

OCCUPATIONAL NOISE EXPOSURE AND ITS IMPACT ON WORKER'S HEALTH AND ACTIVITIES

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ABSTRACT

This Cross-sectional research work based on a number of difficulties faced by workers and effects on their health along with their causes. This study also provides some tips-off to solve the causes in an appropriate way. Data were collected through Environmental Noise Survey, blood pressure measurement and plus rate, Questionnaire filling, and personal interview. Using a digital sound level meter, minimum and maximum sound levels were recorded to distinguish it between average sound levels. This survey was also conducted to identify the health problems like ear allergies, head injuries, fatigue, trauma disease, tinnitus and high blood pressure faced by the workers during the working, and rest of the working hours.

The minimum noise recorded 86.6dB (A) and maximum is 100.8dB (A). This research briefs the outcomes and causes of noise as generated by industries at the workplace.

Keywords: Health Impact, Industrial Noise, Production Units, Workers.

1.0 Introduction

Occupational health and safety are interdependent and complementary to each other; they play a vital role in the life of workers. Hearing loss due to noise pollution is one of the most common occupational diseases, more attention is being paid to its harmful effects (Loukzadeh et al., 2014; Zamanian et al., 2013). Noise hearing loss has been listed as the third epidemic disease worldwide, it can cause physiological and psychological dysfunction (Yuen, 2014). Noises create physiologically, tinnitus and psychologically negative effects on human beings. Among the physiological effects, most of the common is hearing loss (Attarchi et al., 2010; Fada et al., 2017). Development of occupational rules and regulations has been started from the days of the ancient Babylonians (Goetsch, 2008). The safe and healthy workplace is very important for workers, nowadays this is a very growing professional topic (Goetsch, 2008). Occupational health is an important concern, group of working age peoples bear disability burden and sickness due to work place injuries, as noise is drawn a global problem which leads to permanent hearing loss (Ahmad et al., 2001; Gilks & Logan, 2010). Hearing loss can severely compromise the efficiency of workers and their abilities, due to loud noise it is irreversible and may lead to lifetime clinical care or permanent dysfunction (Yankaskas, 2013; Yong & Wang, 2015; Gordon et al., 2016).

In the sense of community noise, where occupational noise due to urban transportation has effected in term of air and noise pollution (Stansfeld, 2015). It is a dangerous risk of hearing keenness, safety, and health due to the high level of noise exposure (Rabinowiz, 2012). Large portion of general public are suffered from chronic noise exposure 79dBA, which is exceeded EPA recommendation limit that possibly will result in long-term adverse effects on hearing (Flamme et al., 2012). The effect of noise can be divided into four categories (A). Physical effects (hearing defects), (B). Psychological effects (irritability and stress), (C). Effects on work performance (reduction of productivity), (D). Physiological effects (increased blood pressure) (Jakovljevic et al., 2006). Occupational injuries arising from work cost the Canadian economy an estimated at 19 billion dollar annually, occupational hearing loss continues to be among ten leading occupational diseases and it is also an alarming sign as hearing is at risk (Gilks & Logan, 2010; World Health Organization, 2014). According to the statistical report, 600 million workers are exposed to occupational noise worldwide (HSME magazine, 2012). Mostly the industrial workers like construction, mining, textile, stone cutting, and loams are severely affected by this problem (Engdahl & Tambs, 2010; Masterson et al., 2015; Fada et al., 2017). It is necessary for industrial workers to be aware of the importance of Primary Protective Equipment in order to overcome the chronic effect of noise (Fada et al., 2017).

Several studies have been published to highlight the negative effects of noise pollution. Hanini & Abdel-Rahim, 2002, identify the strong correlation between Occupational noise and arterial blood pressure (systolic & diastolic), pulse rate, and hearing threshold levels at different frequencies. According to the Chang et al., 2003, they identify a significance difference of 16mmHg of systolic blood pressure in sleep-time existed between two exposures group at automobile factory in China. Kerketta et al., 2011, they worked at India chromite mining complex regarding methodical noise monitoring inside the work zone area. According to the Alsheikh & Dana, 2012, they identify the possible effect of noise pollution related blood oxygen saturation, hearing threshold levels, pulse rate and blood pressure, they indicated workers exposed to noise more than 90 dB. Yousif et al., 2013, assessed the exposure of noise pollution in selected industries in Duhok city Iraq, they discussed the risk of arterial blood pressure where workers exposed with occupational noise effects.

