Occupational Noise Exposure in Small and Medium-Sized Industries in North Cyprus

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ABSTRACT

The aim of the study is to investigate the noise levels in various small and medium-sized industries in North Cyprus in order to identify industries that might need further investigation due to high noise levels.

No prior studies have been done on industrial noise exposure in Northern Cyprus. Occupational safety and health rules and regulations in North Cyprus states that monitoring noise levels, understanding the workers individual noise exposure and providing personal ear protectors is the responsibility of employers. It is observed that none of the companies visited are following these requirements. Exposure to excessive noise can cause health problems including temporary or permanent hearing loss, concentration problems, stress, nervousness, sleeping problems and fatigue.

We measured noise levels in different industrial settings in North Cyprus using cirrus 273 integrated sound level meter with octave band filters. Occupational safety and health standards for noise exposure were used as the benchmark for our data analysis. Questionnaires were designed to determine how much employees were affected by high noise levels in the workplace. We analyzed the data using SPSS statistical program.

Survey responses identified the most likely problems faced by industrial workers in North Cyprus. Sound level mapping informed worker noise exposure. Future studies will focus on industries with the highest noise levels, monitoring worker noise exposure using a dosimeter.

Keywords: Occupational Health and Safety, Noise Exposure, Small and Medium-Size industries in North Cyprus, Hearing Conservation, Perception Risk

ÖZ

Bu çalışmanın amacı Kuzey Kıbrıs taki küçük ve orta ölçekli işletmelerin gürültü seviyelerini araştırmak ve bu yönde daha fazla ilgi isteyen yüksek gürültülü işletmeleri ortaya çıkarmaktır.

Kuzey Kıbrista daha önce endüstriyel gürültü maruziyeti ile ilgili bir çalışma yapılmamıştır. KKTC iş sağlığı ve guvenliği yasasına göre işyerlerinde gürültü seviyesinin izlenmesi, çalışanların kişisel maruziyetinin anlaşılması ve kişisel kulak koruyucu ların sağlanması işverenin yükümlülüğüdür. Ziyaret edilen şirketlerden hiç birinin bu gereksinimleri yerine getirmemektedir. Yüksek seviyedeki gürültü maruziyeti kalıcı veya gecici sağırlık, dikkat sorunu, stres, gerginlik, uyku problemleri ve aşırı yorgunluk gibi sağlık sorunları yaratabilir.

Kuzey Kıbristakı değişik sanayilerin gürültü seviyeleri Cirrus 273 marka gürültü ölçüm cihazı ile ölçülmüştür. Veri analizinde iş sağlıgı ve güvenliği standartları baz alınmıştır. İş yerindeki gürültüden çalışanların ne kadar rahatsız olduğunu anlamak amacıyla anket tasarlanmıştır. Anketlerin analizi Kuzey Kıbrıs taki değişik endüstrilerde gürültü bağlantılı problemlerin ortaya çıkarılmasını sağlamıştır.

Gürültü seviye haritalarının hazırlanması çalışanların iş yerindeki gürültü maruziyeti hakkında fikir vermiştir. Gelecek çalışmalar en yüksek gürültü seviyesi tespit edilen endüstrilerde çalışanların gürültü maruziyetinin dosimeter ile ölçülmesini içerecektir.

Anahtar Kelimeler: İş Sağlığı ve Güvenliği, Gürültü Maruziyeti, Kuzey Kıbrıstaki Kücük ve Orta Ölçekli İşletmeler, İşitmenin Korunması, Algılama Riski

This thesis dedicated to my parents & my sister

Mohammad & Simin ZAHIRI

Rojin ZAHIRI

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY

Decibel (dB): A dimensionless unit equal to 10 times the logarithm to the base 10 of the ratio of two values. In occupational noise measurement, decibels are usually measured in terms of sound pressure, and referenced to 20μPa.

Exchange Rate: Number of dB required to halve or double the allowable exposure duration.

Frequency Weighting: Method of applying frequency-specific weights to any noise measurement. Three weighting networks are available: A, B, and C. A-weighting closely imitates the spectral response of the human ear to sound frequencies, deemphasizing lower and higher frequencies (0-1000 and 5000-16000 Hz)h and emphasizing mid-range frequencies (1000-5000 Hz)

Impact/Impulse Noise: Noise levels which involve maxima at intervals greater than one second. Impulse and impact noise are measured using the fast response setting on a sound level meter

LEQ: The average sound level measured during a given period based on a 3 dB exchange rate and defined as the equivalent average exposure level.

Maximum Level: Maximum weighted sound pressure, in dB, with application of response time constant

Noise: Unwanted sound

Peak Level: Maximum instantaneous unweighted sound pressure, in dB

Response Time: Time constant or exponential averaging time, applied continuously to sound pressure measurement. Two response times are available: SLOW (1.0 s time constant) and FAST (0.125 s time constant)

Sound level: The intensity of noise as indicated by a sound level meter

Sound level meter: An instrument that measures sound levels.

Time Weighted Average (TWA): The sound level in dB accumulated for any time period but with an average level computed over an 8 hour time period.

Chapter 1

BACKGROUND

1.1 Occupational Health and Safety

Health and safety are interdepending and complementary to each other. Historically attention given to health and safety has steadily increased. Developments began from the days of the ancient Babylonians. At that time, the ruler developed codes. Some part of this was the perspective of safety and health which were clauses dealing with injuries, allowable fees for physicians, and monetary damages assessed against those who injured others. This development continued in later Egyptian civilization when an industrial medical service was established. As the civilization developed so did attention to matters of safety and health with the industrial revolution there was a perpetual change in the methods of manufacturing of the products. These changes in the industries led to more attention to the safety and health of the workers. The industrialization with use of steam power increased the risk of exposure to hazards and risks for occupational injuries and diseases. During the industrial revolution children commonly worked in the factories and with long working hours, in difficult unhealthy and unsafely conditions. With these situations the workers started to ask for improving the work environment initiating the first alteration in the health and safety outline. With the growth of the industrial sector, the different health and safety committees and organizations were established. Simultaneously, various laws and regulations were imposed. Specific health problems that were tied to workplace hazards have played a significant part in the development of the modern safety and health movement. Resulting in improved work procedure and better working conditions (Goetsch, 2008 p.13).

After the 1800s different types of accident prevention programs were established in the workplace. Widely used accident prevention techniques included failure minimization, isolation, lockouts, fail-safe designs, personal protective equipment (PPE), time replacements, redundancy, screening and so on. Before that time, employers had little interest for the safety of the worker. Between the first and Second World War, industry discovered the relation between quality and safety (Goetsch, 2008 p.13).

The safety and health movement has changed and developed since the industrial revolution. Today, there is prevalent understanding of importance of having a safe and healthy workplace. On the other hand the complexities of today's workplace have made safety and health a growing professional topic (Goetsch, 2008 p.17).

1.1.1 OSHA

As stated in the previous section, with the growth of industrial sector, committees and organization addressing health and safety were founded in different countries. One the most well-known organizations is the Occupational Safety and Health Administration (OSHA) which is an agency of the United States Department of Labor. OSHA has about a 40 year history in protecting occupational health and safety (U.S department of labor-OSHA (USDOL-OSHA), 2009). Since its establishment, OSHA has helped reduce the injury and diseases rate by more than half. Although accurate recorded are not available, it is estimated that in 1970 around

14,000 workers were killed on the job in USA. This number fell to approximately 4,340 in 2009 (USDOL-OSHA, 2011).

OSHA was established in 1971 and started to officially work that same year. Following establishment of OSHA, a training institute was established to educate private sector and federal government safety personnel. Since its creation, over 210,000 safety professionals have received training at the training institute. In 1992, OSHA Training Institute began partnering with colleges and universities to conduct workplace safety classes. In 1972 the first OSHA state plans standards approved in South Carolina and extending to the government workers. That same year OSHA issued standards for construction workers. Subsequently OSHA starts to impose various laws for different workplaces and sectors. In 1975 OSHA established On-site Consultation programs in order to help small sizes businesses. On Jan 16th 1981 OSHA issue the hearing conservation standard which requires that hearing protective equipment be provided to workers who are exposed to noise levels above 85 decibels. In 2007 OSHA confirms through a rule that employers must pay for PPE such as respirators, earplugs and gloves (USDOL-OSHA, 2011).

OSHA has responded to any diseases and disasters, since of its creation. For example in September 11, 2001, OSHA sent staff to Ground Zero in New York City and the Pentagon to monitor worker exposure to hazards during cleanup and recovery operations and to fit test and distribute respirators. During the deepwater horizon oil spill incident which occurred on 29th of April, 2009 in USA, OSHA acted as part of a coordinated federal response, to ensure that the workers were protected from chemicals hazards (USDOL-OSHA, 2011).

1.1.2 Occupational Noise

One of the most common hazards threatening occupational health and safety is excessive exposure to noise which can result in permanent hearing loss. Excessive noise exposure can occur in small and big industrial and manufacturing environments, as well as in farms and in the public areas.

With the development of industry and mechanization of factories, physical activities decreased and at the same time undesired and unavoidable high noise levels were generated in plants.

“Noise is not a new hazard. It has been a constant threat since the industrial revolution” (National Institute for Occupational Safety and Health (NIOSH), 2009). Noise can affect the ears as a short term problem which usually resolves after leaving the noisy environment. Such transient problems include feeling stuffed up in ears or temporary tinnitus. However, repetitive exposure to permanent high noise levels can lead to incurable hearing loss or permanent tinnitus.

One of the most common occupational illnesses from excessive exposure to noise is hearing loss, which often goes unrecognized because these are non-visible effects. Other health effects include (The State of Queensland Department of Justice and Attorney-General, 2009):

- An increase in heart rate and blood pressure
- Stress which can lead to irritability and head aches
- Annoyance and speech interference
- Sleep disturbance

- Fatigue
- Reduced white blood cell count and reduced immune response
- Gastric ulcer
- And the development of hypertension which can lead to strokes and heart attacks

Noisy work place can cause distraction. Noise can disrupt the workers concentration, which can lead to accidents (Goetsch, 2008 p.633).

Several studies have shown exposure to high noise level cause to several kind of illness. One of the most common of these patients is blood pressure. These studies shows that blood pressure can change when exposed to high noise level. These studies declare the positive association and significant relation between blood pressure and occupational exposure to noise. The disease results include narrowing of the blood vessels of body and heart attack (Powazka, 2002).

To prevent occupational injury due to excessive noise exposure, noise levels should be controlled and reduced to acceptable levels. The best method of controlling noise level is to reducing the noise level form the source of the noise itself, but where the technology cannot adequately control the problem, personal hearing protection such as ear muffs or plugs can be used (USDOL-OSHA , 1992-2011).

In general, sound is defined as any change in atmospheric or water pressure that can be detected by the ear or we can say that sound is what we hear. The ear responds to these fluctuations with vibrations in ear. Noise is unwanted sound. Hence, the difference between sound and noise depends on the understanding and perception of the people. The unit of measurement for sound level is decibel (dB). One decibel stands for the smallest difference in the sound level. The weakest sound that can be heard by the healthy human ear in a quiet position is around 1dBA and is referred to as the threshold of hearing. The maximum level of the sound that can be heard without any pain is 140 dBA and known as the threshold of pain (Goetsch, 2008 p.629).

Industrial noise can be divided in to three main categories: 1) Wide band noise which is the noise spread over a wide range of frequencies, 2) Narrow band noise which is the noise that confined to a narrow range of frequencies, 3) Impulse noise which is consists of transient pluses that can occur repetitively or none repetitively (Goetsch, 2008 p.629).

1.1.2.1 OSHA Noise

A brief overview of the OSHA history has been given in the previous section (1.1.1), and rules and regulations related with noise in the work place created by OSHA will be mentioned in this part.

By April 10, 1973, OSHA had a new assistant secretary that had a unique understanding of workplace hazards, having lost part of his hearing from occupational exposure to noise. As the agency continued to gain experience, they continued to improve and develop their standards. In October 1974, OSHA approves the pervious noise act and standards, which recommends the use of engineering solution to addressing noise levels instead of the need for PPE. After much disagreement from the labor department and industry, a “hearing conservation program” was announced by the agency in the 1980s (USDOL-OSHA, 1996-2011).

1.1.2.2 Occupational Noise in Small Industries

Occupational noise exposure has been identified as a very obvious hazard for some industries especially in the small scale and hand tool industries. And in these countries, the small scale companies are emphasizing more on profit making through productivity enhancement. In developing countries like North Cyprus, with rapid economic growth and technological development, the business owners are trying for increase the sales turnover. Workers are exposed to the various occupational risks such as exposure to the high noise levels. More attention to worker safety and health is important to prevent future occupational injuries.

The GDP per capita in Turkish Republic of North Cyprus (TRNC) was around 14,000 dollar in 2009 and is steadily growing each year. Moreover growth rate of GDP between 2003 and 2009 was 6.47% which is one of the fastest rates compared to other European countries such as Germany with 0.54% or UK with 1.30% (Cyprus Turkish chamber of industry, Apr 2011). Thus, part of this economic growth is the result of progress and development. Industry in North Cyprus is categorized as light industry and over the years it has become more modernized, competent and quality oriented. These industries are divided into the 10 different categories: 1) software and network 2) food, beverage and tobacco products, 3) textile products, 4) wood-furniture products, 5) advertisement, paper products and publishing and printing, 6) chemical, rubber, and plastic products, 7) fabricated metal products, 8) mining and quarrying of sand, 9) cutting, shaping and finishing of stone and 10) electrical equipment (Cyprus Turkish chamber of industry, Apr 2011).

Unfortunately most of the developing countries are lagging far behind in implementing OSHA rules and regulations especially for exposure to high noise level (Singh, et al., 2009).

1.1.2.3 Occupational Noise Regulations in Different Countries

Every year, approximately 30 million people in the United States of America are occupationally exposed to hazardous noise (USDOL-OSHA, 1992-2011). Over 1 million employees in Great Britain are exposed to levels of noise that puts their hearing at risk (Health and Safety Executive UK, 2010). A Canadian Hearing Society Awareness survey indicated five years ago that 25% of people with hearing loss were under 40, and 70 percent under 60 years of age. The average age of those experiencing hearing loss was 51, and 16 percent of 6 to 19 year olds have early signs of hearing loss (Canadian Centre for Occupational Health & Safety, 1997-2011).

In most of the developing countries there are no adopted rules and regulations on occupational health and safety. Generally they do not pay attention to the effect of high noise level and the owners of the factories do not care to provide a safe place for their workers. Therefore developing countries should try to legislate changes in the current law and adjust their rules based on the occupational health and safety situation in their country. In most of these countries, the noise regulations are adopted from developed countries. however the exposure limits of the developed countries are not suitable for them because the working hours in most of the plants in developing countries are 8 hours per day, six days a week. Working hours translating to about 20% more in developed countries (Shaikh, 1999).

For instance, USA is a developed country. OSHA and other federal agencies and organizations have established codification regulations and rules to protect employees from the hazards associated with the workplaces. The following section provides an overview of occupational noise standards for general industries in USA.

Protection against the effects of noise shall be provided when the sound level exceed 90 dBA with slow response for 8 hours per day, 92 dBA with slow response for 6 hours per day, 4 hours per day when exposure to 95 dBA noise level with slow response, 3 hours per day when the noise level is 97 dBA with slow response, 100 dBA for 2 hours per day with slow response and 15 minutes per day with 115 dBA with slow response. When the employees are subjected to sound exceeding those levels which are mentioned above, feasible administrative or engineering control shall be utilized. If such adjustments fail to reduce the sound levels, PPE shall be provided and used to decrease employee noise exposure (USDOL-OSHA, 1996-2011).

One standard explains the variation in noise level. If the variation in noise level occurs at intervals of one second or less, it is to be considered continuous (USDOL-OSHA, 1996-2011).

Another standard is the hearing conservation program. There are 13 paragraphs about the hearing conservation program. The employer shall administer a continuing, effective hearing conservation program, as described in these paragraphs, whenever employee noise exposures equal or exceed an 8 hour time weighted average sound level (TWA) of 85 decibels measured on the A scale or, equivalently, a dose of fifty percent. These paragraphs are about monitoring, employee notification, observation of monitoring, audiometric testing program, audiometric test requirement, hearing protectors, hearing protector attenuation, training program, access to information and training material, recordkeeping, exemptions and appendices (USDOL-OSHA, 1996-2011).

Additional occupational noise exposure standards and guidance in USA have been established by American Conference of Governmental Industrial Hygienists (ACGIH) and the National Institute for Occupational Safety and Health (NIOSH).

