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TEZLİ YÜKSEK LİSANS PROGRAMI

ANALYSIS OF NON-AUDITORY EFFECTS OF INDUSTRIAL NOISE ON WORKER PRODUCTIVITY – CASE STUDY OF ERBIL STEEL COMPANY

YÜKSEK LİSANS TEZİ

Ramzi Faris AHMED

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Siirt Üniversitesi Lisansüstü Eğitim-Öğretim ve Sınav Yönetmeliğine göre hazırlamış olduğum "Analysis of Non-Auditory Effects of Industrial Noise on Worker Productivity-Case Study of Erbil Steel Company" adlı tezin tamamen kendi çalışmam olduğunu ve her alıntıya kaynak gösterdiğimi taahhüt eder, tezimin kağıt ve elektronik kopyalarının Siirt Üniversitesi Sosyal Bilimler Enstitüsü arşivlerinde aşağıda belirttiğim koşullarda saklanmasına izin verdiğimi onaylarım.

Lisansüstü Eğitim-Öğretim yönetmeliğinin ilgili maddeleri uyarınca gereğinin yapılmasını arz ederim.

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Ses, insanların sağlığı için önemli çevresel faktörlerden biridir, hem fiziksel hem de psikolojik yaralanmalarda önemli bir role sahiptir. Ayrıca bireylerin performansını ve üretkenliğini etkiler. Bu çalışmanın amacı, yüksek gürültü seviyelerine maruz kalmanın manuel uygulamalarda performans ve hata oranına etkisini belirlemektir.

Irak Erbil Çelik İşletmesinde, endüstriyel gürültünün, işçiler için, olumsuz etkileri söz konusu olmakta ve endüstriyel gürültü üretici firmalarda karar verme sürecini de etkilemektedir. Ayrıca, gürültü işçi verimliliği üzerinde önemli dış maliyetlere yol açmaktadır.

Makinelerin neden olduğu endüstriyel gürültüyü önlemek veya azaltmak için yapılan maliyetlere ek olarak, işgücü verimliliği de makinelerin gürültüsünden dolayı işyerinde azalmaktadır. Makinelerin artan sayısı ve özellikle makinelere yakın çalışan işçilerin hayatı acı verici ve endişe verici haldedir. Dolayısıyla işçilerin sağlık ve ekonomik riskleri de beraberinde artmaktadır.

Gürültünün işitsel olmayan etkileri Erbil Çelk İşletmesi'nde 120 çalışan üzerinde incelenmiştir. Toplanan cevapların istatistiksel analizleri değerlendirilmiştir. Tanımlayıcı istatistikler SPSS 20 sürümü kullanılarak gerçekleştirilmiş ve grafikler Microsoft Excel 2016 kullanılarak hazırlanmıştır.

İstatistiksel analiz, Erbil Çelik İşletmesi'nde çok fazla gürültü olduğunu ve çalışanların işyerinde gürültüden rahatsız olma riskinin daha yüksek olduğunu

göstermiştir. Gürültünün Erbil Çelik İşletmesi'ndeki işçilerin verimliliğine etkisi, seçilen işçilerin verdikleri yanıtlara göre oldukça yüksektir.

Anahtar Kelimeler: Gürültü, Endüstriyel Gürültü, İşitsel Olmayan, Çevre ve Verimlilik.

ABSTRACT

MASTERS THESIS

ANALYSIS OF NON-AUDITORY EFFECTS OF INDUSTRIAL NOISE ON WORKER PRODUCTIVITY – CASE STUDY OF ERBIL STEEL COMPANY

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Supervisor: Asst. Prof. Dr. Semih Serkant AKTUĞ

2018, 88 Pages

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Sound is among the significant environmental factors for people's health, it has an important role in both physical and psychological injuries, and it affects individuals' performance and productivity. The aim of this study was to determine the effect of exposure to high noise levels on the performance and rate of error in manual activities.

The industrial noise in Erbil Steel Company in Erbil city-Iraq is a concern for workers, possibly due to the negative effects of industrial noise, and industrial noise affects the decision-making process in producing companies. Furthermore, the effects on worker productivity are one of the significant external costs.

The productivity is subjected to decrease in the workplace due to machines' noise in addition to the costs to prevent or reduce industrial noise caused by machines. The increased number of machines made workers' life painful and worrisome especially in the nearby machines, and hence it is accompanied by health and economic risks on the worker.

Non-auditory effects of noise were studied among 120 workers from Erbil Steel Company. Statistical analyses of the responses gathered were analyses and reported. Descriptive statistics was carried out using SPSS version 20 and graphs were plotted using Microsoft Excel 2016.

The statistical analysis showed that that there is so much noise at Erbil Steel Company and that company workers are at a higher risk of being disturbed by noise at

work. The effect of noise on the productivity of workers at Erbil Steel Company was quite high based on responses from the selected workers.

Keywords: Noise, Industrial Noise, Non-auditory, Environment and Productivity

DEDICATION AND ACKNOWLEDGMENT

I dedicate this work to my great parents. My dearest wife who has been of support and encouragement during the challenges of graduate. My sweet children who has formed much of the inspiration for my work.

First thanks and praise to God and I extend thanks and appreciation to all the respected people who assisted me to complete this thesis study.

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LIST OF ABBREVIATIONS

NIHL : Noise-induced hearing misfortune

OSHA : Occupational Safety and Health Administration

TTS : Temporary threshold shift

PTS : Permanent Threshold Shift

MCHC : Mean cell haemoglobin concentration

dB : Decibel

TWA : Time weighted average

WHO : World Health Organization

SPSS : Statistical Package for the Social Sciences

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CHAPTER ONE

INTRODUCTION

Noise is presumably the most well-known work-related risk, and it likewise is a natural threat (Clark & Bohn, 1999). From the physical viewpoint, there is no difference amongst noise and sound. Actually, sound is a sensory awareness, and noise is the psychological awareness of the sound. At the end of the day, noise can be characterized as an undesirable sound (Berger & Ehrsson, 2013). Noise exists in every human action, and, thinking about the impact of noise on human wellbeing, it can be characterized into two classes, i.e., work related noise and natural noise, which incorporate music, traffic and different sources (Stansfeld & Matheson, 2003).

One purpose behind the huge number of dissensions about noise in the workplace is that noise is a physical attribute that can without much of a stretch be felt in the workplace (Persson-Waye, Rylander, Benton, & Leventhall, 1997). Undesirable sound, as a standout amongst the most imperative physical factors in the greater part of production units, causes an extraordinary number of issues on mechanical laborers (Zamanian, Nikravesh, Monazzam, Hassanzadeh, & Fararouei, 2014). Distinctive researches have demonstrated that 30 million people among the American workforce are consistently exposed to abnormal levels of noise (Belojević, Jakovljević, Stojanov, Slepčevic, & Paunović, 2008). Being exposed to noise is a standout amongst the most widely recognized ecological risks in industries; be that as it may, it can have different impacts with respect to the sort of occupation and the workplace (Zamanian, Nikravesh, Monazzam, Hassanzadeh, & Fararouei, 2014).

Noise is one of the physical factors in work places which consideration is being given to its negative impacts. Subsequent to smoking and air contamination, noise is considered as the third reason for heart problems among the inhabitants of Berlin (Asakareh, 2012). World Health Organization (WHO) likewise sees noise as the third perilous contaminant of megacities (Nasiri, Monazam Esmaeelpour, Foroushani Rahimi, & Ebrahimi, 2009). In addition, ear damage, impedance in discussion, visual problems, impacts on balance system, social issue, mental and in addition anxious

impacts, impacts on electrolytes, physiological impacts, and mental impacts are among the impacts of health on the human body (Nasiri, Monazam Esmaeelpour, Foroushani Rahimi, & Ebrahimi, 2009).

Daily, people perform different exercises in various locations and are exposed to an extensive variety of natural noises. Exposure to noise isn't limited to the workplace and may occur during exercises, transportation, and shopping (Diaz & Pedrero, 2006). To date, an extraordinary number of studies have affirmed the impact of noise on the ear. According to various research, decrease in hearing capacity and noise likewise influences the laborers' cardiovascular system and prompts hypertension, cerebral pain, weakness, anxiety, and outrage (Mohr, Feldman, & Dunbar, 2000). In addition, because of the higher noise levels in the workshops, the increase in human blunders brings about the increase in occupational related mistakes and consequently prompts a drop-in efficiency (Zamanian, Nikravesh, Monazzam, Hassanzadeh, & Fararouei, 2014)

In general, the impact of noise on psychological wellness and in addition proficiency has been demonstrated and upheld by modern epidemiological proof (Kamp, Leidelmeijer, Marsman, & Hollander, 2003). Obviously, there likewise is solid proof with respect to sound-related disturbance, which is characterized as the feeling of resentment, disappointment, and despondency that happens as the aftereffect of disorders in a person's emotions, thoughts and day to day exercises (Zamanian, Rostami, Hasanzadeh, & Hashemi, 2013). In spite of the fact that individuals get used to noise and can adjust to high noise conditions, noise causes exhaustion and reduces the people's working ability in intellectual and in addition physical tasks (Saremi & Rohmer, 2008).

Different researches have demonstrated the genuine impact of noise on the workers’ performance and efficiency (Kahya, 2007). Moreover, day by day advancements in businesses and technologies prompt an expansion in the issues identified with noise contamination, and noise, as one of the major natural stressors, can effectively affect individuals and nature. When all is said in done, one of the significant objectives of all occupations is to attain profitability and to expand the staff's proficiency and productivity; be that as it may, environmental factors can adversely affect efficiency (Ising & Michalak, 2004). To date, numerous lab and field researches

have examined the impact of noise on proficiency and have demonstrated that, when hearing signal are vital in carrying out a task, the noise intensity that forestalls understanding the signals profoundly influences execution.

A strange, intense noise can prompt tumult and impedance in doing tasks, too (Cohen & Weinstein, 1981). Overall, a few mishaps can be considered as a pointer of the impact of noise on jobs. A few researches have demonstrated that high noise levels can bring about more mistakes and, therefore, increase the likelihood of accidents. This is very imperative, especially in mental exercises, which require the working memory, including focusing on a few phenomenon in complex frameworks (Zamanian, Monazzam, Satyarvand, & Dehghan, 2012).

In view of what was specified above, noise is one of the natural components that highly influences people's performances, and its impact can be evaluated in people who are exposed to noise in their workplace. Besides, proficiency is a standout amongst the most delicate parameters identified with the impact of noise, and it causes physical and additionally mental harm to people and influences their proficiency. Consequently, since no comparative examinations have been directed on this issue in Erbil- Iraq, the point of this research was to evaluate the effect of noise on performance.

Since noise can have both physiological and mental consequences for people, the present examination was directed keeping in mind the end goal to explore the impacts of noise introduction on circulatory strain and heart rate in steel industry. The discoveries of this examination can give the premise to enhancing the conditions in workshops, manufacturing plants, and instructive situations and, therefore, keep the occurrence of dissatisfaction and the issues stated above.

1.2 Research Aim

The aim of this research is to analyze the effect of industrial noise in the productivity of the workers in Erbil Steel Company in Erbil city, Iraq. Moreover, this research aims to fill the research gap in this controversial subject.

1.3 Research Problem

Lack of vision about the impact of industrial noise in the productivity of the worker, because of the lack of previous studies on the subject at the level of Erbil city/ Iraq, and industrial noise is one of the most important problems facing the worker's productivity, which began to take a serious economic and health exclusion.

Drawn out presentation to noise can bring about perpetual harm to the auditory nerve and additionally its tangible segments (Franks, 1996). This irreversible harm, known as noise-induced hearing misfortune (NIHL) makes it hard to hear and comprehend discourse. NIHL is the most widely recognized work-related problem in the United States today, with around 30 million laborers exposed to over the top noise levels or to harmful operators that are possibly unsafe to their listening ability (Franks, 1996). The issue is especially extreme in every aspect of mining (surface, handling plants and underground), with research demonstrating that 70 to 90 percent of all miners have NIHL sufficiently great to be seen a hearing incapacity (Franks, 1996).

1.4 Research Importance

1. This research is the first research on the impact of industrial noise in the productivity of the worker in Erbil city, Iraq.

2. The importance of the research is based on highlighting and showing the fundamental aspects of the problem of the industrial noise effect in the productivity of the worker.

CHAPTER TWO

LITERATURE REVIEW

2.1 Nuisance of Noise

Noise from industries is amongst prominent causes of noise pollution. The noise disturbance among textile industry workers due to exposure to noise is normal to all laborers, there ought to be industrial noise exposure criteria in view of irritation as opposed to hearing damage criteria (Ohrstrom, 1979). In textile companies, the noise-control procedures embraced ranges from 100-110 dB (A) and called attention to that not very many noise control methods are used in these companies (Baily & Brown, 1973). The work-related noise exposure of textile factory workers in Tanzania, over 30% of laborers were exposed to noise surpassing allowable noise exposure i.e. 90 dB (A) (Yhdego, 1991).

In Indian textile industries, with different aspects of noise pollution, there were high noise levels in various segments that extending from 90-106 dB (A), which consequently affected the worker productivity (Bhatt, Subrahmanyam, & and Swami, 1990). In another study of noise exposure in two Indian textile industries, the noise level was more than the admissible furthest levels of noise i.e. 90 dB (A) for 08 hours permitted by OSHA which impacts on laborers exposed to various levels of work-related noise (Bedi, 2006). Furthermore, in both public and private organizations a country like Pakistan, so far, no study been attempted to gather information about the noise levels in the production sector of the textile businesses (Shaikh, 2006.).

2.2 Effects of Noise Pollution

Noise is one of the significant pollutants in the urban zones of Pakistan. With respect to the quality, duration and exposure of noise, it might have an adverse effect on people health. This adverse effect can be from less extraordinary of noise levels but with transient exposure to exceptional sound or constant exposure. The aftereffect of exposure to noise can cause decrease in yield of work, absence of productivity, hindrance of hearing and feeling of disturbance and so on. Research on people working in loud environments demonstrate that there are Heart issues, occupational accidents,

Irritation, Speech impedance, Headache issues, Respiratory issues, Nervous issues and numerous physiological and mental issues (Memon, 2006).

