An Evaluation of Occupational Safety and Health Hazard Awareness In Steel Rolling Mills in Nairobi Metropolis

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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DEDICATION

This research work is dedicated to my wife Jennifer E. W., my sons Jeremy and Joel.

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LIST OF ABREVIATIONS AND ACRONYMS

ACGIH	American Conference of Industrial Hygienists
ACGIH	American Council of Government Industrial Hygienists
AS/NZS	Australian / New Zealand Standards
COP	Code of Practice
dB (A)	decibels A network weighting
DOSHS	Directorate of Occupational Safety and Health Services
HAV	Hand-arm vibrations
HAV	Hand-arm vibration syndrome
ILO	International Labour Organization
JISHA	Japan Industrial Safety and Health Association
MORT	The Management Oversight and Risk Tree Analysis
OSHA	Occupational Safety and Health Act, 2007 Kenya
WHO	World Health Organization

ABSTRACT

The aim of the research was to evaluate the safety and Health awareness in the steel rolling mill industry in the Nairobi Metropolis City. Stratification and random sampling procedure was used to select workers from steel rolling mill companies in the Athi River area in the Nairobi Metropolis for the study.

Questionnaires were used to determine workers understanding on risks and risk perception. Management commitment to safety and health and legal compliance was determined through observation of records kept.

The study found that all the three companies had safety and health management systems in place. Seventy nine percent of the workers had undergone training on safe work procedures with 75 % having been trained on workplace health hazards. Ninety five percent of the workers were aware that there were safety and health policies in their organizations while 93% had access. Seventy percent of the workers feared having no pay while 64% felt that the management took issues related to safety and health seriously. When determining who was responsible for safety and health, 36 % of the workers indicated that the employee was responsible for safety and health while 39 % believed the employer was responsible.

From the study it was established that the steel rolling mill industry workers were aware of the hazards associated with the nature of their work and the management was committed to safety and health at work. There is need for research on the effectiveness of professionals involved in occupational safety and health contributions towards preventing worker exposure in steel rolling mills.

1.0 CHAPTER ONE

1.1 INTRODUCTION

Promotion of decent, safe and healthy working conditions and environment has been a constant objective of International Labour Organisation (ILO) since 1919. A significant number of international instruments and guidance documents have been developed by ILO over the past 90 years to assist member countries to strengthen their capacities to prevent and manage workplace hazards and risks. Two of the guidance documents are Occupational Safety and Health Convention of 1981 (No. 155) and the Occupational Safety and Health Recommendation, 1981 (No. 164). These documents that relate to safety and health systems in the workplace have been incorporated into the national safety and health policy in Kenya through the enactment of Occupational Safety and Health Act of 22nd October 2007 legislation. Since 1951 when Kenya was a British Protectorate there have been various legislations in the field of safety and health meant to safeguard workers health from accidents and occupational related diseases or ill health (International Labour Organisation Legislative Text on OSH, 2006). Accidents and occupational diseases or ill health in the place of work are preventable through creation of a safe work environment which is to be free of occupational hazards. The steel rolling mills, like any other work places in Kenya are expected to create a safe work environment and ensure workers are not affected by workplace hazards in operations.

The strategy that is adopted by the steel rolling mills is demonstrated by formulation, implementation and periodical review of the organization policy on Occupational Safety and Health, full participation at all levels of employer, workers and other stakeholders.

The International Labour Organisation in 2009 in their 98th Session conference on occupational safety and health; promoting a safe and healthy working environment stated that there was an institutional responsibility on steel rolling mills to provide knowledge, education and training and information to its workers on workplace health hazards.

1.2 Background

1.2.1 Health and safety in industry

In a workplace a worker will be engaged in various types of activities that are important for production of goods and services. The work activities will affect the physical and mental well-being of workers. To maintain and promote the well-being of workers, occupational health broadly deals with the total health of the employed person. Occupational health and safety services need to be put in place to protect workers from occupational related diseases and accidents. These services are preventive in nature (Parmeggiani, 1983). In steel rolling mills safety organization is important as occupational safety and health depends on the reaction of workers to the potential hazards in their work environment. In order to prevent occupational accidents arising from the potential hazards, Kawai, *et al.*, stated that the management has first responsibility to the safest possible physical condition in a workplace. Despite global efforts to address Occupational Safety and Health concerns, the International Labour

Conference held in 2009 reported that an estimated two million work related fatalities and three hundred and thirty million work related accidents still occurred each year.

Occupational safety and health services are provided by different institutions such as research and training institutes, medical schools and governmental safety and health regulating bodies. Occupational health is a preventive activity aiming at identification, assessment and control of hazardous factors at the workplace. To achieve the health of the worker in a workplace like the steel rolling mill, WHO workers' health program in collaboration with ILO and member countries have called for identification and control of health hazards at work, identification of national priorities, evaluation of occupational health measures and provision of information to employers and workers. Evaluation of occupational health of the worker in the steel rolling mill is done through inspections by occupational safety and health officers and the safety and health committee members. The safety and health officers are government employees employed in the Directorate of Occupational Safety and Health Services as part of the national policy system of Kenya to oversee safety measures in operations at work (ILO, 2009).

In Kenya the Occupational Safety and Health Act, 2007 was legislated to secure the safety, health and welfare of persons at work and protect persons against risks to safety and health arising out of, or in connection with, the activities of persons at work. Securing of the safety, health and welfare of workers in steel rolling mills is to be accomplished by raising awareness on occupational hazards and coming up with promotional activities in order to modify attitudes and behavior of the worker. If managers and supervisors are unclear of their roles and responsibilities, and do not

understand training and supervisory needs of the workforce, workers may be unaware of the hazards, how to recognize them and the precautions they need to take. (Foreman, 2004).

Like any other industry, steel rolling mill workers, work with machines in an environment where there is exposure to hazards that can lead to injury, disability, or even death. One of the duties given to the employer by the Occupational Safety and Health Act, 2007 is to provide and maintain the plant, systems and procedures of work that are safe and without risk to the health of workers. The term safe system of work is used to describe procedures for routine operations. A safe system of work forms an integral part of risk management and is a key input of risk control. Fuller and Vassie (2004) stated that since the employer decides on the technology to be used at the workplace, they are expected to be responsible for managing the risks. In November 2003, the ILO came up with a guideline on safety and health in the iron and steel industry referred to as ILO code of practice (ILO, 2009).

The Australian/New Zealand Standard (AS/NZS 4360:2004), entitled Risk Management defines risk management as "the systematic application of management policies, procedures and practices to tasks of identifying, analyzing, evaluating, treating and monitoring risk." Risk management can be defined as the process whereby decisions are made to accept a known or assessed risk and/or the implementation of actions to reduce the consequences or probability of occurrence (Jeremy, 2006). Risk management covers a wide range of hazards and these can be conveniently categorized under the general headings of environment, technical/economic and social/people hazards. Thus risk

management is a system of managing risks within known and tolerable levels. The owners or occupiers of steel rolling mills in Kenya are required by the Occupational Safety and Health Act of 2007 to carry out risk assessment in order to manage their risks at work (DOSHS, 2007).

1.2.2 Implementation of OSHA of 2007 in Kenya

Loewenson, 1998 writing on occupational health and safety law in Southern African countries indicated that there has been an active process of revising occupational safety and health legislation in most of the South African countries. Kenya introduced the OSHA in October 2007. The OSHA legislation is applicable to steel rolling mills and is meant to ensure workers plus persons legally present in the workplace are protected against risk to safety and health arising in connection with work activities. This was meant for identification of hazards, recognition of those at work and inclusion of workers in identifying risk and ensuring a safe work environment (Loewenson, 1998). While complying with OSHA of 2007, steel rolling mills are required to carry out appropriate risk assessment on safety of persons employed and on the basis of their finding, adopt preventive and protective measures on the safety and health. Prevention and protection against workplace health hazards are addressed by having a safety and health management system in the workplace. International Labor Organization Safety and Health Management Guidelines 2001 (ILO, 2001), gives one of the key elements of safety and health management system as the safety and health policy. Once safety and health policies are in place workers are to be trained and awareness on hazards and the preventive mechanism put in place brought to their notice. This reflects the approach

that all parties involved especially in steel roll mills are given roles and duties in safety and health promotion process (Finish Institute of Occupational Safety and Health, 2006) Occupiers of steel rolling mills should have their workplaces audited on safety and health once every twelve months by a safety and health advisor. The safety audit is defined as an evaluation of the working environment and organizational management systems in a workplace for prevention of accidents, occupational diseases, ill health or damage to property (DOSHS, 2007). To facilitate and standardise the safety and health audit the government of Kenya through the Directorate of Occupational Safety and Health Services developed a code of practice on occupational safety and health auditing. Subsidiary legislations provide guidelines for implementing certain sections of the Occupational Safety and Health Act (DOSHS, 2004).

1.2.3 The Factories and Other Places of Work (Safety and Health Committees) Rules, 2004

In order for workplaces to secure a safe work environment, cooperation of the management and workers through formation of Safety and Health Committees has been found to be necessary. An active safety and health committee is important in improving the safety of the workplace. The primary purpose of the safety and health committee is to enable management and workers to work together to monitor the work environment, prevent accidents and improve working conditions. Occupiers of steel rolling mills are expected to establish their Safety and Health Committees. The Factories and Others Places of Work (Safety and Health Committee) Rules, 2004 require all workplaces with twenty or more workers to establish safety and health committees made of management

and worker representatives. Among the duties of the safety and health committees is to advice on the adequacy of safety and health measures for hazardous activities in the steel rolling mills operations. Safety and Health Committee members are able to identify hazards in the steel rolling mills through awareness of occupational hazards(DOSHS, 2004). Hazard awareness in the workplace is achieved through training of workers to help in identifying occupational hazards and cases of ill health among workers at the workplace. Occupational hazards identified in the steel rolling mills may sometimes require the occupier to monitor and evaluate hazards and risks by more knowledgeable persons. Training as one of the educational activities on safety and health risks, raises awareness of both workers and employers about the need of safety and health at work. (JISHA, 1995)

1.2.4 The Factories and Other Places of Work (Medical Examination) Rules, 2005

According to the medical examination rules, workers in steel rolling mill are to undergo medical examinations if they are exposed to specified occupational health hazards for the purposes of preventing and controlling occupational diseases. Medical examinations are required for steel rolling mill workers especially due to exposure to iron and high temperature. Employers of the steel rolling mills are expected to seek the designated health practitioners to perform medical examinations as part of worker screening programs, for both predictive and preventive purposes. Pre-placement and medical surveillance are thus offered to comply with the occupational safety and health standards to ensure a worker is not affected by an occupational hazard (Levy et al., 2006).

1.2.5 The Factories and Other Places of Work (Noise Prevention and Control) Rules, 2005

Occupational exposure to noise levels in excess of OSHA standards places workers to risk of noise induced hearing loss (Reese, 2003). One of the ways of providing a safe workplace where noise is concerned is taking practicable steps to ensure Occupational Exposure Limits of noise exposure is not exceeded. The noise level exposure to workers is determined through a noise assessment to show where levels are exceeding exposure limits (DOSHS, 2005). Where noise level exposures in a steel rolling mill exceeds the continuous equivalent of eighty five decibels for eight hours, an effective noise control and hearing conservation programme shall be developed. The programme is to address noise measurement, education and training, hearing protection and hearing tests. The occupier of a steel rolling mill in Kenya is required to inform all workers in writing the results of any noise exposure measurements done. Steel rolling mill operators are expected to ensure that all workers exposed to harmful noise levels are fully trained on the hazard, and instructed in the measures available for prevention, control and protection against high level noise exposure. Before hearing protectors are given, employees require training in fitting, selection, use, care and maintenance of appropriate hearing protectors. (DOSHS, 2007)

1.2.6 Hazardous Substances Rules

A hazardous substance is any material that poses a threat to human health and or environment. Typical hazardous substances found in steel rolling mills are corrosive acids and metal fumes from the scrap melting furnace area. The metal fumes and dust in

the smoke emitted from the melting process become air pollutants that have possibility of contributing to ill health (Vincoli, 2000). The hazardous substances rules require that where in a workplace such as steel rolling mills materials used or processes done could give rise to exposure to any hazardous substances such as dusts and fumes, appropriate safe work procedures should be written and the employee instructed on them (DOSHS, 2005).

1.2.7 Environmental Management and Co-ordination Act, 1999

At the onset of this environmental law, every company was required to carry out an environmental audit. The environmental audit looks at the management of solid waste, liquid waste and gaseous waste, from activities going on in an industry. Steel rolling mills were required to undertake their first environmental audits using registered National Environmental Management Authority lead experts on environmental issues. Under the Environmental Management and Co-ordination Act of 1999, all new projects or changes in existing projects are required undergo an Environmental Impact Assessment. The Environmental Impact assessment is supposed to address any significant impacts that are positive or negative due to the operations of an activity or project. Various hazards from steel rolling mills are encountered that are known to impact negatively to the environment as well as to the health of workers. The environmental impact assessment is conducted by individual experts or firm of experts authorised on behalf of the Kenyan National Environmental Management Authority. The National Environmental Management Authority in conjunction with other lead agency such as the Directorate of Occupational Safety and Health Services in the Ministry of

Labour address among other matters reduction or minimisation of risks to human health. (Environmental Management and Co-ordination Act, 1999)

1.3 Statement of the Problem

Kenya being among the developing countries undergoing significant industrialization, has steel rolling mills that employ quite a large number of workers who contribute immensely to the construction industry. Little has been done to determine the effectiveness of measures put in place for protection of workers from accidents and ill effect in steel rolling mills.