Noise regulations in Great Britain industries come into force in 1989. These were later replaced by the 2005 regulations which were put into force on the 6th of April 2006. The new regulations included more details related with noise levels in workplace. For example in 1989 regulation the level of the noise was 90 dBA but in the new regulation this limit reduces to 85 dBA. These regulations were revised to reduce the risk associated with exposure to the high noise levels. In these regulations the lower exposure action value are a daily or weekly personal noise exposure of 80 dBA and a peak sound pressure of 135 dBC. The upper exposure action value is 85 dBA with the peak of 137 dBC and the exposure limit value is 87 dBA with the peak of 140 dBC. Where the exposure of an employee to noise varies markedly from day to day, an employer may use weekly personal noise exposure in place of daily personal noise exposure for the purpose of compliance with these Regulations. When being exposed to the high limit value employees should use the hearing protection equipment provided by the employer. The employer is responsible for the employees who are exposed to the high noise level at workplace. Also the employer should measure the noise level with the specific working practices and control the noise level whenever possible. These assessments should include consideration of the level, type and duration of exposure, including any exposure to peak sound pressure and the effect of exposure to the noise on employees whose health is at risk. The employer should give information about the equipment to the worker which is provided by the manufacturers. In addition, the employer should use alternative equipment to reduce the noise level at the workplace, risk assessment should be reviewed regularly, and should prevent the workplaces from high noise before serious problems occur (UK legislation, 2005).

There are other rules about the elimination or control of exposure to noise at the workplace, hearing protection, maintenance and use of equipment, health surveillance, information, instruction and training, exemption certificates from hearing protection and exemptions relating to the Ministry of Defense in Great Britain regulations.

In the European Union directives about health and safety, they set out minimum requirements for the protection of employees. Member States in this union are free to adapt stricter regulations for the protection of their labor force when transposing European Union directives into national rule, and so legislative requirements in the field of safety and health at work can differ across European Union Member States (European agency for safety and health at work, 1998-2008a). On 6 of February 2003 the minimum requirements of health and safety regarding occupational noise exposure were approved by European Union (European Agency for Safety and Health at Work, 1998-2008b). The aim of these regulations was to minimize the hazards related to occupational exposure to high noise levels, the directive defines exposure limit values, and exposure action value and peak sound pressure according to the weekly and daily noise exposure levels which are 87 dBA as exposure limit value and 80 dBA as exposure action lower value and 85 dBA for exposure action upper value. In exposure limit value the workers are expected to wear personal protection equipment. There are additional regulations outlining employer's obligations. In this directive, the employers should measure, record and assess the levels of the noise exposure of workers in the workplace. During the assessment the employers have to address noise exposure level, type and duration of exposure, exposure limit and action value. The risk of exposure to high noise levels must be eliminated or minimized by employers with the several methods which are considered in the European Union directive, for instance using working methods or equipment which do not produce high noise and also instruction on the correct use of equipment. If the employers cannot lower the noise levels, they have to provide PPE for their workers (European Agency for Safety and Health at Work, 1998-2008c).

Belgium, Denmark, France, Irish Republic, Italy, Canada and Australia, allows a noise exposure limit of 90 dBA Leq, and Japan, Germany, Sweden, and Norway allow 85 dBA. These limits had been allowed with exchange rate of 3 dBA and working schedules of 8 hours per day and five days a week, i.e. 40 hours per week (Shaikh, 1999). These regulations are continuously updated.

1.1.2.4 Occupational Noise Regulations in North Cyprus

The new TRNC OSH law was passed in 2008 and is enforced since April 2009. According to the new regulations prepared in harmony with the European Union, minimum requirements regarding occupational noise exposure area as follows:

a) Maximum exposure limit

- daily noise 87dBA with a peak sound pressure 200Pa (or 140 dBC)

b) Lower exposure action value

  - daily noise level 80dBA with a peak sound pressure of 112Pa (or 135 dBC)

c) Upper exposure action value

  - daily noise level 85dBA with a peak sound pressure of 140Pa (or 137 dBC)

If the noise level shows a daily variation, weekly sound levels can be used to determine exposure.

The employer is responsible for determining noise related risks in the workplace. Noise exposure should be prevented or reduced by employer. This can be done by applying the following principles:

a) Choosing methods with lower noise
b) Selecting equipment with lowest possible noise for the job
c) Designing and organizing the work environment properly
d) Reducing noise with technical methods by
  - using a barrier method to absorb the noise carried with air
  - insulation to reduce noise from the building structure
e) Applying a good maintenance program to the methods and equipment in the workplace
f) Organizing work in a way to reduce exposure

Employers should identify, designate with appropriate signage and notify employees of high noise areas.

The employer should provide ear protective equipment (EPE) to employees and monitor their usage.

If noise level increases the employer should identify the reason, reduce noise to acceptable limits and take measures to prevent similar problems from occurring again.

The employer is responsible for informing and training employees regarding noise. This training should include: the risk of noise exposure, sharing sound level measurements in the work environment, appropriate use of EPE, how to understand hearing loss, when and why physical examinations will take place, and safe work applications to minimize noise exposure.

1.2 Literature Review

A number of published studies on occupational noise exposure in different fields, and the relationship of the noise and human health, the effect of the noise on the body, noise characteristics, hearing protection, noise emission levels, noise exposure and threshold levels, and measuring of the environmental noise level in different environments such as farms, trains, traffic and different industries. In this research our aim is to focus on the noise level in the small and medium size industries. While there are number of studies done on occupational exposure to noise in different countries, no such study has been done in TRNC. This project was designed to investigate the noise levels and noise safety of workers in small and medium size of industries in TRNC.

One important study conducted by Polyvios C. Eleftheriou in 2000 in Nicosia, included measurements on noise exposure doses in 90 industries located in South Cyprus. More than 200 workers in this study were examined. Audiometric examinations of the studied workers showed that 27.8 percent suffered some hearing damage while 7.7 percent suffered serious hearing loss (Eleftheriou, 2002). The importance of this article is the similarity of these two countries industrial sector.

The other important article that published in 1999 in Elsevier Science journal by G.H. Shaikh is about "Occupational noise exposure limits for developing countries"; in this article the author has tried to propose a limit of 88 dBA Leq for 8 hours per day and 48 hours per week with exchange rate of 3 dBA. The European Union Countries and developed countries allow a maximum permissible occupational noise exposure limit range of 90 to 85 dBA Leq for 8 hours per day. However in developing countries, most of the industrial plants work for 8 hour per day and 6 days in a week (Shaikh, 1999).

Another study addresses the noise levels and factors that influence noise pollution in two small scale wood and metal industries in Tanzania. The result shows that both sites exhibited equivalent noise levels higher than 90 dBA, exceeding the permissible occupational exposure level limit. At the woodworks small scale industry, he realized that the noise levels correlated with machine use age, wood feed speed, and wood cut depth. The noise emitting from woodworks small scale industries was noted to affect other industries within a 140 meter radius (MBULIGWE, 2004).

Research on the noise level in five small scale hand tool manufacturing industries was done in the Northern India city of Punjab. Noise and sound pressure levels were measured at various sections of these industries. Noise at various sections like hammer section, cutting presses, punching, grinding and barreling process was found to be greater than 90 dBA, exceeding OSHA noise level standards. A cross sectional study using questionnaires showed that 68 percent of the workers were not wearing ear protective equipment and out of these, 50 percent reported PPE was not provided by their employer. While 20 percent had trouble with high noise level about 95 percent reported suffering speech interference. The authors concluded that the maximum noise exposure affected those employees working more than 8 hours per day for 6 days per week. More than 90 percent of employees were noted to be working 12 to 24 hours over time per week which lead to very high noise exposure (Singh, et al., 2009).

A cross-sectional study of one steel industry in Iran assessed sound level exposure of 310 steel workers to impermissible noise which is 85 dBA or higher and also the workers that had at least 3 years work experience. Questionnaires, direct interviews, audiogram and audiometric evaluations were used to assess standard threshold shift. The results showed that 41.3 percent of employees had standard threshold shift in both ears and there was a significant relationship between the noise exposure level and work experience with standard threshold shift, while this study did not demonstrate a significant relationship between age and standard threshold shift (Attarchi, et al. 2010).

A study done in the Netherlands examined hearing threshold levels of a large population of Dutch construction workers and compared their hearing thresholds to those predicted by ISO-1999. Medical reports of 29,644 workers were reviewed. The authors also compared the audiometric results with ISO-1999 predictions, analyzed the relationship between hearing loss and noise intension, noise exposure time and the use of hearing protection. The result of this study revealed that there is a slight increasing in hearing loss when the daily noise exposure level rose from 80 dBA towards 96 dBA, and the duration to expose to noise is an important factor for investigation than level of the exposure (Leensen, et al., 2010).

A study of hearing loss in an American construction industry addressed the Incidence and specifications of hearing loss among engineers operating heavy construction machinery. Audiometric evaluation, questionnaires were used to examine 623 workers mainly in their middle ages. The results proved that the rate of hearing loss was especially high, among employees working in the construction industries for many years. The result shows that constructions workers had significantly lower auditory acuity in the left ear. 62 percent of the workers had problems in hearing and understanding people at high noise levels. The average reported percentage of workers required to use hearing protection devices was 48 percent. As expected there was significant inverse relationship between higher frequency hearing loss and use of hearing protection devices. Workers who used hearing protection devices had significantly better hearing (Hong, 2005).

A study of noise exposure of workers in the construction sector in Spain was done, with measuring noise exposure by using a sound level meter and a dosimeter. The authors compared their measurements with the limits imposed by the different current regulations. They found that there is high noise level in the environment of small and medium sized companies of construction sectors. Between 60 percent and

70 percent of the workers in these sectors are exposed to a high noise dose which was higher than 100 percent along their working day. Workers were unaware the harmful effect of exposure to the high noise levels (Fernández, et al. 2009).

A study of occupational noise in five printing companies in Novi Sad, Serbia, used a sound analyzer. Data on, maximum and minimum sound pressure levels were collected. The authors concluded that major sources of the noise belong to folders and offset printing units with the average Leq levels of 87.66 dBA and 82.7 dBA, respectively. 40 percent of the machines in these five printing companies produced noise levels above the limiting threshold level of 85 dBA, allowed by Serbian low. The noise in all printing companies was dominated by higher frequency noise, and the maximum level mostly appeared at 4,000 Hz. For offset printing machines and folders, the mean Leq levels exceeded the permissible levels (Mihailovic, et al., 2010).

There are only a small number of published studies in the literature looking at the relationship between risk realization and occupational noise exposure. One of these studies was carried out with a sample of 516 Portuguese industrial workers with the aim of evaluating the relationship between individual factors and the use of hearing protective equipment. The analyzed data shows that the best way to decrease the risk perception for workers is to use hearing protective equipment. Workers opinion regarding the company's safety environment also seems to play an important role as predictor of risk perception (Arezes & Miguel, 2008).

Portuguese study assessed the role of individual risk perception and use of hearing protection. 434 industrial exposed to noise pressure levels greater than the action level value in Portuguese rules (85 dBA) were surveyed. Usage of hearing protection devices and risk perception of exposure to high noise was asked from workers. The results revealed that the employers play an important role for encouraging workers to use hearing protective devices in the workplace. These results do suggest that individual risk perception should be considered in the design and implementation of any Hearing Conservation Program (Arezes & Miguel, April 2005).

1.3 Study Aim

The main aim of our study was to investigate the noise levels in various small and medium-sized industries in TRNC in order to understand occupational noise exposure of workers and to make recommendations on how to reduce occupational noise levels in these sectors. Also to assess usage of PPE, noise annoyance, other noise related disturbance or illness, and noise awareness and risk perception.

1.4 Scope and Limitation of this Study

This study was dependent on the cooperation of management of companies to allow for measuring noise exposure and the distribution of questionnaires to their employees. This necessitated the use of a very limited self-report questionnaire for distribution to each factory, rather than a more in depth and detailed questionnaire which might have provided more substantial and useful information.

This study was conducted in North Cyprus for the first time, leading to having more limitation and constraints. There is not enough data available regarding injuries in the country and business owners are not familiar with the hazard of noise. Other limitations include finding appropriate industry for investigation. Since most of the businesses in Northern Cyprus are related with the service sector and during the period of this study many manufacturing industries were working part time or they were not working at all.

We were unable to purchase a noise dosimeter to have a more objective measure of noise exposure of employees. My inability to communicate with workers in their local language was another limitation of this study.

Chapter 2

SETTING

2.1 Selection of Noise Measurement Sites

Study industries were selected according to data collected from the Cyprus Turkish Chamber of Industry (CTCOI) base on following selection criteria:

1) Those industries expected with the highest expected noise level.
2) Small and medium sized companies representing different industries.
3) Small and medium sized companies from two major cities (Famagusta and Lefkosa) in North Cyprus were selected.
4) The sites were selected to include a representative sample of the major industries

The distance between these two cities is about 60 km. Famagusta is located on the east coast of North Cyprus and Lefkosa is capital of North Cyprus which is approximately located at the center of the island. The average of humidity and weather temperature during noise measurement was 59% RH and between 30°C and 36°C respectively which was not effect to measuring noise (Cyprus Climate., 2008-2011). All of these sites are located in close proximity to residential neighborhoods.

2.2 Specification Characteristic of Sampling Sites

Table 2.1 shows the activities and products of each location. Location 1, 2, 4, 5, 8, 9, 11 and 13 are located in Famagusta. Location 1 has printing activities, location 2 produces Turkish coffee, location 4 and 11 both produce mineral water and do bottling, location 5 produces alcohol beverage, location 8 produces construction materials with PVC and aluminum, location 9 is an industrial scale dry cleaners and location 13 produce different kinds of beverage. Location 3, 6, 7, 10 and 12 which are considered as the case studies are situated in Lefkosa; location 3 is a milk factory and produces dairy products, location 6 produces marble and mosaics, location 7 produces furniture, location 10 produces metal handcraft and location 12 is a printing office.

Table 2.1: Activities and products of each location

Location	Activities/products
1	Printing products publishing
2	Turkish coffee
3	Dairy
4	Mineral water
5	Alcohol beverage
6	Marble and mosaic
7	Furniture
8	PVC and aluminum construction material
9	Industrial dry cleaners
10	Metal handcraft
11	Mineral water
12	Printing products publishing
13	Beverage

Based on our study observations all of these factories had a congested layout and all machines placed in indoor space and the production process is carried out adjacent to each other without any barrier between the noise source and the employees. Generally in each factory, there are different kinds of machines working simultaneously. The number of workers in these industries varies from 2 to 75. Some factories have old machinery which generate high noise levels which also affect the environment outside of the plant, few factories, had relatively new and quieter machines however because these machines were in small spaces, noise levels were still relatively high.

Chapter 3

DATA COLLECTION

3.1 Method

1) Employee surveys were distributed to 13 industrial sites.

2) Sound level measurement was conducted.

3) We had a response rate of 45% (out of 280 distributed questionnaires, 126 completed questionnaires were returned).

4) Characteristics of non-respondents is unknown

5) Some employees declined to participate due to not having enough time to respond and release and publish of factory information

3.1.1 Questionnaire

A comprehensive questionnaire was designed in both English and Turkish to assess the subjective information (Appendix C). The questionnaire had two main parts, the first part covered 20 multiple-choice questions and 2 descriptive questions and the second part had 9 multiple-choice questions. The first part of questionnaire was categorized into four sections as follow:

- Basic characteristic of workers in selected industries

- Working condition of workers in work place
- Common occupational illness from expose to high noise level in workplace
- Analyzing awareness of noise and hearing protection equipment

In the first section, descriptive information was gathered about age, gender, work experience and education level. The age question is categorized in to the 9 level from under 20 to above 56 and between these two level, choice options categorized in 5 years age range scales. The gender of the workers categorized in nominal scale (Male/Female). The other question is about work experience which is categorized in 5 levels from less than 1 year to more than ten years. The question on education level is in five ordinal categories base on the educational system of North Cyprus.

The second section of the questionnaire which is related to the working position and condition of workers in their worker place includes 6 questions. The first 2 questions are about sitting/standing position of workers in their worker place with yes/no choice options. The next question asked if employees work with machine(s). The next question addresses the kind of machine(s) the employee work with which is descriptive question and the duration of working with the designated machine(s) which is categorized in 9 ordinal scale choice options from 1 hour to more than 8 hours. The last question in this section gathers information on working hours. Response options include less than 4 hours, 5-7 hours and more than 8 hours.