In the early stage, it is very difficult to diagnose the occupational health diseases as they often have a long latency period, most workers' hearing ability is affected through the dangerous effect of high noise level (Ashrafi, 2005). The productivity of the industrial enterprises and physical burden of work has been decreased by placing modern automated machines in industries.

In Pakistan, noise is the main cause of hearing impairment, and industries are the main source (World health organization, 1997). Pakistan national environmental quality standards (PEQs) is set for motor vehicles noise only, the maximum permissible noise emission limit is 85 dB (A), there are still no other rules and regulations in Pakistan (Pakistan Environmental Protection Agency, 2007). The situation is worst in developing countries like Pakistan due to lack of awareness and weak legislation, the recent negative result is even bigger. To overcome this problem more workshops and public seminars should be established to illuminate the hazards of noise. So, the higher authorities and workers take more interest to maintain the health and safety measures at work place.

The aim and objective of this research are to evaluate noise level and their impact on worker's health and investigates the perception of plant workers attitude about health and safety. This paper also helps to describe the status of occupational noise pollution in the small and medium enterprises in Karachi city. It is very important to understand occupational noise exposure in different areas and relationship between noise and its adverse effect on human body. This study disclosed noise emission level, workers health, and change in blood pressure before and after noise exposure. The effect of noise on industry workers leaves severe economic, psychological impact on worker's life. In Karachi-Pakistan, there is a lot of hidden research areas to discover more in this field. This project was planned to evaluate the exposures of noise levels, health impact and safety measures in some selected industrial workers at Karachi city.

2.0 Materials and Methods

This research work evaluated the occupational noise exposure and its impact on industrial workers. The sample of this study consists of 100 workers from five different industries: Textile, Agro-based (fertilizer), Marble & Mosaic, Khaddi loams (home based) and Lather Industry (Tannery). The worker's age group around 25 to 35 years, with the same working hours, all workers are in a good condition and no history regarding hearing loss and they have at least four years working at the similar workstation. These 100 workers represent five above-mentioned industries (20 workers/Industry). Officers and their subordinates are clearly understood about the theme of this study. Mostly all of them are helpful and self-motivated. Data was collected through Environmental Noise Survey, blood pressure measurement and pulse rate, Questionnaire filling, and personal interview.

Noise survey was conducted in accordance with the procedure standard manual of ASTM E-1503 for accurate and precise results. The blood pressure and pulse rate value were measured for each worker by Electronic Digital Wrist blood pressure Medical Rossmax, accuracy ± 3 mmHg (Z46). Samples were collected twice a day first in morning 9:30 am to 10:00 am and second is after 4hrs-5hrs (during work), the measurement includes systolic and diastolic blood

pressure and pulse rate by using portable equipment. A comprehensive questionnaire was prepared in the English language which is based on five parts (Short description about workers, Analyzing working position and general awareness, Using of primary protective equipment, Agree and disagree statement and risk perception, Awareness of worker's health). Personal interviews were held for those plant workers that they are illiterate but highly experienced. Such workers are usually unable to express their feelings in written form, with the help of interview we understand their feelings and valuable information related noise exposure and relevant to safety measure.

3.0 Results

To understand the impact of noise exposure on worker's health in Karachi City, many variables such as pulse rate, noise level and blood pressure were analyzed.