Work related noise exposure and noise-initiated hearing problem both meddle with the safety of workers. Of specific importance, is the discovery that working in places where noise exposure surpasses 89 dB (A) is more dangerous notwithstanding for those suffering from mild noise instigated hearing problem (Michel, André, Marc, Richard, & Tony, 2008)

2.3 Auditory Effects

Any impact of decrease in hearing ability is for the most part called as "hearing loss". There might be many reasons for hearing loss, yet the fundamental driver is the aftereffect of extraordinary exposure to noise. Individual noise exposure level and higher pre-shift hearing debilitation are essential causes which influences TTS values in the employees. There are three ways in which noise can influence the human ears. It can stun or harm the hearing ability quickly, it can severally diminish the ability of ear to hear specific frequencies over some stretch of time, and it can numb the human ears for a constrained timeframe and which will return back to normal after a period of time depending on the noise intensity (Lin, Wu, Shih, Tsai, & Sum, 2009).

In the event that, after exposure to high noise intensity for shorter timeframe, a quick sensitivity test for the ear should be performed after the exposure uncovers a little hearing loss which is called TTS (Temporary Threshold Shift). The hearing limit is the least sound pressure level, which can be distinguished by the subject, and this may ascend to 20 dB at specific frequencies even after generally short exposure. Luckily, this issue is not permanent in nature, the ear recouping its unique ability after a moderately brief time, any PTS (Permanent Threshold Shift) being too little to gauge (Lin, Wu, Shih, Tsai, & Sum, 2009).

In the contemporary society, one of the most annoying and inevitable thing is the noise automated operations. It not only impedes communication but may bring about various sorts of physiological, physical and mental impacts on the human wellbeing, similar to accident at working environment, proficiency with which undertakings are performed, weakness of hearing, work impedance, tumor and heart infections and so

forth depending on the level, quality and exposure time (Abbasi, 2008). Regrettably, the long duration work (about eight hours per day) with high noise exposure in manufacturing plants and workshops will stop the effect for short time. A permanent and irreversible hearing misfortune occurs which make normal discussion exceptionally hard to hear and this prompts ceaseless disability (Abbasi, 2008).

2.4 Non-Auditory Effects

Noise has immediate and particular consequences for human wellbeing and abnormal impacts on sleep. As a result of noise, there might be substantial number of physiological and mental impacts on health and wellbeing. According to the physiological function, the level of noise at which the physiological noise effects start to happen differs and limited significant changes are prompted by noise under 70 dB (A). The harmful risk criteria ranging from a level of conceivable physiological response at 60 dB (A) to a conceivable start of damage as 95dB (An) (Agarwal, 2005).

From a physical perspective, Non-auditory effects might be viewed as happening in three phases by various physiological system. The quick straining of muscles at the abrupt start of a noise is the most imperative among these stages. This straining is trailed by slight slower impacts which are intervened via automatic sensory system delivering changes in the heart rate, volume of breath, blood discharge and so on. Non-auditory effects incorporate communication impedance, rest obstruction, sleep impedance, Annoyance and loss of working productivity (Stansfeld & Matheson, 2003).

The clinical examinations have demonstrated that noise can cause physiological burdens like raised blood pressure and increase in heart beat rate. Noise likewise aggravates rest and cause speech obstruction. Under ominous conditions like unreasonable noise, the hearing system of human ear could be harmed temporarily or permanently depending on the sort, power and exposure time to noise. Noise can negatively influence the productivity of any individual while working, critical thinking, and reading or doing any kind of work, it can even prompt accidents. Noise intensity over 80 dB (A) may build the aggressive conduct of individuals (IOSH, 2018).

2.5 Other Effects of Noise Pollution

Exposure to noise with the exception of hearing loss as the most common effect causes other negative health results. Mostly, the organic impacts of noise are separated into two sections: auditory and non-auditory (Nassiri, Monazzam, Dehghan, & Jahangiri, 2013). Non-auditory impacts of noise are physiological, activity interference, and mental. Noise at all levels leads to body peripheral vasoconstriction (Agrawal, Niparko, & Dobie, 2010). Heart rate can change because of noise; its cardiovascular yield will be diminished and breathing will be noticeably fast (Chepesiuk, 2005). Expanded systolic and diastolic pulse upon exposure to noise higher than 85 dBA has been seen in most human researches (Huang, Deng, Wu, Lu, & Hao, 2013).

Different researches have demonstrated that exposure to noise can increase circulatory strain and the danger of cardiovascular problems, which, in the long run, tends to increase with age and work involvement (Abbate, Giorgianni, Munao, Costa, & Brecciaroli, 2002). Different investigations have demonstrated the impact of excessive noise on blood and immune system (Sobrian, Vaughn, Ashe, Markovic, & Djuric, 1997). Sabahi & Moradi (2002) examined the impact of noise on blood parameters in mice, demonstrated that exposure to noise expands the quantity of red platelets, white platelets, hemoglobin, and hematocrit of platelets.

He additionally proved that excessive noise is accompanied with decrease in the normal volume of platelets (MCV), the normal size of hemoglobin (MCH) and mean cell haemoglobin concentration (MCHC) (Sabahi & Moradi, 2002). Different examinations have demonstrated that excessive noise can increase red platelets, hematocrit, and hemoglobin (Boĭko, 1970). Impacts of Noise are additionally said to affect feeding and water utilization rates and furthermore the pituitary hormones in the plasma, which, thusly, adjusts biochemical parameters, including triglycerides, glucose, cholesterol, and so on (Armario, Castellanos, & Balasch, 1984).

Different researches have exhibited an increase in the level of blood serum cholesterol and reduction in glucose levels in noise exposure (Simpson, Cox, & Rothschild, 1974). Research on mice have demonstrated that exposure to noise can increase blood cholesterol (Prabhakaran, Suthanthirarajan, & Namasivayam, 1988). Human investigations additionally have demonstrated the effect of working

environment noise on expanded cholesterol and triglyceride levels (Melamed, Froom, Kristal-Boneh, Gofer, & Ribak, 1997). Animal research have demonstrated that excessive noise diminishes blood cholinesterase protein movement and the measure of glycogen put away in the liver (Tsapkov, Kalistratova, & Tishchenko, 1981).

Some investigations have affirmed higher levels of cortisol because of noise exposure, which, thus, increase cholesterol, LDL (terrible cholesterol or low-thickness lipoprotein), triglycerides, diminished cholesterol HDL (great cholesterol or high-thickness lipoprotein), and debilitated insulin discharge. So far, no research has explored the impact of excessive noise on hematological and biochemical parameters of industry employees over a long period of time. Given the developing significance of employee health as the promoter of industry on the planet, the objective of this examination is to explore the non-auditory impact of work related noise exposure on laborers (Melamed, Froom, Kristal-Boneh, Gofer, & Ribak, 1997).

2.6 Exposure Limits of Noise

A great part of the research in the field of work related wellbeing and safety in connection to health effect of noise has connected to discourses of exposure limits to noise. In any case, take note of that noise can be regarded as a physical and mental boost (Akerstedt & Landstrom, 1998). In this manner, it is essential to understand the concepts of 'sound' and 'noise'. All the more particularly, 'sound' is an objective fact, while 'noise' is normally characterized as an undesirable sound and, consequently, is viewed as a mental phenomenon. Hence, while considering the health effect of noise it is, in this manner, vital to consider psychological responses, and also target exposure levels (Smith A. , 1991).

Much of the study into health effect of sounds/noise has been analyzed in modern setting (where abnormal amounts of sound/noise) are normal. Nevertheless, considering less research has studied the health effect of noise in non-industrial work-related settings, for example, office settings. Regardless of the fact that exposure to noise has been seen to be a standout amongst the most regularly distinguished stressors in the workplace condition (Sundstrom, Town, Rice, Osborn, & Brill, 1994). A study of 54 worksites discovered 54% of employees reported being annoyed by normal office noise,

particularly by individuals talking and telephones ringing (Sundstrom, Town, Rice, Osborn, & Brill, 1994).

A later investigation of 88 employees from two worksites found that 99% showed that their focus was incapacitated by basic office noises (Banbury & Berry, 2005). A developing assemblage of research is progressively showing that exposure to work related noise is connected with an extensive variety of medical problems far beyond the, maybe, more clear relationship with hearing issues; yet through its negative effect on a scope of physical, psycho-physiological and mental markers. However, in the overall population exposures to intemperate levels of noise have been related with a scope of negative results, including: impeded physical health (Bronzaft, 2002), poorer mental health (Bronzaft, 2002), weakened personal satisfaction (Hiramatsu, 1999), and debilitated language improvement, comprehension and learning in kids (Passcheir-Vermeer & Passchier, 2000).

2.7 Effect of Noise on Employees

Early research studying the impacts of noise on employees' conduct can be traced back to research by German exploratory clinician Whilhelm Wundt in 1874 (Wundt, 1867), who examined the impact of noise on response times in his Leipzig lab. In spite of the fact that, it is expected that noise is both a source of irritation and natural worry there has generally, in any case, existed some level-headed discussion on what makes noise unpleasant. The customary view has concentrated, seemingly only, on the simply physical properties of noise, particularly its commotion and how it is identified with mental excitement or stress (Wundt, 1867).

A general subject that can be seen to cut across this historical writing is the perception of the fluctuation of individuals' reaction to noise, recommending that distinctions among people are normally very wide and differed. In fact, research examining the mental effect of noise is frequently convoluted by two issues: (1) noise can by irritating in view of its physical qualities, as well as on account of its significance to the audience; and (2) individuals vary generally in what they characterize and in the way they react to it. Thus, contemporary perspectives propose that noise may create stress through its meaning, as a signal of a possibly debilitating occasion or through the perception that noise itself is terrible (Cohn, 1980).

From a stress point of view, and in accordance with contemporary hypothetical models of stress, this features the focal part of subjective evaluation inside the connection between noise exposure and employee's health and productivity. Considering this, it is their impression of those qualities and the degree to which they evaluate them as being consistent or incongruent with the person's present needs and objectives. Along these lines, so as to completely comprehend the negative effect of noise on health, a reflective record must be taken of the social setting in which a sound event occurs, and of the qualities of the noise itself (duration, source, predictability and intensity). It is vital to note and state that such clarifications stress the significance of considering the manner by which parts of the physical workplace interact with psychosocial factors in their impact on conduct and health (Leather, Beale, & Sullivan, 2003).

The relationship amongst noise and productivity is a standout amongst the most widely recognized and seriously considered issues for the field of brain science of the physical workplace. In any case, most of these investigations originate from laboratory settings, as opposed to field studies carried out in work place. The impact of noise exposure on productivity has been observed to be dependent upon various elements: including, the nature of the noise and the kind of work carried out (McCoy & Evans, 2005). In reality, studies state that unpredictable noises are more serious than those of predictable noise, and, by and large, the effect of noise on work increases with job complexity (Evans & Stecker, 2004). The accompanying section will review the study of predictable and unpredictable noise independently.

2.8 Predictable and Unpredictable Noise

Predictable noise includes nonstop sounds (e.g., for example, those made a ventilation systems and engines) and redundant or consistent sounds (e.g., stamping machines, presses or different sorts of gear). Early research center investigations by (Sundstrom, Workplaces: They psychology of the physical environment in offices and factories, 1986) found that ceaseless or customary noise prompted decreases in the exactness of execution commonly under four conditions: (1) during administrative assignments, when the noise changes; (2) during some profoundly tasking motor tasks; (3) during highly demanding vigilance task when the noise is loud (100 decibels); and

(4) when double assignments when noise was uproarious (100 decibels) (Sundstrom, Workplaces: They psychology of the physical environment in offices and factories, 1986).

Various trial and field experiments have exhibited a relationship between exposure to uncontrollable noise and inspiration deficiencies. An early investigation by Glass and Singer in 1972 discovered that when people were exposed to a wild noise, this was found to have a verifiable adverse effect on task persistence: in particular, the members were less inclined to persevere on tough puzzles following noise exposure (Glass & Spinger, 1974). Various lab and field tests have recreated these early discoveries by Glass and Singer: for instance, (Cohn, 1980) and (Evans & Stecker, 2004).

A survey of the early research center examinations by (Sundstrom, Town, Rice, Osborn, & Brill, 1994) of unpredictable noise, or discontinuous or sporadic sound, observed it to be related with diminishes in execution under four situations: (1) during administrative undertaking after beginning or offset of noise; (2) during mental tasks including mental calculation; (3) during exceptionally or tasking motor tasks; and (4) during double errands. Sundstrom (1986) proposed that the observed antagonistic impacts of unpredictable noise could be clarified by temporary diversion of attention, as in a few examinations the impacts were seen amid the couple of moments immediately after burst of noise.

For sure, issues related with low levels of discontinuous or unpredictable noise have progressively turned into a typical source of worry in work related settings (e.g., phone ringing, individuals talking, and so on.), with the expanding use of open-design workplaces and systems furniture (Sundstrom, Town, Rice, Osborn, & Brill, 1994). For sure, low-intense noise (a typical element in numerous office settings) might be fit for delivering performance deficits too, especially when data preparing requests are high. A research by Leather and associates explored the effect of low intensity noise on British office employees by conveying a survey among 143 laborers (Leather, Beale, & Sullivan, 2003).

This research did not locate a fundamental impact for high noise levels (i.e., aerating and cooling, phones, workplaces machines, individuals talking, and road noise)

with stress. Nevertheless, a mediator impact between noise exposure and work-related stress was observed, with higher noise compounding negative impacts of occupation strain, hierarchical responsibility and health. This research states that in spite of the fact that the physical attributes of an environment won't be stressful in themselves, they may however influence the negative effect of some simultaneously occurring psychosocial stretch.

2.9 Noise-Related Stress

Noise-related stress is regularly connected with psychosocial conditions in the working environment. For instance, an examination by Lercher, Hortnagl, & Kofler (1993) discovered disturbance with noise had a positive relationship with diastolic pulse: in particular, as disturbance with noise increased, so did the measured diastolic circulatory strain. This experimental correlational relationship was observed to be increased among employees who detailed high job disappointment and low levels of social support at work (Lercher, Hortnagl, & Kofler, 1993).

In a simulated open-office experiment led by Evans & Johnson (2000) in a research center setting, they observed that an ordinarily low intensity office noise has no adverse impact on basic errands, yet stress hormones were observed to be increased and task motivation was decreased after a 3-hour exposure period. In spite of the fact that, there was seen to be physiological, inspiration and perception confirmation of increased stress for low-intensity noise exposure, employee's self-reports and a straightforward record of profitability were unaffected by low intensity noise (Evans & Johnson, 2000).