The third section of the questionnaire is attempted to collect data about common occupational symptoms or illness of workers which may result from exposure to high noise levels in their work place with 5 different questions. Questions about headache, uncomfortable feeling, stressful and speech interference is categorized in 5 point ordinal scale from always to never. And the other question is designed to ask about worker's blood pressure with yes/no nominal scales.

The fourth section of the questionnaire was designed to assess employee awareness of noise and hearing protective equipment. This part tried to ask from workers about information of hazardous effect of high noise level and benefit of using earing protection equipment with a yes/no of response. One question collects information on their manager or head of their factory forces to use ear protective equipment. Other questions are included to assess duration of hearing protective equipment use in 5 point scale from always to never and if not used to assess the reason for not using PPE. This is multiple-choice multi-response conditional question, in this question workers allow to choose more than one choice option such as employer did not provide, not comfortable equipment, is not my habit, feeling stuffy, etc… The remaining questions address whether employees recognize any occupational health and safety training with yes or no response and yes responding are asked to describe this training.

The second main part of the questionnaire is designed to find out subjective occupational risk perception including:

- Knowledge of noise exposure
- Knowledge of hearing protection

The first section in part two of questionnaire tried to find out knowledge of noise with 4 designed questions, and the responders are asked to express level of agreement with each statement. Questions include: exposure to high noise levels can cause temporary loss of hearing, high noise levels can permanently affect hearing, it is possible to reduce the noise level in my workplace and noise in my work place is not dangerous.

The second section of part two of the questionnaire assesses knowledge of hearing protection with 5 designed questions and the responders are asked to express their level of agreement with each statement. Questions include: all hearing protectors offer the same protection, protection of hearing depends on the duration of ear protection use each day, there is no need to use ear protection equipment in my work place, there are several types of hearing protective equipment, and I, avoid being exposed to high noise levels. Responses were ranked on a 5 point Likerts scale from strongly agree to strongly disagree.

The questionnaire was developed base on Health and Safety Executive (HSE) of United Kingdom (Health and Safety Executive UK, 2002) with consideration of OSHA standards and criteria (USDOL-OSHA, 2004-2011) and after reviewing questionnaires from previous studies (Arezes & Miguel, 2008; Singh, et al, 2009).

The data collection was based strictly on questionnaires. Oral interviews were not conducted among the workers with the assumption that none of the workers were illiterate.

The questionnaire was pretested and distributed to workers of each location in Turkish language copy and in a few locations were given English version as distributed as the workers were not local or Turkish. For more accuracy the returned data were checked with manager or head of factory. Surveys were administrated with a brief explanation about the study and the confidential nature of the data collected.

3.1.2 Sound Level Measurement

Noise level measurements were conducted simultaneously with the distribution of questionnaires at each location. The method and purpose of the measurement was explained to the workers and managers and they were permitted to observe the method of measurement. According to recommendations of the Canadian Center for Occupational Health and Safety (CCOHS) and OSHA, in case that employee and workers had tendency of knowing exposure level, the results would be given to them.

3.1.2.1 Sound Level Meter

The noise exposure level was assessed by using type 1 CR: 273 model CIRRUS sound level meter (A11947F serial No.), and the device was calibrated with CR: 513A. This instrument is appropriate for measuring industrial sound level, and it is compliant with standards IEC 804 and IEC 651 (international electro technical commission regulations) (MAKGOE, 1998). It is also able to measuring noise in A-weight and C-weight level (Cirrus Research PLC, 1989-2001)

The sound level meter was adjusted to the A-weight level measuring noise levels in the range of 80 to 140 dB in the slow response position throughout all measurements at every location. The instrument was calibrated to 94 dB in all measurements as described in the user manual.

The average temperature and humidity in North Cyprus which is mentioned in chapter 2 did not affected in the noise measurement of this survey, since the device met both IEC 804 and IEC 651 standards and according to user manual, the device can work from -20 °C to 50 °C and 0-99% RH. There was no need to use a windshield as the measurements were all conducted indoors area with less than $5ms^{-1}$ wind.

3.1.2.2 Procedure of Measuring and Noise Layout

The sound level measurement device was placed on a tripod in each area of measurement to meet IEC 651 standard regulation, in order to increase the accuracy of measurement the operator stood away from the device and the device was placed in an area without vibration. According to OSHA standards and EU directives the sound level meter was adjusted to stand 1.5 meter from the floor, 1 meter from any machine(s) or equipment, and 0.5 meter from the shoulder of any employee (Dolehanty, 2005). After each measurement the L_{peak} and L_{eq} values were recorded in the designated record sheet (Table A.13 in appendix A), the device was restarted and ready for next measurement.

We measured sound levels from different noise sources in each study area. The sound level meter was positioned near busy machines and if the operator was present, the device was positioned near the operator's ear. Measurements were taken from different machines at each location and at the end of each measurement the device was installed in the middle area of the factories in order to measuring inside environmental noise levels.

Sketch of the each plant is drawn to show the graphically approximate place of each factory's machineries which measured by sound level meter for more perception. The name of each machine and noise level of them shown for every location, also enclosure between each block of factory marked with black line (appendix B).

The duration of measurement was considered 5 minute for each machinery place or work station and 15 minute for measurements conducted at the middle of the factories. Measurements were carried out with different timing duration from 5 to 15 minutes, during the pretest and in order to check for accuracy of measurements. A minor difference of 0.5 to 1.0 dBA was found which was considered and unlikely to affect study results.

Adjustment of sound level meter was rechecked before each measurement and the acoustic calibrator was calibrated before and after each measurement.

3.1.3 Method of Data Analysis

Questionnaires and all data collected from recorded measurements were transferred to import an electronic spreadsheet and into the Statistical Package for Social Scientists (SPSS) version18 and Microsoft Excel 2010 program for analysis. In order to evaluate for any meaningful and statistically significant relationship between variables, different statistical tests were performed.

The variables were analyzed sequentially according to the categorization which is discussed in 3.1.1. First of all frequency and percentage distribution of each variable were analyzed and according to the type of each independent variable(s) and dependent variable(s), and base on application of the questionnaire and the past researches some variable were gathered and the appropriate test was chosen with regard to the assumptions of each tests. In this study the normality test was done for the group of nominated variables in order to find out which test is suitable.

3.1.3.1 Logistic Regression

The variables which were chosen were classified into independent and dependent groups. Multi regression analysis was applied in order to analyze non-normality distribution of variables. Multi logistic regression was used to analyze a meaningful and statistically significant relationship between risk perception of high noise levels and two main dependent variables which 1) awareness of noise exposure and the benefit of usage of ear protective equipment, using a 5 point Likerts scale, and 2) with independent variables such as employee OSH training, information about hazardous effect of high noise levels, information about benefit of using ear protective equipment, and education level using an ordinal and nominal scale.

Binary logistic regression was used to analyze responses to yes/no questions. We applied binary logistic regression to assess any meaningful or significant relationship between blood pressure as a dependent variable and the four independent variables such as feeling stressed, annoyed and uncomfortable, speech interferences and headache from high noise levels.

3.1.3.2 Logistic Regression Assumptions

In linear regression we assume that there is a linear relationship between dependent variables and predictor(s) but in logistic regression there is no need to have a linear relationship among the variables. Normal distribution of dependent variable is not required for logistic regression and there is no need for homogeneity of variance for independent factors. Interval and unbounded condition is not needed for independent variable.

Analyses of variance (ANOVA), chi-square distribution, U-test and McNemar test were also obtained.

Chapter 4

ANALYZING DATA

4.1 Analysis

Occupational hearing loss or hearing disability in many industries caroused by harmful sound levels in these industries is listed in the first ten types of injuries (Karlidaq, 2002). Although controlling sound level is the best and most effective way to reduce occupational exposure to noise, most companies refuse to implement sound control solutions due to high initial cost. They instead prefer to protect their workers by personal hearing protection devices (Williams, 2007). However, usage of personal hearing protection device is the last way to protecting workers, but most workers do not use these devices regularly or properly (Arezes & Miguel, 2008).

A study, conducted in Malaysia, showed that hearing protection equipment had been provided for 80 percent of the workers exposed to noise, but only 5 percent of these workers used their equipment regularly (Oloqe, et al., 2005). In another study conducted in Nigeria, investigations awareness of attitudes towards the use of personal hearing protection. Results showed that despite worker awareness of the hazardous effects of high noise levels (93%), and awareness of the benefit of using hearing protection equipment (92%), only 28 percent of workers used hearing protection equipment regularly (Oloqe, et al., 2005). Another study conducted in Sweden, showed that 95 percent of workers have information about the hazardous effect of high noise levels while 90 percent considered temporary or permanent hearing loss a serious effect of high noise levels and 85 percent believed that protection of hearing depended on duration of hearing protection equipment usage very few use protection devices (Sevenson, et al., 2004).

While in some researches suggests that perception risk of hearing loss and perceived and cognitive factors are identified as factors affecting the usage of personal hearing protection (Arezes, Miguel 2008). Other study in several countries shows that risk perception, knowledge of employees and organizational factors, such as legislation and regulations are not sufficient to explain lack of usage (Cheung, 2004).

One goal of our study was to investigate the perception of risk and worker's attitudes to safety in small and medium size industries in North Cyprus in order to find the reasons for not using hearing protection equipment (HPE) and any factors associated with poor usage. We collected the primary data and made objective sound level measurements with the goal of learning at risk sites and making recommendations for improvement.

4.1.1 Analyzing Locations

The number of workers who responded to the survey form each location is shown in Table 4.1. This table also shows the percentage of respondents from each factory and a percentage of total responses from each plant.

Table 4.1: Sample percentage for each plant

Factory	Industrial population	Number of response to questionnaire	Response percent (%)	Sample percentage (%)
Location-1	21	12	9.5	57.14
Location-2	11	6	4.8	54.55
Location-3	45	18	14.3	40.00
Location-4	9	6	4.8	66.67
Location-5	15	10	7.9	66.67
Location-6	27	12	9.5	44.44
Location-7	10	5	4	50.00
Location-8	3	3	2.4	100.00
Location-9	36	16	12.7	44.44
Location-10	2	2	1.6	100.00
Location-11	20	11	8.7	55.00
Location-12	5	2	1.6	40.00
Location-13	75	23	18.3	30.67
Total	279	126	100	

Site specific response rates ranged between 31 and 100 percent.

4.1.2 Analyzing Questionnaire

This part tries to analyze the statistical data of the questionnaire according to the classification which is explained in the previous chapter.

4.1.2.1 Basic Characteristic of Workers

The first part of the questionnaire represents the basic characteristic of the workers under study by occupational exposure status to noise. In the researches which have been done on the hearing loss field, indicate that there are no significant relation between age, gender and education levels factors with hearing loss of the people lonely (Kopper, et al., 2009; Pinto, et al., 2010).

The purpose of collecting these statistical samples is to analyzing with statistical experiments and comparing with the other aspects and these data use as response and explanatory variable for further analyze.

Also these samples of data are contributed to illustrate the age and education status in industries of North Cyprus. This information can be a good representative of north Cyprus's industry's workers basic characteristic.

Table 4.2: Age

	Factory name	Mean	Age categorize	Std. Deviation
Age	Location-1	4.50	36-40	2.276
	Location-2	4.33	36-40	1.033
	Location-3	4.24	36-40	1.888
	Location-4	4.33	36-40	2.066
	Location-5	5.70	41-45	2.452
	Location-6	3.92	31-35	1.505
	Location-7	4.40	36-40	1.342
	Location-8	3.00	26-30	1.000
	Location-9	4.94	36-40	2.144
	Location-10	4.50	36-40	3.536
	Location-11	5.27	41-45	2.328
	Location-12	1.50	20-25	.707
	Location-13	4.35	41-45	1.799

Table 4.3: Age percentage

		Frequency	Valid Percent
Valid	Under 20	1	.8
	20-25	25	20.0
	26-30	14	11.2
	31-35	30	24.0
	36-40	23	18.4
	41-45	6	4.8
	46-50	13	10.4
	51-55	10	8.0
	Above 56	3	2.4
	Total	125	100.0

Table 4.2 and table 4.3 shows the age of workers in each location and the distribution of the workers in each age group category. The average of the mean revealed that the age average of the workers is between 31 and 40. The age distribution of workers at each location is also represented by the box plot in appendix B.

65.1 percent of all participants were men and 34.9 percent were woman (Table 4.4) and the age average of the men in the categorized age groups less than the woman with normal distribution for both age and gender (Table 4.5).

Table 4.4: Gender percentage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	82	65.1	65.1	65.1
	Female	44	34.9	34.9	100.0
	Total	126	100.0	100.0	

Table 4.5: Gender mean descriptive statistic

	Gender	Statistic	Std. Error
Age	Male	4.44	.208
	Female	4.59	.334

The distribution of the work experience in each group is shown in table 4.6, most of the workers (23.4 %) had more than 10 years' experience but this was not statistically significant. The average of work experience for participants in this study was 3.2 years with a standard deviation 1.35.

Table 4.6: Percentage of Work experience

		Frequency	Valid Percent	Cumulative Percent
Valid	Less than 1 year	16	12.9	12.9
	1-3 years	26	21.0	33.9
	4-6 years	28	22.6	56.5
	7-9 years	25	20.2	76.6
	More than 10 years	29	23.4	100.0
	Total	124	100.0	
Missing	System	2		
Total		126		

Table 4.7 shows the highest education level achieved for the 126 study participant. 29 % of the participants had a high school level of education, 21% junior high, and

27.4 % primary school level of education. 14.5 % completed university and 8.1 % technical school.

Table 4.7: Highest level of Education

		Frequency	Valid Percent	Cumulative Percent
Valid	Elementary/Primary school	34	27.4	27.4
	Junior high school	26	21.0	48.4
	High school	36	29.0	77.4
	Technical school	10	8.1	85.5
	University	18	14.5	100.0
	Total	124	100.0	
Missing	System	2		
Total		126		

Table 4.8 displays the relationship between education level and gender. 61.8% of men had a primary school education while this percentage was 38.2% for the women, 73.1% of the male workers and 26.9% of female workers had junior high school education level. The percentage for male and female participants with a high school education was 75% and 25% respectively. 80% of men and 20% of women respectively had technical degrees. Twice as many (66.7%) of woman then men had a university degree.

Table 4.8: Percentage within education level and gender

Education level		Gender		Total
		Male	Female	
Education level	Elementary/Primary school	61.8%	38.2%	100.0%
	Junior high school	73.1%	26.9%	100.0%
	High school	75.0%	25.0%	100.0%
	Technical school	80.0%	20.0%	100.0%
	University	33.3%	66.7%	100.0%
Total		65.3%	34.7%	100.0%

The chi-square test for gender and education level (Table 4.9) shows that education level and gender are dependent variables with a value of 11.451 and 4 degrees of freedom p value of 0.022.

Table 4.9: Chi-Square Tests for gender and education level

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.451[a]	4	.022
Likelihood Ratio	11.132	4	.025
Linear-by-Linear Association	1.807	1	.179
N of Valid Cases	124		

The chi-square test shows no dependency between age and education level (appendix A).

Education level was inversely correlated with the age of workers. The distribution of age education level is highest among technical school education (Figure 4.1).

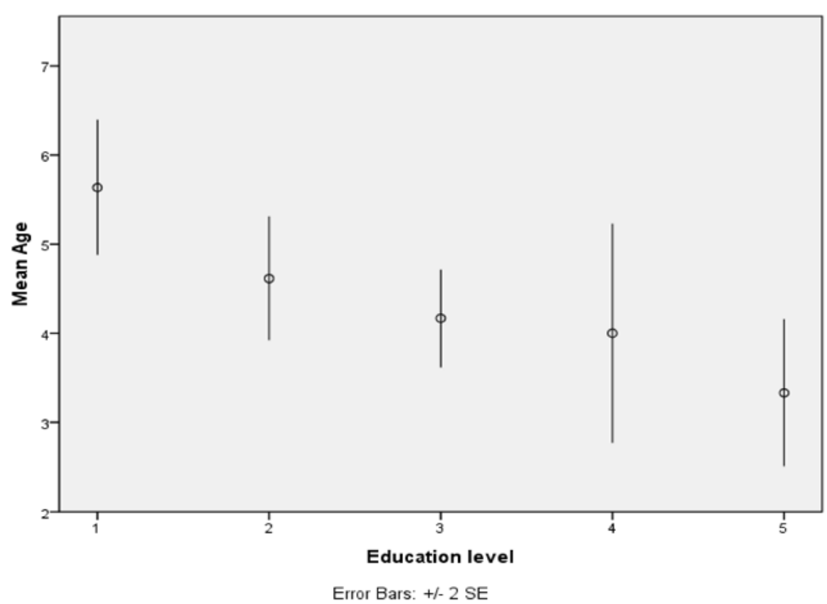

Figure 4.1: Error bar chart for mean of age and education level categories

4.1.2.2 Analyzing Working Condition

The table 4.10 shows the position of employees in the worker place while working. 97.7% of the workers responded standing and 60.5% responded both standing and sitting, while only 30.5% responded working in the sitting position.