The International Labour Organisation has a code of regulation for the iron and steel industry which is yet to be adopted for use in the country's steel rolling mills (ILO, 2005). Until this code is adopted as a specific requirement for the steel industry, the industry will continue using the general law being used by other industries.

The number of workers dealing with metal and registered under amalgamated union of Kenyan metal workers is over ten thousand while those employed indirectly through scrap collection are higher (ILO, 2001).

Accidents due to the type of machinery used, and worker ill effect due to emissions are known to be a major cause of deterioration of workers health. High temperatures are capable of causing an increase in accidents due to worker fatigue and ill effect on workers exposed high thermal environmental will arise due to dehydration (ILO, 1991).

1.4 Justification/Significance of the study

Workers in the steel rolling mills need improved protection of their health as the country faces a rapid expansion of the building industry. The building industry, though addressing the high unemployment rate being faced in the country, employs a large workforce that has limited understanding of the consequences of the hazards encountered. It has been noted that there are serious accidents taking place in this industry some of which have even claimed workers lives as a result of serious safety and health law violations at the workplaces in the past.

1.5 Objectives

1.5.1 General Objectives

The aim of the study was to determine the measures that have been put in place in steel rolling mills, to protect workers from exposure to occupational hazards in Nairobi Metropolis.

1.5.2 Specific Objectives

To establish management controls in place to address hazard exposure to workers within steel rolling mills.

To identify some human factors associated with workers exposure to the hazards.

To establish physical controls in place for protecting against workplace hazards.

To determine role played by the government in reduction of exposure.

1.6 Research Hypothesis

HO: There are no significant measures in the steel rolling mills that create health hazard awareness to prevent workers from being exposed to workplace health hazards which cause injury or ill health.

H1: There are significant measures in the steel rolling mills that create health hazard awareness to prevent workers from being exposed to workplace health hazards which cause injury or ill health.

1.7 Research Questions

What controls has the management put in place to protect workers from hazard exposure?

What human factors cause workers to be exposed to hazards in steel rolling mills?

What physical controls are in place to prevent hazards in steel rolling mills from affecting the workers?

What has the government done to ensure there is reduction of hazard exposure in steel roll mills?

1.8 Conceptual Framework

The conceptual framework below gives an outline of possible causes of action or presents a preferred approach to occupational safety and health management system to safeguard workers from work related hazards. Factors that may lead a worker to seek employment in hazardous areas are poverty, high unemployment rate, increased population growth and a large number of school dropouts.

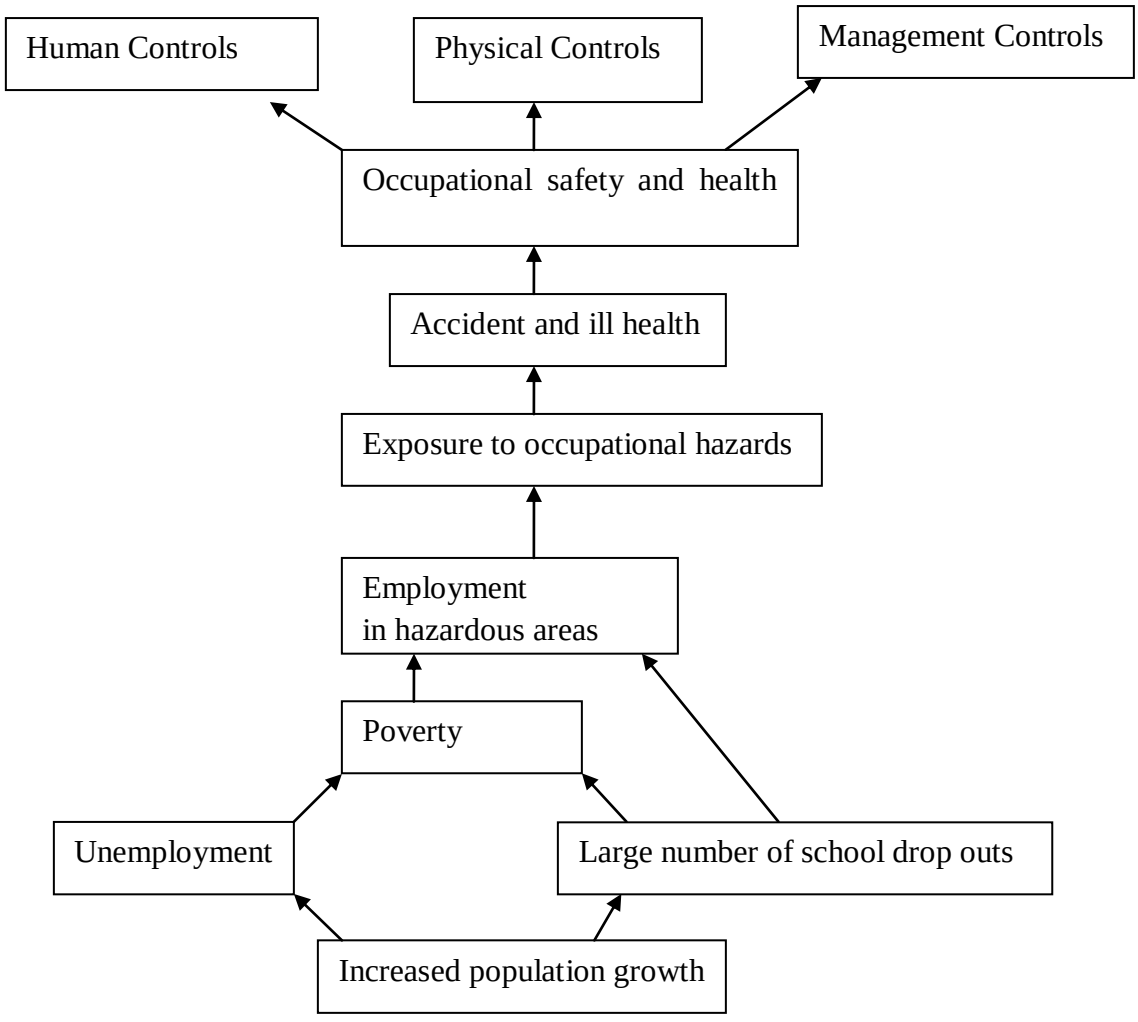

Figure 1: Conceptual framework

2.0 CHAPTER TWO

2.1 LITERATURE REVIEW

2.1.1 Introduction of iron and steel industry

The iron and steel industry comprises of steel mills, iron and steel foundries and the suppliers of ferrous scrap and iron ore (Fenton, 2005). The major raw material from which iron and steel products are made is iron ore mines. Iron and steel scrap raw materials are also collected and distributed to steel mills and foundries by brokers, collectors and dealers in the ferrous scrap in the ferrous scrap industry. Steel mills may be divided into integrated mills, which produce pig iron from iron ore and refine the pig iron to steel, and non integrated mills, which use scrap as their primary raw material (ILO, 2005). Steel mills produce relatively simple steel shapes that adjoining finishing mills roll or hammer into finished products, such as bar, sheet, or structural shapes.

The term rolling mills covers a wide variety of operations – hot or cold rolling which may be found in largely automated installations as well as in small premises that involve quite a lot of manual work. Rolling mills may exists separately may be incorporated in the primary production of the metal (Parmmegiani, 1983).

The largest number of rolling mills is concerned with ferrous metals, but non ferrous metals such as copper and aluminium are also treated in similar ways. In the rolling mill, the ingots from the soaking pits will be treated in the slabbing mill to produce billets or slabs and thereafter, sheet and strips steels are rolled into slabs, structural steel from billets, bars and rods from blooms or billets. Generally, hot rolling is used for heavy

sections and cold rolling to give a desired surface condition with only slight reduction of section. (ILO, 2005)

In Kenya the main type of steel mills are the non integrated mills though material from the integrated mills are imported for the rolling mills to produce same products.

Worldwide growth of demand for iron and steel products has increased steadily throughout the 20th century as well as demand in least developed countries. A historical high in global crude steel expected production was attained in 2002 when more than 900 Metric tonnes of steel was produced and by the turn of the 21st century, the world steelmaking capacity far exceeded steel demand, which caused an excess of available steel in the world market. The result was 30 percent world plunge in steel prices to a 20 year low in 2001. (Fenton, 2005)

The first making and use of iron may have been meteoric in origin because pieces of iron can be hammered into useful shapes without the necessity of smelting. Mesopotamians smelted non meteoric iron as early as 5000 B.C. and the remains of iron ornaments that date back to 4000 B.C. have been found in Egypt. Smelted iron objects have been reported in increasing numbers in Anatolian, Egyptian, and Mesopotamian archaeological sites dated between 3000 and 2000 B.C. Iron has been found in the pyramid of Giza dating back to 2900 B.C. Until 1600 B.C. iron was used as a ceremonial or ornamental metal. At about 1200 the process of carburization, which is heating of iron in contact with carbon was discovered. (David, 2005)

Steel is an iron-base alloy that contains up to 2 percent carbon. Manganese and residual amounts of phosphorous, silicon, sulphur and has carbon content between 0.05 percent and 1.25 percent. Crude or raw steel is the first solid state after melting, it includes ingots, steel castings, and strand or pressure cast steel (http://en.wikipedia.org/wiki/Alloy_steel).

Carbon steel are also often classified by degree of de-oxidation. Rimmed steel contains sufficient oxygen to give a continuous evolution of carbon monoxide while ingot is solidifying (ILO, 1991).

Killed steel is steel de-oxidized with aluminium or silicon to reduce the oxygen content to a level such that no reaction between carbon and oxygen occurs during solidification.

Medium and high carbon steel may be hardened and strengthened by heat treatment, which consist of heating to a certain temperature, quenching in a cooling medium, such as water or oil, and tempering by heating to a lower temperature that partially softens the steel and restores ductility (ILO, 1991).

The scrap industry consists of collectors and small dealers, large dealers and processors, and brokers. Collectors and small dealers generally handle all types of recyclable scrap, and the large dealers and processors specialize in iron and steel scrap, non ferrous metal. Processors of scrap use a large variety of machinery equipment. Various types of cutting machines may be used but the commonest method is use of gas cutting equipment. Balers are hydraulic presses capable of compressing an automobile or other light scrap into a dense cube. Types of processing equipment includes cutting torch, the drop ball for breaking cast iron scrap, the rail breaker and turning crushers. Material handling

machines includes belt conveyors, overhead and crawler cranes equipped with electromagnets or grapples (ILO, 2005)

Recycling of iron and steel scrap (ferrous scrap) is an important activity worldwide in particular in Kenya. Obsolete iron and steel products and ferrous scrap generated in steel mills and steel product manufacturing plants are collected because it is economically advantageous to recycle iron and steel products by melting and recasting them into semi finished forms for use in manufacture of steel products (USEPA, 2010).

2.1.2 Occupational Safety and Health development - Industrial Revolution

During the days of the ancient Babylonians, circa 2000 B.C., the ruler Hammurabi developed his Code of Hammurabi which encompassed all the laws of the land. In relation to safety and health the code contained clauses dealing with injuries, allowable fees for physicians, and monetary damages assessed against those who injured others.

In the Egyptian civilization during the reign of Rameses II, while undertaking the construction of the Ramesseum temple, the Pharaoh created a medical service to care for the workers. The workers were required to bath daily in the Nile and were given regular medical examinations and the sick were isolated (David, 2005).

The Romans were also concerned with safety and health of workers as may be seen in the remains of their construction projects. They built aqueducts, sewerage systems, public baths, latrines and well-ventilated houses. As civilization progressed so did safety and health development. (David., 2005)

From the early 1900s to the present time, employers and safety practitioners adopted the philosophy of the *three E's* (engineering, education, and enforcement) to guide their

safety-related interventions. To make a difference in the health and safety of employees, the three Es of safety focus on: 1) developing *engineering* strategies that decrease the probability of an employee engaging in at-risk behaviors; 2) *educating* and training employees regarding equipment, environmental hazards, policies and procedures; and 3) *enforcing* the policies and procedures related to operating equipment, wearing proper personal protective equipment, and handling specific hazardous substances. (Pettinger, 2009)

The Great Factory Act was passed in Britain in 1844 and by 1850, industrial engineers were improving the physical working conditions by increasing ventilation, improving lighting, and providing guarding for dangerous moving machinery. (Ladou, 1986)

Industrial safety engineering research has suggested that injuries occur as a result of excess energy between the body and the work environment (Geller, 1996). The pioneering work of William Haddon during the mid-1900s hypothesized that engineering modifications would make the largest impact and achieve the greatest long-term reductions in injuries. Studies in Occupational epidemiology have shown that hot metal workers have high rates of respiratory cancer. (Ward, 1982)

In their study of iron and steel workers, Vernon and Rusher (1920) showed that in comparison with the average for a group of 20,000 workers in industry, steel melter's and paddlers suffered excessively from rheumatism and respiratory disease, while tinplate mill-men and rolling mill-men did not. (Merewether, 1954)

Workers of today go to their jobs confident that they will return safely, and in good health. While hazards may be encountered on the job, for the most part these risks have been controlled. However, this was certainly not the case for much of our history.

