwali, Nandipur, Khanki Headworks, Kamoke, Nowshera Virkan, Wazirabad, Dhaunkal, Rasul Nagar, Sohdra and Alipur Chatta (GOP, 2000). It is the districts headquarter of the Gujranwala, Hafizabad, Sialkot, Gujrat and Narowal. Gujranwala is situated on the main railroad track connecting Lahore and Peshawar. The city distance from other major cities of Pakistan like Lahore is about 63 kilometers, Rawalpindi is 200 kilometers. Important roads of the city are Grand Trunk road, Circular road, Gujranwala Sialkot road and Kutchery road. The estimated population of Gujranwala is 3,400,940, and the population density is 939 persons per square kilometers (GOP, 2000; Minallah, 2016). Gujranwala is an industrial city and the people have to work in light and heavy manufacturing. Major industries are chemicals, food products, and textile and engineering goods. Different types of goods made in the engineering sector like fans, electric washing machines, electric motors and air conditioners. Other industries are steel rolling mills, edible oil and ghee, sugar mills, paper boards, hosiery, marbles and sanitation.

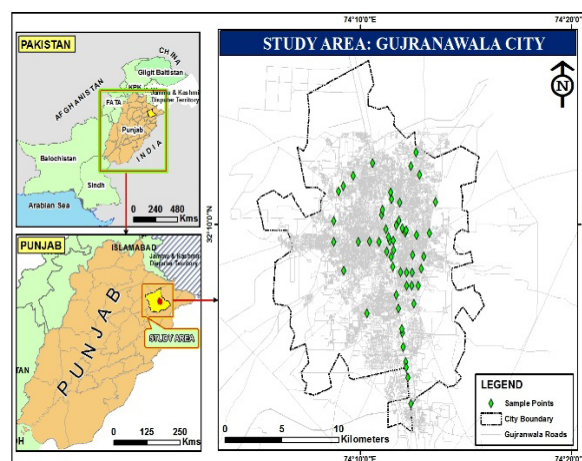


Fig. 1 locational map of the study area Gujranwala city.


Materials and Methods

Water Sampling and Analysis

According to the aims and objectives of the research both primary and secondary data sources were collected. General information about workers was obtained through filed survey. A weighted sound level meter (Table 1) was used to measure the noise pollution level at fifty selected industries of Gujranwala city. Noise pollution level varies according to the location and human behaviors. The sound level meter has calculated the sound as the human ears. A properly structured questionnaire was prepared and

used to get information. Questionnaire contains 26 questions some questions are related the worker's personal profile, diseases that occurred in the noisy environment like headache, hearing loss, ear discharge, earache, annoyance, irritation, tinnitus, exposure of noise pollution and awareness about noise pollution among the workers. In data collection binary earth software GPS device handy GPS (version 16.6) with the accuracy level approximately 15 feet was used to trace the geographical location of the industries visited during the survey. Microsoft Excel 2010 and cross-tabulation was used for the graphical presentation. Chi-square run over to summarize data, in chi-square test find out the association among different variables. Spatial data were analyzed using Arc GIS. Interpolation IDW and buffering analysis were performed to show the noise pollution levels in Gujranwala industries and prepared maps to show hearing loss among industrial workers and pollution level in different location of Gujranwala.

Table 1 specifications of sound level meter.

Measuring rand of sound level meter	30-130Db	
Time for the response	Fast and slow	
Mode of measuring	Immediate, Max hold and leq,	
Way of out put	AC and DC	
Mode of power supply	With power batteries	
Display	LCD	

Results and Discussion

The industrial noise pollution was measured at selected industries in Gujranwala city. The noise levels at all the sample industries exceeded the maximum permissible limits. Table 2 shows the association between impacts of noise level on hearing loss. Results of the above table show that there is a significant association between the impacts of noise pollution. Sixty-six (66.36%) workers experience a very high noise level.

Note. χ^2 = Chi-square. * = $p < .05$. ** = $p < .00$.

Figure 2 shows that maximum noise pollution in industries of the study area was 106 (dB) Mahboob steel re-rolling mills, HSK steel and rolling mills and minimum noise pollution was 86 (dB) in Master

ballpoints pen industries and Sharif industries. Results were shown in (Figure 2) by using raster interpolation IDW with unique value technique. Different colors such as red, orange, yellow were used to present maximum noise levels while tones of green were used to present minimum noise levels in study area. In Figure 2 Red, tones of orange, and yellow was showing highest noise pollution levels in different industries such as Haroon textile industries, Rehman marble factory, Gujranwala steel industries, Mazhar implex and steel industries, Asif steelworks, Malik stainless steel industries, Mahboob steel re-rolling mills, HSK steel and rolling mills, Irfan grinding factory, Haji factory, Aftab marble industries, Diamond marble industries, Khurshid marble industries, Burraq marble industry, Eman marble industry, Fahad textile industries international and Modern textile industry,

Figure 2 tone of green showing lowest noise pollution levels in different industries such as Pepsi beverages, Coca Cola beverages, Industrial estate, Citizen international plastic industries, Khawaja hosiery, Casio metal industries, Master poly plastic industries, Anwar industries, Citizen electrical industries, Master ballpoints industries, Star Mughal industries, Bright metal industries, Fico industries, Gujranwala steel industries, Master tiles industries, Prostar industries, General ceramic industries, Super Asia, Sharif industries, Shaukat soap and ghee industries, Ikram textile industries, Nizam ceramics, Beta fans industry, Sonex international private limited, Domestic cookware, Ali industries, A.T industries, bravo cookware, Ajwa food industry, Zeeshaan food industry, Reliance on food industries and Sonica washing machines industry.