Table 4.10: Position of employees during work (Cross tabulation)

			Working in a standing		
			Yes	No	Total
Working in the sitting position	Yes	Count	23	15	38
		% within Working in sitting position	60.5%	39.5%	100.0%
	No	Count	84	2	86
		% within Working in sitting position	97.7%	2.3%	100.0%
Total		Count	107	17	124
		% within Working in sitting position	86.3%	13.7%	100.0%

65.1% of the workers reported operating a machine and of these 55.7 % responded working with a machine at least 8 hours. In general, the mean operating time of machines was 6 and 7 hours each day (17.7%) with a 2.13 standard deviation (Table 4.11). In small and medium sized industries the major source of noise is from industrial machines. Workers operating these machines are significantly exposed to high noise levels compared to other workers. Our survey included questions on total machine operation time in order to accurately assess duration of employee noise exposure.

Table 4.11: Percentage of time operating a machine

		Time of operate with a machine								Total
		2 hours	3 hours	4 hours	5 hours	6 hours	7 hours	8 hours	More than 8 hours	
Operation a machine	Yes 65.1%	2.5%	10.1%	6.3%	7.6%	11.4%	6.3%	31.6%	24.1%	100.0 %
	Total	2.5%	10.1%	6.3%	7.6%	11.4%	6.3%	31.6%	24.1%	100.0 %

Most participants respond 74.2%, working 8 hours or more hours a day. And one quarter of the participant responded, working less than 8 hours (Table 4.12).

Table 4.12: Frequency of daily working hours

		Frequency	Valid Percent	Cumulative Percent
Valid	Less than 4 hours	1	.8	.8
	5-7 hours	31	25.0	25.8
	More than 8 hours	92	74.2	100.0
	Total	124	100.0	
Missing	System	2		
Total		126		

Table 4.13 shows a positive correlation between age and daily working hours, however this was not statistically significant. ANOVA test with work experience, education level and daily working hours as subjective factors and age of the workers as fix factor revealed a significant relationship between age and work experience with a 7.901 value of F-test (Table 4.14).

Table 4.13: 2 tail correlations between age and daily working hours

		Age	Daily working hours
Age	Pearson Correlation	1	.213*
	Sig. (2-tailed)		.018
	N	125	123
Daily working hours	Pearson Correlation	.213*	1
	Sig. (2-tailed)	.018	
	N	123	124

*. Correlation is significant at the 0.05 level (2-tailed).

As noted previously with the chi-square analysis no relationship was found between age and education level and ANOVA test confirm this independency. Additionally no relationship between age and daily working hours was observed. Figures B.2, B.3, B.4 show the mean of these factors with respect to the fixed factor in appendix B. these figures show that with increasing age of workers, the mean education level and working hours decrease. With decreasing age, work experience also decreases.

Table 4.14: Analyze of variance (ANOVA)

		Sum of Squares	df	Mean Square	F	Sig.
work experience	Between Groups	80.076	8	10.009	7.901	.000
	Within Groups	144.428	114	1.267		
	Total	224.504	122			
Education level	Between Groups	36.704	8	4.588	2.811	.007
	Within Groups	186.093	114	1.632		
	Total	222.797	122			
Daily working hours	Between Groups	2.217	8	.277	1.320	.240
	Within Groups	23.929	114	.210		
	Total	26.146	122			

The chi-square test represent relationship between education level and work experience. From the significant value of the test (0.02) which is less than 0.05 we can conclude that significant relationship between education level and work experience is real and not due to chance. And also phi and cramer's V and contingency coefficient confirm this statistical significant relationship (Tables 4.15, 4.16).

Table 4.15: Education level and work experience

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	29.563[a]	16	.020
Likelihood Ratio	36.136	16	.003
Linear-by-Linear Association	11.051	1	.001
N of Valid Cases	122		

a. 13 cells (52.0%) have expected count less than 5. The minimum expected count is 1.23.

Table 4.16: Symmetric measures between education level and work experience

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Phi	.492			.020
	Cramer's V	.246			.020
	Contingency Coefficient	.442			.020
Interval by Interval	Pearson's R	-.302	.085	-3.473	.001[c]
Ordinal by Ordinal	Spearman Correlation	-.278	.086	-3.170	.002[c]
N of Valid Cases		122			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

According to observations, review of results obtained, analysis of available data, and considering the significant relationship between education level and working hours and between work experience and age, it is possible say that this can be explained by part time employment of students.

4.1.2.3 Analyzing Common Occupational Illness in Workplace

23% of the study participants reported having a known diagnosis of hypertension (Table 4.17).

Table 4.17: Frequency of blood pressure

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	29	23.0	23.0	23.0
	No	97	77.0	77.0	100.0
	Total	126	100.0	100.0	

Analytical survey from these four factors which are threatened the worker's health has been done. Table 4.18 and figure 4.2 represent frequency and percentage of these four factors clearly. This table and figure display that accumulation of answer distribution in these four variables was in sometimes choice option. 32.3% of participants reported sometimes feeling uncomfortable or annoyed from high noise levels, and 42.4% reported sometimes having headache during or after work due to high noise levels, 34.1% reported sometimes had speech interference, and 27.2% reported sometimes feeling stressed during or after work in a noisy area (Table 4.18 and Figure 4.2).

Table 4.18: Frequency of noise annoyance

Effects on Communication and Performance		Valid					
		Never	Seldom	Sometime	Often	Always	Total
Uncomfortable feeling or annoyed from high noise level	Frequency	11	29	40	32	12	124
	Valid Percent	8.9	23.4	32.3	25.8	9.7	100.0
Headache while or after working due to high noise level	Frequency	23	18	53	26	5	125
	Valid Percent	18.4	14.4	42.4	20.8	4.0	100.0
Speech interference with high noise level	Frequency	23	15	43	18	27	126
	Valid Percent	18.3	11.9	34.1	14.3	21.4	100.0
Feel stressful while or after working in noisy area	Frequency	21	26	34	26	18	125
	Valid Percent	16.8	20.8	27.2	20.8	14.4	100.0

67.8% reported having uncomfortable feeling or being annoyed at high noise levels at least sometimes, 67.2% and 69.8% reported headache during or after work due to high noise level and had speech interference with high noise level at least sometimes respectively. 62.4% reported had feel stressed during or after work in noisy area at least sometimes.

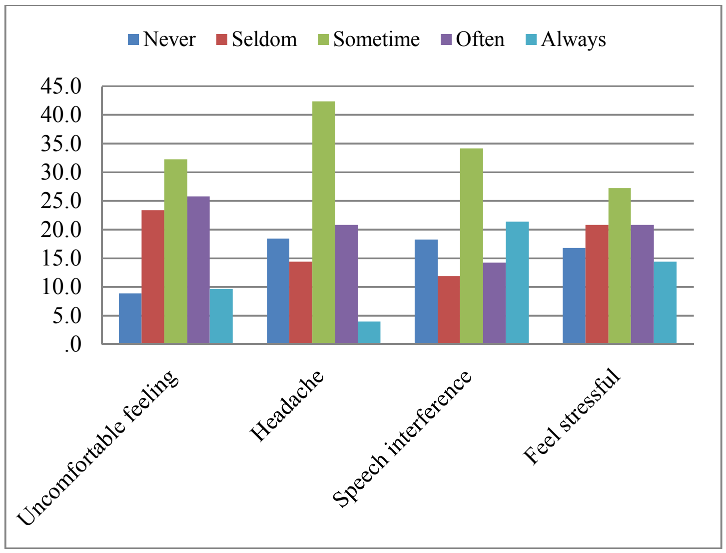

Figure 4.2 Percentage distributions of noise annoyances

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From anaylzing mean of each variable, figure 4.3 also confirm this fact. As mentioned befor in chapter 3, this part of questionnarie has 5 choice option which are ranked from 1 to 5. Bar chart shows that the mean of the data for each variables are approximatley near 3 = sometimes.

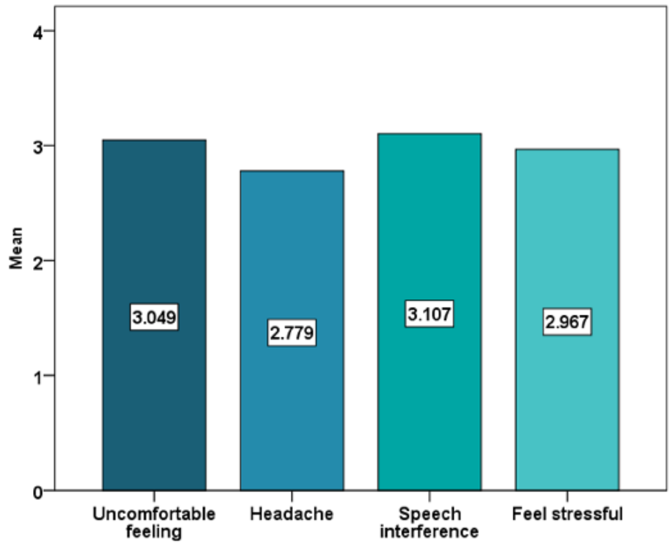

Figure 4.3: Mean distributions of annoyances

Since the distribution of age and gender in this survey was not normal, the Mann-Whitney U Test was used to find the relationship between these factors. Table 4.19 provides information on the output of Mann-Whitney U test. This table shows that, namely, the rank of age that they have high blood pressure is more than the workers who do not have blood pressure. Table 4.20 represents actual significance value, of the statistical U test. From this data it can be concluded that there is statistically significant difference between age and blood pressure (U=705.500, P=0.00), and negative Z statistics indicate that the rank sums are lower than their expected value.

Table 4.19: Ranks of blood pressure with age and gender

		High blood pressure	N	Mean Rank	Sum of Ranks
Age	dimension1	Yes	29	86.67	2513.50
		No	96	55.85	5361.50
		Tota	125		
Gender	dimension1	Yes	29	67.57	1959.50
		No	97	62.28	6041.50
		Tota	126		

Table 4.20: Statistics[a] test for relation of blood pressure with age and gender

	Age	Gender
Mann-Whitney U	705.500	1288.500
Wilcoxon W	5361.500	6041.500
Z	-4.079	-.828
Asymp. Sig. (2-tailed)	.000	.408

a. Grouping Variable: Blood pressure

Testing hypertension (HTN) as dependent factor with four independent variables was tested by binary logistic regression of the 122 workers who participated (96.8%) (Appendix A, Table A.3). The base rates HTN 23% (28/122) and for not having high blood pressure is 77% (94/122) (table A.4). Also the predicted odd of deciding that these 4 factors have effect on blood pressure of the workers are 0.298 (Table A.5). Omnibus tests of model coefficient shows designated variables (annoyed and uncomfortable feeling, stress, headache, speech interference) are significantly correlated with a known diagnosis of HTN (Table A.6) with a chi-square value of 29,684 and 16 degree of freedom (DF). The value of Wald from table A.7 in appendix A shows the importance of the contribution of each variable in the model. The importance of noise annoyance and uncomfortable feeling was more than the other factors in this analysis. This table shows that workers who reported always having an uncomfortable feeling and being annoyed from high noise levels were 38.6 times more likely to have HTN than workers who reported never having an uncomfortable feeling or being annoyed. This relation with the persons who have always uncomfortable feeling and annoyed from high noise level with never is 43 percent. Form the data in this table and regards to table A.8 the following generated formula obtained:

$$\ln(\text{ODDs}) = -1.566 + 0.198\, Uncomfortable_{\,Seldom/Never} - 1.521\, Uncomfortable_{\,Sometimes/Never} - 1.461\, Uncomfortable_{\,Often/Never} - 3.554\, Uncomfortable_{\,Always/Never} + 1.533\, Headache_{\,Seldom/Never} + 2.230\, Headache_{\,Sometimes/Never} + 3.351\, Headache_{\,Often/Never} + 4.012\, Headache_{\,Always/Never} + 0.358\, Speech\ interference_{\,Seldom/Never} - 0.761\, Speech\ interference_{\,Sometimes/Never} + 1.438\, Speech\ interference_{\,Often/Never} + 1.132\, Speech\ interference_{\,Always/Never} - 1.317\, Stressful_{\,Seldom/Never} - 1.134\, Stressful_{\,Sometimes/Never} - 0.582\, Stressful_{\,Often/Never} - 2.013\, Stressful_{\,Always/Never}$$

This model is use to predict odds to having HTN by $s = e^{(a+x_1+x_2+\cdots.+w_3+w_4)}$. Numeric values obtained from B value of table A.7 and the recorded values (0 or 1) for each level of variables (never, seldom, sometimes, often, always) explained in table A.8. For instance if one worker reports seldom having an uncomfortable feeling or being annoyed, always having headaches, often have speech interference and never feeling stressed while working in noisy area, the predicted odds for having high blood pressure (HTN) is as follow:

Ln (odds) =-1.566 +0.198 (1)-1.521(0)-1.461(0)-3.554(0) +1.533(0) +2.230(0) +3.351(0)

+4.012(1) +0358(0)-0.761(0) +1.438(1) +1.132(0) -1.317(0) -1.134(0)-0.582-2.013(0) = 4.09

Odds= $e^{4.09}$ = 59.73

The odds ratio is a measure of effect size, describing the strength of association or non-independence between two binary data values. It is used as a descriptive statistic, and plays an important role in logistic regression. Unlike other measures of association for paired binary data such as the relative risk, the odds ratio treats the two variables being compared symmetrically, and can be estimated using some types of non-random samples.

This value specified that the worker with regards to his/her answers has 59.73 odd of having HTN.

Table 4.21: Discrimination model for blood pressure test

Observed			Predicted		
			Blood pressure		Percentage Correct
			No	Yes	
Step 1	Blood pressure	No	87	7	92.6
		Yes	17	11	39.3
	Overall Percentage				80.3

The cut value is .500

For classify subject for regression analysis, decision rule must take into account. The discrimination model (Table 4.21) shows that the overall accuracy or overall success rate of this analysis to predict subject for all the cases with probability of 0.5 or greater is 80.3 percent and also area under ROC curve prove this fact (Figure B.5). Also the sensitivity is given by 11/28=39.3 percent to having blood pressure. The P (correct | event did occur) that is the percentage of occurrences correctly predicted. And specificity of prediction =87/94=92.6 percent, P (correct | event did not occur), that is the percentage of nonoccurrence correctly predicted. This data is usable for classifying correctly. And positive predictive value is 11/18=61.2 percent and negative predictive value =87/104=83.6 percent which means that the decision rule predicted a decision to having high blood pressure 18 times that prediction was wrong 7 times. A decision rule predicted a decision of not having high blood pressure 104 times; that prediction was wrong 17 times. In addition the non-significant value of chi-square indicates that the data fit the model well (table A.9). Table 4.22 shows predicted probability on the criterion variable.as it shows in the table the cases ordered in the 10 groups from probability less than 0.1 to probability greater than 0.9. In the outcome the expected frequencies will run from high to low. For the outcome which is having blood pressure the frequencies ranged from low to high.

Table 4.22: Contingency table for Hosmer and Lemeshow test

		Blood pressure = No		Blood pressure = Yes		
		Observed	Expected	Observed	Expected	Total
Step 1	1	12	11.862	0	.138	12
	2	11	10.626	0	.374	11
	3	11	11.346	1	.654	12
	4	10	9.949	1	1.051	11
	5	11	11.087	2	1.913	13
	6	10	9.617	2	2.383	12
	7	4	7.684	6	2.316	10
	8	11	9.326	2	3.674	13
	9	9	6.951	3	5.049	12
	10	5	5.551	11	10.449	16

In this test only report of having a headache had statistically significant relationship with HTN. From the value of odd ratio (Exp (B)) we can say that the workers who report always or having often headaches, the probability to have HTN was high in this group.

The relationship between blood pressure and operating industrial machinery was analyzed. With regard to type of variables, McNemar test has been chosen. In total 126 pair of participants, a significant dependency was found between HTN and operating machinery (Table 4.23).