2.10 Brief Historical Overview and Perspective of Noise Pollution

The issue of hearing loss from work related exposure to noise dates from at least middle age where employee in certain jobs; for example, blacksmithing, mining, church chime ringing was known to endure such issues (WHO, Community Noise, 1995). As early as 1831 "blacksmiths’ deafness" with the attendant element of tinnitus (known as "ringing and noise in the ears") was studied to in a research work (Berger, Royster, Royster, Driscoll, & and Layne, 2003) 50 years later, another research work referred to as "kettle makers’ deafness" since the researcher around then based his research on the

examination of 40 men from the steam - heater shops in port land (Berger, Royster, Royster, Driscoll, & and Layne, 2003).

The impact, namely loss of hearing was unmistakably distinguished; however, the component was not well understood. A study credited it to consistent disturbance of the joint of the ossicles, in this way causing alkalosis (solidifying due to the development of fibrous of any hard union), particularly of the stapes (Berger, Royster, Royster, Driscoll, & and Layne, 2003). Prevention systems were additionally not known at the time. Another study announced that men attempted closing their ears with pads and cotton wool but derived no benefit consequently: he had no alternative proposals. In the meantime, in Scotland it was accounted that men (likewise boiler fabricators) were biased against utilization of cotton ear plugs since it would incline them to coming down with cold when the attachments were expelled around evening time (Berger, Royster, Royster, Driscoll, & and Layne, 2003).

Asamoah-Boateng (2002) noticed the rising noise level in businesses and argued for an international Board of Physicians to be set up to screen the subsequent hearing loss of industry workers. This worry was communicated because of the expansive number of individuals influenced by the noise source. Quantitative research on vast quantities of subjects with permanent threshold shifts needed to hold up the improvement of noise-measuring gear for noise, and instrument for the estimation of hearing to decide hearing misfortune then again. Noise estimation turned out to be less demanding than hearing threshold determination which at first centered around discourse assessment. Not long after the presentation of audiometric, researchers watched dips at 4 kHz and published most likely the principal audiometric information showing the typical frequency loss obtained by those exposed to too much noise (Berger, Royster, Royster, Driscoll, & and Layne, 2003).

In 1960, noise in processing plants which was distributed by the Department of Scientific and Industrial Research (Asamoah-Boateng, 2002) plainly stated out the impacts of unreasonable noise on the welfare, security and work proficiency. This was trailed by the Wilson Report (Berger, Royster, Royster, Driscoll, & and Layne, 2003), which accentuated the danger of perpetual hearing threshold shift over the 90dB (A) noise level. In huge part, genuine and sustain enthusiasm for hearing protection created

because of World War II, resulting to which many soldiers returned home with hearing loss. Truth be told, one of the earliest regulations managing hearing preservation was the Air Force Regulation stated by (Berger, Royster, Royster, Driscoll, & and Layne, 2003).

Industrial Hearing Conservation Programs started to show up in the late 1940s and mid 1950s with a portion of the main detailed projects set up in the flying and metals ventures. Government noise control followed in the late 1960s (Berger & Ehrsson, 2013) and turned out to be more noticeable and generally implemented with the establishment of the Occupation Safety and Health Act (OSHA) of 1970 and proclamation of the noise standard in 1971 (Berger, Royster, Royster, Driscoll, & and Layne, 2003). It took an extra decade for OSHA to create the hearing conservation amendment that indicated the points of interest of a work-related hearing preservation program that was just referred to in the first 1971 standard. Unmistakably, the above writing and issues by different researchers shows that concern for work related noise exposure and its impact on the hearing on exposed populace is relatively not a current issue (OSHA, Occupational Hearing Exposure Hearing; Conservation Amendment; Final Rule, 1988).

2.11 Sound Intensity and Sound Pressure

Sound intensity is known as the sound power per unit area. The SI unit is watt/m² or watt/cm². Sound intensity measurements are usually made relative to the sound threshold of hearing intensity I_o:

$I_0=10^{-12}$ watts/m²$=10^{-16}$watts/cm² (Synder, 2000)

Sound pressure can be defined as difference between the instantaneous at a point in a sound field and the average pressure at that point (TAHDEL, 2003). It is the sound pressure rather than the intensity of the sound wave which our ear reacts to. When a vibrating body moves in air, it creates a slight disturbance of the atmospheric pressure. The oscillating variations in sound pressure propagate in the form of a sound wave. Sound pressure may be measured in Newton per square meters (N/m^2) or Pascal (Pa), where 1 Pascal = $1N/m^2$ (Synder, 2000).

2.12 The Decibel

The decibel (dB) is a logarithmic scale used to denote the intensity or pressure level of a sound relative to the threshold of human hearing (WHO, 2000). A normative human ear can detect a pressure as small as 0.00002Pa or 20µPa, where the frequency of the sound is equal to 1000Hz (Howard & Angus, 2001). This reference pressure level has been internationally agreed upon, and it is usually called the threshold of hearing (Barlow & Mollon, 1982). The pressure variation within the range of perception by the human ear lies between 20µPa (audio threshold) and 200Pa (pain threshold). It is impossible to fit the spectrum of more than 107Pa on the scale of an instrument. It was further found that the reaction of the ear was not linear but logarithmic in proportion to the applied stimulus (Roberts, 2002).

The above problems are overcome by using logarithmic scale, known as the decibel (dB). The equation that gives the decibel can be written as:

$$dB = 20\log[P/P0]$$

Where P is measured in sound pressure and $P0$ is the reference sound pressure which is equals to 0.00002Pa. So, the threshold level takes the value of (0) decibels (0 dB) (Roberts, 2002)

2.13 Sources of Noise Pollution

According to the World Health Organization's Guidelines for group noise, air noise is more irritating than street activity, which thusly is more irritating than noise from railroads. Moreover, transportation noise produces transitory disturbance, as well as is a reason for serious health issue (WHO, Guidelines for Community Noise, 1999).

While many sources are limited inside walls and structures, far from people, noise from transportation proliferates into the surrounding irritating extensive and different segment of people. This source is imperative due to its extensive and ever developing notoriety. Popular sources of noise pollution are Road traffic, Air traffic, Rail traffic, Construction noise and building services noise, Domestic noise, noise from leisure activities and Occupational noise (Peeters & van Blokland, 2018).

2.14 Occupational Noise

Industrial noise is considered as one of the popular noise sources. Be that as it may, these factories have a lot of devices and machines, for example, cutting machines, fans, motors, compressors and transportation sources. These sources could be, or generally exchanged from the inside to the outside through open windows and entryways, and through building walls (Abbasi, 2008).

Occupational sources of noise constitute an extensive source of noise, this can be unsafe for the employee, and approximately around 30 million individuals in the U.S. are occupationally exposed to unsafe noise (OSHA, 2004). The sources of noise in work are few and varied yet most have a connection to mechanical devices and procedures, for example, internal combustion engine, turbulent fluid flow, impact processes, blasting, electrical machines, drilling, crushing, pumps, gears, pneumatic equipment, and compressors. Exposure for over 8 hours daily is unsafe (NIOSH, Analysis of Audiograms for a Large Cohort of Noise-Exposed Miners, 1996).

2.15 Occupational Noise Exposure and Its Effects

Numerous researches with respect to noise pollution in different work environments have been carried out around the world. High frequency tactile neural hearing loss and other medical issues of noise were discovered in the greater part of the examinations. In an examination led by Asamoah-Boateng (2002) to decide the danger of noise exposure and its related hearing issues among modern and non-mechanical laborers, it was seen from the audiograms that exposure to noise levels of 85dB (A) was sufficient to deliver critical hearing loss at 4 KHz. The hearing loss at 4 KHz among the industrial employees was seen to surpass the control group hearing levels at that frequency by a normal 35dB (A). A conclusion was in this way drawn, despite the fact that the trial groups‟ normal hearing loss did not fall inside the compensable range, notwithstanding the longest exposure times, the hearing loss at 4 KHz was extremely huge and could create quantifiable loss in hearing ability (Asamoah-Boateng, 2002).

In a literature review on the occurrence of work related hearing loss in ranger service specialists in connection to the noise level estimated at the work destinations, an epidemiological investigation was performed between 1967 and 1974 (Rafalski,

Bernucki, & Sivituniok, 1976). The non-stop 5 years research included 207 motorized saw operators and 95 individuals from a control gathering. The outcomes demonstrated that noise delivered by engine saw enormously surpassed generally adhered standards, therefore causing serious health issues for engine saw operators. Around 68% of the engine saw operators were found to be suffering from hearing loss following 7 years at work. A research led by (Mulugate, 1992) in the carpentry business in Ethiopia likewise showed that most carpentry machines create noise higher than the allowable level of 85dB (A), which is conceivably perilous. In the furniture industry, it has been demonstrated that around 40% youths‟ entering the business develop noise-related hearing loss before the end of the initial 5 years of work (Quainoo, 1992). Another research uncovered that sound levels of saws can be as high as 106dB (A) (Goeltzer, Colin, Hanson, & Gustav, 2001).

The impact of exposure to noise in connection to the frequency and intensity of the noise was likewise examined in Tanzania textile factories (Kahema, 1981). They discovered that, significantly high noise levels with extensive wide frequency were observed to be produced by machines in the wearing and spinning areas of the processing plant. A high noise level of well over 85dB (An) and a perilous frequency range of 2500-5000Hz were recorded. The impact of noise exposure was observed to be corresponding to the force and the phantom arrangement of the noise. The risk of danger harming ones hearing increased with the length of noise exposure. This was consistent with the fact that noise severity relies on factors, for example, the frequency distribution, length of noise exposure, intensity level and individual susceptibility to noise (Kahema, 1981).

A research with respect to the noise pollution levels and their effects on exposed populace at work environments in various nations in Asia discovered that, around 38 percent (Singapore), 42 percent (Hong Kong), 83 percent (Korea) and 92 percent (Philippines) laborers were exposed to noise levels over 85dB (A) in the work environments. The hearing limits of those employees was assessed and broke down to survey the danger of the noise levels. He likewise revealed that 12 percent (Korea), 15 percent (Hong Kong), 40 percent (Singapore) and 74 percent (Philippines) had hearing loss in abundance of 30dB. The increase number of laborers exposed to hearing serious

noise and the hazardous effects of unsafe noise on the hearing ability of employees in these nations were therefore established by the research (Asamoah-Boateng, 2002).

McMahon & Mallanus (1988) studied the noise exposure of 274 printing production laborers in 34 foundations in New York City zone. Results demonstrated that 43 percent were exposed to 8 hrs time weighted average (TWA) noise exposure of 85 dB (An) or more and that 14 percent were exposed to 90dB (An) or more. A more prominent number of employees in the bindery divisions were observed to be exposed to conceivably dangerous noise more than the employees in the printing business and that the former may be in danger of work related hearing loss. The researchers thus suggested that further research be done to decide the degree of the hearing loss in this group of employees. Employees who are occupied with various exercises in a modern plant and are exposed to perilous noise in Karachi were likewise examined (Hassan, Abdul-Barry, & Al-Hakiem, 1994). The results of the examination demonstrated that 14441(12%) employees out of the aggregate 173,300 who enrolled with Sindh Social Security Institution in 1992 have noise-induced hearing loss (NIHL) (Hassan, Abdul-Barry, & Al-Hakiem, 1994).

Additionally, research completed by various authors with respect to the problem of hearing deterioration during extreme long exposure to noise in the factory demonstrates a comparable hearing loss in the scope of 3-8 KHz from about all researches. The fact that loss of hearing because of noise begin in light frequencies, with a plunge in the audiogram at 4 KHz was additionally found in this investigation (Melnick, 1994).

2.16 Non- Auditory Effect of Noise on Man

Usually, the auditory impact of noise on employees are mainly studied. However, the effect of exposure to noise stretches out to non-auditory impact. Non-auditory impact are reliant on the noise and are known to incorporate side effects identified with the automatic nervous system, as fatigue, vascular pressure, abnormal skin temperature, high pulse rate, nausea, and decreased appetite (Edwards, 2008). Indications identified with higher mind working have been recorded incorporating impedance in thought preparing and assignment execution. These indications result from more prominent focus and listening exertion required when working in noise and thus prompt

touchiness, hostility, despondency and unsettling influence in rest designs (Edwards, 2008).

Another long term non-auditory impact of NIHL is appearance of tinnitus (Axelsson & Barrenas, 1992). Tinnitus usually weakens its patients and can impact state of mind, personality, speech recognition and concentration. Tinnitus happens in around 33% of cases whose history is marked by noise exposure ((Edwards, 2008) and (Axelsson & Barrenas, 1992).

2.17 Effect of Industrial Noise on Workers Productivity

Exposure to noise can cause a few dangers to the health and strength of workers. It is notable that the noise can cover both, the alarm and speech sounds. Voice issues, similar to knobs, loss of voice and variations from the norm in the vocal chords can be endured by the workers that need to talk inside loud situations with levels higher than typical if there is no other method to communicate but the voice. In this manner, it is expressed that noise is one factor that can increase the danger of mishaps in the work environment (Smith A, 2007) and (Cortes, 2003). Moreover, the impacts of the noise-induced hearing misfortune, together with the prerequisite of utilizing hearing protection gadgets, add to aggravate the rate of mishaps because of obstructions with sound signals and other non-hearing impacts caused by the noise on the wellbeing, similar to pressure, loss of consideration, increment of pulse, and so forth. (Van Dijk, 1990).

Expulsion of too much noise in the work environment isn't only a legitimate duty of the organizations, as it is likewise required with the market interests of a company. The more secure and more advantageous a working environment is, the less probabilities of truancy, mischances and low execution, and therefore, cost savings will be accomplished. A conventional approach for diminishing dangers because of noise in the working environment comprises in a three-stage process: evaluation of dangers; appropriation of components for avoiding or controlling dangers; and, in the long run, keeping a periodical checking and a modification of the viability of the embraced mechanisms (Cheremisinoff, 1996).