Certain industrial episodes occurred in early times which prompted the development of safety and health after workers became victims of workplace hazards (David,2005).

2.1.3 Occupational Safety and Health Law in Kenya

Safety and health was introduced in Kenya in 1951 when the country was a British colony. Development of safety and health has depended on law enforcement as a driving force with limited understanding on the part of the industrialists. Lack of coordination on matters related to safety and has led to lack of reliable data on occupational accidents and occupational diseases by the department given the responsibility of safeguarding the safety and health of the workers.

Unlike other countries where noted improvement has been due to pressure from legislation promoting safety and health, Kenya has lacked the political will from the legislatures who do not understand safety and health. This is evidenced by the lack of ratification of important International Labour Organisation tools such as the Occupational Safety and Health Convention No. 155 since 1981 (Sommer, 2003)

Lack of ratification of the convention No. 155 does not mean Kenya has not incorporated the recommendations made through the said convention.

Through the Directorate of Occupational Safety and Health, a department in the ministry of Labour, the government introduced the Health and Safety committee Rules through a legal Notice No. 31 of 2004. These rules are a subsidiary legislations established through

section 65(A) of the factories and other places of work act. The safety and health committee rules give guidelines on the running of the safety and health committees. The safety and health committees are to be established in any workplace which regularly employs twenty or more workers. In this subsidiary legislation, recognition has been made that training of the employer and employee is necessary to create awareness of hazards and need for both parties to take charge of their safety and health at the workplace (DOSHS, 2007).

During the training, workers and employers are sensitized on hazards and their control methods to secure a safe workplace. In his book "Occupational Safety and Health for technologists, engineers and managers" David L. Goetsch says improvement in the future of the field of Health and Safety is likely to come as a result of safety and health awareness of the cost effectiveness and resultant competitiveness gained from a safe and healthy workforce. (David, 2005)

The International Labour Organisation (ILO) in its effort to create safety and health awareness promotes decent, safe and healthy work conditions through convention No. 155 as one of its blue prints to deal with Occupational Safety and Health and the Work Environment. This right of decent, safe and healthy work conditions and the environment has been reaffirmed in the 1944 Declaration of Philadelphia and the ILO Declaration on social Justice for a Fair Globalisation. All branches of economic activities are supposed to comply with the Occupational safety and health requirements incorporated in the national laws addressing the safety and health of workers.

Article 16 requires employers to ensure so far as is reasonably practicable, workplaces, machinery, equipment and processes under their control be safe and without risk to the health of the worker and that chemical, physical and biological substances and agents under their control are also without risk to health by ensuring measures are put in place for the worker protection (ILO, 1981).

Employers are required to provide, where necessary, adequate protective clothing and protective equipment to prevent risk from accidents or from adverse effects on health.

Under the Occupational Safety and Health Act of 2007 which replaced the previous law, there is provision of securing the safety, health and welfare of persons at work. The act governs the safety, health and welfare of workers and persons present legitimately at places of work from hazardous exposure. Employers are given duties under the law to ensure the safety, health and welfare at work for all persons in their workplaces. (DOSHS, 2007)

The employer is to prepare a safety and health policy that will govern all activities in the workplace and also bring this document to the awareness of the employees. It is also a requirement of the law that a risk assessment be done to determine the significance of the various hazards in the work environment (DOSHS, 2004).

Workers are obligated by the law to cooperate with the employers for their safety and observation of all health and safety requirements. They are to ensure their own safety and that of others by removing workplace hazards that they can or reporting the presence of the hazards which they are unable to remove. Where personal protective appliances are provided by the employer the worker is expected to use them (DOSHS, 2007).

2.1.4 Hazards in the steel rolling mills

In order to prevent a worker or any person in a steel rolling mill from being affected by workplace injuries and ill health in a steel rolling mill it is important to identify and recognize the principle hazards, the anticipated injuries, diseases, ill health and incidents. Some of the hazards encountered in the steel rolling mills listed in the ILO Steel Code are: Slips, trips and falls, unguarded machinery, engulfment, moving machinery, on-site transport, forklifts and cranes, exposure to controlled and uncontrolled energy sources, skin contact with chemicals irritants (acids, alkalis), solvents and sensitizers, extreme temperatures, radiation (non-ionizing, ionizing), noise and vibration, manual handling and repetitive work (ILO, 2005)

2.1.5 Manual handling and Lifting

Manual handling leads to a number of injuries. One of these injuries is back injuries. This is one of the most common injuries in the workplace. From compensation point of view, almost one-fourth of all workers compensation claims involve back injuries. According to the California Workers' Compensation Institute, medical care costs are 43 percent higher when part of workers' compensation claim than when part of group medical plan. (DOSHS, 2007)

Automation and mechanization are the only way to reduce many of the traditional hazards associated with the handling of material as back problems continue to affect workers in this industry. Very few of the back injuries are reported by the workers or the industry. The time lost due to back problems is reflected by sick leaves (Wikipedia, 2004).

Training in proper lifting methods and the increased use of mechanical devices wherever available will decrease the number and severity of injuries due to handling of material (ILO, 1983).

2.1.6 Crushing

Crushing occurs during the transport of raw material, semi – finished and finished products. Many modes of transport are used such as railways, conveyors, industrial motor vehicles and overhead cranes (ILO, 1981). Workers protection is ensured if the machineries used are selected properly and training on the hazardous operations is done. At the blast furnace the main crashing hazard is in the tap–hole gun and drilling machines. Care is usually taken in the design of this installation and its control operation (Parmmegiani, 1983). Although rolling mills have undergone much automation, they still retain some of the hazards connected with operation of labor intensive mills. Crush hazard involved comes from contact with the transmission machinery on the powered rollers in the conveyor system. Simple but robust guards can be placed to prevent workers from coming into contact with dangerous moving parts Well guarded and properly constructed bridges are necessary barriers for crossing over the conveyor lines (ILO, 1983).

2.1.7 Noise and vibrations

Noise levels in the industry should be measured to establish levels and duration of exposure to the workers and identify the sources of noise and exposed workers in order to come up with control measures. Harmful effects of noise can be categorized as

exposure to high level over a significant period of time which may cause both temporary and permanent damage, noise that interferes with speech communication and warning signals, that which interferes with work performance and the noise that interferes with relaxation and sleep. Stress causing noise may contribute to heart disease, ulcers and other stress related problems (ILO, 1991).

Increasing noise levels will be expected in any society or country that strives for faster and more economical ways to work, travel, or play and therefore noise exposure levels can be expected to increase if concerted efforts are not put in place on political and technical fronts. (Patty, 1981)

Studies done have shown that workers in many industrial process have sufficient level of noise exposures that may cause significant hearing impairment. In the studies hearing impairments for industrial populations are 10 to 30 percent greater for all ages than for general populations that have relatively low exposure. Hearing loss is a concern when faced with noise hazard in the workplace. It should also be noted that when dealing with noise hearing loss, it is not the only detrimental effect of excessive noise. Noise can also cause communication problems, isolation and productivity problems (Smith, 1997). Noise interferes with a workers ability to think, reason and solve problems. Isolation as a problem affects those workers who are required to act as a group or must communicate frequently with supervisors or co-workers. They may feel left out and uninformed, the antithesis of the goal of modern teamwork oriented organization (ILO, 1991).

The problem of noise and vibration hazards is serious issue in the iron and steel industry in many of the operations. This is noted from the preparation stage of the raw materials

to the blast furnace stage and especially at the rolling operations. In a recent study in Mexico it was reported that at least 80 percent of all workers are exposed to two or more occupational hazards, including that of noise. Of the 210 workers that underwent audiometric tests 75 per cent were found to have some hearing loss related to occupational exposure. (ILO, 1981)

Kenya has occupational deafness as a reportable occupational diseases and has set up rules and guidelines Legal Notice no. 25 of April 2005 that require noise measurement be done and where levels are above 85 decibel A weighted scale noise control program be put in place (DOSHS, 2005).

Hot and cold rolling mills have many sources of both steady and impact noise, which in some cases has been reported to reach levels in excess of 120 dB(A). Principal factors that influence how much effect a sound will have on a potentially affected receptor are the level of sound being assessed and the level of other sounds which also affect the receptor (Patty, 1981).

As one gets further away from the source of sound in the environment, the level of noise from the source reduces. The principal factor contributing to this is probably geometric dispersion of energy. As one gets further away from the sound source, the sound power from the source is spread over a larger and larger area. The rate at which this happens is between 3 dB per doubling of distance for very big sources such as major roads and 6 dB for doubling distance for comparatively small sources e.g. individual small machinery (ILO, 2005).

The other most important factor that governs noise level exposure from source is whether the propagated path from noise source to the receptor is obstructed.

It is important at times to consider physical characteristics of sound being assessed such as whether the sound is impulsive – it contains distinctive clatters and thumbs, tonal – whine, scream, and hum or whether it contains information content - such as speech or music.

The significance of noise exposure generally will be dependent on the number of people affected and how badly they are affected.

Control or mitigating measures will be necessary where the exposure levels are above the statutory recommended standards. Sometimes it is important to put in place mitigating measures where the stipulated standards are not being exceeded.

Mitigating or control measures will also require monitoring of the effectiveness of the control methods being implemented to ensure, Noise Induced Hearing Loss does not result either due to failure of Personal Protective Appliances in use or other modes of control in place (DOSHS, 2005).

Control of noise can be done is various ways. The equipment in use can be changed or modified through engineering controls to reduce level of noise being emitted. Noise being emitted by a process can be insulated through glazing or use of silencers or the process itself can be isolated. These noise control methods can be applied where a large number of workers are being unnecessarily exposed (Patty, 1981).

Well maintained machinery is known to be less noisy as compared to poorly maintained ones.

Vibration hazards are closely related or associated with noise hazards because tools that produce vibration typically also produce excessive levels of noise. Vibration related problems are not only serious, they are also widespread. According to Donald Wasserman, author of Human Aspects of Occupational Vibration, says up to eight million workers are exposed to some type of vibration hazard and of these it is estimated more than half will show some sign of injury. Workers operating heavy equipment often experience vibration over the entire body. This can lead to motion sickness to spinal injury. The most common vibration-related problem is known as hand-arm vibration syndrome (HAV). The condition strikes an alarming number of workers who use vibrating power tools day in day out as part of their jobs (Wasserman, 1987).

2.1.8 Micro–climate

In the iron and steel industry the safety and health professional is concerned with high temperature exposure to the worker especially at the furnace, the melting of the scrap metal area and the red glowing metal billets and bars at the rolling mill area.

It is of significance to note that there is a range of temperature that a worker can be exposed to without experiencing heat strain or any other adverse effect. Heat stress is the net heat load that a worker is exposed from combined contribution of metabolic cost of work, environmental factors (i.e., air temperature, humidity, air movement and radiant heat exchange) and clothing requirements. (ACGIH, 2003)

The micro-climate in the iron and steel industry can vary widely depending on the nature and design of work methods and buildings. Micro-climate associated with iron and steel making process and heat radiation, are factors that can cause certain occupational

diseases such as cataracts and pathological conditions of the alimentary tract and blood circulatory system. As much as ten percent of the heat generated in a blast furnace can be lost by radiation from its surface (ILO, 1981).

The first recorded evidence of the influence of temperature on the incidence of industrial accidents is that obtained by Vernon (1918) during World War I. At a large ammunitions factory Vernon recorded the average temperature, number of cuts, and other minor accidents. He discovered that when the factory temperature was between 65^0 and 69^0 F accidents were less frequent (Merewether, 1954).

Protective measures, such as shielding, remote work posts, medical surveillance, rest periods, protective clothing and correct body liquid and salt balance are necessary (Duffy and Saul 2008).

2.1.9 Burns

Burns are a common occurrence in the iron and steel industry because of the very nature of operations. Accidents vary from minor splashes to major incidents of explosions of molten metal caused by water or sudden expansions of a gas in a closed vessel that may result in loss of life.

There are various means of protection available from these burns. Where minor splashes of molten metal may occur, workers are always provided with special suits and foot wear to minimize the effect of the splashes. Emergency showers are provided to cool molten metal or to extinguish fires caused by splashes (ILO, 1981).

2.1.10 Air borne substances injurious to health

An issue that may be considered to be one of the largest single occupational problems is airborne substances. Some toxic agents and potentially hazardous substances produced in an iron and steel industry are aromatic hydrocarbons, benzopyrene, carbon monoxide, coke oven emissions, manganese compounds, nitrogen oxide particulates and sulfur oxides. These types of hazards will not only affect the workers but also the surrounding community that may be having residential houses nearby. The metal pollutants have been known to contribute to respiratory problem and most seriously lung cancer. (ILO, 1983)

2.2 Training of workers

Safety frequently depends on individuals in a place like the steel rolling mill having the knowledge and skills to perform tasks safely. If safety training is to make contribution to the 90% improvement goal that Johnson and others working with MORT see as attainable, safety training must integrate traditional and effective training methods with new approaches and methodologies to improve its output and effect on performance of people (Richard, 2004).