Table 4.23: MCnemar Test

	Operation a machine & Blood pleasure
N	126
Chi-square[a]	37.041
Asymp. Sig.	.000

a. Continuity Corrected

Multivariate analysis demonstrates a significant relationship between the duration of machine operation and the 3 common symptoms of illnesses such as headache, feeling stressed and having an uncomfortable feeling (0.024<0.05) (Table 4.24).

Table 4.25, shows that both uncomfortable feeling and being stressed have homogeneity of variances (p>.05).

Table 4.24: Multivariate Tests between time of operating with machine and 4 factors

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Intercept	Pillai's Trace	.878	160.725[a]	3.000	67.000	.000	.878	482.174	1.000
	Wilks' Lambda	.122	160.725[a]	3.000	67.000	.000	.878	482.174	1.000
	Hotelling's Trace	7.197	160.725[a]	3.000	67.000	.000	.878	482.174	1.000
	Roy's Largest Root	7.197	160.725[a]	3.000	67.000	.000	.878	482.174	1.000
Operate time	Pillai's Trace	.454	1.755	21.000	207.000	.025	.151	36.865	.969
	Wilks' Lambda	.602	1.774	21.000	192.938	.024	.155	35.511	.960
	Hotelling's Trace	.571	1.786	21.000	197.000	.022	.160	37.497	.971
	Roy's Largest Root	.367	3.618[c]	7.000	69.000	.002	.268	25.326	.960

Table 4.25 : Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
Uncomfortable feeling or annoyed from high noise level	1.323	7	69	.253
Headache while or after working due to high noise level	2.270	7	69	.039
Feel stressful while or after working in noisy area	1.508	7	69	.179

Likewise, using ANOVA both feeling stressed and having an uncomfortable feeling had a statistically significant relationship with duration of working or operating machinery (Table A.10).

4.1.2.4 Analyzing Awareness of Noise and Hearing Protection Equipment

Table 4.26 shows the frequency of responses to questions about the hazardous effect of high noise levels and the benefit of using earing protection equipment (EPE). Half of the participant reported having information about the hazardous effect of noise on hearing and the benefit of EPE.

Table 4.26: Frequency of general information

General information		Valid		
		Yes	No	Total
Information about hazardous effect of high noise level	Frequency	67	58	125
	Valid Percent	53.6	46.4	100.0
Information about benefit of using EPE	Frequency	66	59	125
	Valid Percent	52.8	47.2	100.0

14.3% of respondents responded that their manager forced them to use EPE (Table 4.27). 73% of the workers never using EPE (Figure B.6 in appendix B).

Table 4.27 : Frequency of manager coercion to use EPE

		Frequency	Percent	Valid Percent
Valid	Yes	18	14.3	14.5
	No	106	84.1	85.5
	Total	124	98.4	100.0
Missing	System	2	1.6	
Total		126	100.0	

Table 4.28: Duration of using EPE in work place

	Valid					Missing	Total
	Never	Seldom	Sometime	Often	Total	System	
Frequency	92	20	12	1	125	1	126
Percent	73.0	15.9	9.5	.8	99.2	.8	100.0
Valid Percent	73.6	16.0	9.6	.8	100.0		

Table 4.29 shows the frequency of reasons for not using EPE. Workers could give multiple-responses to this question. Most workers (30.5%) reported EPE was not provided by their manager.

Table 4.29: Frequencies of reasons not using EPE

		Responses		Percent of Cases
		N	Percent	
Reason for Not using EPE[a]	EMPLOYER DID NOT	51	30.5%	47.7%
	NOT COMFORTABLE	15	9.0%	14.0%
	IS NOT MY HABIT	36	21.6%	33.6%
	FEELING STUFFY	11	6.6%	10.3%
	HEADACHE	4	2.4%	3.7%
	NEGLIGENCE	25	15.0%	23.4%
	OTHER	25	15.0%	23.4%
Total		167	100.0%	156.1%

a. Dichotomy group tabulated at value 1.

And also 57.1% of workers said that they did not have any training for occupational health and safety.

Table 4.30: Training about OSH

		Frequency	Percent	Valid Percent
Valid	Yes	47	37.3	39.5
	No	72	57.1	60.5
	Total	119	94.4	100.0
Missing	System	7	5.6	
Total		126	100.0	

Mann-Whitney and Wilcoxon tests were used to assess the relationship between OSH training of workers, their knowledge of the hazardous effect of high noise levels and EPE (Table 4.31). The rank table is divided into two panels, one panel for each test variable. Average ranks adjust for difference in the number of workers in both groups.

Table 4.31: Ranks of 3 variables

		Training about OSH	N	Mean Rank	Sum of Ranks
Information about hazardous effect of high noise level	dimension1	Yes	47	48.82	2294.50
		No	71	66.57	4726.50
		Total	118		
Information about benefit of using EPE	dimension1	Yes	47	54.10	2542.50
		No	71	63.08	4478.50
		Total	118		

The negative Z statistics indicate that the rank sums are lower than their expected values. The 2 tailed P value shows that there is a significant relationship between knowledge of the hazardous effect of high noise level and OSH training.

Table 4.32: Test Statistics of training about OSH

	Information about hazardous effect of high noise level	Information about benefit of using EPE
Mann-Whitney U	1166.500	1414.500
Wilcoxon W	2294.500	2542.500
Z	-3.198	-1.614
Asymp. Sig. (2-tailed)	.001	.106

The Kruskal-Wallis test was used to evaluate relationship between worker education level and knowledge of the hazardous effect of high noise level and benefit of using EPE (Table A.11, appendix A). Table 4.33 shows that there is a significant difference between each level of education, knowledge of noise hazards and benefit of using EPE.

Table 4.33: Statistical test of education level with information about EPE and noise hazardous (Kruskal Wallis Test)

	Information about hazardous effect of high noise level	Information about benefit of using EPE
Chi-square	24.133	25.605
df	4	4
Asymp. Sig.	.000	.000

Chi-square test of association was used to assess for any relationship between age of workers and their OSH training. The cross tabulation table in appendix (Table A.12) shows the distribution of each age levels with respect to their training. The table below shows that there is no statistically significant association between age of workers and OSH training.

Table 4.34: Chi-Square Tests for age and OSH training

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.417	8	.712
Likelihood Ratio	5.757	8	.674
Linear-by-Linear Association	.952	1	.329
N of Valid Cases	118		

No significant relationship was found between duration EPE use and OSH training of workers with using the Mann-Whitney test (Table 4.35).

Table 4.35: Statistics test from OSH training as grouping variable with duration of using EPE

	Duration of using EPE in work place
Mann-Whitney U	1509.500
Wilcoxon W	4065.500
Z	-1.147
Asymp. Sig. (2-tailed)	.251

4.1.2.5 Analyzing Risk Perception

In response to the statement that "high noise levels can cause temporary hearing loss" 39.3% of respondents strongly agreed, 41% agreed, 17.9% had no opinion and only 0.9% disagreed and 0.9 strongly disagreed. In response to the statement "high noise levels can permanently affect hearing" 37.1% were strongly agreed, 33.6% agreed, 22.4% had no opinion and 6.9% disagreed. In response to the statement that "it is possible to reduce the noise level in my workplace", 7.8%, 18.3%, 28.7%, 27% and 18.3% of the workers were strongly agreed, agreed, had no opinion, disagreed and strongly disagreed respectively. Also out of 115 workers 8.7% were strongly agreed, 16.5% agreed, 24.3% had no opinion, 30.4% disagreed and 20% strongly disagreed to "noise in my work place is not dangerous".

Table 4.36: Risk perception frequency and percentage

Question		Strongly disagree	Disagree	No opinion	Agree	Strongly agree	Total
		Valid					
KNOWLEDGE ABOUT NOISE							
Exposure to the high noise levels can cause temporary loss of hearing	Frequency	1	1	21	48	46	117
	Percent	.9	.9	17.9	41.0	39.3	
High noise levels can permanently affect hearing	Frequency	0	8	26	39	43	116
	Percent	0	6.9	22.4	33.6	37.1	
It is possible to reduce the noise level in my workplace	Frequency	21	31	33	21	9	115
	Percent	18.3	27.0	28.7	18.3	7.8	
Noise in my work place is not dangerous	Frequency	23	35	28	19	10	115
	Percent	20.0	30.4	24.3	16.5	8.7	
KNOWLEDGE ABOUT HEARING PROTECTION							
All hearing protectors offer the same protection	Frequency	10	16	58	24	7	115
	Percent	8.7	13.9	50.4	20.9	6.1	
Protection of hearing depends on the duration of ear protection use in each day	Frequency	3	17	49	31	16	116
	Percent	2.6	14.7	42.2	26.7	13.8	
There is no need to use ear protection equipment in my work place	Frequency	27	35	26	20	8	116
	Percent	23.3	30.2	22.4	17.2	6.9	
There are several types of hearing protection equipment	Frequency	7	15	48	33	12	115
	Percent	6.1	13.0	41.7	28.7	10.4	
I, avoid myself from being exposed to high noise level	Frequency	13	20	17	45	16	111
	Percent	11.	18.0	15.3	40.5	14.4	

The response to second part of this section the questionnaire was as follow: 6.1% strongly agreed, 20.9% agreed, 50.4% had no opinion, 13.9% disagreed and 8.7% strongly disagreed which the statement “all hearing protectors offer the same protection”. In addition 13.8%, 26.7%, 42.2%, 14.7% and 2.6% of the workers had strongly agreed, agreed, had no opinion, disagreed, and strongly disagreed respectively to the statement that “protection of hearing depends on the duration of EPE use in each day”. In response to the statement “there is no need to use ear protection equipment in my work place”, percentage of the worker’s responses were 6.9% strongly agree, 17.2% agree, 22.4% no opinion, 30.2% disagree and finally 23.3% strongly disagree. 6.1% strongly disagreed, 13% disagree, 41.7% had no opinion, 28.7% agreed and 10.4% strongly agreed to the statement “there are several types of hearing protection equipment". Lastly 14.4% strongly agreed, 40.5% agreed, 15.3% had no opinion, 18% disagreed and 11.7% strongly disagreed to the statement "I, avoid myself from being exposed to high noise level". This data is represented in table 4.36 and figure 4.4.

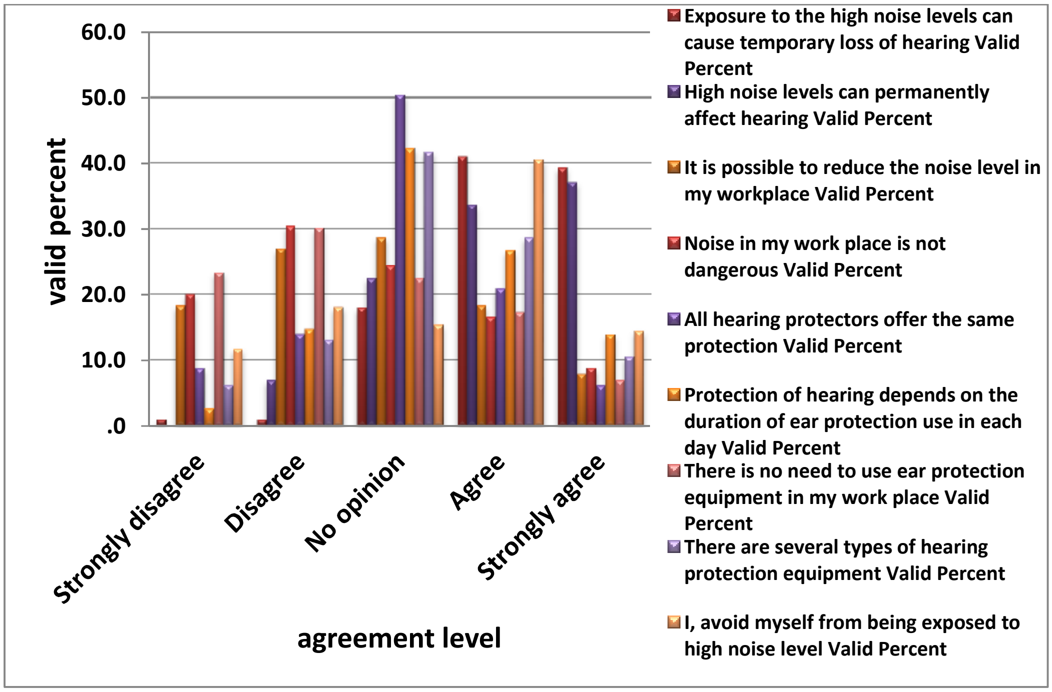

Figure 4.4: Bar chart for percentage of risk perception

Multi regression analysis was used to determine if a meaningful, statistically significant relationship exists between four factors of knowledge of noise and independent variables such as OSH training and knowledge of the hazardous effects of high noise levels and education level.

Table 4.37: Multi regression of 'exposure to high noise level can cause temporary loss of hearing' model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	4.932	.376		13.130	.000		
	Training about OSH	-.362	.146	-.234	-2.475	.015	.888	1.127
	Information about hazardous effect of high noise level	-.250	.154	-.164	-1.617	.109	.769	1.301
	Education level	.084	.056	.148	1.484	.141	.804	1.244

Table 4.37 shows that OSH training (p=0.015<0.05) was found to be a statistically significant predictor of the worker's agreement with the statement "high noise level can cause temporary loss of hearing".

Table 4.38: Multi regression of ' high noise levels can permanently affect hearing' model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	4.550	.471		9.657	.000		
	Training about OSH	-.446	.184	-.236	-2.428	.017	.893	1.120
	Information about hazardous effect of high noise level	-.096	.193	-.052	-.496	.621	.774	1.292
	Education level	.124	.071	.178	1.747	.084	.809	1.236

Table 4.38 shows that OSH training (p=0.017<0.05) is a statistically significant predictor of the worker's agreement with the statement "high noise levels can permanently affect hearing".

Table 4.39: Multi regression of 'It is possible to reduce the noise level in my workplace' model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.783	.662		4.204	.000		
	Training about OSH	.142	.257	.057	.551	.583	.884	1.131
	Information about hazardous effect of high noise level	-.166	.272	-.069	-.611	.543	.756	1.323
	Education level	-.032	.099	-.035	-.320	.749	.794	1.260

Table 4.39 shows that none of factors were found to be a significant predictor of the worker's agreement with the statement "It is possible to reduce the noise level in my workplace".

Table 4.40: Multi regression of 'noise in my work place is not dangerous' model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	3.151	.667		4.720	.000		
	Training about OSH	-.378	.249	-.153	-1.517	.132	.879	1.138
	Information about hazardous effect of high noise level	.204	.264	.085	.770	.443	.740	1.351
	Education level	.207	.098	.230	2.114	.037	.757	1.322

Table 4.40 shows that only education level ($p=0.037<0.05$) was found to be a significant predictor of worker's agreement with the statement "noise in my work place is not dangerous". Also figure B.7 displays that mean of education for the workers whom were strongly disagree with the sentence that noise in my work place is not dangerous are higher than others.

Multi regression model was used to assess the relationship between five factors of knowledge about EPE and independent variables such as OSH training and knowledge the benefit of using EPE and education level of workers.

Table 4.41: Multi regression of 'all hearing protection offer the same protection' model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.878	.500		3.759	.000		
	Training about OSH	.123	.177	.064	.692	.490	.928	1.078
	Information about benefit of using EPE	.034	.184	.018	.183	.855	.807	1.239
	Education level	.308	.070	.441	4.380	.000	.779	1.284

Table 4.41 shows that education level ($p=0.00<0.05$) was found to be a significant predictor of worker's agreement with this statement "all hearing protection offer the same protection". Also figure B.8 displays the mean education level for each level of agreement from 1=strongly agree to 5=strongly disagree.

Table 4.42: Multi regression of 'protection of hearing depends on the duration of ear protection use in each day' model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	4.193	.553		7.583	.000		
	Training about OSH	-.555	.198	-.275	-2.806	.006	.923	1.084
	Information about benefit of using EPE	.011	.203	.006	.056	.955	.825	1.213
	Education level	.002	.078	.002	.021	.983	.792	1.263

Additionally a statistical significant relationship was noted between OSH training and dependent factor (protection of hearing depends on the duration of ear protection use in each day) as designated in table 4.42.

Table 4.43: Multi regression of 'there is no need to use ear protection equipment in my work place' model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.352	.671		3.507	.001		
	Training about OSH	.161	.241	.066	.669	.505	.941	1.063
	Information about benefit of using EPE	.151	.251	.063	.601	.549	.832	1.202
	Education level	-.114	.095	-.128	-1.199	.233	.809	1.236

Table 4.43 shows that there is no significant relationship between independent factors and agreement levels of the workers to the statement "there is no need to use ear protection equipment in my work place".