The earth is man's immediate encompassing which he controls for his reality. Wrongful control presents risks that make the situations risky and reduce the efficiency

rate of the worker. Consequently, the work environment involves a domain in which the laborer plays out his work while a successful work environment is a situation where results can be accomplished of course by administration Physical condition influences how workers in a company interface, perform assignments, and are driven. Physical condition as a part of the workplace have specifically influenced the human sense and unpretentiously changed relational co-operations and subsequently profitability (Mike, 2010) and (Shikdar, 2002).

This is so in light of the fact that the attributes of a room or a position of meeting for a gathering have outcomes with respect to profitability and fulfilment level. The work environment condition is the most basic factor in keeping a representative fulfilled in the present business world. The present work environment is unique, differing, and continually evolving. The normal manager/representative relationship of old has been flipped around. Specialists are living in a developing economy and have relatively boundless openings for work. This blend of elements has made a domain where the business needs its representatives more than the workers require the business (Smith D. , 2011).

A substantial number of workplace examines have demonstrated that specialists/clients are happy with reference to particular workspace highlights. These highlights inclination by clients are profoundly critical to their efficiency and workspace fulfilment, they are lighting, ventilation rates, access to regular light and acoustic condition ((Becker, 1981) and (Veitch, Charles, Newsham, Marquardt, & Geerts, 2004). Lighting and different variables like ergonomic furniture has been found to have positive impact on workers wellbeing (Dilani, 2004); (Milton, Glencross, & Walters, 2000) and (Veitch & Newsham, Exercised control, lighting choices and energy use: An office simulation experiment., 2000) and therefore on efficiency.

Noise is one of the main sources of workers' diversion, prompting diminished efficiency, genuine errors, and expanded occupation related pressure. As per (Bruce, 2008), research demonstrated that work environment diversions cut representative profitability by as much as 40%, and increment mistakes by 27%. Additionally, referring to Loftiness investigation of 2003 affirmed the significance of noise to worker

efficiency. The investigation demonstrated a 3-18% increase in profitability in structures with less noise (Moloney, 2011).

Viable working environment correspondence is a key to development of achievement and polished skill (Canadian Centre for Communication, 2003). An organization that communicates all through the work environment in a powerful way will probably maintain a strategic distance from issues with finishing the everyday methods, and less inclined to have an issue with inappropriate event and will produce a more grounded resolve and a more inspirational disposition towards work. At the point when workers discuss successfully with each other, efficiency will improve in light of the fact that compelling communication implies not so much complains but rather more work completion (Quilan, 2001).

It eliminates perplexity and wasted time that would have been generally spent on clarification or contention (Fleming & Larder, 1999). It makes work environment more pleasant, less uneasiness among associates which implies positive state of mind towards work and expanded profitability (Tayler, 2012). Besides, another part of communication that influences profitability is noise level. Noise has negative effect on communication, dissatisfaction levels increase while efficiency diminishes in connection to steadiness and loudness of noise. A reason illustrated for this is verbal communication turns out to be logically more difficult as noise levels increase.

Hughes (2007) in a study in an overview revealed that the vast majority of workers stated that a workspace quality influences their state of mind and improves their profitability. Likewise Chandrasekar (2011) affirm that perilous and undesirable work environment condition as far as poor ventilation, improper lighting, inordinate noise and so forth influence laborers efficiency and wellbeing.

2.18 Effect of Prolonged Noise

An alluring and steady workplace can be depicted as a place that pulls in people into the profession, urges them to stay in the workforce and empowers them to perform adequately. The motivation behind giving workplaces is to make impetuses for entering the workforce and for staying in the workforce. Moreover, steady workplaces give conditions that empower wellbeing specialists to perform successfully, making best

utilization of their insight, abilities and skills and the accessible assets with a specific end goal to give top notch. This is the interface of the workplace and nature of care administrations (Leshabari, Muhondwa, Mwangu, & Mbembati, 2008).

Working condition can be isolated into two segments to be specific; physical and behavioral segments (Stallworth & Kleiner, 1996). The physical condition comprises of components that identify with the workplace occupiers‟ capacity to physically associate with their office condition. The behavioral condition comprises of segments that identify with how well the workplace occupiers associate with each other, and the effect the workplace condition can have on the conduct of the person. As per Haynes (2008), the physical condition with the efficiency of its inhabitants falls into two fundamental classifications office format (open arrangement verses cell workplaces) and office comfort (coordinating the workplace condition to the work forms), and the behavioral condition speaks to the two principle parts specifically connection and distraction (Tarime, 2011).

These segments can additionally be separated in major traits and operationalised as various independent factors. These factors will be utilized for investigation of their effect on dependant variable. It is by and large comprehended that the physical outline of workplaces and the ecological conditions at work places are critical factors in hierarchical execution (Stallworth & Kleiner, 1996).

According to Ganime, Almeida, Robazzi, Valenzuela, & Faleiro (2010), industrial noise exists in all companies because of machines of different types, a few machines basically that are outfitted with less innovation deliver too much noise, past acceptable. This kind of noise is in conflict with the states of human life and is against the expansion of the efficiency of the work and the nature of wellbeing of the workers, in other words, if the worker is compelled to work in rowdy situations, it diminishes his profitability by psychophysiological impacts, going from basic irritation to hearing loss.

Noise is in many nations the most well-known hazardous operator in the working environment. Its presence in the mechanical exercises is added to its wide dispersion in the urban and social means, particularly in relaxation exercises. This relatively all-inclusive dissemination of noise in social and workplaces turns out to be more critical if hearing harm is thought to be irreversible, and exposure causes different issues - natural,

physiological and psychoemotional - that leads to an unmistakable decrease in the personal satisfaction and soundness of workers (Themann, Suter, & Stephenson, 2013) and (Sierra & Bedoya, 2016).

Unlike different toxins, the impacts of noise can be in a flash unnoticed and their build-up can prompt clear physical, mental and social issues. The best considered impact of overexposure to noise is hearing loss. The issue is that affected individuals are barely mindful of the cause-impact relationship, since it happens gradually yet progressively (Montiel, et al., 2006) and (Fernández, Butrón, & Colina, 2009).

The principle impact of excessive exposure to this physical hazard factor on laborers' wellbeing is hearing misfortune, called hearing loss or deafness, which is distinguished as the most recorded and every now and again perceived impact as Occupational Illness (Guerra, Lourenço, Bustamante, & Alves, 2005) and (Sierra & Bedoya, 2016)]. Furthermore, the noise interferes with the communication and modifies the affectivity, which instigates the disconnection and can trigger depression. Other general impacts of constant and uniform noise presentation incorporate mental pressure, weakness, sleeping problem, diminished alertness and speed of motor responses, and lessened responsiveness (Llorca, Llorca, & Llorca, 2015).

Noise is one of the inter-organizational stressors most ordinarily experienced in workplaces that have different impacts on people. Chacín-Almarza, Corzo-Alvarez, Rojas-González, Rodríguez-Chacín, & Corzo (2002) states that most modern specialists point to noise as the fundamental natural condition that Affects their work, studies demonstrate the impact of exposure to interminable mechanical noise in 1680 men and 688 lady's members of the Cordis Study, and revealed that men displayed work dissatisfaction and post-work-day crabbiness, while for lady's substantial disorders, Anxiety and depression were documented. All pressure indications were higher for ladies, particularly the individuals who were exposed to direct levels of noise (75-84 dBA), typically not considered destructive to hearing (Chacín-Almarza, Corzo-Alvarez, Rojas-González, Rodríguez-Chacín, & Corzo, 2002).

According to Alonso (2014) in Spain and through the VII National Survey of Working Conditions directed by the National Institute of Occupational Safety and Health in 2011 demonstrates that 35% of laborers are exposed to a level of Noise

irritation, high or very high, being the industrial specialists and mechanics and workshop representatives the most influenced groups (Gómez, Jaramillo, Luna, Martínez, & Velásquez, 2012).

As per information from the review, just 42% of specialists thought to be exposed to a high noise level (2% of the aggregate) expressed that it is obligatory to wear hearing protectors at their work environment. Then again, of the workers who are thought to be exposed to a high noise level (8% of the aggregate), just 32% demonstrate this mandatory. Hence, noise bolstered by a substantial gathering of laborers surpasses subjectively sufficient levels without seeing the requirement for the utilization of individual protection, which supports the presence of hearing loss among those influenced and makes fundamental the acknowledgment of instrumental investigations to identify the onset of the problem.

In the same vein for Fernández, Butrón, & Colina (2009), they call attention to that consistently a great many European workers are exposed to noise and all their resulting dangers in their working environment. One of every five specialists in Europe must raise their voices to be heard for the greater part the working day and 7% of them experience the ill effects of work related hearing issues.

As indicated by European information, hearing loss caused by noise is the most well-known work-related infection in the European Union. Noise can be a reasonable issue in areas, for example, assembling or construction, however it can likewise be an issue in some other workplaces. The most evident parameter for describing noise might be its level, estimated in decibels, yet there are some other vital components to consider, for example, span of exposure, impulsivity, recurrence and range, occurrence and dispersion to all through the working day (Fernández, Butrón, & Colina, 2009).

In Colombia, based on Gómez, Jaramillo, Luna, Martínez, & Velásquez (2012), one of the fundamental results of exposure to delayed work-related noise in the working environment is sensorineural hearing misfortune, characterized as hearing misfortune created by delayed exposure to unsafe noise levels. As indicated by the report of professional infection in Colombia, led by the Directorate General of Professional Risks of the Ministry of Social Protection distributed in 2004, sensorimotor soft drinks are the fourth reason for work related dreariness in the contributory administration and

worldwide after presbycusis, is the most well-known reason for diminished sound-related acuity. The extensive number of instances of sensorineural hearing misfortune recorded in Colombian and military representatives, and the results thereof, make it a genuine general medical issue that fundamentally influences the hearing limit of laborers (Gómez, Jaramillo, Luna, Martínez, & Velásquez, 2012).

The estimation of the noise permits a more exact examination of the segments of amplitude, frequency and span that are important to decide their harmfulness. It is vital to know the measure of sound energy that an individual aggregate amid their working hours in raucous situations. To decide the causal connection between work related exposure to noise and hearing misfortune, the differential analysis is indisputable and the occupational doctor, who will set up the connection. In the investigation, notwithstanding the audiometric setup or consecutive development, different factors, for example, the laborer's clinical and work history, age; Past time and current introduction to sound weight levels; The levels of sound weight to which the specialist is or has been exposed over the span of work; Not work related presentation to sound weight levels; Occupational exposure and not work related exposure to other hazard operators for the sound-related framework (Furtado, Moraes, & Ferreira, 2014).

CHAPTER THREE

MATERIALS AND METHODS

This research will be an analytical descriptive study that deals with data collection on the phenomenon of industrial noise on the productivity of the workers in Erbil Steel Company in Erbil city-Iraq. The research methodology employed here was based on data collection through questionnaire. The objectives of the study were to investigate the non-auditory effect of occupational noise. This study also identifies its effects on worker's health by comparing the noise levels with WHO and OSHA guidelines. As far as the parameters of the questionnaire were concerned, the number of workers working in the premises has been taken into consideration during study to know the health hazards.

Survey was conducted in various units of different sections to record the personal opinion of the employees regarding their feelings and difficulties due to high occupational noise levels and its pollution.

3.1 Survey of Study Area

A survey was conducted in the Erbil Steel Company to determine workers activity and the non-auditory effect of occupational noise levels within study site.

The creation of Erbil Steel Company was initiated in the year 2006 at Erbil-Iraq. Currently they have 650 workers. Erbil Steel Company begun steel creation in December of the year 2007. Erbil Steel is a company that generates energy by itself via its 32 MW powerhouse that boasts a yearly steel generation limit of 240.000 tons. Considering its creation and employment volume, Erbil Steel Company right now is unmistakably the most substantial industry interest in its locale, delivering standard steel bars for use in the construction division (Erbil Steel, 2018).

With the consistent generation of ASTM 615 GRADE 60, Erbil Steel Company keeps on serving its clients with its expert and experienced devoted workers. It produces exactly 600 tons of steel every day from purifying of scrap press at its steel industrial facility moving plant. Having effectively brought together its sector prerequisites

oriented mission with improvement concentrated on a ground-breaking vision, Erbil Steel Company has a driving role in the Iraqi steel sector (Erbil Steel, 2018).

Having started its activities in Erbil in December 2007, Erbil Steel Company creates its own power and is a huge importance for the future of the Iraqi development industry with a yearly iron and steel generation limit of 240,000 tons. Erbil Steel Company is regarded as one of the greatest and most essentially overwhelming industry investment carried out in the district with respect to workers number and production volume. The plant creates more than 600 tons of iron and steel every day and addresses the issues of the Iraqi development industry with these fundamental metals (Erbil Steel, 2018).

As the first and biggest iron and steel plant in Iraq, Erbil Steel Company works with two arrangements of enlistment heaters, each with 25-ton limit. Covering a region of 100,000 sqm and furnished with cutting edge hardware, Erbil Steel Company produces world class N12 - N32mm type steel with a qualified group of 700 experienced professionals, engineers and staff (Erbil Steel, 2018).

Erbil Steel Company creates power for its tasks with five 6.4-megawatt (MW) diesel generators. The plant utilizes 32 MW of power in the different phases of iron and steel creation. The power delivered is utilized as a part of the manufacturing plant to noticed piece iron and cast the steel and in the moving plant to roll fortified steel bars (Erbil Steel, 2018).

On account of its programmed remuneration framework controlled by a programmed receptive power framework the power control house outfitted with PLC programmed framework keeps the power factor within efficiency limits as far as possible required, giving unwashed, harmonically separated power to help the plant offices. In the completely coordinated electrical powerhouse, all activity and maintenance is performed by the Erbil Steel Factories in house group of qualified professionals and engineers (Erbil Steel, 2018).

3.2 Research Method

A survey was conducted by using questionnaire to investigate the perceptions of workers who are currently working in the Company and how this noise may affect the

productivity of the workers. The selected sample size is 120 out of the total 650 workers by using the random sampling method.

A questionnaire was designed to assess the effects of noise exposure among miners. The idea for the designing of questionnaire for the assessment of non-auditory effect among miners was to generate information on all possible factors which might act in concert to cause hearing loss and to quantify those at the highest risk of non-auditory issues. For this reason, the presence of risk factors such as age, gender, occupation, medical history and non-occupational exposure were included in the questionnaire and their possible impact on the outcome evaluated.