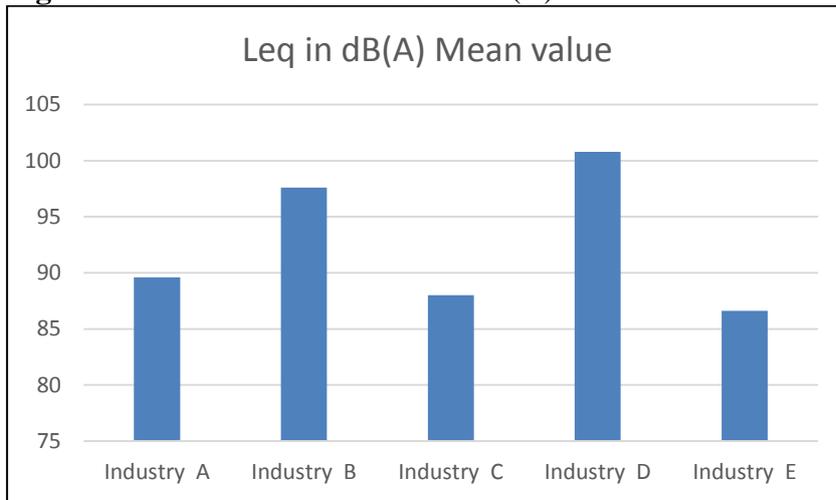
3.1 Environmental noise survey

Quest, U.S.A 2900 type-2, measuring unit (dB), accuracy ± 0.5 were used for noise measurement. Noise exposure were measured in work stations corresponding to each sampled workers location. Noise survey was conducted in accordance with the procedure standard manual of ASTM E-1503 for accurate and precise results.

Table 1: Noise Level Pollution in dB (A)

S.no	Name of Industry	Type	Number of Worker Examined	Leq in dB(A) Mean value
1	Industry A	Textile Sector	20	89.6
2	Industry B	Agro-based (Fertilizer Unit)	20	97.6
3	Industry C	Marble and Mosaic	20	88.0
4	Industry D	Loam Unit, Khaddi (home based)	20	100.8
5	Industry E	Lather Industry (Tannery)	20	86.6

Figure 1: Noise Level Pollution in dB (A)



3.2 Measuring blood pressure and pulse rate.

The blood pressure and pulse rate value were measured for each workers by Electronic Digital Wrist blood pressure Medical Rossmax, accuracy ± 3 mmHg (Z46).

Table 2: Net change of blood pressure (systolic and diastolic), and pulse rate before and after exposure.

	Systolic (mmHg)	Diastolic (mmHg)	Pulse rate (Beats/minute)
Before exposure	120.0	77.0	76.7
After exposure	127.8	85.0	89.5
Net change	7.8	8.0	12.8

Sample were collected twice a day first in morning 9:30am to 10:00am and second is after 4hrs-5hrs (during work), the measurement includes systolic and diastolic blood pressure and pulse rate by using portable equipment.

Figure 2: Values of average systolic blood pressure Vs noise pollution level (before and after)

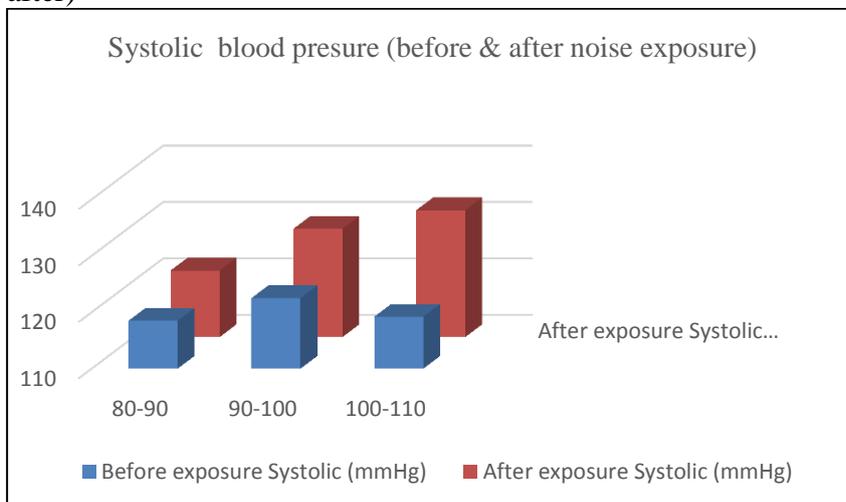


Figure 3: Values of average Diastolic blood pressure Vs noise pollution level (before and after)