Figure 3, reflects the level of noise pollution and enclosed source area. The major source of noise in Gujranwala is the industries that produced noise pollution. GIS technique was used to describe the noise pollution level though the creation of buffers zones, which provide a proximity analysis tool. Buffers are generated based on the level of noise pollution present in industries. Four buffers used to present the intensity of noise level. Figure 3 described that green shade buffer created 10-meter radius and area encircled by buffers shows that the people living within this zone directly suffer from noise-related problem. Cyan color is showing radius 50 meters, magenta shade is presenting radius 100 meters and red shade showing radius 200 meters.

Table 2. Impact of noise pollution on hearing loss.

Impacts of noise level on hearing loss							
Noise level	Yes	Percentage	no	percentage	total	χ^2	P
High	36	33.64	64	68.82	100	24.621 ^a	.000
very high	71	66.36	29	31.18	100		
Total	107	100	93	100	200		

Note. χ^2 = Chi-square. * = $p < .05$. ** = $p < .00$.

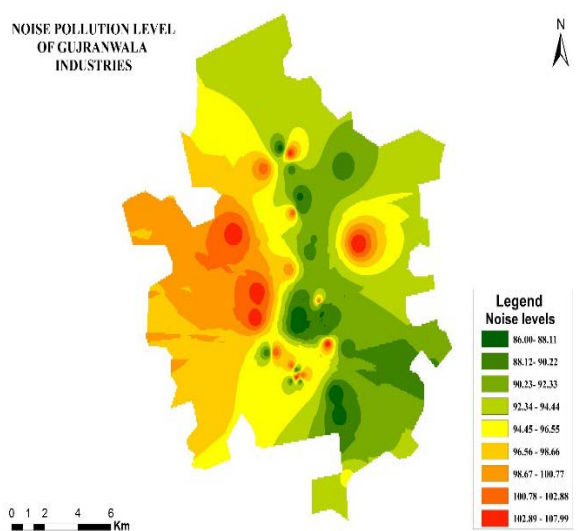


Fig. 2 Noise Pollution Level of Gujranwala Industries

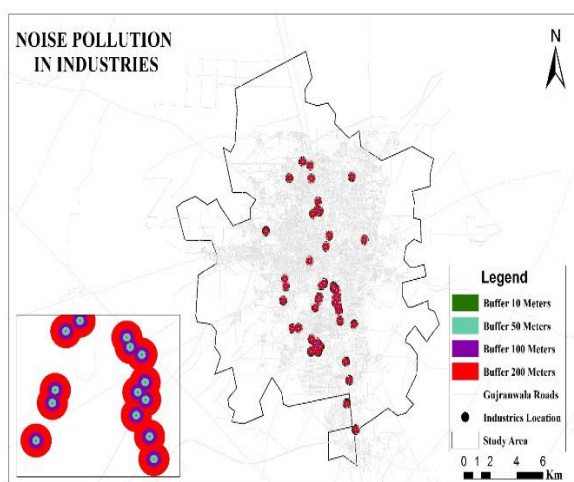


Fig. 3 Noise Pollution in Industries

Conclusion

The present study has a particular and neutral idea about the noise pollution at various sample sites of Gujranwala city. Noise levels were collected at 50 sample sites. It was concluded that noise pollution has increased the maximum permitted parameters of national environmental quality standards at all the sample locations over the city. It shows that all sample locations are experienced to higher noise levels more than 80 (dB). In these industries noise pollution level was higher than 100 (dB) Gujranwala steel industries, Mazhar implex and steel industries, Asif steel works, Malik stainless industries, Mahboob steel re-rolling mills, HSK steel and rolling mills, Irfan grinding factory, Aftab marble industries, Diamond marble industry, Khurshid marble industries, Burraq marble industry, Eman marble industry, modern textile industry, Fiaz textile industries and Fahad asad silk textile industry. Noise level above 85 (dB) measured in these industries Pepsi beverage factory, coca cola beverages, citizen international plastic industries, Khawaja hosiery, Casio metal industries, master and

poly plastic industries, Anwar industries, Citizen electrical industries, Master ball points pen industries, Star Mughal industries, Bright metal industries, Fico industries, Master tiles industries, Prostar industries, General ceramic industries, Super Asia, Sharif industries, Shaukat soap and ghee industries, Ikram textile industries, Nizam ceramics, beta fans, Sonex international private limited, Domestic cookware, Ali industries, Bravo cookware, Ajwa food industry, Zeeshaan food industry, Reliance on food industries and sonic washing machines. It has been identified that there are many diseases associated with noise pollution like depression, headache, sleeplessness, irritation, and annoyance and hearing impairment. All the industries in Gujranwala noise level exceed the permissible noise level that becomes harmful for the workers and many workers suffering from hearing loss, sleeplessness, depression, headaches, annoyance, irritation and speech interferences.

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