The first step in the design of the questionnaire was to investigate current concerns regarding hear loss and sources of noise exposure among employees. The information gathered was used to determine what items should be included in the questionnaire. The main topical items that were decided to be included in the questionnaire were:

- Symptoms on non-auditory hearing issues
- Possible sources of (occupational and non-occupational) noise exposure
- Medical history-particularly of diseases that could cause hearing loss

Awareness, satisfaction, workplace information and other subjective effects related to health in terms of auditory and non- auditory effects were also included in the questionnaires.

A random sampling method was used to select participants from the company. All employees were given the same chance of participating in the study. This ensures a firm basis for the application of significance tests and statistical methodology.

3.3 Data Collection

The researcher will prepare a questionnaire in a standard form, so that the data can be processed statistically and to find out the relationship between its elements. The researcher used the following procedures in the design of the questionnaire:

1. Access to previous studies and research and theoretical publications related to the subject of the research.

2. Identify the most important indicators and axes related to the subject of the research.

CHAPTER FOUR

DATA ANALYSIS AND RESULTS

4.1 Introduction

In this chapter, statistical analyses of the responses gathered were analysed and reported. Descriptive statistics was carried out using SPSS version 20 and graphs were plotted using Microsoft Excel 2016. The chapter contains report on the socio-demographic characteristics of respondents and their perception about noise in their work center and its preventive measures.

4.2 Socio-Demographics

This section examines the socio-demographic characteristics of the study respondents. Out of the total 650 workers, there were 120 respondents in all with the characteristics measured including the respondent's age and educational level.

4.2.1 Age Distribution of Respondents

The table 4.1 shows the distribution of the respondents according to their ages. The ages were initially recorded on a nominal level but were reclassified into different age groups as follows.

Table 4. 1 Age Distribution of Respondents

Age group	Frequency	Percentage (%)
18 – 25	39	32.5
26 – 35	37	30.8
36 – 45	30	25.0
46 – 55	14	11.7
Total	**120**	**100**

Source: Prepared by the researcher based on the questionnaire result

It is seen from the table above that majority of the respondents were aged between 18 and 25 years representing 32.5% of the total responding population. This is closely followed by workers aged between 26 and 35 years whose percentage stood at 30.8%. Ages 36-45 and 46-55 represented 25.0% and 11.7% respectively.

Summary of Ages

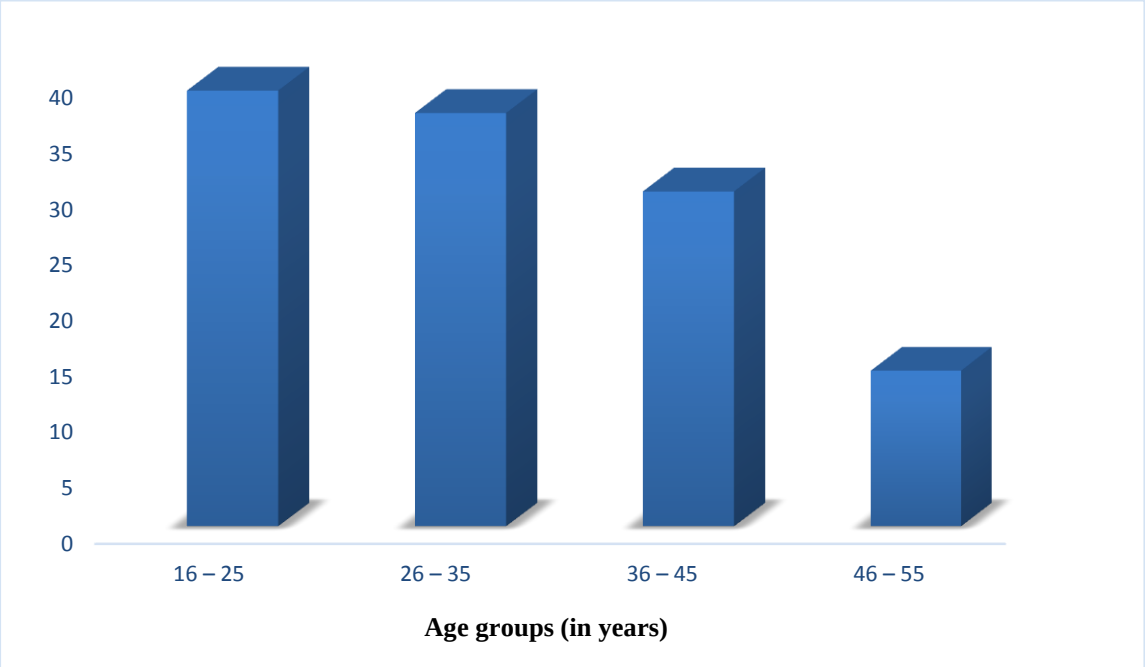
Table 4.2 and figure 4.1 show that the minimum age of Erbil Steel Company workers is pegged at 18 years while the oldest of all respondents was 52 years with an average of about 33 years and a deviation of 9.5. Meanwhile, workers of age 40 years were more than workers of any other age as indicated by the mode.

Table 4. 2 Summary of Respondents' Ages

	Minimum	**Maximum**	**Mean**	**Std. Deviation**	**Mode**
Age (in years)	18	52	32.1917	9.51628	40

Source: Prepared by the researcher based on the questionnaire result

Figure 4. 1 Age distribution of Respondents



Source: Prepared by the researcher based on the questionnaire result

4.2.2 Distribution of Respondents According to Educational Level

The table 4.3 demonstrates the distribution of the respondents according to their level of education.

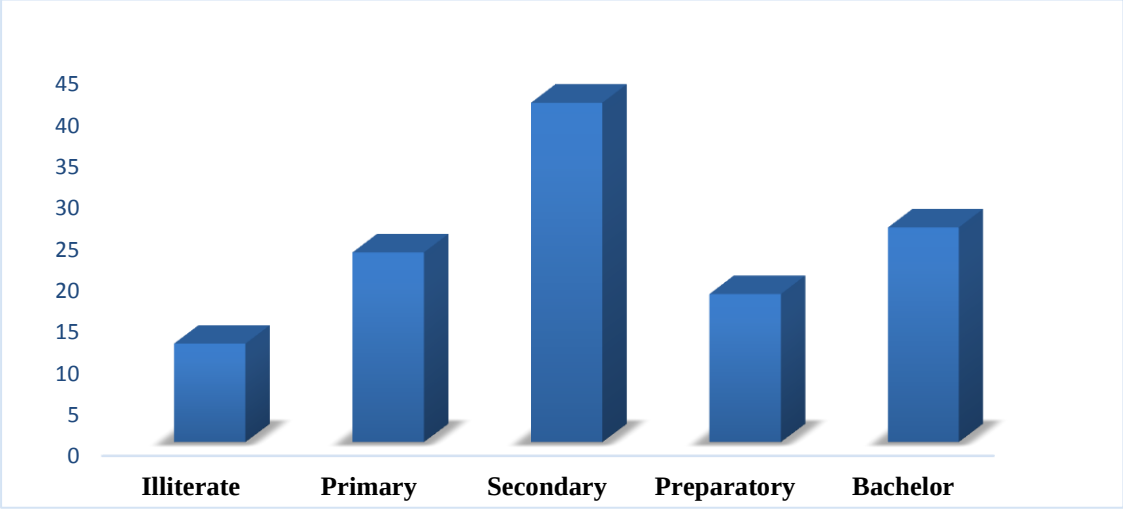
Table 4. 3 Distribution of Respondents according to Educational Level

Educational Level	Frequency	Percentage (%)
Illiterate	12	10.0
Primary	23	19.2
Secondary	41	34.2
Preparatory	18	15.0
Bachelor	26	21.7
Total	**120**	**100**

Source: Prepared by the researcher based on the questionnaire result

It is seen from the above table that most (34.2%) of the workers were secondary school graduates with some (29.2%) being illiterate or primary school leavers. While 15.0% of them were in preparatory Class, 21.7% were bachelor's degree holders (see figure 4.2).

Figure 4. 2 Distribution of Respondents According to Educational Level



Source: Prepared by the researcher based on the questionnaire result

4.3 Level of Noise in Work Place

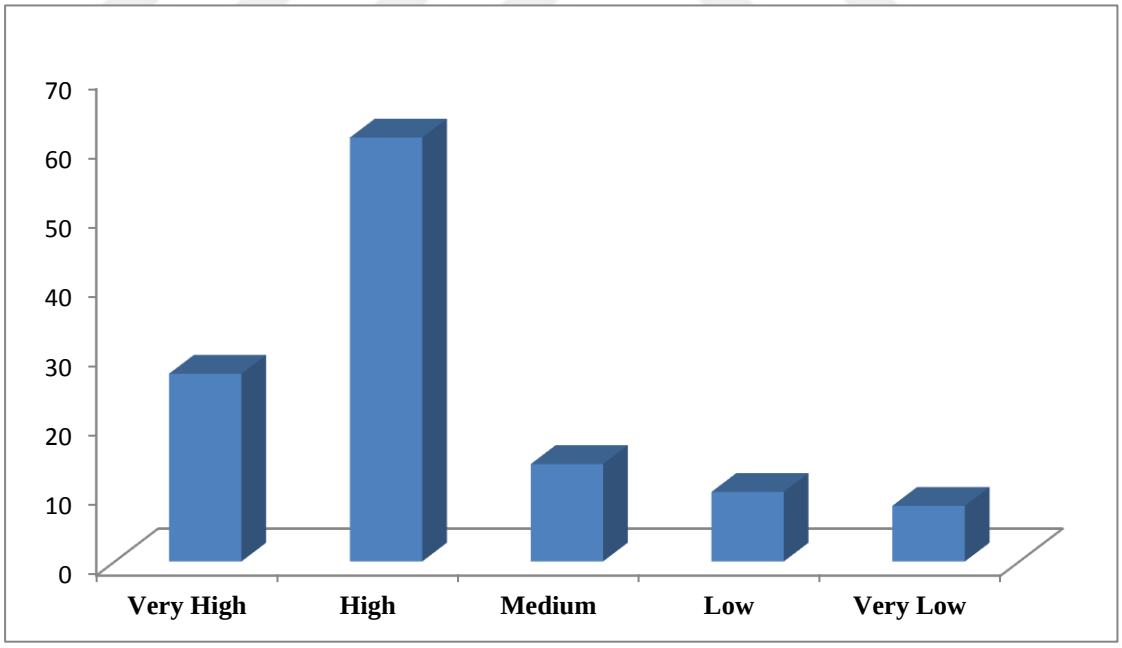
The table 4.4 and figure 4.3 illustrating the perception of workers concerning the level of noise in their workplace. 15.0% of workers feel that the Noise at workplace is low while 11.7% perceive that the noise level is on a medium while majority (73.3%) feel that the noise level is high. It can thus be concluded that there is so much noise at Erbil Steel Company and workers are at a higher risk of being disturbed by noise

Table 4. 4 Noise Level in Erbil Steel Company

Questions	Very High	High	Medium	Low	Very Low
Are the noise levels in your business center?	27 (22.5%)	61 (50.8%)	14 (11.7%)	10 (8.3%)	8 (6.7%)

Source: Prepared by the researcher based on the questionnaire result

Figure 4. 3 Noise Level in the Company



Source: Prepared by the researcher based on the questionnaire result

4.4 Exposure to Varying Level of Noise in Work Place

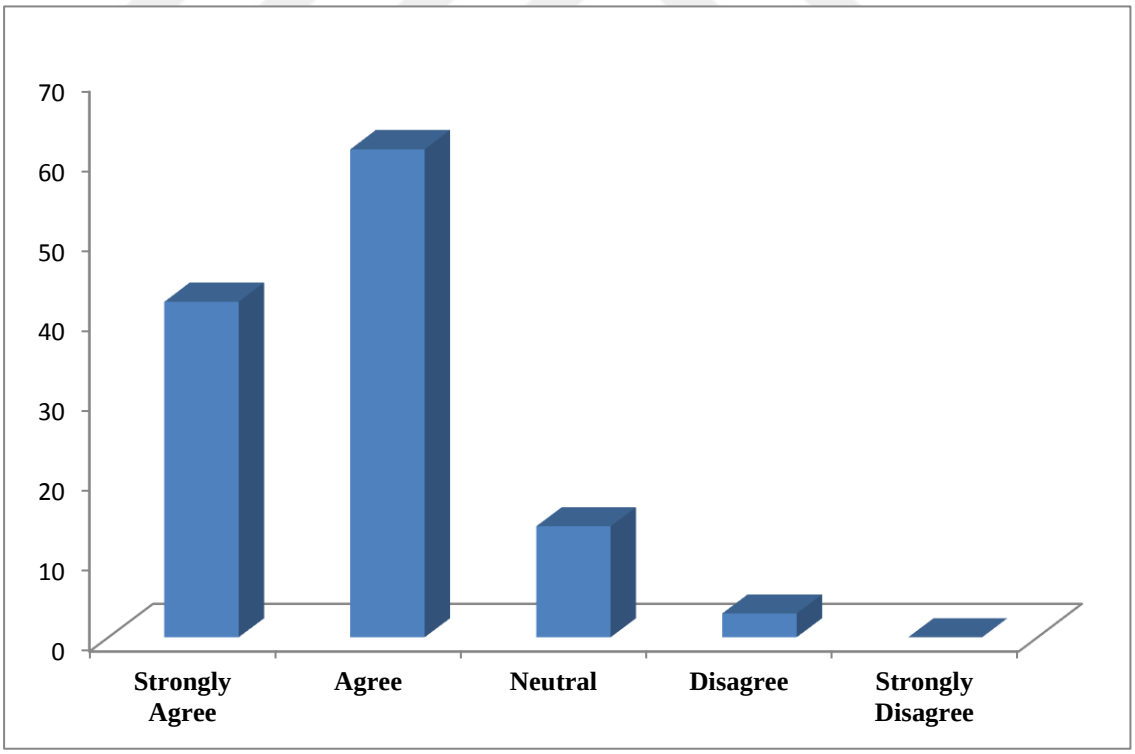
Regarding the exposure to level of noise, the study showed that 2.5% of the respondents consented that they were not exposed to varying level of noise. While majority (85.8%) were exposed to varying level of noise with 11.7% being neutral about the level of noise (See table 4.5 and figure 4.4).