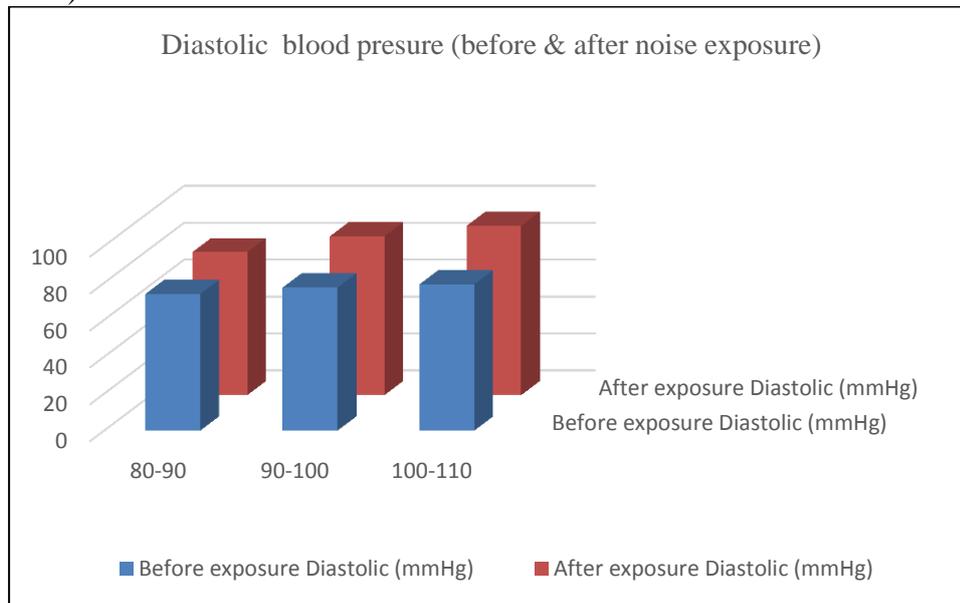
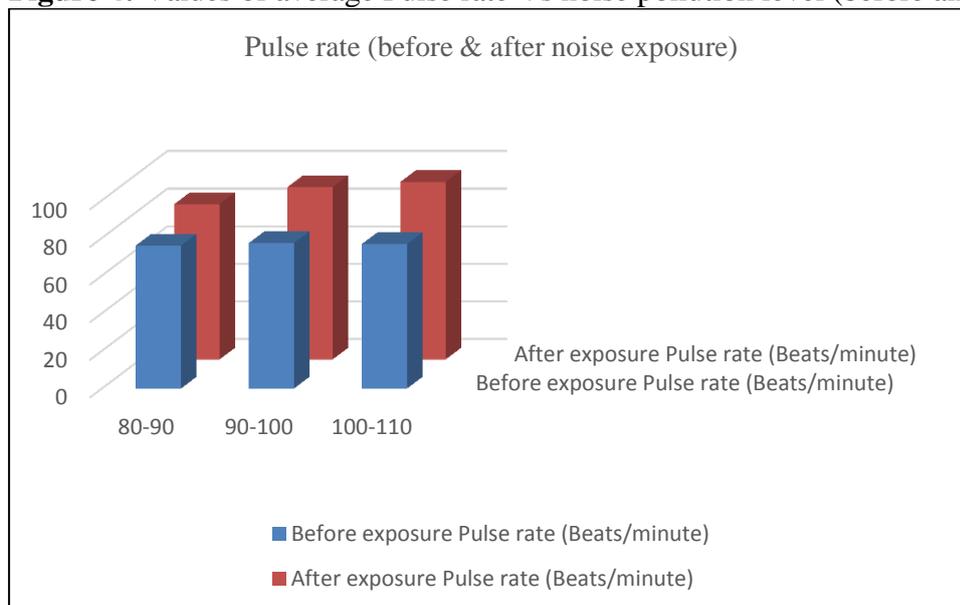


Figure 4: Values of average Pulse rate Vs noise pollution level (before and after)



3.3 Analyzing Questionnaire

A comprehensive questionnaire were prepared in English language. This part was to examine the data of the questionnaire according to the classification.

3.3.1 Analyzing working position, noise exposure and workers health Injuries

This part have seven (07) questions. 1st and 2nd questions includes standing and operating position of worker in work place, 3rd and 4th question consist of about the mental feelings, 5th to 7th about to understand speech interference working stress and educational background related to threat of noise exposure.