In training, an operation or activity is selected for which trainings is needed. This is done once hazards that is or may have an adverse effect have been identified. In the training effort, attention may be focused on the hazards that will be encountered during the performance (or non performance) of the workers. The ultimate responsibility for successful implementation of training programs is with the top management (ILO, 2001). Most studies on safety management have shown that full involvement of the top

management is a very important factor. The top management aims to achieve and maintain high levels of safety through knowledge of the hazards, their effects and the techniques to counter those effects. The employer has a responsibility of ensuring that employees of all levels have correct knowledge and sound technical base about hazards encountered at work. The provision of that knowledge through training, instruction and information constitutes a major contribution towards high safety performance. In providing the training, account of the level of employee's knowledge must be taken into consideration. (Ridley, 2007)

Among the applications of the general systems model to safety activities, one of the most useful activities due to its contribution to understanding of development of safety training is the risk management process. The risk management process is the systematic application of management policies, procedures and practices to the tasks of communicating, establishing the context, identifying, and analyzing, evaluating, treating, monitoring and reviewing risks (AS/ NZS, 2004). Steel rolling mills must have risk management process in process in order to safeguard the safety and health of worker.

Steel rolling mills like all other workplaces in Kenya must conduct risk assessment and the management is to establish appropriate measures to mitigate against hazards encountered at work (DOSHS, 2007).

Risk assessment can be defined as the characterization of the potential adverse health effects of human exposures to environment hazards. In his book Science, technology and society: a philosophical perspective Wenceslaso J. G. states that the National Research Council (1983) listed four steps in the process of risk assessment as follows;

Hazard identification: determination of whether a particular chemical is casually linked to health effects.

Dose-response assessment: Determination of the relationship between the magnitude of exposure and the probability of occurrence of the health effects in question.

Exposure assessment: Determination of human exposure before or after application of regulatory controls.

Risk characterization: description of the nature-and often the magnitude-of human risk, including attendant uncertainty.

3.0 CHAPTER THREE

3.1 MATERIALS AND METHODS

3.1.1 Research Methodology

3.1.2 Study Area

At the time of the research Nairobi metropolis had nine steel rolling mills with four of them located in the Athi River area. During the research work only three of the rolling mills were fully operational due to a serious drought that affected electrical energy supply to the industries for production processes. The three steel rolling mills in operation at the time were A Steel Mills Limited, the D Steel Roll Mills Limited and the G Steel Plant Limited. The actual names of the three steel rolling mills have been withheld for confidentiality. These three companies employed the largest number of workers in the country.

The survey was conducted on administrative management and production workers of A Steel Mills Ltd, D Steel Roll Mills Ltd and G Steel Plant Ltd to determine the health and safety awareness on hazardous exposure. Their real names are not used for confidentiality purposes.

3.1.3 Methodology

3.1.3.1 Sample design

Two sampling design methods, non-probability sampling and probability sampling methods were available for the research study.

The Probability sampling method of random sampling provided an equal chance of every person in the population being selected for the study. The three industries and the respondents were used to provide the necessary data for the research.

3.1.3.2 Data collection method

Questionnaires were administered to the three organizations in order to gather data from the management and production workers. The questionnaire was tailored so as to determine the first two specific objectives which were management controls and human factors contributing to worker exposure to hazards.

Most of the workers in the three industries were employed on a temporary basis. Such a term of employment resulted in fluctuations of the workers thus affecting administering of the questionnaires. To address the anticipated worker fluctuation, a stratified random sampling method was used because it allowed the different subgroups of the population to be represented and it therefore did not matter what nature of employment a worker had. Once stratification was done in terms of the different sections established in the various steel rolling mills, questionnaires were distributed to the study population with the help of the management. The management personnel included the health and safety committee secretaries, safety and health chairmen and supervisors.

In order to establish the physical controls in place and the role of the government in reducing worker exposure, a walk through inspection and perusal of documents required to be in place as per the Occupational Safety and Health Act(OSHA) was done.

The walkthrough survey was conducted using the code of practice established under the OSHA by the government safety and health regulating body for creating a safe work environment.

The general registers, a document kept under the OSHA, in the three companies were examined to establish accidents and occupational diseases that had occurred due to workers exposure to hazards. Other statutory documents to confirm that the OSHA and the subsidiary legislation were being complied with were perused. These statutory documents were the training certificates of safety and health committee members, the health and safety committee meetings minutes and inspection of workplace records, summary of the medical examinations of the workers, the noise survey report, the safety and health audit reports and examination reports of pressurized and lifting appliances in the workplace.

3.1.3.3 Identification of the population

A truly representative sample population of steel rolling mills was found in the Athi River area in Mavoko Municipality located within the Nairobi Metropolis. The major rolling mills in the area purposively picked were D Steel Roll Mills Limited, the A Steel Mills Limited and the G Steel Plant Limited as they employ the largest number of workers. D Steel Rolls Mills Ltd is the leading steel rolling mill in the country. These steel rolling mills had most production operations going on at the time.

All the organizations were engaged in export business of the steel products to the neighboring countries. One of the companies, D Steel Roll Mills Limited had two other major plants one which is in the Nairobi Metropolis and the other in Mombasa City.

The workers in the organizations were stratified according to the different operational sections in the rolling mills. Workers from the following areas were identified for the administration of questionnaires: administration, the garages, the tube mills, galvanizing plant in D Steel Roll Mills, bending and loading areas, the roll mill sections, cutting sections, the twisting sections, the roll mill workshops, eight inch mill section the new roll mill, the furnace, the scrap yard and wiring plant.

3.1.3.4 Population and sample size

All the three rolling mills dealt with suppliers who delivered scrap metal in small and big track Lorries. The scrap metal was collected through a chain of suppliers. Individuals collected scrap metal and delivered to collection centres which then fed suppliers who had a direct link with the companies. In total all the three organisations had at least one hundred and twenty suppliers. The scrap delivered by suppliers was measured in tonnes at a weigh bridge before offloading in the scrap yard for the sorting process.

There were at least two levels of suppliers in a chain before the scrap reached the steel rolling mill companies. At least ten persons fed the first level supplier with scrap metal directly from the field. At least fifty of these suppliers fed the final supplier with enough scrap for delivering to the steel roll mills. The minimum number of persons dealing with scrap metal was therefore at least sixty thousand people. (10 X 50 X 120 = 60,000).

The number of workers involved or engaged in the steel roll mill operations beginning with scrap metal dealers, collectors and those employed in the steel roll mills were over ten thousand. Using Fischer et al. the sample size of three hundred and eighty four based on the following formula was determined as follows:

$$n = \frac{Z^2 pq}{d^2}$$

Where:

n = desired sample size (if the target population was greater than 10000)

z = the standard normal deviation at the required confidence level

p = the proportion in the target population estimated to have characteristics being measured

q= 1-p

d= the level of statistical significance set

Where the estimate of the targeted population is not available as the case is for this study a characteristics interest of 50% is recommended by Fisher *et al.**

Taking the proportion of a target population with a certain characteristics is 0.5, the z statistics is 1.96 and the desired accuracy is at the 0.05 level, the sample size is:

$$n = \frac{(1.96)^2 (0.5) (0.5)}{(0.05)^2}$$

$$= 384$$

3.1.4 Data collection

3.1.4.1 Approach

Before the questionnaires were distributed to the three companies for the management and the general workers to fill a meeting with the top management was arranged so that they could be explained about the research work. During the meeting the management of the organizations brought to attention the difficulties they were going through due to

economic recession and power supply fluctuations that were causing them to operate at limited capacity.

After the initial management meeting another meeting was scheduled with the safety and health committees of the organization. In the meetings it was agreed that the secretaries of the safety and health committees were to supervise the completing of the questionnaires. The secretaries of the safety and health committee's were to be assisted by the supervisors of the various departments in the organizations.

The questionnaires were hand delivered to the senior managers of the organizations, who were responsible for the implementation of safety and health management system. The supervisors and the persons in charge of safety and health were taken through the questionnaires before undertaking the questionnaire administration exercise.

Persons to fill the questionnaires were chosen randomly while ensuring that the temporary as well as the permanent workers were not missed. It was agreed that a sufficient number of copies of the questionnaire be left with the person from the management in charge of safety.

The night shift workers were also to be given questionnaires for filling. Night shift workers filled their questionnaires in the morning while the day shift workers filled their questionnaires during their free time.

Each organization was given enough questionnaires whose number was based on the ratio of the population. With the help of the management the population was stratified and the number of workers in each section to fill the questionnaires established. The appropriate number for each of the organization was worked out on a ratio basis.

A total of 384 questionnaires were distributed. Some questionnaires got lost and some workers who had been issued with the questionnaires were laid off. A significant number of visits had to be made and fresh questionnaires given as workers and the supervisors kept misplacing the questionnaires. The secretaries of the committees being in the senior management were not readily available as they had other roles in the companies besides being in charge of safety and health matters.

Some challenges encountered when using the questionnaires data collection method were;

Language barrier when administering the questionnaire. Those workers that did not have understanding of the English language used in the questionnaire needed interpretation.

Some of the workers in the steel roll mills were semi-illiterate and needed assistance from their colleagues to fill the questionnaire.

Lack of time to fill the questionnaires by the workforce.

Some workers did not understand the importance of the research and thus kept failing to fill the questionnaires.

Some workers felt that information given would give a negative impression of them or the company.

The global recession and electrical power failures kept affecting those person employed and thus layoffs were on and off which affected the study population and the sample size.

The third and forth objectives were determined through a walk through survey using the OSHA code of practice. The OSHA code of practice is used to determine the

management system in place to protect workers from occupational hazards. It also established legal compliance with the OSHA in the organizations. Through observations of safety of production activities and checking of documents required by the OSHA, role played by the government was confirmed.

3.1.5 Data analysis

Before the data analysis was done using the Statistical Package for Social Scientists (SPSS) program, responses were analyzed, the questionnaires were edited to completeness, relevance and accuracy. The data was then coded to enable the responses to be grouped into categories for both closed and open ended questions.

The statistical analysis method which included percentages, means and mode (descriptive statistics) was used. This also included pie charts and bar charts, tables, frequencies and percentages. During the calculations of the chi sqaure, the expected yes values had to be reduced by one as this was the minimum that could be accepted by the SPSS program.

Inferencial analysis (measures of dispersion) was also conducted using chi-square for goodness of fit and contingency table analysis. Goodness of fit was used to for testing what is recommended (expected) and what was observed. Contingency analysis table was used for checking whether there can be association of human factors to workplace hazard exposure.

4.0 CHAPTER FOUR

4.1 Results and Discussions

4.1.1 Respondent's Profile

4.1.1.1 Distribution of workers per industry

Planning and designing of a safe and healthy work environment involves use of primary prevention approach. In primary prevention hazards are engineered out of the production processes. The more the number of workers the more likely a hazard may harm a worker in the workplace.

Out of the 384 questionnaires distributed, only 268 were returned. This gave approximately a 70 % response rate which was satisfactory considering the difficulties the country was going through such as power shortages, maintenance and repairs due to explosion at the smelting pots and most of the workers being semi-skilled.

As shown in figure 2, this study found that D Steel Roll Mills Ltd had 41% percent, G Steel Plant Ltd 35% and A Steel Mills Ltd 24% of the total number of workers interviewed. D Steel Roll Mills Ltd had the highest number of workers followed by G Steel Plant Ltd then A Steel Mills Ltd. Lack of hazard awareness in D Steel Roll Mills Ltd would mean a significant number of workers being exposed to occupational hazards. The study found that D Steel Roll Mills employed more workers than the other two industries.

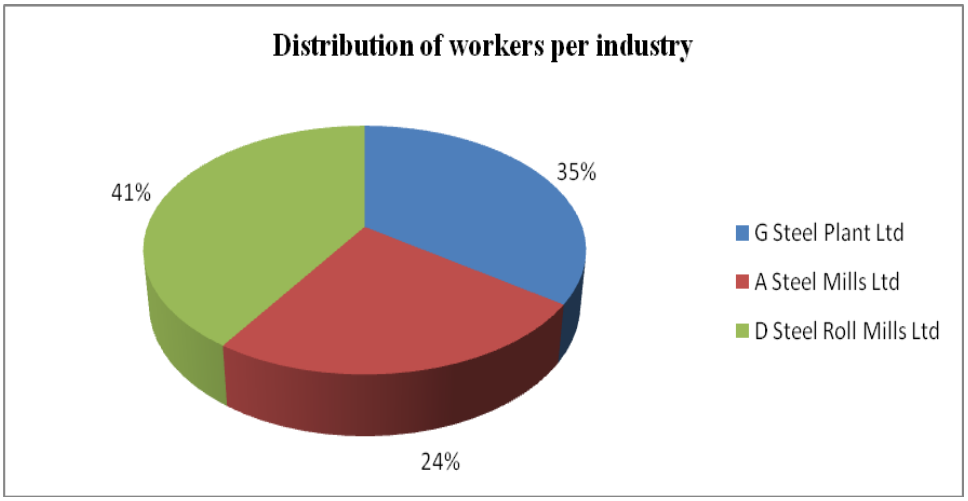

Figure 2: Distribution of workers per industry.