Table 4.44: Multi regression of 'there are several types of hearing protection equipment' model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.503	.542		4.615	.000		
	Training about OSH	.263	.195	.132	1.349	.180	.928	1.077
	Information about benefit of using EPE	-.155	.203	-.080	-.765	.446	.816	1.225
	Education level	.190	.077	.259	2.455	.016	.795	1.259

Table 4.44 shows that only education level ($p=0.016<0.05$) was found to be a significant predictor factor of worker's agreement levels to the statement "there are several types of hearing protection equipment".

Table 4.45: Multi regression of 'I, avoid myself from being exposed to high noise level' model

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	3.935	.749		5.250	.000		
	Training about OSH	-.141	.266	-.055	-.531	.597	.918	1.089
	Information about benefit of using EPE	-.306	.276	-.122	-1.108	.271	.808	1.237
	Education level	-.010	.105	-.010	-.093	.926	.776	1.288

Table 4.45 represent that there is no significant relation found between independent factors and dependent variable (I, avoid myself from being exposed to high noise level).

4.2 Investigate Noise Levels

Table 4.46 shows noise level at the center of each study site. The equivalent noise levels at all the small sized industries were more than 90 dBA except location 5 at 89.4 L_{eq}. C weighted maximum values reached by sound pressure (Peak) were more than 100 dBC. Table 4.47 displays the L_{eq} and L_{peak} for industrial machinery at each location.

Table 4.46: Noise level at the center of each location

LOCATION	Leq	L_{Peak}
Location 1	93.9	110.8
Location 2	94.0	115.3
Location 3	94.1	104.1
Location 4	94.0	119.9
Location 5	89.4	101.2
Location 6	94.6	103.2
Location 7	93.9	102.2
Location 8	94.1	115.8
Location 9	94.0	122.3
Location 10	93.2	109.0
Location 11	94.9	119.0
Location 12	94.4	110.5
Location 13	94.8	112.5

Table 4.47: Noise level in each location according to machines

LOCATION	Leq	Peak	Type of machines
Location 1	94.6	108.8	binding machine
	94.3	119.4	cutting paper machine
	94.5	109.3	offset machines
Location 2	93.9	109.9	blending machine
	94.0	109.3	packaging machine
Location 3	94.4	104.6	cheese packaging and labeling machine
	94.1	106.2	milk blending machine
	94.1	131.8	cheese blending machine
Location 4	93.8	116.2	label machine for big bottle
	93.7	129.9	filling machine for big bottle
	93.8	109.2	packaging machine
	93.9	107.7	filling machine for small bottle
	93.9	103.0	label machine for small bottle
Location 5	84.8	94.6	bottle filling machine
	84.2	92.5	label machine
	87.4	97.1	x ray
Location 6	94.3	110.4	mosaic production line
	94.8	128.2	cutting big stone
	95.0	120.5	cutting marble
	94.8	109.8	cutting small stone
	94.5	136.2	grinding stone
	94.8	132.6	stone polish
Location 7	95.1	104.4	automatic cutting machine
	93.9	105.9	cutting machine
	94.6	121.5	gluing machine
Location 8	93.8	103.5	cutting machine
	94.0	113.2	cutting machine
Location 9	93.8	108.5	pressing & drying sheet
	93.9	115.9	packing sheet
	94.0	116.4	pressing & drying sheet (NE)
	94.0	117.1	drying
	94.1	121.2	washing machine
	94.2	124.1	washing machine
Location 10	95.2	107.4	cutting iron
	93.2	109.0	drilling iron
Location 11	94.1	112.1	big water filling machine
	94.3	107.1	label for big water
	95.0	112.3	bottle maker
	94.9	119.0	small water label
	94.9	107.9	small water filling
Location 12	94.4	108.0	offset machine
	94.8	103.2	Form printing machine
Location 13	95.1	108.5	blowing machine
	94.6	130.3	filling machine (pet)
	95.2	115.2	filling machine (can)
	95.3	108.1	dryer
	95.1	130.2	can packing machine

Table 4.48: Mean and standard deviation of L_{eq} and L_{peak} for each location

location		Leq	Peak
1	Mean	94.47	112.50
	Std. Deviation	0.15	5.98
2	Mean	93.95	109.60
	Std. Deviation	0.07	0.42
3	Mean	94.20	114.20
	Std. Deviation	0.17	15.26
4	Mean	93.82	113.20
	Std. Deviation	0.08	10.47
5	Mean	85.47	94.73
	Std. Deviation	1.70	2.30
6	Mean	94.70	122.95
	Std. Deviation	0.25	11.25
7	Mean	94.53	110.60
	Std. Deviation	0.60	9.47
8	Mean	93.90	108.35
	Std. Deviation	0.14	6.86
9	Mean	94.00	117.20
	Std. Deviation	0.14	5.32
10	Mean	94.20	108.20
	Std. Deviation	1.41	1.13
11	Mean	94.64	111.68
	Std. Deviation	0.41	4.73
12	Mean	94.60	105.60
	Std. Deviation	0.28	3.39
13	Mean	95.06	118.46
	Std. Deviation	0.27	11.13

Table 4.48 shows mean and standard deviation of L_{peak} and L_{eq} for each site, the mean of L_{eq} in location 13 was higher than any other locations with a Std. Deviation of 0.27, the means of each index is shows graphically in Figure B.9 in appendix B. Table 4.49 shows mean L_{eq} and peak standard deviation for all the 13 locations.

Table 4.49: Descriptive Statistics of L_{eq} and peak for 13 locations

	Mean	Std. Deviation
L_{eq}	93.8106	2.28475
peak	113.1319	10.09395

In addition the noise layout of each locations show in appendix b from figure B.10 to figure B.22. These layouts show the name of each machines and level of the noise for each of them and the place of measurement.

Chapter 5

DISCUSSION

5.1 Noise Levels

The daily noise exposure of small and medium size factory workers in North Cyprus exceeds the maximum OSHA exposure limit of 90 dBA.

Factory workers further exceeded OSHA standards for occupational exposure to high noise levels due to long work hours. 70% reported working more than 8 hours per day and 25% more than 5 days per week. Old machines are responsible for most of the noise and 50% of workers are machine operators.

Our study demonstrated that noise exposure was not limited to machine operators. Sound levels in the center of the factory also exceed OSHA standards. at some factories noise levels also extended beyond the factory to the surrounding neighborhood.

These factories need to address this very serious occupational safety issue. A number of very simple engineering solutions can often be implemented with great success (Bruce, 2007):

- Proper maintenance for machinery.

- Modified operating procedures such as relocating an operator and equipment controls to a quieter position.
- Relocation of noisy vents away from workers.
- Replacement of equipment such as buying a quieter version of the product.
- Modified room treatment such as introducing sound absorption in the space between equipment and worker to reduce noise in the distant reverberant field.
- Relocation of equipment, for example putting noisy equipment in areas that are often unoccupied.
- Proper operating speed for instance running equipment at lower speed to reduce noise.

If such controls fail to reduce sound levels, PPE should be provided and use to decrease noise levels.

5.2 Subjective Response to Noise

Summary of main content from statistical analysis of 13 locations and cross-sectional investigation from 126 workers which are representative of North Cyprus industries can be enumerated as follows; the average of the workers in these industries was in middle age between 31 and 40 and most of them were male. Older workers were less educated and had longer work experience.

Our finding are consistent with the literature demonstrating that common occupational illnesses are observed when exposed to high noise levels. Symptoms reported while working in a high noise area included speech interference, headaches, feeling uncomfortable, and stresses or annoyed. Feeling stressed or uncomfortable was correlated with the duration of work or operating a machine. Workers who often or always had headaches were more likely to have a known diagnosis of hypertension.

Workers knowledge of the hazards of high noise level and the benefit of usage earing protection equipment was linked to OSH training and worker education level. Most workers did not have occupational health and safety training. Most workers did not use ear protection because one was not provided and they were not in the habit of using these devices.

Those workers with OSH training and higher education level were more likely to be aware of the risks of exposure to high noise levels.

Small scale industries of developing countries like North Cyprus are still far behind in implementing occupational health and safety programs. For more effective control of occupational noise in small and medium sized of industries, it is recommended that an integrated noise control approach be taken. Such an approach would consider all the noise influencing factors in the context of occupational and environmental impacts to determine effectively and technically feasibility options. The focus of the approach should be prevention of noise generation followed by controlling noise at the source. Other reactive measures such as use of PPE should be considered as a last resort.

Perception of risk in workplace influence workers behavior, hence they avoid to expose to the high noise level. Awareness of noise could play an important role in safety and health behavior. Also awareness of industry's managers has effective role to exclude their workers from expose to high noise levels by providing personal hearing protection or by holding applicable occupational safety and health training classes.

Workers should be motivated to use PPE and be educated regarding noise induced hearing loss and other non-auditory effects of noise exposure. The factories should be encouraged and assisted in implement hearing conservation programs under the direction of an occupational and environment health professional. There is a dire need ethical and legal obligation to implement the noise working hour standard and hearing conservation programs in North Cyprus.

Chapter 6

CONCLUSIONS

Health and safety are independent and complementary to each other. Attention to occupational health and safety has historically increased. One of the most common hazards of occupational health and safety is noise. In small and big industrial and manufacturing environments, as well as in farms and in the public areas, permanent hearing loss is the main concern. Noise is not a new hazard. It has been a constant threat since the industrial revolution. Occupational noise exposure has been identified as a very obvious hazard for some industries especially in the small scale and hand tool industries which are still not mechanized. In most developing countries, manpower and traditional methods still play an important role for small scale industries. In countries like North Cyprus with rapid economic growth and associated industrial growth, it is essential that there is more attention given to worker safety and health in order to prevent irreversible consequences of occupational injury. We looked at noise levels in various small and medium-sized industries in North Cyprus in order to identify occupational noise exposure of workers and to make recommendations on how to reduce occupational noise levels in these sectors with several limitations. The levels of the noise in these locations were in the action level.

Small scale industries of developing countries like North Cyprus are still far behind in implementing occupational health and safety programs. For more effective control of noise pollution from the small and medium sized of industries, it is recommended that an integrated noise control approach be taken.

The workers should be motivated to use PPE and educated for the noise induced hearing loss and other non-auditory effects of noise exposure. The factories should be encouraged and assisted in implement hearing conservation programs under the direction of occupational environment health professional. There is a dire need, ethical and legal obligation to implement the noise working hour standard and hearing conservation programs in North Cyprus.

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APPENDICES

Appendix A: Tables

Table A.1: Percentage with in age and education level

		Education level					
		Elementary/ Primary school	Junior high school	High school	Technical school	University	Total
Age	Under 20	.0%	.0%	100.0%	.0%	.0%	100.0%
	20-25	12.5%	16.7%	20.8%	12.5%	37.5%	100.0%
	26-30	14.3%	21.4%	35.7%	7.1%	21.4%	100.0%
	31-35	24.1%	20.7%	41.4%	10.3%	3.4%	100.0%
	36-40	26.1%	21.7%	34.8%	4.3%	13.0%	100.0%
	41-45	16.7%	50.0%	16.7%	16.7%	.0%	100.0%
	46-50	38.5%	30.8%	15.4%	.0%	15.4%	100.0%
	51-55	60.0%	10.0%	20.0%	10.0%	.0%	100.0%
	Above 56	100.0%	.0%	.0%	.0%	.0%	100.0%
Total		26.8%	21.1%	29.3%	8.1%	14.6%	100.0%

Table A.2: Chi-Square Tests between age and education level

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	42.713[a]	32	.098
Likelihood Ratio	43.266	32	.088
Linear-by-Linear Association	17.389	1	.000
N of Valid Cases	123		

Table A.3: Case processing summary

Un weighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	122	96.8
	Missing Cases	4	3.2
	Total	126	100.0
Unselected Cases		0	.0
Total		126	100.0

Table A.4: Classification Table[a,b] for blood pressure

Observed			Predicted		
			Blood pressure		Percentage Correct
			No	Yes	
Step 0	Blood pressure	No	94	0	100.0
		Yes	28	0	.0
	Overall Percentage				77.0

a. Constant is included in the model.

b. The cut value is .500

Table A.5 Variables in the equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-1.211	.215	31.643	1	.000	.298

Table A.6: Omnibus tests of model coefficients for blood pressure test

		Chi-square	df	Sig.
Step 1	Step	29.684	16	.020
	Block	29.684	16	.020
	Model	29.684	16	.020

Table A.7: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	Uncomfortable feeling (Never)			7.874	4	.096	
	Seldom vs. Never	.198	1.419	.020	1	.889	1.219
	Sometimes vs. Never	-1.521	1.543	.972	1	.324	.218
	Often vs. Never	-1.461	1.498	.952	1	.329	.232
	Always vs. Never	-3.554	1.905	3.680	1	.055	.026
	Headache (Never)			5.199	4	.268	
	Seldom vs. Never	1.533	1.461	1.102	1	.294	4.634
	Sometimes vs. Never	2.230	1.430	2.433	1	.119	9.296
	Often vs. Never	3.351	1.641	4.169	1	.041	28.523
	Always vs. Never	4.012	1.937	4.292	1	.038	55.271
	Speech interference (Never)			5.787	4	.216	
	Seldom vs. Never	.358	1.013	.125	1	.724	1.431
	Sometimes vs. Never	-.761	.938	.658	1	.417	.467
	Often vs. Never	1.438	1.143	1.582	1	.208	4.211
	Always vs. Never	1.132	1.143	.815	1	.367	2.807
	Stressful (Never)			4.315	4	.365	
	Seldom vs. Never	-1.317	1.065	1.529	1	.216	.268
	Sometimes vs. Never	-1.134	1.141	.987	1	.321	.322
	Often vs. Never	-.582	1.207	.232	1	.630	.559
	Always vs. Never	-2.013	1.380	2.569	1	.109	.109
	Constant	-1.566	.906	3.800	1	.051	.171

Table A.8: Categorical variables codings in blood pressure test

		Frequency	Parameter coding (1)	(2)	(3)	(4)
Feel stressful while or after working in noisy area	Never	20	.000	.000	.000	.000
	Seldom	26	1.000	.000	.000	.000
	Sometime	32	.000	1.000	.000	.000
	Often	26	.000	.000	1.000	.000
	Always	18	.000	.000	.000	1.000
Headache while or after working due to high noise level	Never	22	.000	.000	.000	.000
	Seldom	18	1.000	.000	.000	.000
	Sometime	52	.000	1.000	.000	.000
	Often	25	.000	.000	1.000	.000
	Always	5	.000	.000	.000	1.000
Speech interference with high noise level	Never	22	.000	.000	.000	.000
	Seldom	15	1.000	.000	.000	.000
	Sometime	40	.000	1.000	.000	.000
	Often	18	.000	.000	1.000	.000
	Always	27	.000	.000	.000	1.000
Uncomfortable feeling or annoyed from high noise level	Never	11	.000	.000	.000	.000
	Seldom	28	1.000	.000	.000	.000
	Sometime	39	.000	1.000	.000	.000
	Often	32	.000	.000	1.000	.000
	Always	12	.000	.000	.000	1.000

Table A.9: Hosmer and Lemeshow for blood pressure test

Step	Chi-square	df	Sig.
1	11.010	8	.201

Table A.10: Tests of between-subjects effects (time of operating machines)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	Uncomfortable feeling or annoyed from high noise level	22.401[a]	7	3.200	2.821	.012	.223	19.747	.892
	Headache while or after working due to high noise level	19.792[c]	7	2.827	2.956	.009	.231	20.692	.908
	Feel stressful while or after working in noisy area	29.814[d]	7	4.259	2.877	.011	.226	20.141	.899
Intercept	Uncomfortable feeling or annoyed from high noise level	454.148	1	454.148	400.338	.000	.853	400.338	1.000
	Headache while or after working due to high noise level	356.628	1	356.628	372.839	.000	.844	372.839	1.000
	Feel stressful while or after working in noisy area	390.247	1	390.247	263.643	.000	.793	263.643	1.000
Operate time	Uncomfortable feeling or annoyed from high noise level	22.401	7	3.200	2.821	.012	.223	19.747	.892
	Headache while or after working due to high noise level	19.792	7	2.827	2.956	.009	.231	20.692	.908
	Feel stressful while or after working in noisy area	29.814	7	4.259	2.877	.011	.226	20.141	.899
Error	Uncomfortable feeling or annoyed from high noise level	78.274	69	1.134					
	Headache while or after working due to high noise level	66.000	69	.957					
	Feel stressful while or after working in noisy area	102.134	69	1.480					
Total	Uncomfortable feeling or annoyed from high noise level	824.000	77						
	Headache while or after working due to high noise level	675.000	77						
	Feel stressful while or after working in noisy area	813.000	77						
Corrected Total	Uncomfortable feeling or annoyed from high noise level	100.675	76						
	Headache while or after working due to high noise level	85.792	76						
	Feel stressful while or after working in noisy area	131.948	76						

Table A.11: Average rank of dependent variables for each level of education

	Education level	N	Mean Rank
Information about hazardous effect of high noise level	Elementary/Primary school	34	78.72
	Junior high school	26	68.98
	High school	35	56.34
	Technical school	10	39.65
	University	18	43.75
	Total	123	
Information about benefit of using EPE	Elementary/Primary school	34	80.03
	Junior high school	25	69.90
	High school	36	53.50
	Technical school	10	45.30
	University	18	43.25
	Total	123	

Table A.12 Age and Training about OSH cross tabulation

Age		Training about OSH		Total
		Yes	No	
Age	Under 20	1	0	1
	20-25	9	16	25
	26-30	7	5	12
	31-35	10	17	27
	36-40	11	12	23
	41-45	2	4	6
	46-50	4	9	13
	51-55	2	6	8
	Above 56	1	2	3
Total		47	71	118

Table A.13: Noise measurement record sheet

factory name : .... address:.. calibration:..............................

number of the worker: .... product:.. range:..............................