Figure 5: Noise exposure and workers health Injuries

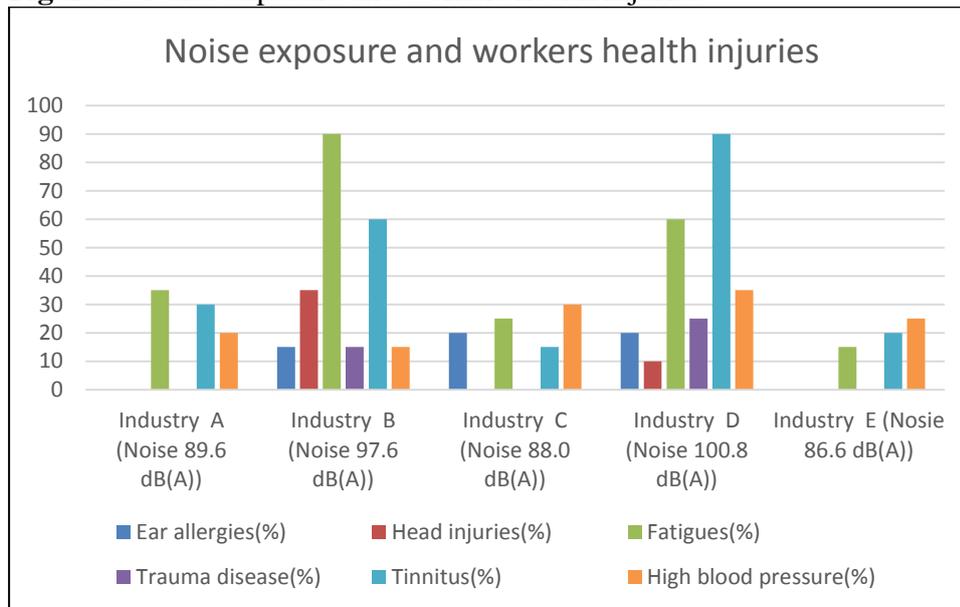
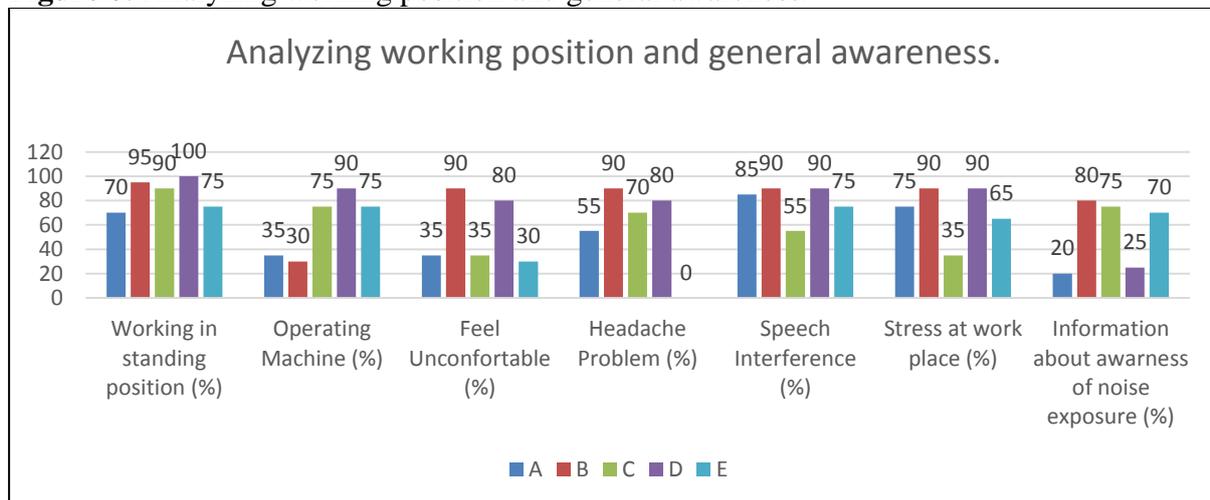


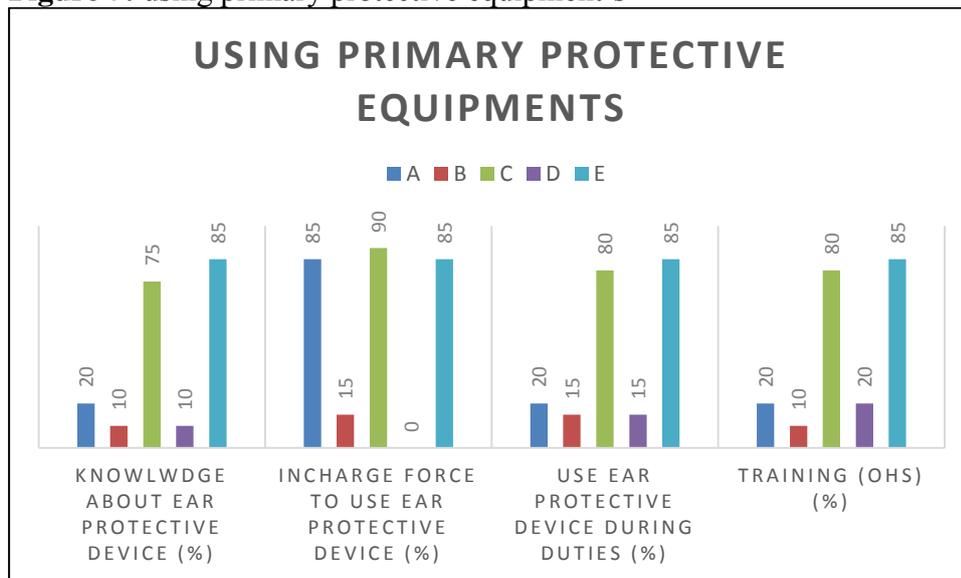
Figure 6: Analyzing working position and general awareness.