Table 4. 5 Exposure to Varying Level of Noise in Work Place

Questions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Are you exposed to varying noise levels in your workplace?	42 (35.0%)	61 (50.8%)	14 (11.7%)	3 (2.5%)	0 (0.0%)

Source: Prepared by the researcher based on the questionnaire result

Figure 4. 4 Exposure to Varying Level of Noise in Work Place



Source: Prepared by the researcher based on the questionnaire result

4.5 Effect of Noise Level on Workers Productivity

The effect of noise level on employees' productivity is summarized in table 4.6 which shows the various effects of noise on workers' productivity. It is seen that while 3.3% opined that noise did not cause changes in their degree of nervousness, only 10.8% were being neutral on the object with majority (81.6%) feeling nervousness due to the presence of noise.

Furthermore, 87.5% of the respondents agreed that they lose focus because of noise and commit errors at work while 1.7% disagreed to loosing focus at work due to noise and 10.8% were neutral about the situation of noise in relations to lose of focus and error during work.

While 3.3% of the workers do not feel exhausted due to noise at work, 79.2% usually are exhausted due to noise with 16.6% being neutral to exhaustion at work due to noise.

85.8% of the respondents were usually tired at work while 10.8% were neutral on tiredness at work with 3.3% not usually tired at work under the influence of noise.

Whereas, 76.7% were usually absent due to noise, 3.3% claimed that the noise was not enough reason to be absent from work while 20% were neutral on the subject.

77.7% usually increase their break time at work due to noise while only 3.3% still kept to their break time even with the presence of noise with about 20% being neutral.

Though, 11.7% of the respondents indicated that noise had no influence of their workmanship and level of productivity, majority (85.8%) claimed that the noise level in their workplace had a bad influence on their workmanship and level of productivity. 2.5% were indifferent about the influence of noise on the level of production and workmanship.

Generally, it is seen from the responses above that noise greatly and negatively affect the level of productivity of workers at Erbil Steel Company as evident from the responses above.

Table 4. 6 Exposure to Varying Level of Noise in Work Place

Questions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Have you caused various degrees of noise prevailing in your work center any changes in the degree of nervousness?	28 (23.3%)	70 (58.3%)	13 (10.8%)	3 (2.5%)	1 (0.8%)
Did the different noise levels prevailing in your business center cause you to lose focus and increase errors?	41 (34.2%)	64 (53.3%)	13 (10.8%)	0 (0.0%)	2 (1.7%)
Did the various noise levels prevailing in your workplace cause you exhaustion?	63 (52.5%)	32 (26.7%)	20 (16.6%)	4 (3.3%)	1 (0.8%)
Did the various noise levels in your workplace cause you to feel tired?	31 (25.8%)	72 (60.0%)	13 (10.8%)	3 (2.5%)	1 (0.8%)
Did the different noise levels prevailing in your workplace cause you to increase absenteeism, hearing and work leave due to illness?	29 (24.2%)	63 (52.5%)	24 (20.0%)	3 (2.5%)	1 (0.8%)
Did the different noise levels prevailing in your workplace cause you to increase break time at work?	20 (16.7%)	72 (60.0%)	24 (20.0%)	3 (2.5%)	1 (0.8%)
Did the different noise levels prevailing in your business center cause a bad influence on workmanship and quality of production?	45 (37.5%)	58 (48.3%)	3 (2.5%)	11 (9.2%)	3 (2.5%)

Source: Prepared by the researcher based on the questionnaire result

4.5 Relationship of Levels of Noise on Workers Productivity

4.5.1 Noise level and Workers Nervousness

As can be seen from Table 4.7 and Figure 4.5, the cross responses of workers to the effect of noise on their level of nervousness at work. It was seen that majority (70.5%) of the respondents who indicated that the noise level at work was high showed support that noise increases their nervousness at work while only 3.3% disagreed to being nervous at work even under high level of noise with 25% being neutral.

While, the majority (71.4%) of the respondent who indicated medium noise at work were neutral to being nervous at work, only 28.6% agreed to being nervous under medium level of noise.

Majority (55.6%) of those who experience low level of noise were neutral as to whether they were usually nervous at work due to noise while the remaining 44.4% claimed to be nervous under even under the influence of low level of noise.

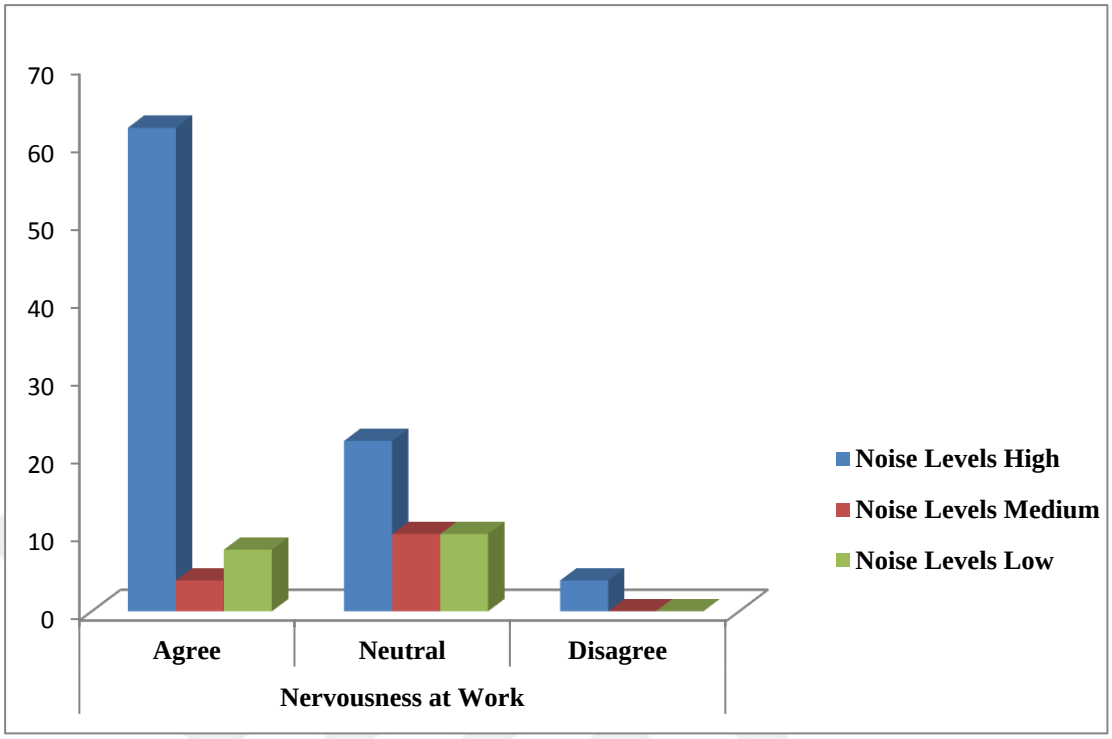
Generally, it can be concluded that every level of noise caused nervousness in workers at Erbil Steel Company. Although there is a reduction in nervousness level as the noise reduces as seen in the dropping percentages above.

Table 4. 7 Noise level and Workers Nervousness

		Have you caused various degrees of noise prevailing in your work center any changes in the degree of nervousness?		
		Agree	**Neutral**	**Disagree**
Noise Levels	**High**	62 (70.5%)	22 (25.0%)	4 (3.3%)
	Medium	4 (28.6%)	10 (71.4%)	0 (0.0%)
	Low	8 (44.4%)	10 (55.6%)	0 (.00%)

Source: Prepared by the researcher based on the questionnaire result

Figure 4. 5 Noise level and Workers Nervousness



Source: Prepared by the researcher based on the questionnaire result

4.5.2 Noise level and Workers Loss of Focus and Increase Error

Referring to Table 4.8 and Figure 4.6, the cross responses of workers to the effect of noise on their level of focus at work and error levels. It was seen that majority (96.6%) of the respondents who indicated that the noise level at work was high had increasing loss of focus at work while only 1 person was neutral with 2 persons not losing focus at work even under high level of noise.

The majority (71.4%) of those who experience medium level of noise usually lose focus at work and commit errors while 28.6% showed neutrality towards the subject.

About 55.6% of the workers who experience low level of noise experience loss of focus at work due to noise while 15.0% showed indifference to the subject.

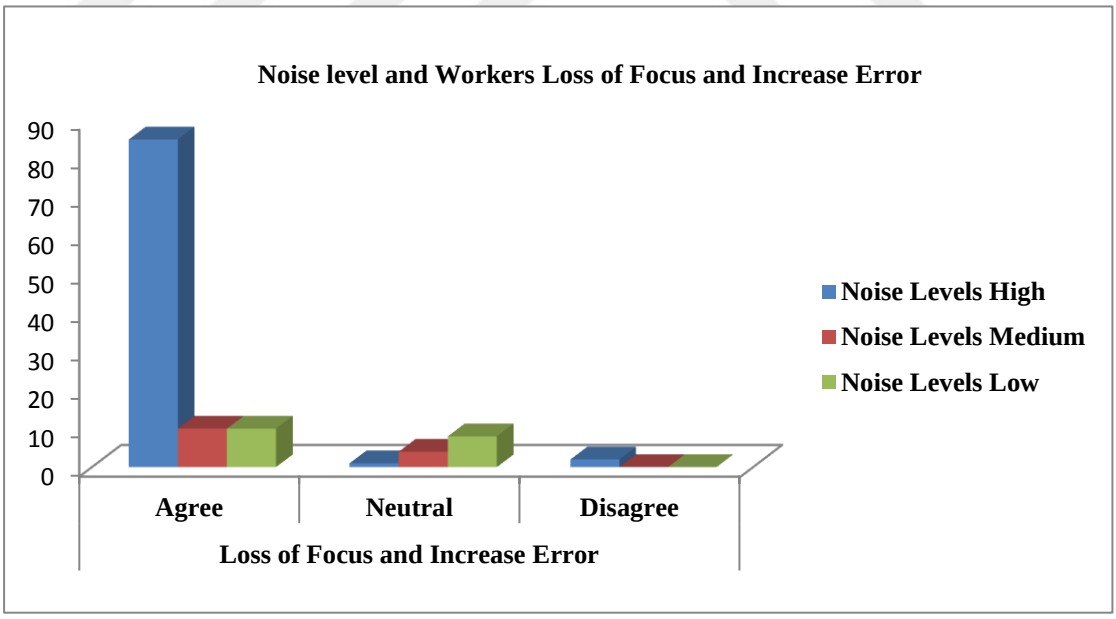
Generally, it can be concluded that the level of noise usually causes loss of focus of workers at Erbil steel company as only 2% of respondents who experienced high level of noise were free from this challenge.

Table 4. 8 Noise level and Workers Loss of Focus and Increase Error

		Did the different noise levels prevailing in your business center cause you to lose focus and increase errors?		
		Agree	**Neutral**	**Disagree**
Noise Levels	**High**	85 (96.6%)	1 (1.1%)	2 (1.7%)
	Medium	10 (71.4%)	4 (28.6%)	0 (0.0%)
	Low	10 (55.6%)	8 (44.4%)	0 (0.0%)

Source: Prepared by the researcher based on the questionnaire result

Figure 4. 6 Noise level and Workers Loss of Focus and Increase Error



Source: Prepared by the researcher based on the questionnaire result

4.5.3 Noise level and Workers Exhaustion

The cross responses of workers to the effect of noise on their level of exhaustion at work is illustrated in Table 4.9 and Figure 4.7. It was seen that majority (70.5%) of the respondents who indicated that the noise level at work was high showed support for noise exhausting them at work while only 5 persons representing 5.7% disagreed to being exhausted at work even under high level of noise.

While 35.7% of the respondent who indicated medium noise at work get exhausted at work due to noise, 64.3% showed indifference to exhaustion under medium level of noise.

44.4% of those who experience low level of noise get exhausted while at work under the influence of noise while 55.6% showed indifference to the subject under the influence of low level of noise.

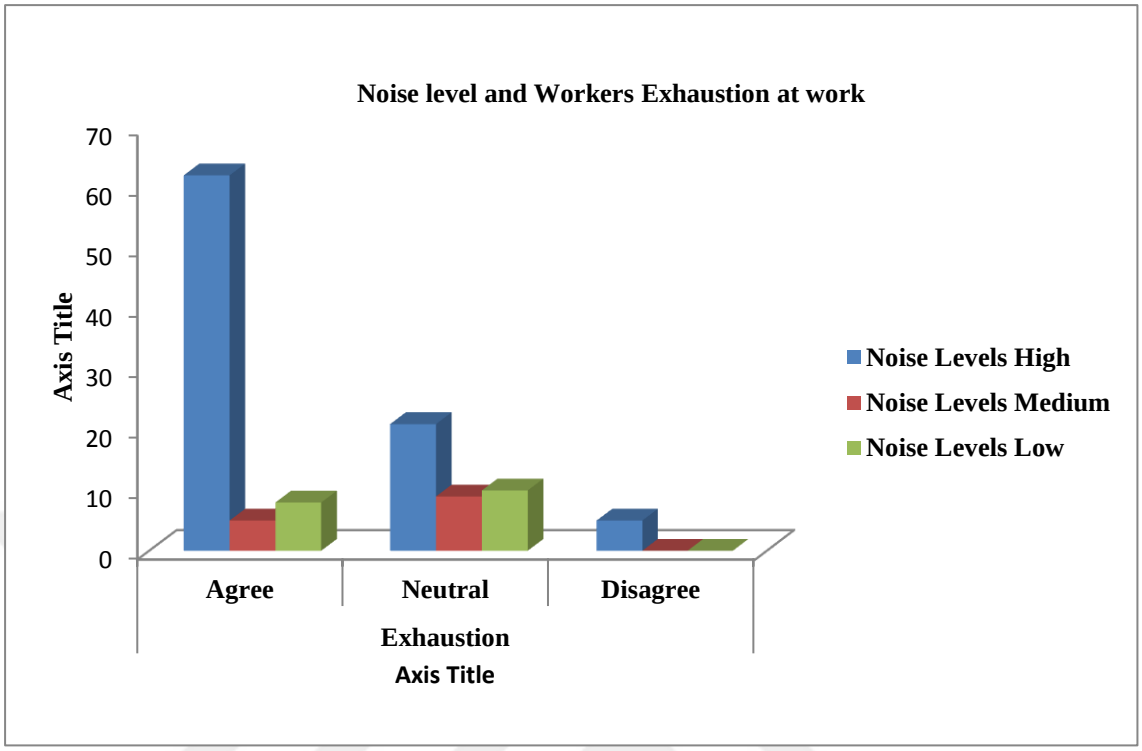
Generally, it can be concluded that the level of noise (majorly high) caused exhaustion of workers at Erbil Steel Company as only 5.7% of respondents who experienced high noise did not experience this challenge while majority of them were indifferent about the level of noise and their exhaustion at work.