#	name of the machine	ideal / bussy	L_{eq}	Peak	duration	place and area of the factory	L_{eq}	Peak	duration	comment
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										

date & time.. working hours:..

Appendix B: Figures

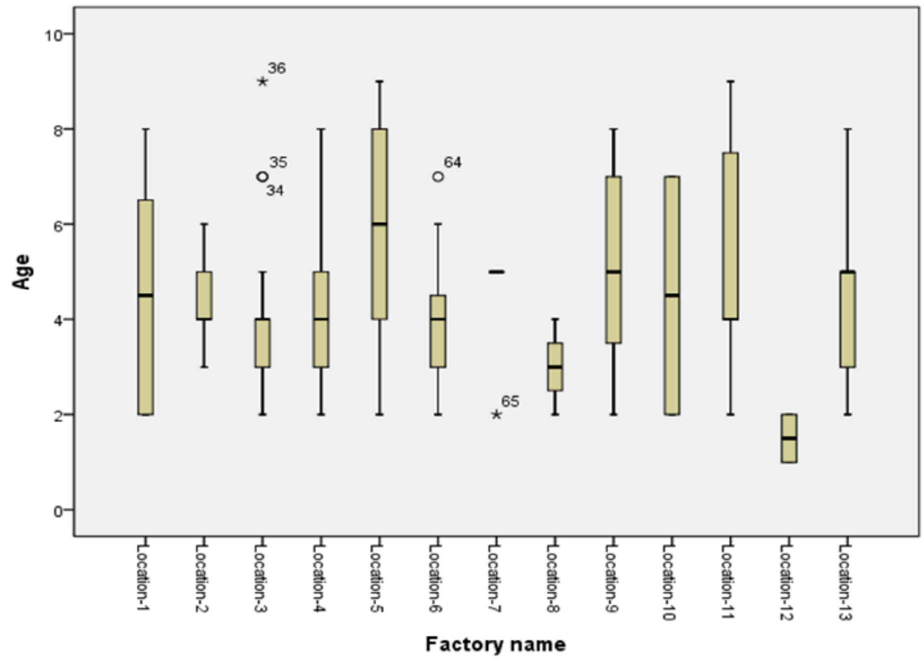

Figure B.1: Boxplot for age and location

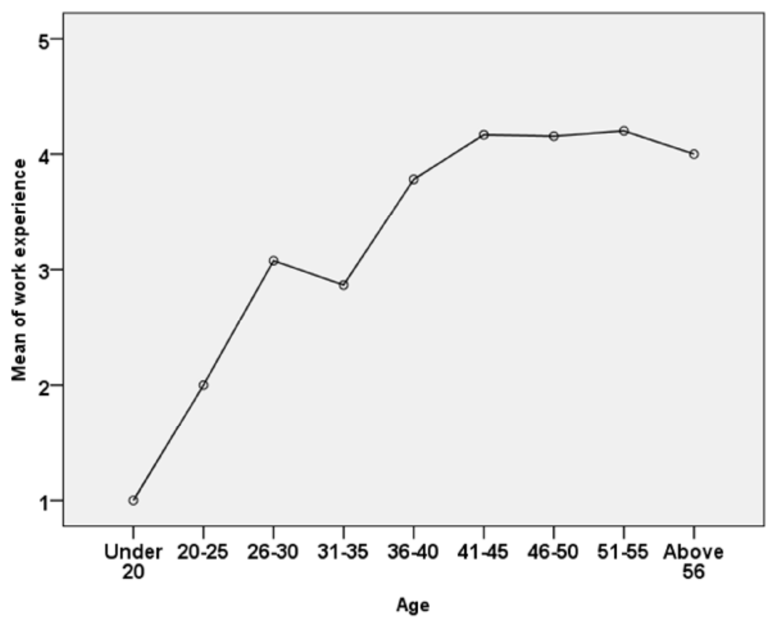

Figure B.2: Mean plot of work experience and age

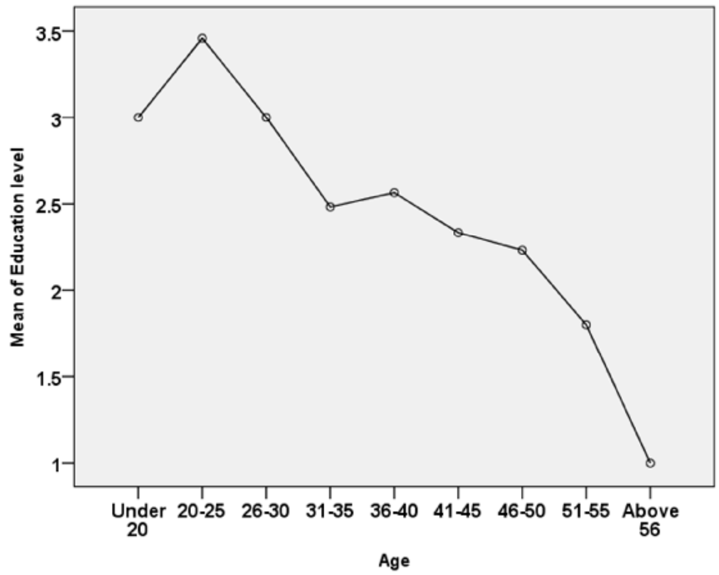

Figure B.3: Mean plot of education level and age

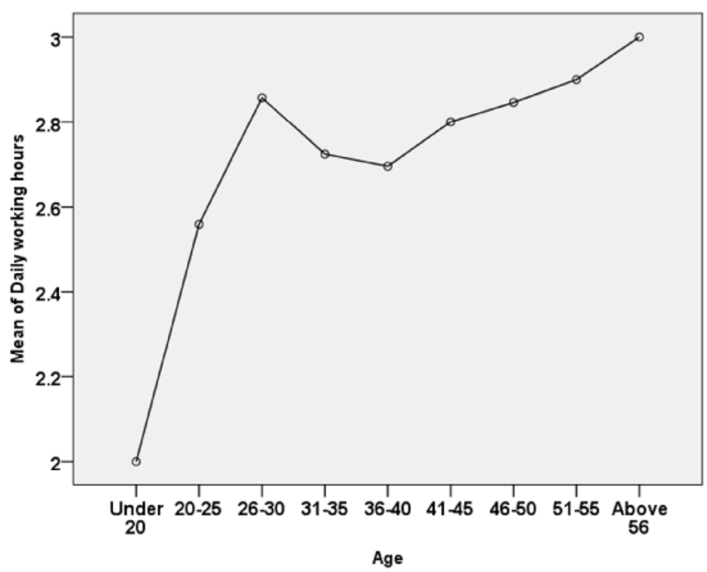

Figure B.4: Mean plot of Daily working hours and age

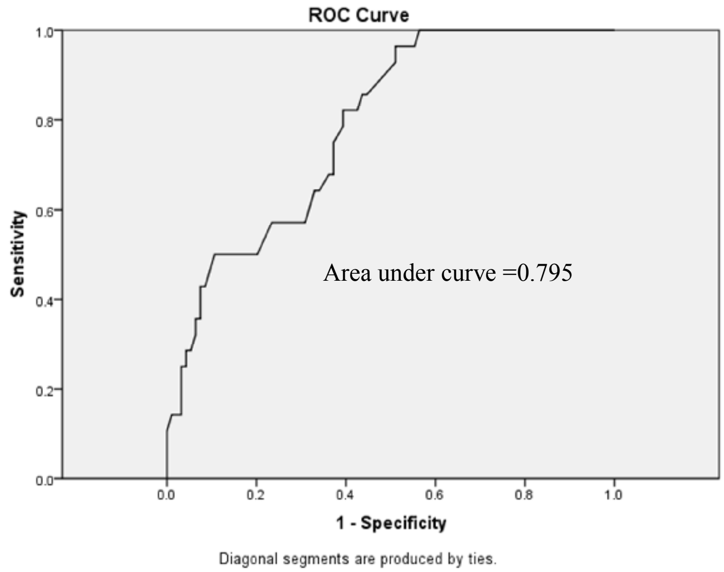

Figure B.5: ROC curve for blood pressure test

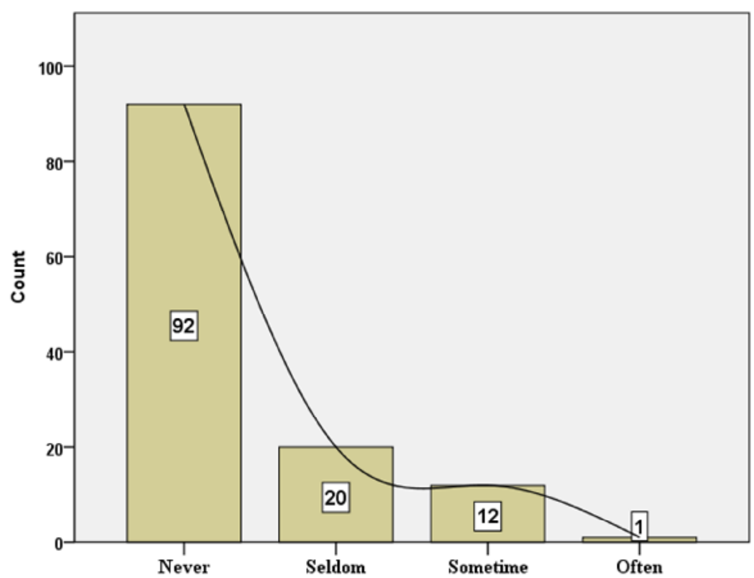

Figure B.6: Duration of using EPE

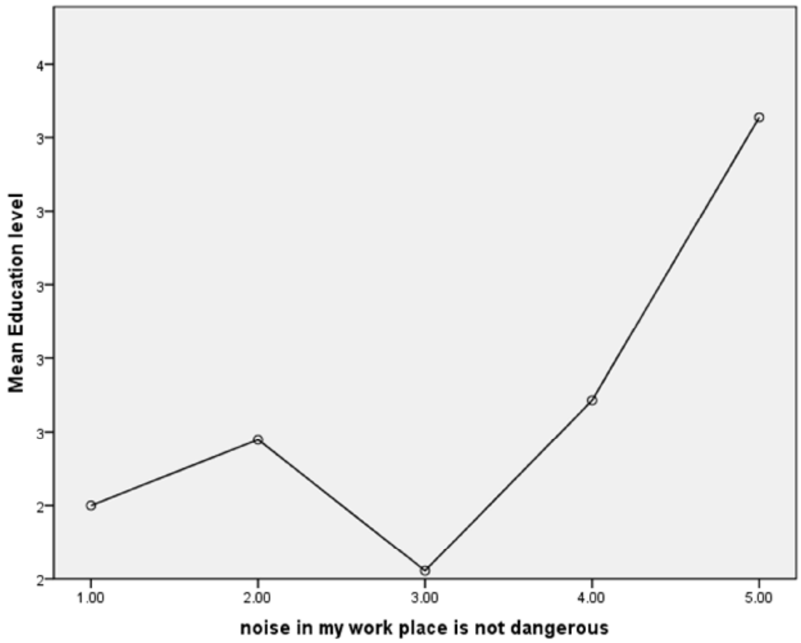

Figure B.7: Line chart mean of education level in each level of agreement

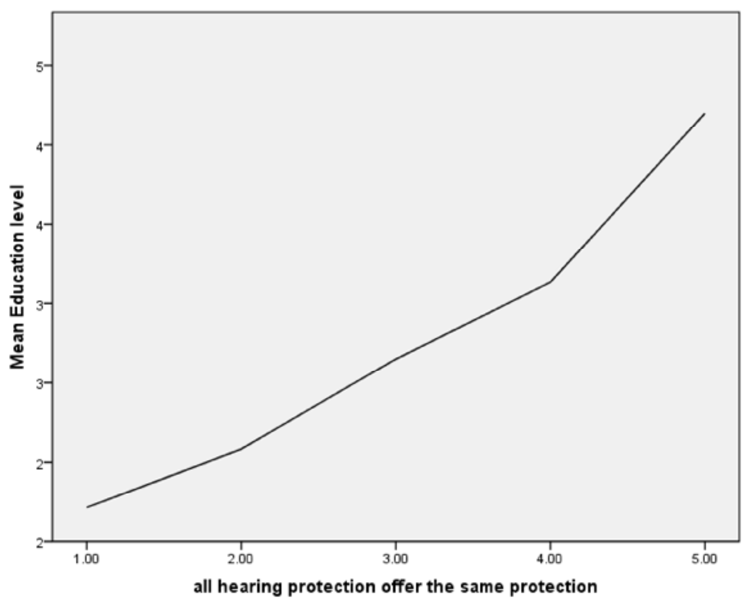

Figure B.8: Line chart mean of education level in each level of agreement

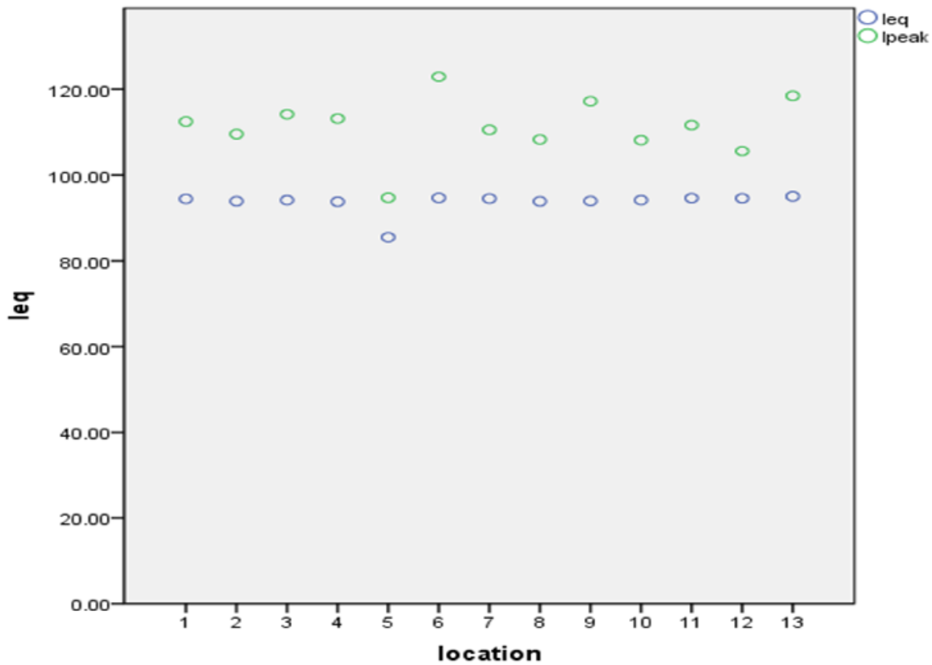

Figure B.9: Line chart for peak and L_{eq} for each location

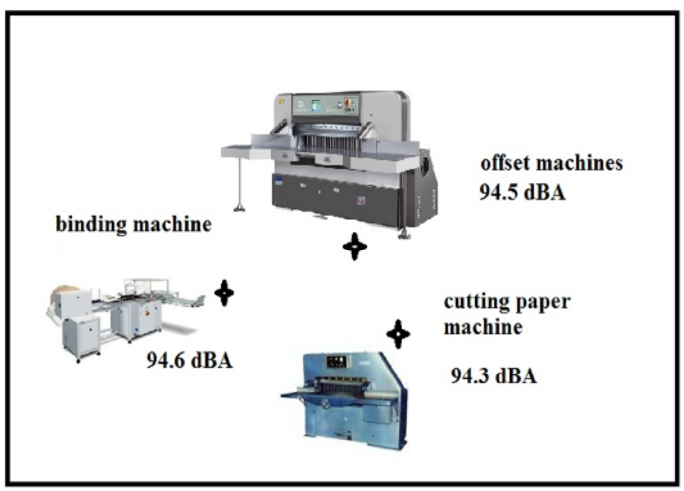

Figure B.10: Noise layout of location 1

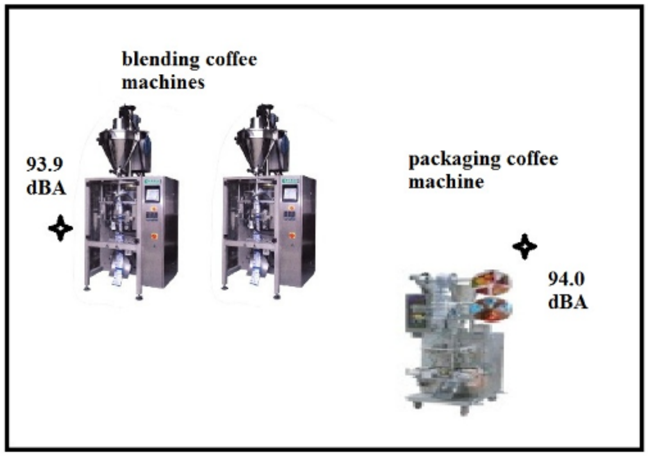

Figure B.11: Noise layout of location 2

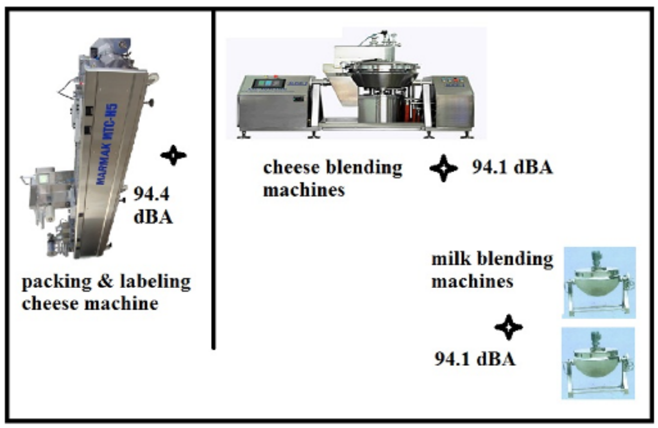

Figure B.12: Noise layout of location 3

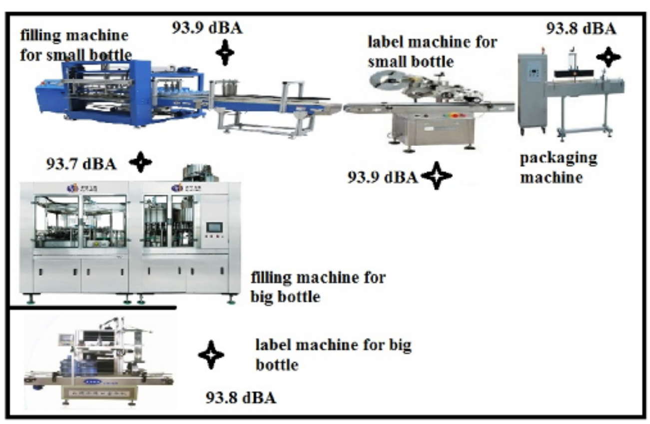

Figure B.13: Noise layout of location 4

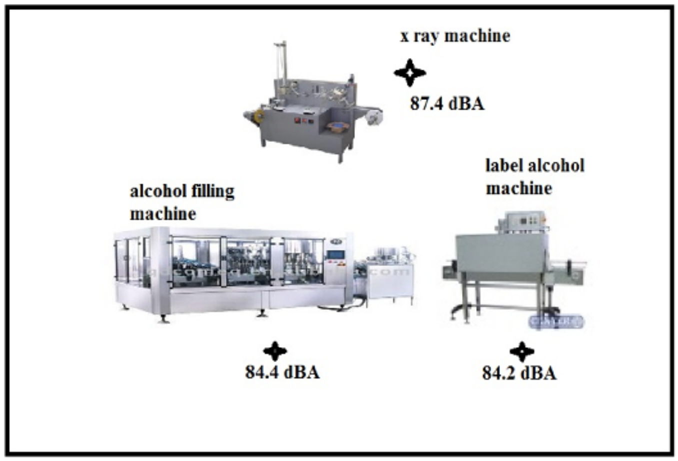

Figure B.14: Noise layout of location 5

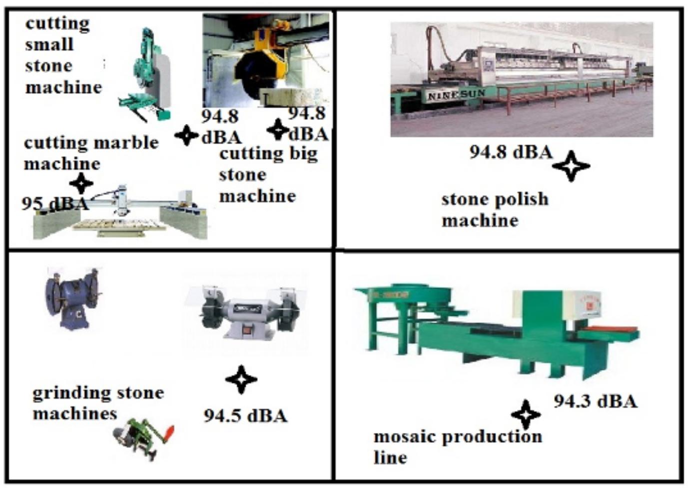

Figure B.15: Noise layout of location 6

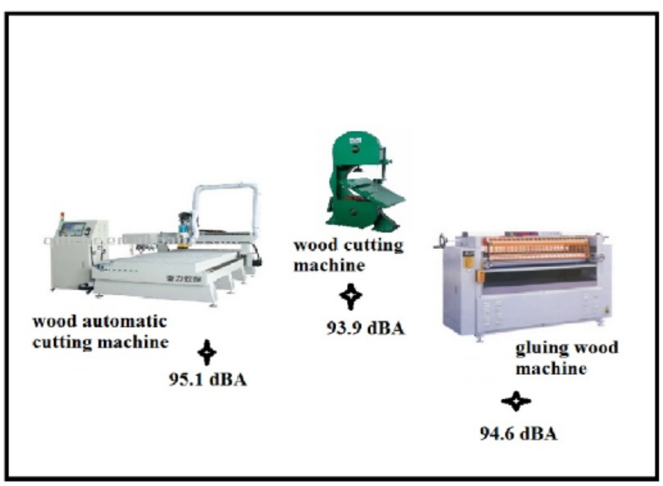

Figure B.16: Noise layout of location 7

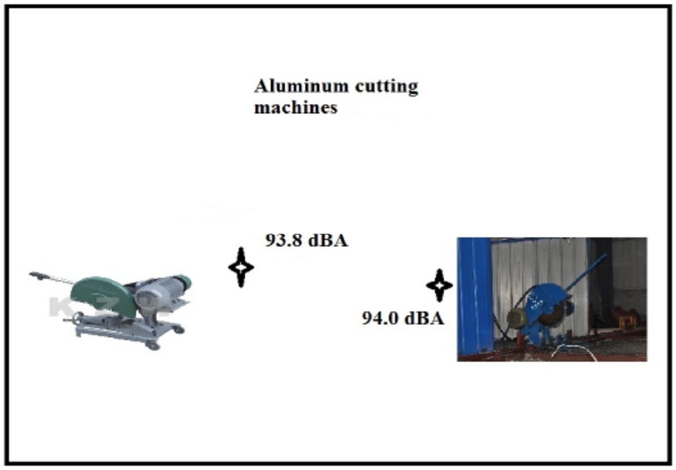

Figure B.17: Noise layout of location 8

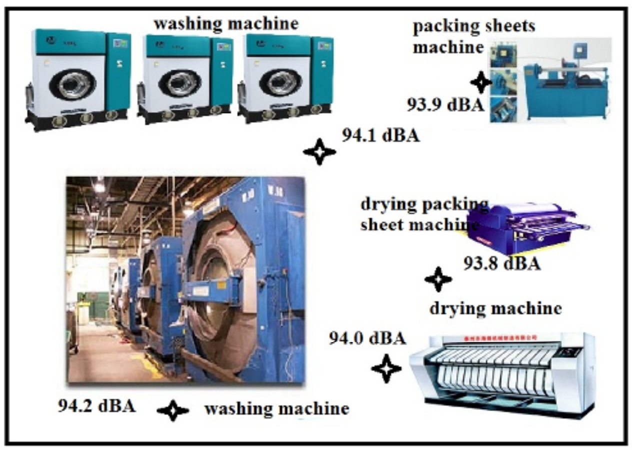

Figure B.18: Noise layout of location 9

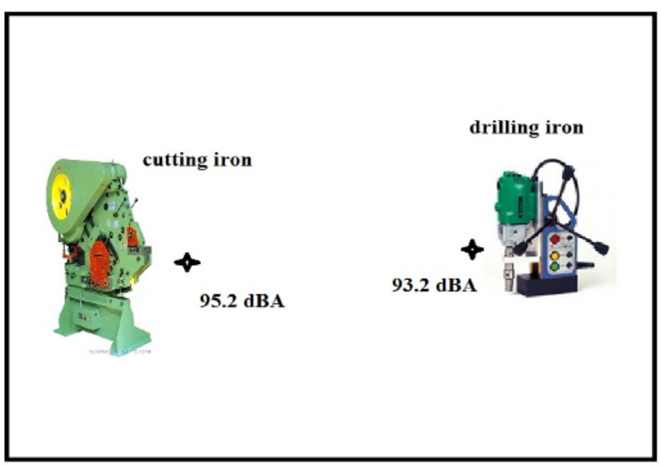

Figure B.19: Noise layout of location 10

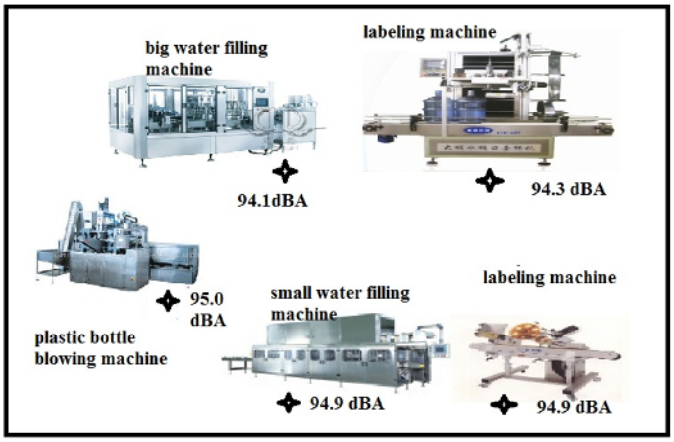

Figure B.20: Noise layout of location 11

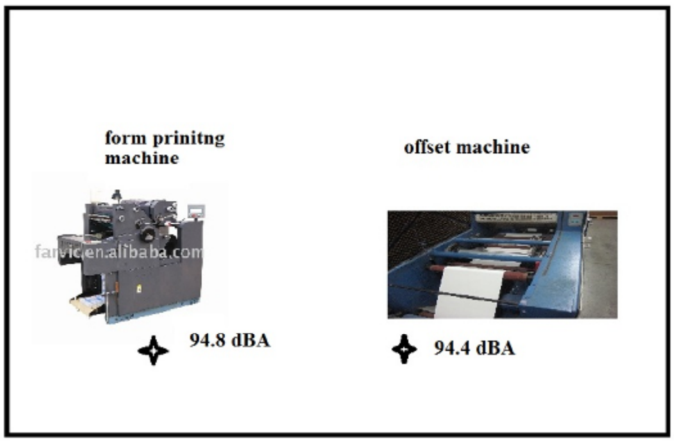

Figure B.21: Noise layout of location 12

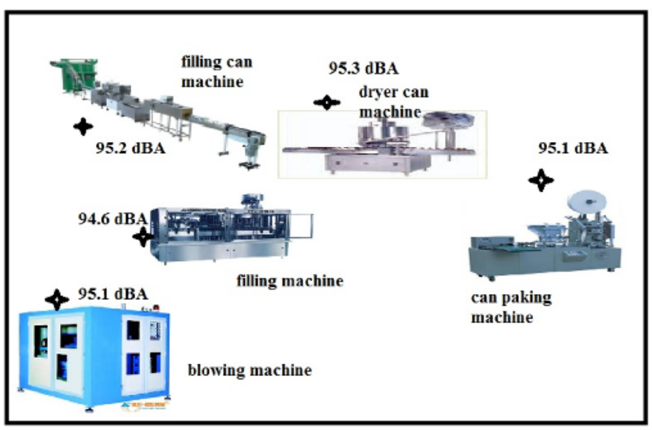

Figure B.22: Noise layout of location 13

Appendix C: Questionnaire

This questionnaire is prepared in order to understand and help improve the current situation of noise related Occupational Health and Safety in Northern Cyprus. This study is part of a master thesis taking place in EMU industrial engineering department and participation is voluntary of volunteers. If the survey results are published all the information about the factory and workers such as name and address will be kept confidential.

Please (√) the most appropriate choice.

1. Please answer the following question.

a) How old are you?

Under 20	*20 - 25*	*26 - 30*	*31 - 35*	*36 - 40*	*41- 45*	*46 - 50*	*50 - 55*	*Above 56*

b) What is your gender?

MALE	*FEMALE*