4.1.1.2 Production and management of workers

The table below shows that the management workers were 11% while the other workers constituted 89%. The study shows most of the workers in the industry were the production workers.

Table 1: Production and management workers.

Group	Frequency	Percentage
Management Workers	29	11
Other Workers	239	89
Total	268	100.0

Focus on hazard awareness is expected to be on the production workers because they are the majority. It is also important that the management workers know the hazards that production workers are likely to encounter to assist in creating a safe environment.

The management workers in the three companies should be aware of the hazards present in the offices for their own safety.

According to the ILO management guidelines of 2001 the employer being part of management is responsible for the safety and health of the workers. The ILO safety and health management guidelines of 2001 state under accountability and responsibility element, that safety and health should be considered as a line management responsibility.

4.1.1.3 Age distribution of workers in the three industries.

Figure 3 below shows that the majority of the respondents were between the age brackets of 25 to 34 years (61.5%). This group therefore needed to be aware of the hazards encountered in the tasks undertaken. A good safety and health management system would focus on creating hazard awareness to this group as one of the risk factors is number of people exposed to a hazard. Figure 3 also shows that most of the workers experiencing injuries in the three industries were from this age bracket of 25 to 34 years. It was observed that 26% percent of worker in this age group had been involved in accident as per figure 4. Figure 4 also showed that within an age bracket, 25 to 34 years were more prone to injury. This same age bracket contributed most to the number of injured workers.

The study found that 25 to 34 years age group were more predisposed to hazards in the three industries than any other age group.

The managements of the three companies would be encouraged to direct the efforts of hazard awareness to those workers between 24 to 34 years because they happen to be the majority.

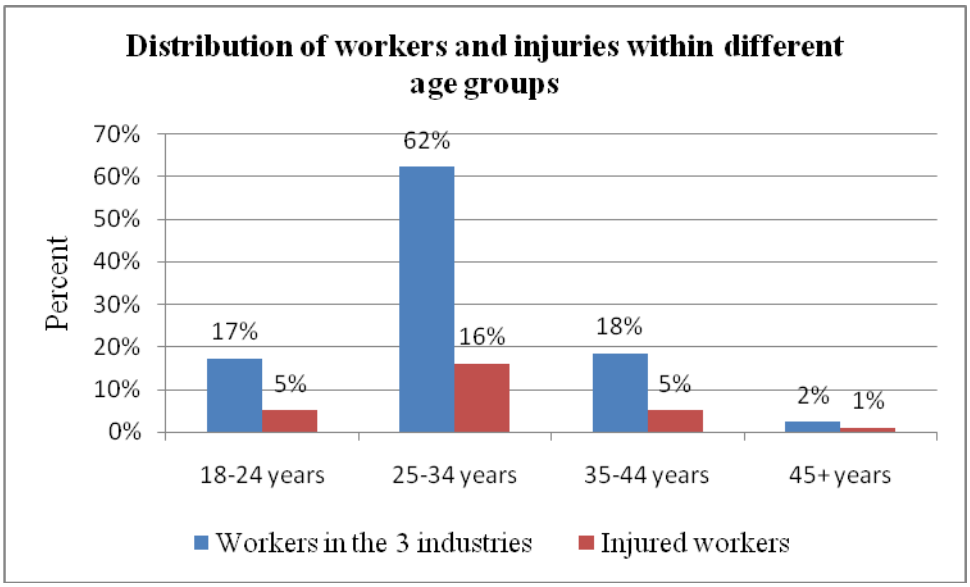

Figure 3: Workers and injuries distribution in the three industries.

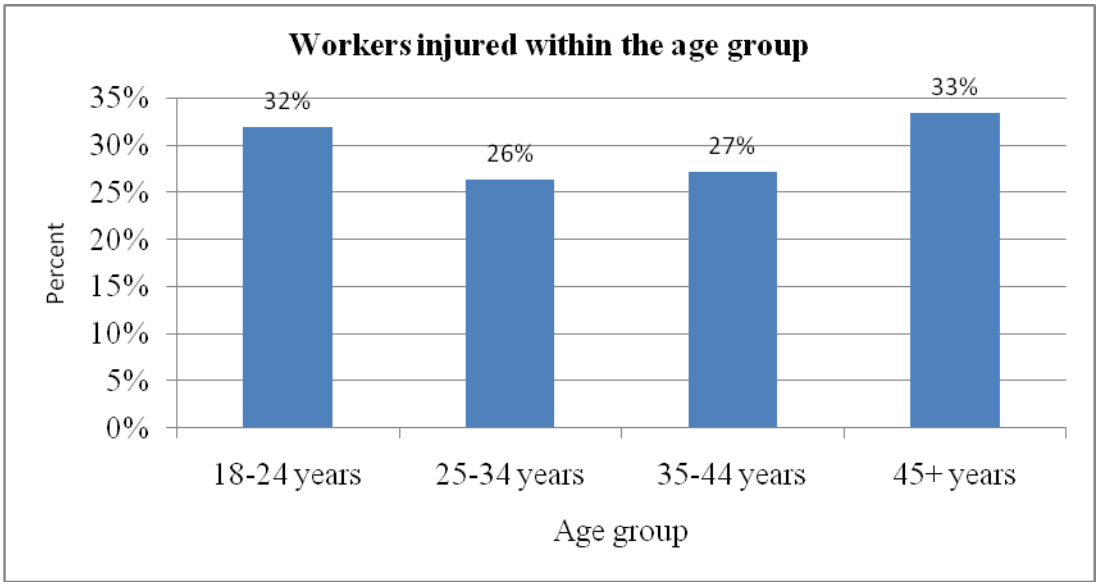

Figure 4: Injuries and age distribution of workers.

4.1.1.4 Workers level of education in the industries.

Figure 5 shows that 52% of workers had a secondary level of education while 27% had primary education. The college education workers were 12% of the total sampled workforce and the non educated workers was seven percent. As depicted in the figure below it was also seen that most of the workers suffering accidents in the industries were of the secondary level of education. It would have been expected that since most of the workers had gone to secondary level, they would understand safe work procedure and be less likely to get injured as compared to the primary and non educated workers.

From the study most of the workers in the industry were of secondary level education which would be important during hazard awareness creation through training and following of safe work procedure. With most of the workers having a secondary education it would be easy to implement the organizations safety and health policies.

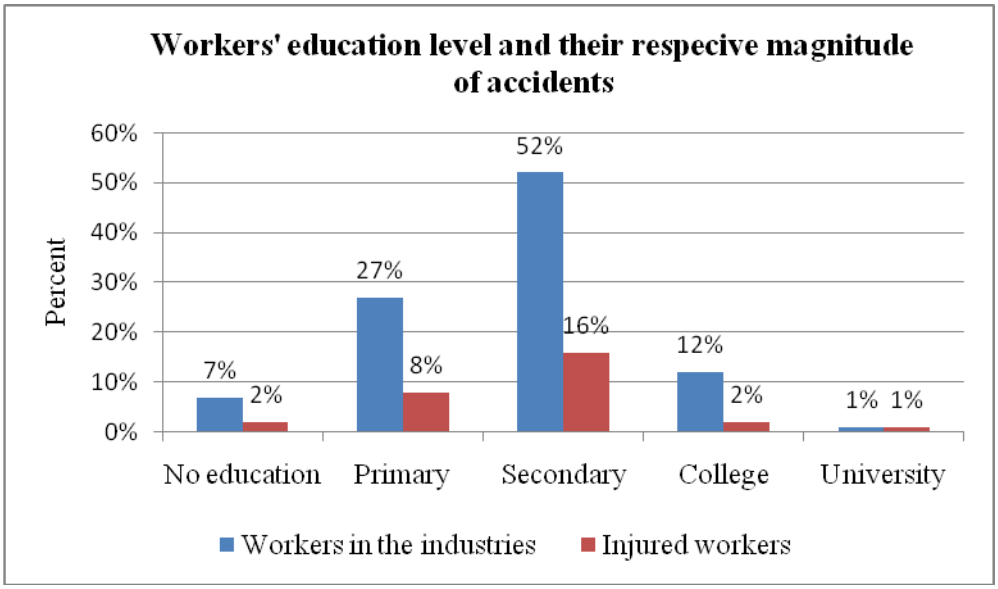

Figure 5: Level of education and respective magnitude of accidents that occured.

Figure 6 shows that 59% of the workers being injured were of between 25 to 34 years. The same figure also shows that 26 % of those within this age bracket had gotten injured. For the workers between 18 to 24 years, 32% of this age group had been involved in a workplace accident as shown by figure 6. Workers above 45 years had most of their members being injured than the other age brackets.

The study revealed that majority of the workers in the steel rolling mills are between the age of 25 to 34 years i.e. 62% of the total workforce in the steel rolling mills. Incidentally this is the age group that the highest percentage of accidents. The management would be encouraged to focus on the workers in this age bracket when improving on hazard awareness.

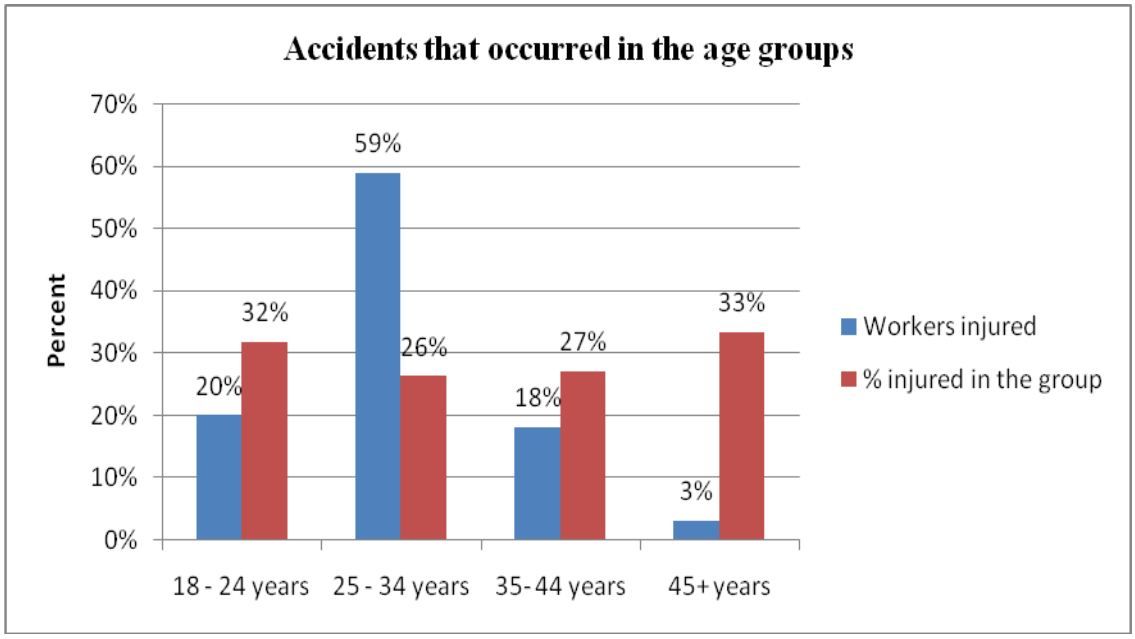

Figure 6: Accidents occuring in respective age groups.

4.1.1.5 Accident occurrence in different worker's education levels

Figure 7 below shows that 30% of the workers with secondary level of education suffered accidents compared to 28% of those with primary level of education. Further 21% of non educated workers and 18% of the college level education workers suffered accident. A correlation analysis on workers education level and accident occurrence revealed no correlation. The study observed that regardless of a worker's level of education workers were being injured.

When creating awareness innovative methods will be necessary due to language barrier. The management will be expected to use at least another language other than English during hazard awareness in trainings.

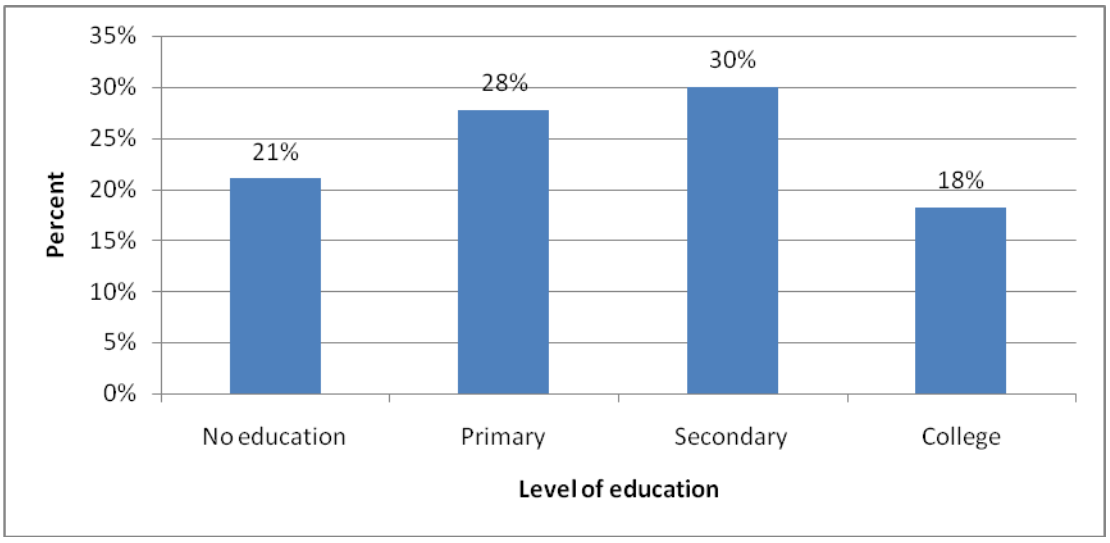

Figure 7: Injuries occurring to workers as per their respective education levels.