3.3.2 Using primary protective equipment's

This part consist of Five (05) questions is to understand about the individual's knowledge for using of primary protective devices and his feeling about using these safety devices and employers strictness wearing safety devices during working hours.

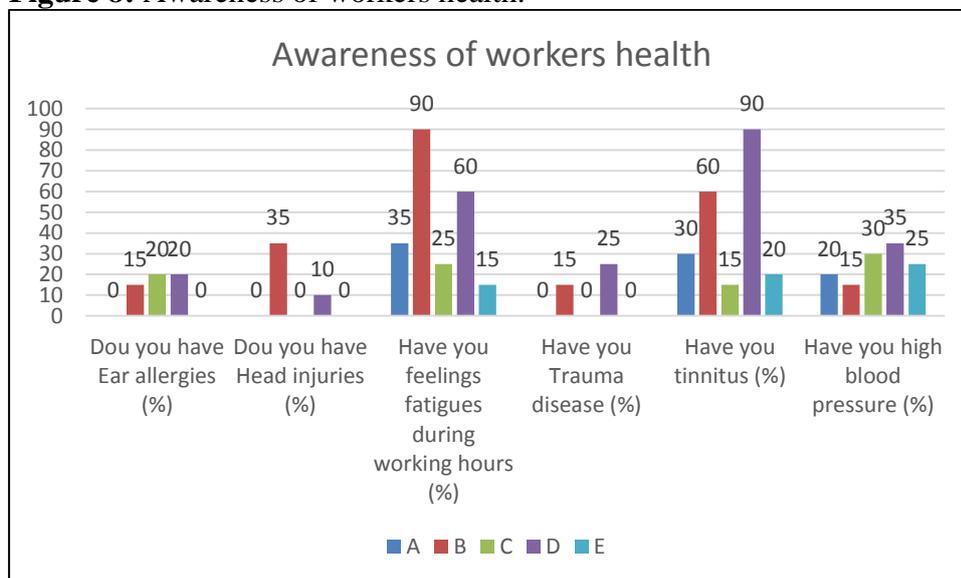
Figure 7: using primary protective equipment's



3.3.3 Awareness of worker's health

This part of the questionnaire comprise six (06) questions. These questions is to understand and analyze the worker's health and study the injuries level due to noise exposure.

Figure 8: Awareness of workers health.



4.0 Discussion

Fig. 1 and Table 1 showed the different sound level in selected industries situated in Karachi city which lies between 86.6 dB (A) to 100.8 dB (A) with mean value of 92.5 dB (A), which can be considered as a high value according to Pakistan standard 85dB (A) and OSHA permissible limit 90dB (A). Working hours are similar to each selected plants (8hrs per day). Blood pressure (systolic and diastolic) and pulse rate before exposure are close for the many individuals (sample), and the strength of the outcome is good; Fig. 2, 3 and 4 show that the measured values are increased after noise exposure which indicates that the change of values is depending on the noise exposure level. From Table: 2 we can see the systolic blood pressure increased by 7.8 mmHg, while the diastolic blood pressure increased by 8.0 mmHg and the pulse rate increased by the value of 12.8 beats/minute.

This research is similar and comparable with other studies, which give it high credibility, for example, Talbott et al., 1999, showed the range of noise exposure 83 dB (A) to 89 dB (A), here the mean increase value of systolic blood pressure is 2.5 mmHg and that of diastolic blood pressure 2.5 mmHg. Alsheikh & Dana, 2012, found significant increase in both diastolic and systolic blood pressure in response of noise pollution. According to Kamil & Faris, 2017, showed that for noise level difference between 76.5 dB (A) to 98 dB (A), there is a mean increased of systolic blood pressure is 6.07 mmHg and diastolic blood pressure is 2.63 mmHg. Katya et al., 2017, estimated the prevalence of hearing loss, occupational noise and using of hearing protection devices, his finding consistent with other industrialized countries, underscoring the need for ongoing awareness of noise pollution.