Table 4. 9 Noise level and Workers Exhaustion at work

		Did the various noise levels prevailing in your Workplace cause you exhaustion?		
		Agree	**Neutral**	**Disagree**
Noise Levels	**High**	62 (70.5%)	21 (23.9%)	5 (5.7%)
	Medium	5 (35.7%)	9 (64.3%)	0 (0.0%)
	Low	8 (44.4%)	10 (55.6%)	0 (0.0%)

Source: Prepared by the researcher based on the questionnaire result

Figure 4. 7 Noise level and Workers Exhaustion at Work



Source: Prepared by the researcher based on the questionnaire result

4.5.4 Noise level and Workers Feeling Tired at Work

The Table 4.10 and Figure 4.8 illustrate the cross responses of workers to the effect of noise on whether they feel tired at work. It was seen that majority (88.6%) of the respondents who indicated that the noise level at work was high showed agreement to being tired under the effect of noise with only 3.4% not being affected or tired at work under the effect of high level of noise while 8.0% were indifferent concerning being tired at work due to the effect of high level of noise.

All (100.0%) of the workers who experience medium level of noise were usually tired at work due to noise.

Majority (61.1%) of those who experience low level of noise agree to being tired at work due to the effect of noise while 33.3% were being neutral.

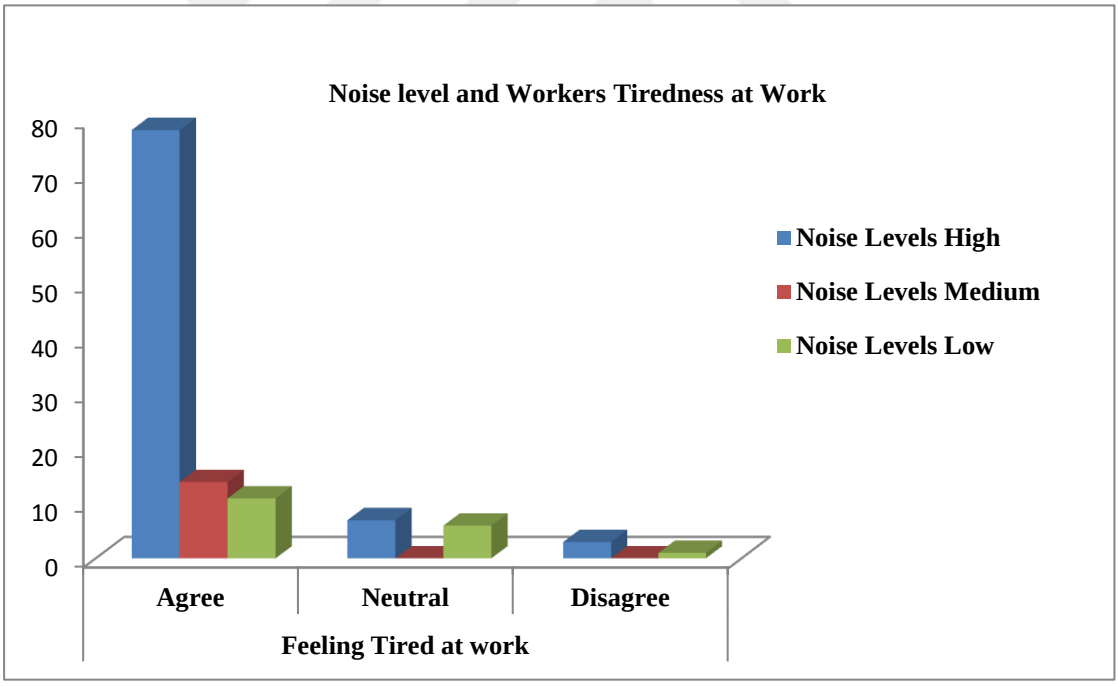
Generally, it can be concluded that the level of noise caused tiredness in workers at Erbil steel company as seen from the responses above.

Table 4. 10 Noise level and Workers Tiredness at Work

		Did the various noise levels in your workplace cause you to feel tired?		
		Agree	**Neutral**	**Disagree**
Noise Levels	**High**	78 (88.6%)	7 (8.0%)	3 (3.4%)
	Medium	14 (100.0%)	0 (0.0%)	0 (0.0%)
	Low	11 (61.1%)	6 (33.3%)	1 (5.6%)

Source: Prepared by the researcher based on the questionnaire result

Figure 4. 8 Noise level and Workers Tiredness at Work



Source: Prepared by the researcher based on the questionnaire result

4.5.5 Noise level and Workers Absenteeism

The cross responses of workers to the effect of noise on their level of absenteeism at work is demonstrated in Table 4.11 and Figure 4.9. It was seen that majority (76.7%)

of the respondents who indicated that the noise level at work was high showed support that noise increases their absenteeism at work while only 3.3% disagreed to being absent at work even under high level of noise with 20% being neutral.

While majority (71.4%) of the respondent who indicated medium noise at work were usually absent from work, only 28.6% were neutral to being absent due to the level of noise.

Majority (61.1%) of those who experience low level of noise were neutral as to whether they were usually absent from work due to noise while the remaining 38.9% claimed to be absent even under the influence of low level of noise.

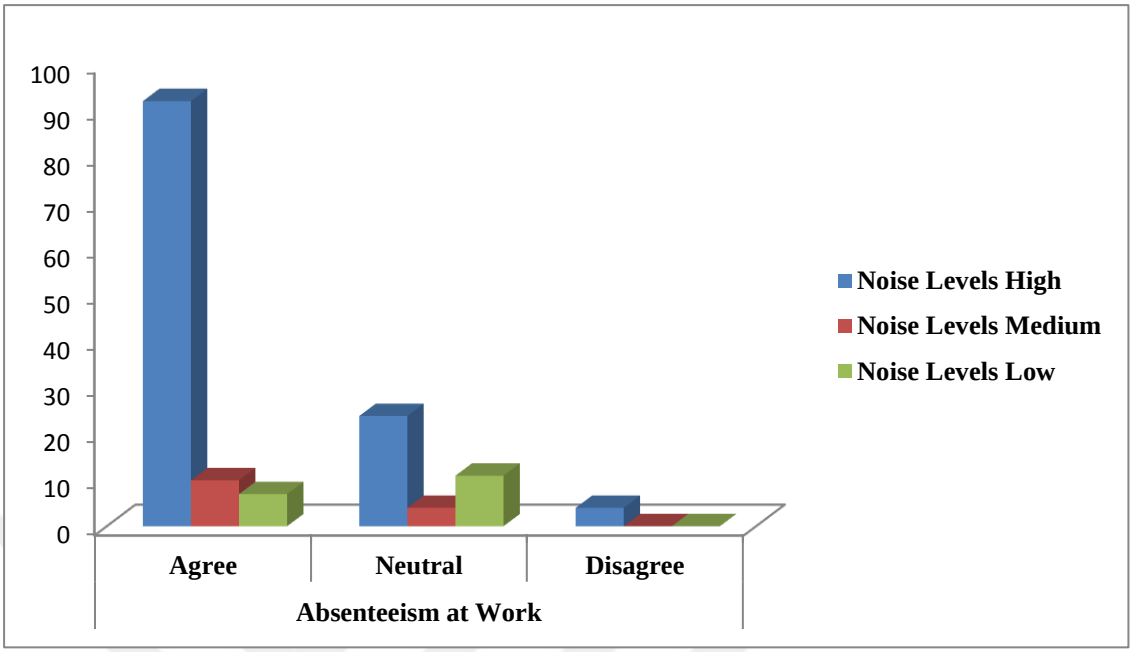
Generally, it can be concluded that every level of noise caused absenteeism of workers at Erbil steel company. Although there is a reduction in absenteeism level as the noise reduces as seen in the dropping percentages above.

Table 4. 11 Noise level and Workers Absenteeism from Work

		Did the different noise levels prevailing in your workplace cause you to increase absenteeism, hearing and work leave due to illness?		
		Agree	**Neutral**	**Disagree**
Noise Levels	**High**	92 (76.7%)	24 (20.0%)	4 (3.3%)
	Medium	10 (71.4%)	4 (28.6%)	0 (0.0%)
	Low	7 (38.9%)	11 (61.1%)	0 (.00%)

Source: Prepared by the researcher based on the questionnaire result

Figure 4. 9 Noise level and Workers Absenteeism from Work



Source: Prepared by the researcher based on the questionnaire result

4.5.6 Noise level and Workers Increasing Break Time

Referring to Table 4.12 and Figure 4.10, the responses of workers to the effect of noise and their increase in break time at work. It was seen that while 4.5% of the respondents who experienced high level of noise disagreed to increasing their break time due to the level of noise, majority (85.2%) of them usually increase their break time due to noise about noise while 10.2% were neutral.

While 78.6% of the respondents who experience medium level of noise consented to increasing their break time from work due to noise, 21.4% showed indifference.

Majority (66.7%) of those who experience low level of noise were indifferent about increasing their break time at wok due to the level of noise while 33.3% agreed to increase their break time to stay away from the noise.

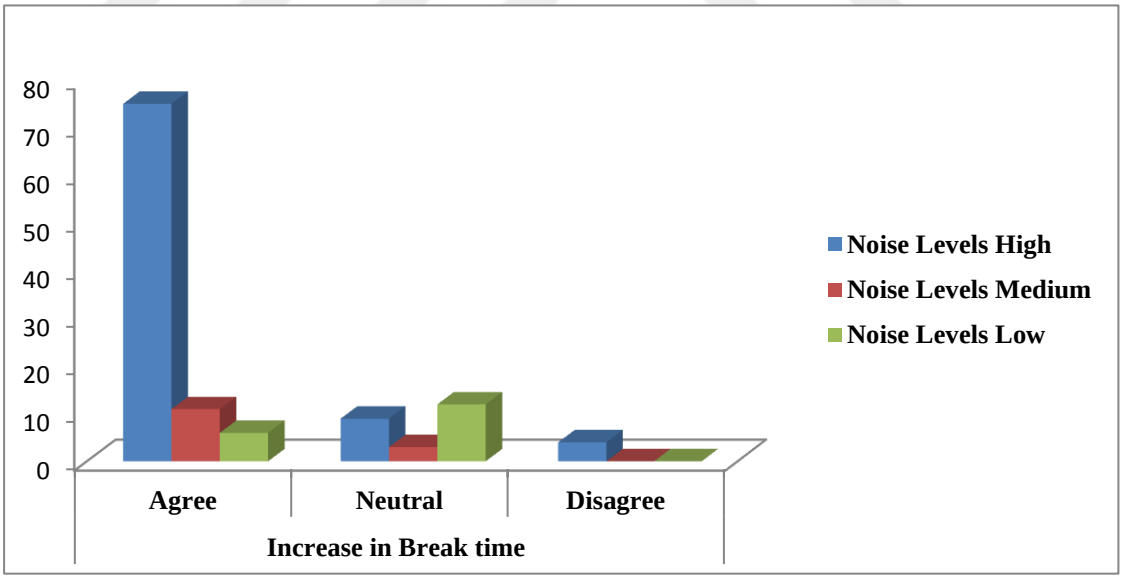
Generally, it can be concluded that most of the workers at Erbil Steel Company usually increase their break time from work in other to stay away from the noise as seen from the responses above.

Table 4. 12 Noise level and Workers Increase in break time at work

		Did the different noise levels prevailing in your workplace cause you to increase break time at work?		
		Agree	**Neutral**	**Disagree**
Noise Levels	**High**	75 (85.2%)	9 (10.2%)	4 (4.5%)
	Medium	11 (78.6%)	3 (21.4%)	0 (0.0%)
	Low	6 (33.3%)	12 (66.7%)	0 (0.0%)

Source: Prepared by the researcher based on the questionnaire result

Fugers 4. 10 Noise level and Workers Increase in Break Time at Work



Source: Prepared by the researcher based on the questionnaire result

4.5.7 Noise level and its bad Influence on Workmanship and Quality of Production

The Table 4.13 shows the responses of workers to the effect of noise and its bad influence on workmanship and quality of production. It was seen that majority (85.2%) of the workers who perceived the noise level at workplace to be on a high, agreed to noise having a bad effect on workmanship and quality of production. 13.6% of the respondents were of the opinion that high level of noise did not have a bad influence on workmanship and quality of production with another 1.1% being neutral to the subject.

All (100.0%) of the workers who experienced medium level of noise consented that the noise had a bad influence on workmanship and their corresponding level of production.

Of all respondents who perceive noise at workplace to be low, 77.8% claim that the noise had bad influence on workers' productivity and level of production while 11.1% were of a differing opinion on the claim and 11.1% on neither side of the fence.

Generally, it can be concluded that noise, at all levels, and did have a bad influence on workers' productivity as seen from the responses above.

Table 4. 13 Noise level and its bad influence on workmanship and quality of production

		Did the different noise levels prevailing in your business center cause a bad influence on workmanship and quality of production?		
		Agree	**Neutral**	**Disagree**
Noise Levels	**High**	75 (85.2%)	1 (1.1%)	12 (13.6%)
	Medium	14 (100.0%)	0 (0.0%)	0 (0.0%)
	Low	14 (77.8%)	2 (11.1%)	2 (11.1%)

Source: Prepared by the researcher based on the questionnaire result.

4.6 Summary of Findings

1. It can thus be concluded that there is so much noise at Erbil Steel Company.
2. Erbil Steel Company workers are at a higher risk of being disturbed by noise at work.
3. The effect of noise on the productivity of workers at Erbil Steel Company is quite high based on responses from the selected workers.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

5.1 Discussion

In general, from the data analysis, it can be stated that the sound environment which the construction workers are within is quite noisy and potentially harmful to health, since the lower limit is exceeded in most of the cases, and even more, the percentage of cases that go beyond the top limit is quite high. Similar results have been obtained in studies carried out in Germany by the BIA–BG Institute for Occupational Safety and Health (Paulsen, 2006) and (Maue, Knipfer, Pfeiffer, Funke, & Paulsen, 2004) which validates this study. Many measurements have been reported in those splendid reports from the BIA, but only considering the noise dose, whereas in this study, in addition to the noise dose, the peak level, the percentiles and the spectrum has been taken.