4.1.2 Awareness of safe work procedures and training in the industries.

4.1.2.1 Safe work procedure awareness in the three industries.

Among the total number of workers in the industries, 90% were aware of safe work procedures in their respective organizations. A total of 79% of the steel rolling mills workers had undergone training (figure 8). A Steel Mills Ltd had 98% of its workers aware of its safe work procedures with 89% of the workers having been trained on the procedures. Ninety three percent of the workers of D Steel Roll Mills Ltd had had access to the procedures and 84% of the workers had undergone training. G Steel Plant Ltd had had 85% of its worker aware of the safe work procedures with 64% of those having access having training on the same.

The study showed that A Steel Mills had most of its workers aware of safe work procedures followed by D Steel Roll Mills Ltd as shown by figure 8.

During safe work procedures development, hazards that are likely to cause injury are identified. During trainings in safe work procedures, workers are informed of the hazards in tasks and methods adopted to minimize impacts of exposure. New and inexperienced workers once trained on the safe work procedures are able to refer to them if the procedures are accessibility.

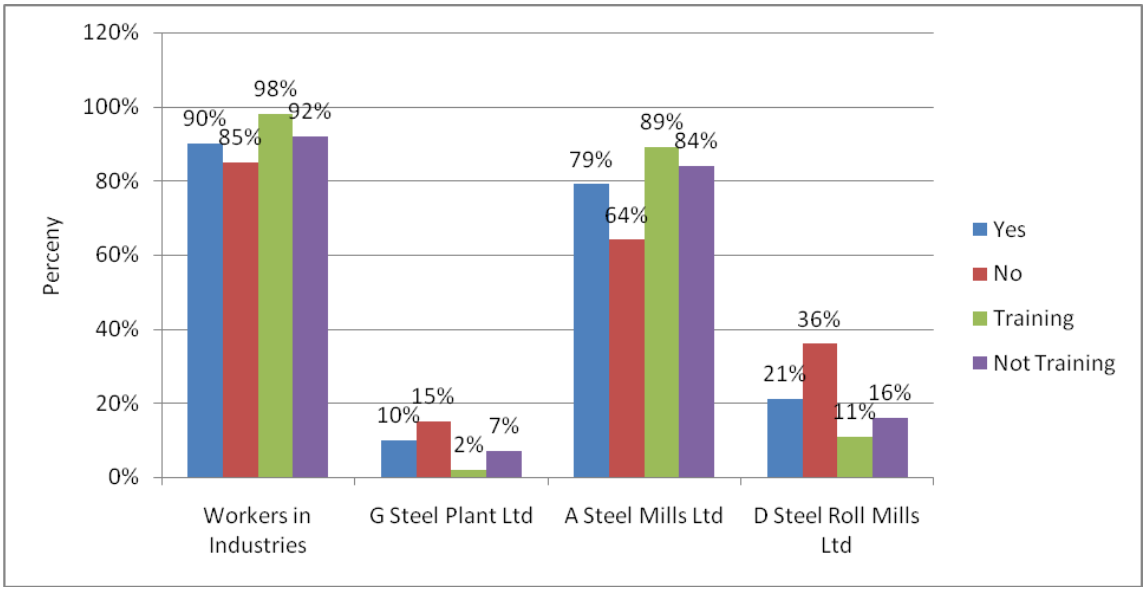

Figure 8: Safe work procedures awareness and training.

Table 2: Workers aware of safe work procedures.

Category	Observed	Expected	Residual
Yes	240	267	-27
No	28	1	27
Total	268		

Chi square = 731.730 degree of freedom = 1

Asymptotic significance = 0.000

There is a significant difference between the expectation of having all workers aware of safe work procedure and those not aware. The steel rolling mills management should do more to create awareness that there are safe work procedures for the various tasks. The employees are expected not only to be aware of safe work procedures but also use them so as to be safe from workplace health hazards.

4.1.2.2 Safe work procedure training per industry

The figure below shows that D Steel Roll Mills had 44% of the workers who had been trained in safe work procedures. The other two industries had 28% each of the trained workers. The study showed that D Steel Roll Mills had trained more workers on safe work procedures.

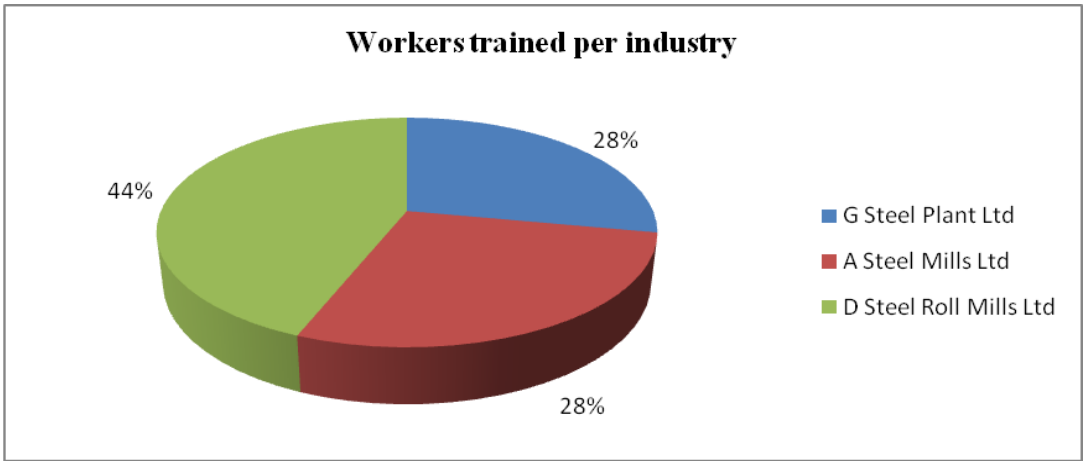

Figure 9: Safe work procedure training in each industry.

The more the workers trained in safe work, the less likely a worker will be affected by the hazards encountered while working. Training on safe work procedures creates hazard awareness by ensuring that at each basic step hazards have been identified and controlled. The training is a cornerstone of creating a safety and health culture in the workplace (African Newsletter on Occupational Safety and Health, vol. 10, 2000). Workers that have been trained on safe procedures, are less likely to suffer injuries or ill health. Workers not trained on safe work procedures to use when undertaking various activities at work learn how to work through other methods such as observation or relying on informal methods from colleagues. In such non standardized working

methods, it is difficult for a supervisor to effectively monitor and control how a worker is working. With no standard work procedures accidents and other health related injuries are likely to occur.

4.1.2.3 Safe work procedure training done per age group.

Figure 10 shows that respondents between 25 to 34 years and 35 to 44 years had 83% of their respective members trained in safe work procedures. It was also established that 67% of those workers between 18 to 25 years and 50% of those above 45 years had undergone training on safe work procedures. The study showed that most of the workers trained on safe work procedures were in the age brackets of 25 to 34 years and 35 to 44 years. These two age brackets contributed to 80% of the total workers in the steel rolling mills as seen in figure 3.

Training on safe work procedures was very important for these two groups as they were likely to injured if they failed to be aware of hazards at their work environment. According to the European Agency for Safety and Health at Work risk observation report in 2006, age is likely to influence accidents (Elke, 2006).

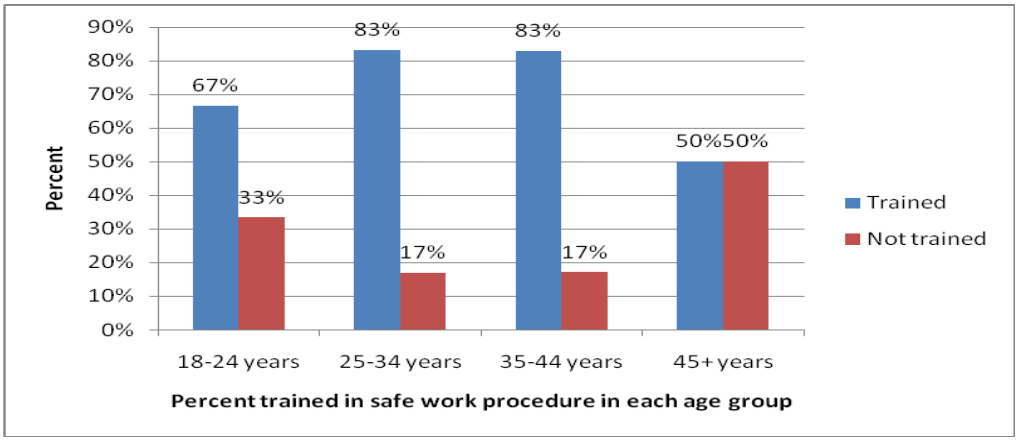

Figure 10: Safe work procedure training done per age group.

Table 3: Trained workers injured at work.

Workers trained in safe work procedures	TOTAL	Have you suffered an accident?	
		No	Yes
Yes	228	23	205
	100%	90%	10%
No	12	1	11
	100%	8%	92%

Out of all the workers trained on safe work procedures 10% had suffered accidents while from all the untrained of the procedures workers 92% had been injured while at work as shown by Table 3 above.

The study revealed workers trained on safe work procedures are less likely to be injured as compared to those had not received the training

The three organisations are encouraged to place alot of emphasis on the training of its workers as this reduces the number of workers likely to be injured while at work.

4.1.2.4 Medical examinations conducted.

Table 4: Workers medically examined.

Medical examinations	Yes	No
The industries	82%	18%
G Steel Plant Ltd	90%	10%
A Steel Mills Ltd	70%	30%
D Steel Roll Mills Ltd	82%	!8%

Table 3 shows that the study established 82% of the respondents had undergone medical examinations in the steel rolling mills. G Steel Plant Ltd had the highest number of its workers having undergone medical examinations followed by D Steel Roll Mills Ltd.

The medical examination rules, a subsidiary legislation under the Kenyan OSHA, requires workers in the steel rolling mills to undergo medical examinations due to exposure to noise, high temperatures and also air pollutants due to metal fumes and other particulate matter. The government of Kenya through the Directorate of Occupational Safety and Health Services, has appointed designated health practitioners to carry out the necessary medical examination based on the hazard identified at a worker's station. Before medical examinations are done, a designated health practitioner is expected to establish the hazards that are likely to affect a worker. The examinations are meant to ensure that a worker is not suffering from the work related hazard encountered at work.

The study revealed that most of the workers in steel rolling mills had undergone medical examinations showing the industries are complying with government regulations.

4.1.2.5 Workplace health hazards training in the three industries.

The number of workers that had undergone training on workplace health hazards constituted seventy five percent as shown by figure 11. Figure (11) also shows that A Steel Mills Ltd had 85% of its workers trained on workplace health hazards followed by D Steel Mills Ltd which had 83% and G Steel Plant Ltd at 59%.

The study showed that most of the workers in A Steel Roll Mill Ltd were aware of the workplace health hazards through the training given by their industry. Workers in G Steel Plant were the least aware of health hazards at work in the steel rolling mill industry.

The importance of work place health hazard training is that the workers understand type of accidents and occupational injuries that would occur if one is exposed. The understanding aids in ensuring one uses the laid down safe work procedures and the provided protective clothing necessary to control the workplace hazard. A worker is also able to take action in line with section 13 of the OSHA of 2007, which requires one to correct the situation or inform the supervisor for more technical address. A Steel Mills Limited and D Steel Roll Mills Limited had most of their workers aware of the hazards at work. The management of these two companies was demonstrated to be keen in creating hazard awareness at work.

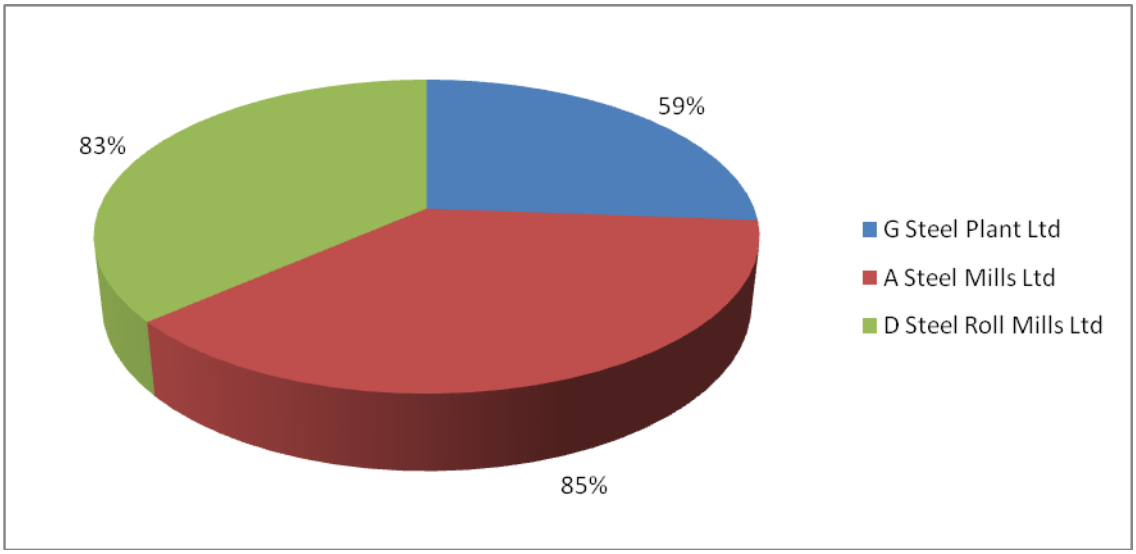

Figure 11: Workplace health hazards training.