The questionnaire was examined according to the following classification. Short description about the workers, analyzing the working position and general awareness, using of primary protective equipment, awareness of workers health.

a. Short description about the workers

Purpose of this part is to understand the basic and formal knowledge about all the workers, thus candidates with same age, gender, education, experience level group and similar working hours were chosen in all selected industries.

b. Analyzing working position and general awareness

Industry-A, according to the Fig. 6, there are 70% employees working in a standing position and 35% workers operating the machine at least 8hrs per day. In general, the mean operating time of the machine is 7hrs each day. 35% workers feel uncomfortable and 55% workers complain headache issue during working hours. 75% workers feel stressful and 85% workers complain about speech interference, in Industry-A maximum number of workers do not aware about the effect of noise exposure.

Industry-B, (fertilizer plant) 95% workers are working in standing position. 30% workers are working with a machine, 90% workers feel uncomfortable, headache and speech interference during working hours. In this agro-based unit, 80% workers know about hazards effect of high noise exposure.

Industry-C, 90% workers are working in a standing position and 75% workers are operating machine while during working hours 35%, 70%, and 55% workers feel uncomfortable, headache and speech interference respectively. 35% workers feel stress with noise 75% workers are aware of the hazards effect of high noise level.

Industry-D, which is home-based (khadi) plant, where 100% workers are working in standing position, 90% plant workers are operating the machine, 80% workers feel uncomfortable and headache, 90% have stress while working in a noisy area, while only 25% workers have knowledge about noise hazards effect.

Industry-E is a Lather based Tannery unit, where 75% workers are operating a machine in standing position, 30% workers feel uncomfortable, 75% to 65% workers feel speech interference and stress in working hours, respectively. 70% workers have knowledge about hazards effect of noise.

c. Using primary protective equipment

According to the Fig. 7 Industry-A, only 04 (20%) persons know about the benefits of primary protective equipment here 20% workers are those who have safety training 30% & 35% are those who feel stuffy and headache while using PPE's.

Industry-B, agro-based fertilizer unit here 16 (80%) Of 20 know about the hazards effect of noise but their managers are immature to understand the benefits of PPE's 85% workers complain that their bosses do not give proper protective device, here only 10% are who have self-training about HSE.

Industry-C, this is stone cutting marble and mosaic unit here 75% have information about PPE's, 90% workers say that their managers force them to use PPE's during working hours, 16(80%) workers are self-motivated for using safety devices these 16 of 20 workers have certified occupational health and safety training, only (20%) 04 Of 20 feel stuffy and criticize for wearing safety devices.

Industry-D, Loam (Khaddi) unit here only 10% have information about protective devices, here many plants workers want to wear noise protective devices and their bosses unable to do. 90% workers complain that their employer does not give safety devices. 20% have safety training these 04 of 20 workers are those who have the interest to learn safety procedure and noise control measures.

Industry-E, this is ISO certified Tannery so here 85% knows about the benefits of ear protective devices and they also agree that their managers force them to take safety measures during working hours, these 17(85%) Of 20 workers have certified safety training.

d. Awareness of workers health

Fig. 1, 5 & 8 express the worker's health and noise level at their work site. Industry-A (Textile unit) in this Unit mean noise value is 89.6 dB (A), workers do not complain of any ear allergies, head injuries and trauma disease many workers complain that their plant managers do not provide noise safety devices. Safety literacy level is also low according to the filled questionnaire and personal interview it is noted that 35% samples feel fatigue, due