In addition, the use of personal hearing devices in the population studied is very low although their use is compulsory in many occasions in accordance with the new provisions of EU Directive 2003/10/EC (EU D. , 2003). This fact reveals two fundamental aspects to deal with the problem of noise at work: first, the workers are not aware of this problem and they are the first that overlook their own hearing health by rejecting the use of the personal hearing devices; and second, many companies are not persistent with the observance of the directives against noise. These two aspects turn the noise into a first-class problem regarding the health at work and it is also one of the main physical contaminants in the industrial precincts (Utley & Miller, 1985) (Neitzel, Seixas, Camp, & Yost, 1999).

It should be advisable to develop a noise management procedure as a general preventing guide to avoid the noise problem. A few enterprises have become aware of the problem the noise at work supposes and have already stated strategies for managing noise risks for the workers (Aubrit-Clochard & Templier, 2007) and for the neighbourhood (Aubrit & Autuori, 2006).

Some of the actions to control the noise that should be planned in advance are, for instance:

- That the noisy works should be avoided or reduced during the design stage.
- That the way the construction work will be managed and the risks will be controlled should be planned during the organization stage.
- That the risks should be assessed and eliminated, and the assessment revised during the construction stage.
- That a policy to acquire low-noise machinery and equipment should be considered before the beginning of the construction work, and the action for controlling the noise should be included in the specifications sheet.
- That a planning of the working processes should be done to reduce the noise exposure of the workers to the minimum.

Three types of actions are usually considered in the working procedures of the industrial hygiene to try to control the noise: on the source, on the environment and on the worker. The actions stablished on the noise source are the preferred ones, whenever they are possible, as these measures try to eliminate the noise. Next, actions on the environment should be considered. They normally consist of restraining the propagation of the noise from the source to the worker; these are the actions in which more work should be done. Actions on the worker should be considered only when all the previous actions fail, but despite that, actions on the worker are usually the first to be applied because their cost is lower than the cost of the actions on the source.

The excess of noise at the source could be reduced according to this policy by using machines with less noise emissions, for what the labelling systems of emitted sound power can be very useful.

For instance, the labels promoted by international regulations (EU, 1998)or the labels developed by some countries like Germany with the German Blue Angel (German, 2008) or even more innovative proposals that label both objective and subjective aspects of the noise that has been emitted by the machines (Fernández, Butrón, & Colina, 2009). Some other actions also contribute to that reduction of noise at the source, such as the avoidance of metal on metal impacts, isolation for reducing noise

or even vibrations, installation of silencers, preventive works of maintenance given that the noise can change depending on the weakening of the machines.

Together with the former, more actions can be applied to reduce the noise exposure of workers, taking into account the ISO 11690-1:1996 (ISO, 1996) for instance. Among the collective actions, there are:

- Isolation of noisy procedures and access limitation to noisy zones.
- Breaking the propagation path for the airborne noise through sound enclosures and barriers.
- Use of absorbent materials to reduce sound reflexions.
- Control of noise and vibrations transmitted through the floor through a floating floor.
- Organizing the tasks to limit the presence in noisy zones.
- Distributing the noisy tasks so that the minimum number of workers are exposed to noise.
- Applying working procedures that take into account the control of noise exposure.
- Finally, the last measure should be the actions on the worker by using personal hearing devices.

In case the noise exposure exceeds the top limit, their use is compulsory. There are several models of personal hearing devices in the market with several shapes, materials and ranges of attenuation so that each worker could find the most suitable. For the correct election of a protector, it is necessary to calculate the attenuation given considering the manufacturer's data and check if the one elected fulfils the specific requirements of attenuation for a given worker.

Consequently, it seems necessary to find a reasonable combination of worker's behaviour and preventive strategies in the construction site. Unfortunately, it was checked experimentally along the study that such combination is absent for the little and medium-sized construction companies. Regarding that, this study, and other similar ones are encouraging the workers, the construction companies and the authorities to become aware of the problem with the noise at work.

The control of noise particularly in underground and the various workshops are highly recommended through the implementation of engineering noise control, administrative noise control or the use of hearing protection device that suite with the task during working. Hearing conservation programme should be established to prevent the risk of NIHL. The setting up of a database for all workers and the records of their pre-employment hearing thresholds, their annual hearing screening and any further diagnostic audiology testing would also be a helpful tool in controlling the hearing conservation programmes.

Industrial noise exposure has been identified as a very obvious danger especially in small and hand tool industries which are still not mechanized. During our measurements it has been determined that the noise levels in the majority industries are exceeds the maximum (OSHA) exposure limits.

According to results of the questionnaire applied to the all workers in all industries:

1. Majority of workers in the industries are annoyed from the noise in their workplaces.

2. Mostly workers are of little education even under primary, primary and intermediate therefore they are not fully aware of the hazardous effects of noise.

3. There is strong relation between duration of employment years and feeling annoyed.

4. Psychological and physiological effects of industrial noise in seven factors (headache, dizziness, disturbs their peace of mind, nervousness, stressful, speech interference and insomnia) was analytic.

5. Most of workers like to move to a quieter work they said that the noise in their industries is affecting their performance.

5.2 Implication of Findings for the Industry Workers

⇒ With the introduction of modern technology and the intent to reduce cost of operations by employers, the industry worker should intervene by making sure that the cost reduction does not adversely affect them. For instance, workspace decisions should

be made to create an investment in employees' quality of life. Furthermore, the physical environment at work should be such that will better the employees' health. It would come in form of quality of indoor aim (open office place), ergonomic furniture and lighting.

⇒ The workplace space features are designed to promote collaboration and good interpersonal relationship without been detrimental to output. The workers should agitate for this because it supports mentoring, problem solving, routine communication and information sharing. The environment should be noise-free, social, spontaneous and productive.

⇒ The worker should advocate with management to see to the need to create a work environment that attracts, keeps, and motivate its workforce. This is with the intent to make employees enjoy what they do (job satisfaction), feel like they have a purpose (goal orientation) have pride in what they do (job attainment) and can reach their potential (self-actualisation).

5.3 Conclusion

This project is the first research on the impact of industrial noise in the productivity of the worker in Erbil City. The importance of the research is based on highlighting and showing the fundamental aspects of the problem of the industrial noise effect in the productivity of the worker.

This study carries out an analysis of effect of excessive noise on factory workers. The number of measurements is representative of the real number of workers belonging to a small and medium-sized company involved in an average construction work in the country where the study has been done. The main conclusion that can be obtained is that there are high levels of noise for the working environment. This is evident in table 4.5 as a staggering 85% of the workers admitted that they were exposed to a noise level higher than the 100% along their working time. Only 2.5% of the respondents consented that they were not exposed to varying level of noise. Noise

exposure level in the industry is found to be above normal and that is well above the healthy noise level recommended by World Health Organization (WHO). The limit of 85 dB(A) for 8 hours/day stipulated by OSHA has to be followed with caution.

Based on the data analyses in section four part 4.13 of this study, the responses of workers revealed that majority (85.2%) of the workers who perceived the noise level at workplace to be on a high, agreed to noise having a bad effect on workmanship and quality of production. On the other hand, 13.6% of the respondents were of the opinion that high level of noise did not have a bad influence on workmanship and quality of production with another 1.1% being neutral to the subject. Noise is in conflict with the conditions of human life and is opposed to the increase of the productivity of the work and the quality of health of the worker, that is to say, if the employee is forced to work in noisy environments decreases his productivity by psychophysiological effects.

Furthermore, the section four part 4.9 shows the cross responses of workers to the effect of noise on their level of exhaustion at work. It was seen that majority (70.5%) of the respondents who indicated that the noise level at work was high showed support for noise exhausting them at work while only 5 persons representing 5.7% disagreed to being exhausted at work even under high level of noise. While 35.7% of the respondent who indicated medium noise at work get exhausted at work due to noise, 64.3% showed indifference to exhaustion under medium level of noise. 44.4% of those who experience low level of noise get exhausted while at work under the influence of noise while 55.6% showed indifference to the subject under the influence of low level of noise. Unlike other pollutants, the effects of noise can be instantly unnoticed and their accumulation can lead to obvious physical

Additionally, the section four part 4.11 demonstrates the perception of workers on whether there are Personal protective equipment and preventive measures and for noise at workplace. Majority of all the workers who experience different levels of noise disagreed that there were preventive measures put in place to cater for noise at workplace. This is evident from the 85.2% from respondents who experience high level of noise. Just a few; 6.8% and 11.1% respectively consented to having preventive measures against high and low level of noise while the rest were neutral about the measures put in place against noise. This shows that the use of personal hearing devices in the population studied is very low although their use is compulsory in many occasions in accordance with the new provisions of EU Directive 2003/10/EC (EU, 2003). This fact reveals two fundamental aspects to deal with the problem of noise at work: first, the workers are not aware of this problem and they are the first that overlook their own hearing health by rejecting the use of the personal hearing devices; and second, many companies are not persistent with the observance of the directives against noise.

5.4 Recommendations

The study recommends the following to protect from auditory and most known possible non-auditory effects of noise:

- Pre-employment medical examination to exclude individuals with health problems that would be aggravated by noise exposure.
- Environmental monitoring to check sound pressure levels periodically and to institute control measures when necessary.
- Periodic medical evaluation for early detection of hearing affection and other non-auditory effects.
- Heath education programs at all levels.
- Proper maintenance of machinery with the purpose of reduces noise.

- Use of personal protective device where indicated.

(i) Most of the people do not know about the impacts of industrial pollution, therefore it is recommended that Radio, TV, Newspapers, NGOs and other media should provide wide publicity to keep the people aware about the effects of industrial pollution and their remedial measures.

(ii) It is recommended that noise protection devices(mufflers/silencers) be provided to the workers during working hours to protect their ears from the effects of high noise intensity.

(iii) It is recommended that noise-insulating enclosures be provided at the working places to reduce the noise level. Following measures are very essential to adopt during the operation of machines.

- Reducing the speed of rotating and moving parts of the machines would result the smooth operation and would reduce the noise output.
- By reducing the friction between rotating parts, sliding or moving parts in the mechanical system obviously results in smooth operation and decreases the noise output. Similarly, by reducing flow resistance in fluid distribution systems results less noise produced.
- Proper alignment of the machines, rotating or moving or contacting parts results in less noise output. Good axial and directional alignment in pulley system, gear trains, shaft couplings, power transmission systems bearings and alignment of axle are the fundamental requirements to control the noise output.
- The noise levels could be reduced by properly lubricating the different parts of the machines time to time. This would increase the life of the mechanical system and would help to reduce the noise levels.
- There is no real distinction between mufflers and silencers. They are often used interchangeably. They are in fact acoustical filters and are used when noise is required to be reduced.
- As the light reflects from one source to another, the noise can bounce from one hard surface to another. In noise control system this

phenomenon is called reverberation. If a soft, spongy material is placed on the walls, floors and ceilings the reflected sound will be defused and soaked (absorbed) up.

- One of the main sources of machinery noise is structural vibration caused by rotation of poorly balanced parts such as fans, flywheels, pulleys, cams and shafts etc. If the measures would be taken to correct these parts, the result would be achieved in less noise produced.
- It is recommended that exhaust fans and ventilators be properly arranged at the working places to reduce dust particles and their impacts.
- It is recommended that Government should take measures for legislation of such industries, as they (industries) should get their selves registered with government and abide the rules and regulation prepared by the authorities from time to time.

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APPENDIX

Siirt University - Siirt, Turkey

Faculty of Economic and Administrative Sciences

Questionnaire form

Greeting:

We are carrying out the scientific research titled"

"Your opinion on the paragraphs of the answer to the questionnaire will have a significant role in the completion of scientific research efficiently, knowing that the data provided will be used for the purposes of scientific research only, wishing you good and success."

Please place a symbol (√) in front of the option that you think represents your required answer in all fields of the questionnaire.

1. Age ( )

2. Educational level

( ) Illiterate) ( ) Primary ( ) Secondary ( ) Preparatory ( ) Bachelor

3- Are the noise levels in your business center?

( ) High ( ) Medium ( ) Low ( ) Very low

4. Are you exposed to varying noise levels in your workplace?

( ) Strongly agree ( ) Agree ( ) Neutral ( ) Disagree ( ) Strongly Disagree

5. Have you caused various degrees of noise prevailing in your work center any changes in the degree of nervousness?

( ) Strongly agree ( ) Agree ( ) Neutral ( ) Disagree ( ) Strongly Disagree

6. Did the different noise levels prevailing in your business center cause you to lose focus and increase errors?

( ) Strongly agree ( ) Agree ( ) Neutral ( ) Disagree ( ) Strongly Disagree

7. Did the various noise levels prevailing in your workplace cause you exhaustion?

( ) Strongly agree ( ) Agree ( ) Neutral ( ) Disagree ( ) Strongly Disagree

8. Did the various noise levels in your workplace cause you to feel tired?

( ) Strongly agree ( ) Agree ( ) Neutral ( ) Disagree ( ) Strongly Disagree

9. Did the different noise levels prevailing in your workplace cause you to increase absenteeism, hearing and work leave due to illness?

( ) Strongly agree ( ) Agree ( ) Neutral ( ) Disagree ( ) Strongly Disagree

10. Did the different noise levels prevailing in your workplace cause you to increase break time at work?

( ) Strongly agree ( ) Agree ( ) Neutral ( ) Disagree ( ) Strongly Disagree

11- Did the different noise levels prevailing in your business center cause a bad influence on workmanship and quality of production?

( ) Strongly agree ( ) Agree ( ) Neutral ( ) Disagree ( )Strongly Disagree

Thanks for your cooperation
Researcher
Ramzi Faris AHMAD

CURRICULUM VITAE

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EDUCATION AND TRAINING		
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Bachelor of Science	Salahaddin University, College of Economic and Administration, Department of Economic	2009 - 2013
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PEROSONEL SKILS	
Languages	Kurdish mother language
	Arabic
	English
Computer skills	MS word, MS excel, MS Publisher.
Publications	-Exchange Rate 2013 -Principles of Macroeconomics 2015 (Translation)