From three steel rolling mill industries figure 12 shows that 75% of the total workers were trained on workplace health hazards. Those workers that were above 45 years had 83% of them trained on workplace hazards, while 78% of those between 35 to 44 years and 77% of those between 25 to 34 years had undergone a similar training. Only 66% of the workers between 18 to 24 years were trained on workplace hazards. From these findings it was shown that the percentage of those trained in an age bracket increased as the age increased. This could have been due to the length of time a worker had been in the organization.

It was also noted that the group that had most workers untrained was those between 18 to 24 years. Workers in this age bracket are likely to be exposed to hazards without their being aware and thus face a risk of being injured. It is important that the management of the rolling mills ensure the hazard awareness programs cover all these workers as they are likely to be in industry for a longer period than the older workers.

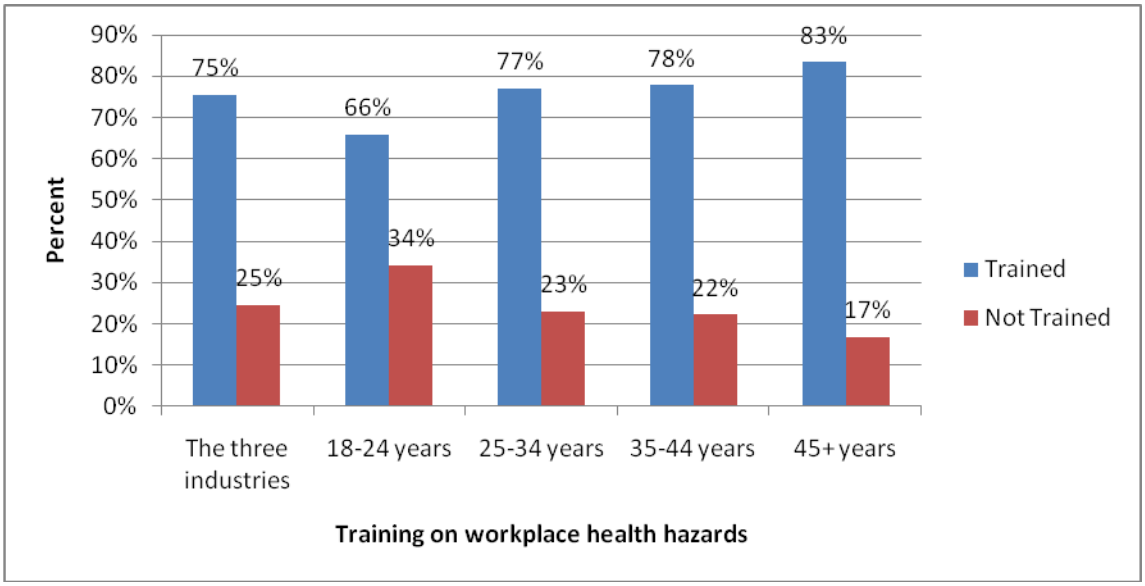

Figure 12: Workplace health hazards training per age bracket.

Table 5: Workers trained on workplace health hazards.

Category	Observed	Expected	Residual
Yes	239	267	-28
No	29	1	28
Total	268		

Chi square = 786.936 degree of freedom = 1

Asymptotic significance = 0.000

The Chi square asymptotic significance is less than 0.05 indicating there is a big a difference between what was observed and what was expected. The employers of steel rolling mill workers should do more on training workers on workplace hazards which is expected to contribute to hazard awareness.

4.1.2.6 Workers knowledge on workplace hazards.

Table 6 shows that fire was mentioned by 17% of the workers in the industries followed by drunken behaviour and sleeping during work hours at 14 %. Fire as a hazard was mentioned by 30% of G Steel Plant Ltd workers while only 10% and 15% of the A Steel Mills Ltd and D Steel Roll Mills Ltd respectively gave the same response. The highest percent of workers that mentioned noise as one of the workplace health hazards were from A Steel Mills Ltd at 33%. The table shows that only 8% and 3% of workers in G Steel Plant Ltd and D Steel Plant mentioned noise as a workplace health hazards. Workers of A Steel Mills Ltd are likely to be more noise conscious and thus use hearing protective devices than workers of the other two companies.

The major workplace health hazards mentioned by the workers were fire 17%, drunken behaviour and sleeping during working 14%, noise 13%, rotating machines 11% and working without personal protective equipment 11%. D Steel Roll Mills Ltd workers mentioned the most number of workplace hazards encountered than the other industry.

The findings showed that D Steel Roll Mills Ltd workers were aware of more hazards found in the steel industry than workers from the two other organizations. D Steel Roll Mills had also trained more on workplace hazard than the other two organizations.

The types of hazards mentioned by the workers showed that the workers were aware of the hazards at work. The workers were likely to cooperate with management's mitigating methods of hazard control such as compliance with safe work procedures and use of personal protective clothing.

From the study workers in D Steel Roll Mills Ltd are aware of more workplace health hazards than those of the other two industries.

Table 6: Workplace health hazards mentioned by workers.

Health hazard	percent workers response	G Steel Plant Ltd	A Steel Mills Ltd	D Steel Roll Mills Ltd
Fire	17%	30%	10%	15%
Drunken behavior and sleeping at working hours	14%	20%	20%	5%
Noise	13%	8%	33%	3%
Rotating machines	11%	6%	16%	9%
Working without proper equipments and tools	11%	12%	4%	13%
Air pollution	8%	12%	0%	12%
Dropping objects	5%	0%	2%	11%
Electric shock	5%	8%	2%	4%
Cuts	3%	0%	4%	5%
Small pieces of metals	2%	0%	6%	1%
Don't follow instructions	2%	0%	2%	4%
Explosive chemicals	2%	2%	0%	4%
Operating faulty machines	2%	0%	0%	5%
Burns	2%	0%	2%	3%
Careless operators	2%	2%	0%	3%
Fighting	1%	0%	0%	3%

4.1.2.7 Workers trained on nature of work with respect to period worked.

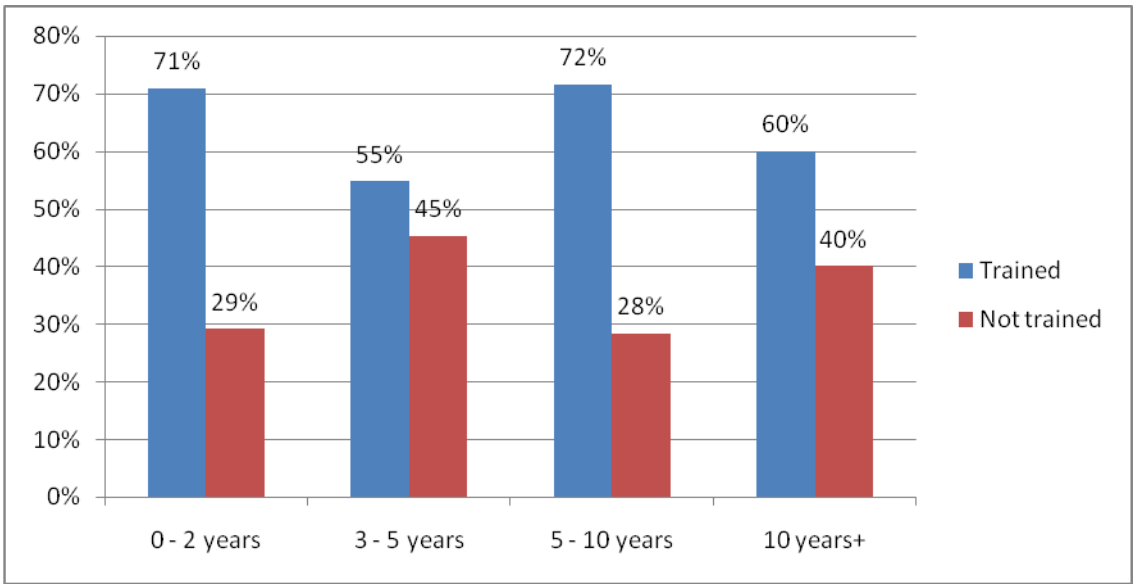

Figure 13: Workers trained on nature of work they do.

The study revealed that 72% of workers who had worked between 5 to 10 years had undergone training as seen in figure 13. It was also seen that 71% of the workers that had worked for up to two years had undergone training. Workers that had worked between 3 to 5 years had only 55% of them trained. It was noted that this group of workers that had worked between 3 to 5 years were the most in the industry (Figure 14). They also contributed to most of the workers trained in the three organizations.

All the three workplaces had at least fifty five percent of their workers trained on the nature of work to be undertaken (figure 13). During the training it was expected that hazards to encountered would brought to workers awareness. It is important that the management increase their effort in making sure more workers are trained on the nature of work a especially during induction of new employees. This will be expected to reduce workers being exposed to the hazards.

The study showed that the number of years worked in the industry did not necessary mean a worker would have undergone training. Thus from the research irrespective of the number of years worked a worker was likely to be exposed to a hazard due to lack of awareness that would have been done during training.

4.1.3 Worker's length of service in the three industries.

Figure 14 shows that 41% of the workers had worked between 3 to 5 years while 29 % had worked between 5 to 10 years. The same figure indicated that 28% had worked up to 2 years while only 2% had worked for more than ten years. In total those who had worked below five years were sixty nine percent and were more than those who had worked for five years and above. It was observed that most of the workers in the industry have worked for a short period that does not exceed five years.

The study showed that most of the workers in the steel industry have not worked for more than five years and very few have worked for over ten years. It is important that all workers be made aware of the hazards at work to avoid work related injuries.

Figure 13 showed that 71% of the workers that had worked not more than two years had been trained on nature of while 55% of those between 3 to 5 years had been trained. It is thus expected that although most the workers in the steel industry have worked for not more than five years a significant percentage is aware of the hazards at their work.

The organization would have been expected to focus on those workers that had worked for less than five years as they contributed to most of the workforce in the steel industry.

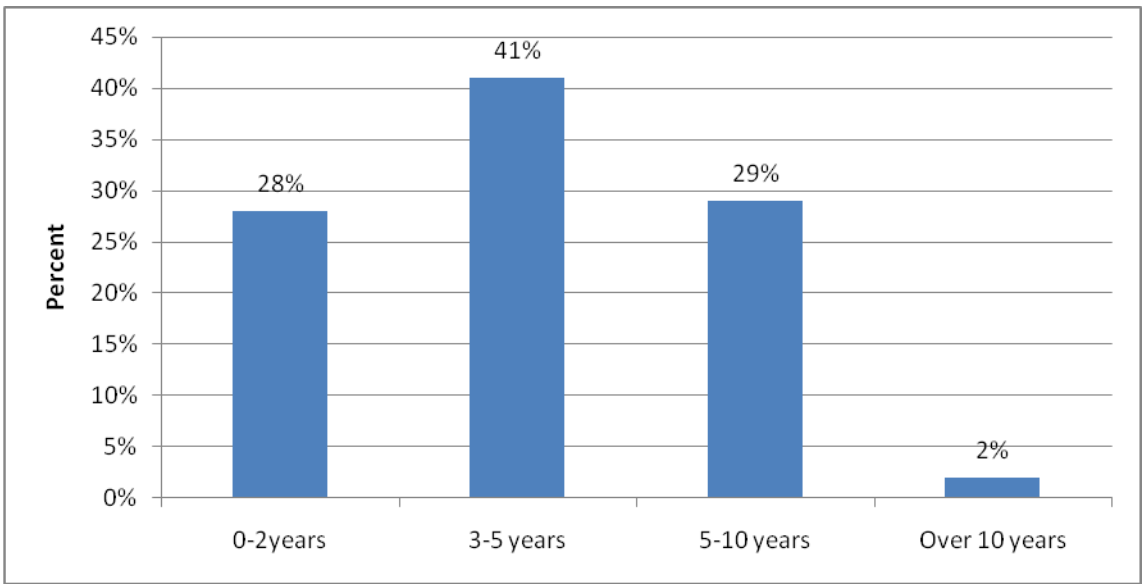

Figure 14: Workers length of service in the three industries.

4.1.4 Safety and health policy awareness.

Under the OSHA the government of Kenya expects every company to formulate a safety and health policy in order to create a safe work environment by identifying and addressing hazards likely to affect workers. According to the ILO safety and health management guidelines of 2001, the safety policy is to be publicised in the organisation through training in order to create hazard awareness and cooperation from workers.