to high noise exposure 30% have tinnitus and 4(20%) have high blood pressure, 4 persons are those who work in power plant area where mean noise value is 97.5dB(A) in 8hours duration. Industry-B (Agro-based) this is a liquid fertilizer manufacturing unit mean noise value is 97.6 dB (A), only 10% workers have safety training 90% workers are those who have headache problem during working hours, in this unit here managers are not serious regarding high noise pollution and its impact on their workers, in this industry 15% have ear allergies, 35% have head injuries, 90% feeling fatigue in working duration, 15% have high blood pressure and heart disease. Due to noise exposure, 60% workers have tinnitus problem. Industry-C (Marble & Mosaic) here mean noise level is 88.0 dB (A), many people have a knowledge about noise and safety measures, employer of this unit is keen to obey defined health and safety procedures, only 20% who feel stuffy while using PPE's, only 20%, 15% have ear allergies and tinnitus these are those who work in stone cutting area where noise is 88.0 dB (A), there is no one who complains trauma disease. Industry-D (Loam Unit, Khaddi), mean noise value is 100.8 dB (A) in this unit information about occupational noise is low only 20% have safety training this 20 % are those who have self-motivated and education lover, due to high noise exposure 20% workers have ear allergies, 10% have head injuries, 60% people feel fatigue during working hours, 20% have trauma disease this 20 % are those who work with machine in standing position. 90% have tinnitus who work in the production area, 35% have blood pressure. Industry-E (Lather Industry) here mean noise value is 86.6 dB (A) this is a certified unit here maximum people have a training about occupational safety and health, managers are strongly interested to implement health and safety procedure in their working premises, 85% workers use safety devices there is no any complaint regarding ear allergies, head injuries and trauma disease, only 15% have feeling fatigue during working hours these 15% are those who do not use safety devices. 20% complain about tinnitus these are those who work in compressor room due to high noise at generator room 25% workers feel high blood pressure.

5.0 Conclusion and recommendation

Noise is not a new hazard, Health and Safety are mandatory to each other. With the reference to studied plants, Industries needs to pay attention as hearing loss is their main concern. In all studied plants, noise pollution is very extensive. The range of occupational noise exposure is from 86.6 dB (A) to 100.8 dB (A). Our Home-based industries, occupational noise exposure is a very obvious hazard, many Units are not mechanized. It is noted that high level of noise pollution can affect the human ear and lead to the increase of blood pressure, which can cause heart disease.

Furthermore, because of the economic and political condition, most of the machines are not working or even running at half capacity, so it is expected that the noise ratio would exceed the measured value.

One of the biggest problems is that especially in home-based units there is no awareness about noise pollution among workers, managers and plant owners, even they have not any safety procedures and any devices to prevent from the hazards noise.

Another high issue being noticed during surveying is that the many industries do not obey and they neglected Health and Safety Laws.

While sum up all the discussion, present situation of noise pollution in the industries is worst. It is necessary to protect the plant workers and make some necessary action to control this situation.

For the prevention and control of the noise hazards, controlling measures must be implemented in all the factories urgently.

Most of the plant workers have problem with high noise pollution but the main thing is that they even do not have any knowledge of the harmfulness of Industrial Noise Pollution, thus it is recommended that it is necessary to mitigate this problem through publishing helpful material in print media and awareness programs in TV channels to make people aware the effects of Industrial Occupational Noise pollution and their corrective measures.

In Pakistan, there is no authentic legislation to cope with industrial noise pollution at the National level. Therefore, "Occupational Noise Pollution Control Act" should be passed by Government for the betterment of Pakistani Workers.

The government takes a stand for such Un-registered Industries, as they should register themselves with local administration, adopt and implement Health and Safety rules.

Home-based Industries are facing the financial problem. In this aspect, we suggest that the governmental organizations support and provide an interest-free loan for small and home-based industries. So, that they would take care of health and safety of their workers.

Industries should place insulating enclosure on high noisy areas to reduce the hazards of noise. Those machines with the problem of wear and tear should go for the proper maintenance and noise problem could be adjusted by reducing the speed of rotating and moving parts of a machine.

It is recommended that mainly workers are not provided Primary Protective Equipment by management. So, it's recommended to take a step to mitigate noise effect by providing Primary Protective Equipment in all sort of Industries.

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Declaration

Author(s) declare that all works are original and this manuscript has not been published in any other journals.

Authors contribution

Author 1: Idea conceptualizing, literature review, drafting the final manuscript, publication.

Author 2, Author 3, Author 4: Advice, guidance and technical assistance during manuscript preparation.

Author 5: Assistance during surveying and data collection.

Abbreviations

PPE's:	Primary Protective Equipment's
dB:	Decibel (unit of sound)
dB (A):	Decibel (unit of sound) by the A-weighted
mmHg:	Millimeters of Mercury (unit of blood pressure measurement)
hrs:	Hours
HSE:	Health Safety and Environment

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