c) How long have you been doing this job?

Less than 1 year	*1-3 years*	*4– 6 years*	*7– 9 years*	*More than 10 years*

d) What is your education level?

Elementary/primary school	*Junior high school*	*High school*	*Technical school*	*university*

e) Are you sitting somewhere when you are working in your workplace?

YES	*NO*

f) Are you working in a standing position?

YES	*NO*

g) Are you working with or operating a machine in your work place?

YES	*NO*

h) If yes give information about the machine(s) you are working with or operating:

....

....

i) If your answer to question ***g*** was YES, how long do you operate a machine during the day?

1hr	*2hr*	*3hr*	*4hr*	*5hr*	*6hr*	*7hr*	*8hr*	*More than 8 hr*

j) What is your daily working hour?

Less than 4 hr	*5-7hr*	*More than 8 hr*

k) Do you have high blood pleasure?

YES	*NO*

l) Do you have any uncomfortable feeling or are you annoyed from the high noise level in your work place?

Always	*Often*	*Sometime*	*Seldom*	*Never*

m) Do you have any headache while working or after working due to high noise level?

Always	*Often*	*Sometime*	*Seldom*	*Never*

n) Do you have speech interference with high noise at your work place?

Always	*Often*	*Sometime*	*Seldom*	*Never*

o) Do you feel stressful while working or after working in a noisy area?

Always	*Often*	*Sometime*	*Seldom*	*Never*

p) Do you have information about the hazardous effect of high noise levels?

YES	*NO*

q) Do you have any information about the benefit of using ear protection equipment?

YES	*NO*

r) Does your manager or head of the factory force you to use ear protection when you are working in noisy area?

YES	*NO*

s) How long do you use ear protection equipment during your working hour?

Always	*Often*	*Sometime*	*Seldom*	*Never*

t) If you do not use ear protection what is the reason? *(more than one can be marked)*

Employer did not provide	*Not comfortable equipment*	*Is not my habit*	*Feeling stuffy*	*Headache*	*Negligence*	*Other*
						....

u) Did you have any training about occupational safety and health?

YES	NO

v) If your answer was YES, give brief information about this training?

....

....

Please (√) the most appropriate choice.

2 How do you agree with the following statement?

	Strongly Agree	Agree	No opinion	Disagree	Strongly disagree
a) Exposure to the high noise levels can cause temporary loss of hearing.					
b) High noise levels can permanently affect hearing.					
c) All hearing protectors offer the same protection.					
d) Protection of hearing depends on the duration of ear protection equipment use in each day.					
e) There is no need to use ear protection equipment in my work place.					
f) Noise in my work place is not dangerous.					
g) There are several types of hearing protection equipment.					
h) I, avoid myself from being exposed to high noise level.					
i) It is possible to reduce the noise level in my workplace.					