The figure below shows that 95% of the workers were aware that their respective organizations had safety and the health policies. Of the workers in the three organizations aware of the existence of the safety and health policy, 93% had access to it. All the A Steel Mill Ltd workers were aware that the organization had a safety and health policy and 98% had access to the safety and health policy as shown by the figure. G Steel Plant Ltd had 92% of its workers were aware of the existence of the safety and health policy and also having access to it. Only 89% of the 94% of D Steel Roll Mill Ltd

aware of the safety and health policy had access. Awareness and accessibility of the safety and health policy is an indicator of publicizing this document on safety precaution at work as required by the Kenya Occupational Safety and Health Act of 2007. The safety and health documents in the three companies create hazard awareness to workers during induction training of new workers and safe work procedures enforcement.

The study showed that there was a significant effort by the industries to avail the safety and health policy to their workers as required by the law.

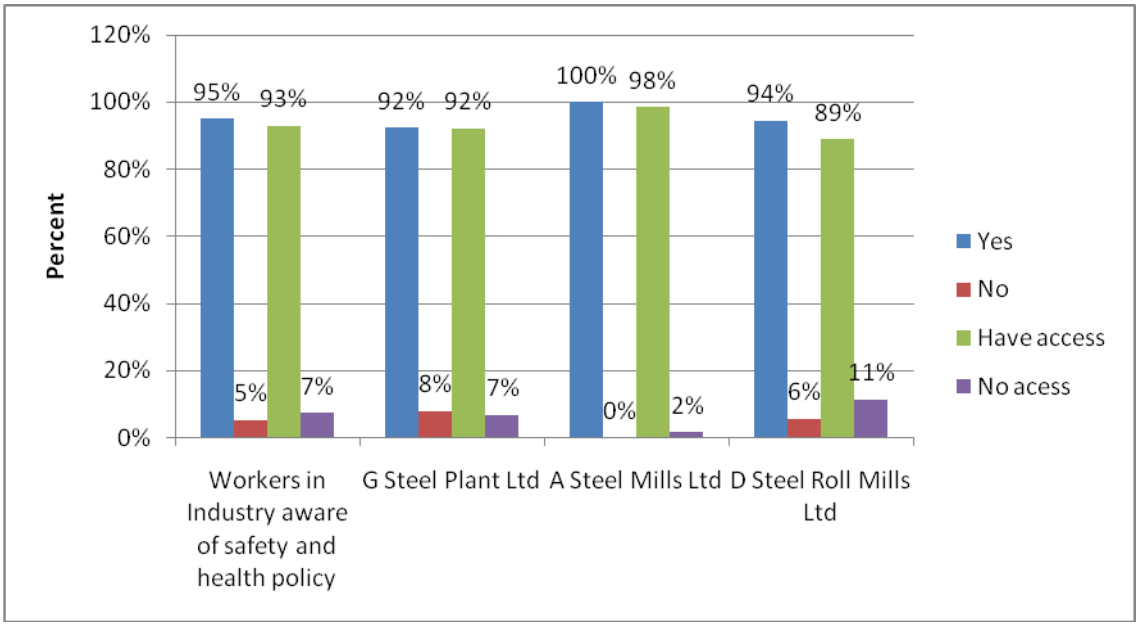

Figure 15: Worker aware of existence of the safety and health policy.

Table 7: Workers aware of the safey and health policy

Category	Observed	Expected	Residual
Yes	172	267	-95
No	96	1	95
Total	268		

Chi square = 9,058.801 Degree of freedom = 1

Asymptotic significance = 0.000

Although there is a large number of workers saying they have access to the safety policy the low significance 0.000 which is less than 0.05, suggests that there is a big difference between those who have access and those who do not. The chi square value asymptotic significance indicates the awareness of safety and health policy is significant in hazard awareness. There is therefore need for the industry to create more awareness to reduce the difference between observed and expected values.

4.1.5 Personal protective equipment.

4.1.5.1 Protective equipment provision in the three industries, age groups and on length of period worked.

Protective clothing or equipments are devices used to protect workers from injuries. These devices include hand gloves to protect against sharp objects, ear mufflers, eye goggles and respirators used against air pollutants (Charles, 2003).

Ninety eight percent of the workers interviewed had been provided with personal protective equipment. As figure (16) shows D Steel Roll Mills Ltd had ninety seven

percent of its workers provided with personal protective clothing, while G Steel Plant Ltd and A Steel Mills Ltd both had ninety nine percent.

The study established that 5% of the workers who had worked between 3 to 5 years had not been provided with personal protective equipment. Failure to provide these workers with personal protective devices meant that there was a likely hood of being exposed to hazards encountered at work. Workers are provided with personal protective equipment if there is a likely hood of hazard exposure. Proper use of personal protective equipment by the worker is done through informing the worker on type of hazard they are being protected from.

It was observed that the three industries legally comply with the requirement of provision of personal protective clothing under the Kenyan Occupational Safety and Health Act of 2007 (Figure 16).

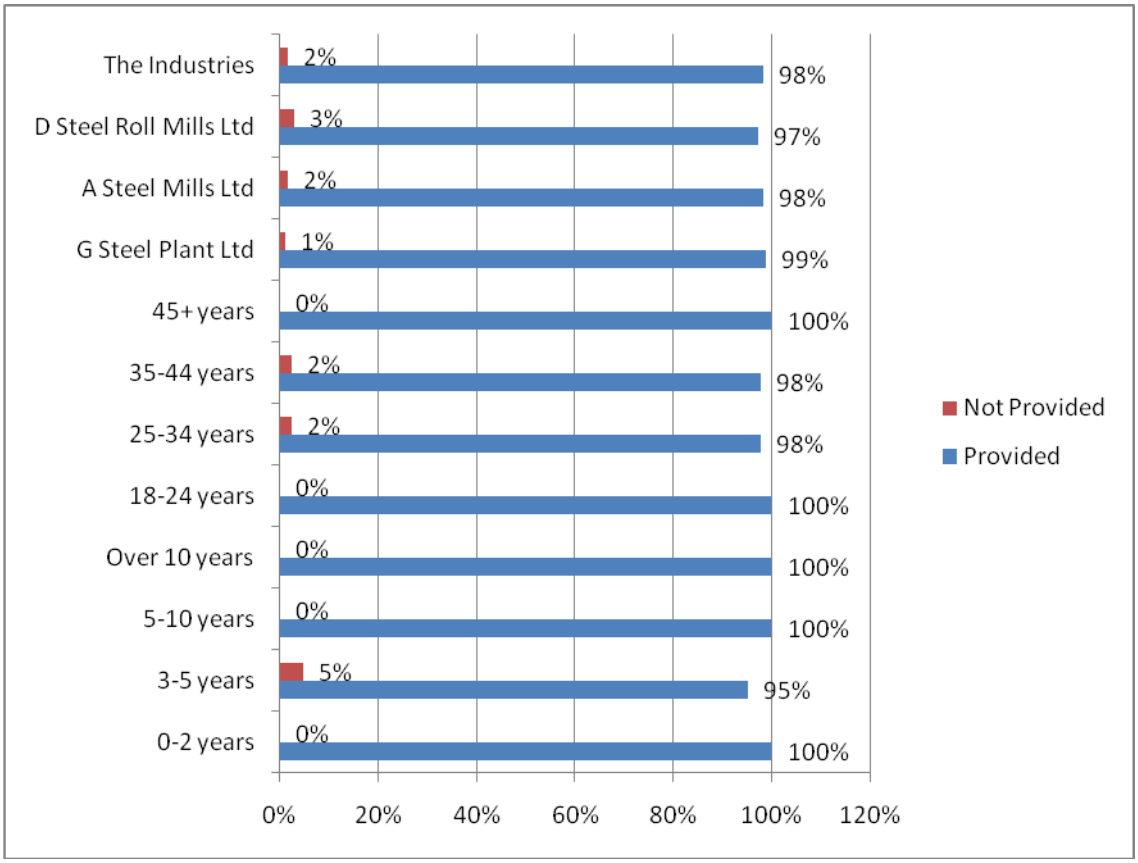

Figure 16: Protective equipment provision in the three industries, age groups and period worked.

Table 8: Workers provided with personal protective equipment in the industry.

Category	Observed	Expected	Residual
Yes	262	267	-5
No	6	1	5
Total	268		

Chi square = 25.094 degree of freedom = 1

Asymptotic significance = 0.000

From the chi square asymptotic significance there is a significant difference when workers are provided with personal protective equipment as a means of protection against hazards. The three industries should focus on providing more workers with personal protective equipment.

4.1.5.2 Type of protective equipment provided to the workers.

The type of personal protective equipment provided to mitigate against a hazard encountered depends on the hazard a worker is likely to encounter while working. The need to provide personal protective equipment as a mitigating factor against a hazard is determined after characterising and quantifying amount of harm anticipated to the worker (Levy S. B. et al. – 5th ed., 2006).

Figure shows gloves were the most offered protective equipment among all the employees in the industry. Others were overalls (64%), safety boots (58%), helmets (38%), goggles(20%), air masks(10%) and ear muffs lastly with 8% among others.

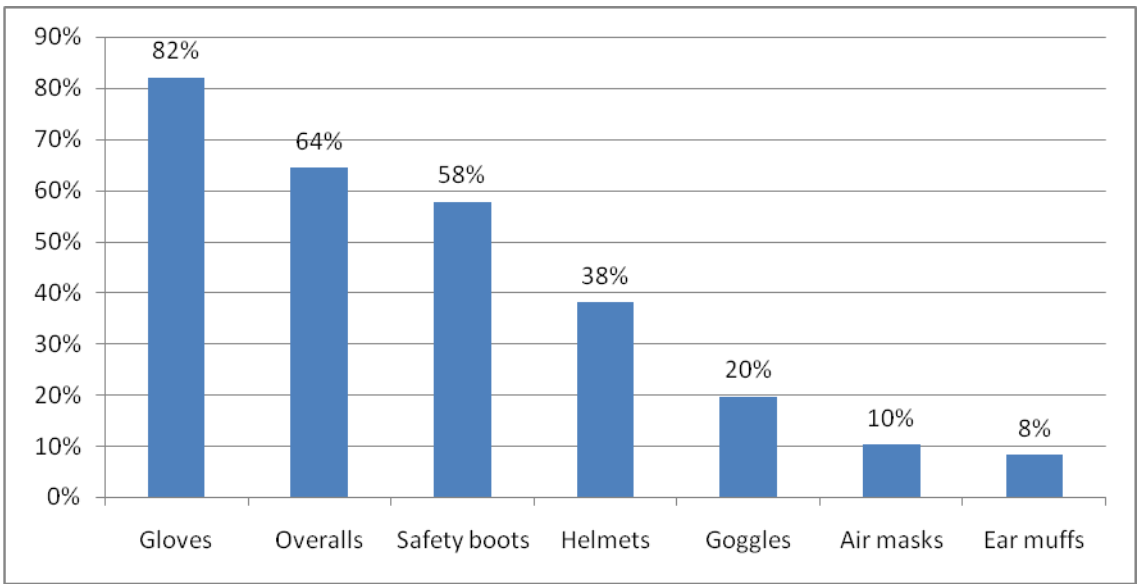

Figure 17: Percentage of different protective clothing provided.

The study revealed more hand gloves were being provided than any other personal protective clothing for the protection of workers from occupational hazards. This is due to the need to protect workers from hand related injuries as they sort out scrap metal, feed the smelter, remove hot billets using tongs and carry the metal bars from the cooling bed to the storage area.

The study also showed that D Steel Roll Mills Ltd more hand gloves than the other two industries. The reason D Steel Roll Mills Ltd provided more gloves than the two other organizations was because it employed a larger workforce.

Provision of the different personal protective clothing demonstrates that workers had been made aware of the hazards to be encountered while working. Section 101 of the Occupational Safety and Health Act requires employers to provide appropriate protective clothing and train workers on their use (DOSHS, 2007).

4.1.6 Accidents and injuries occurrence at work.

4.1.6.1 Health hazard injuries that occurred in the industries.

Figure 18 shows most of the injuries occurring in the three industries are minor injuries which account for 32% of total injuries. In details, cuts constituted 31% of the injuries followed closely by burns with 14%. Other injuries included injured fingers with 7% and Iron fillings dust entering the eyes 7%. Also notably some 4% of the injured said that they lost their finger tips as seen in figure 18.

The cuts occurring in the steel rolling mills were likely to occur when handling the scrap material and the bars without hand gloves or with worn out gloves. The handling of steel bars exposes a worker to burns from hot metal at the cooling bed.

Workers may have suffered injuries because not all had undergone training on nature of work (figure 13) or safe work procedures (figure 10) or were provided with personal protective clothing (figure 16). Besides making sure all workers are trained on nature of hazards to be encountered, personal protective equipment should be provided, used and maintained. This will minimise the likely hood of a worker being injured by hazards at the work environment.

Table 9: Accident injuries that occured at the workplace.

Category	Observation	Expectation	Residual
Yes	56	1	55
No	212	267	-55
Total	268		

Chi squared = 3,036.330 degree of freedom = 1

Asymptotic significance = 0.000

The asymptotic significance is less than 0.05 and therefore indicating there is a great difference between those that have suffered accidents and those who have not. The industries would be adviced to direct their efforts on reducing accidents to have no workers being ijured.

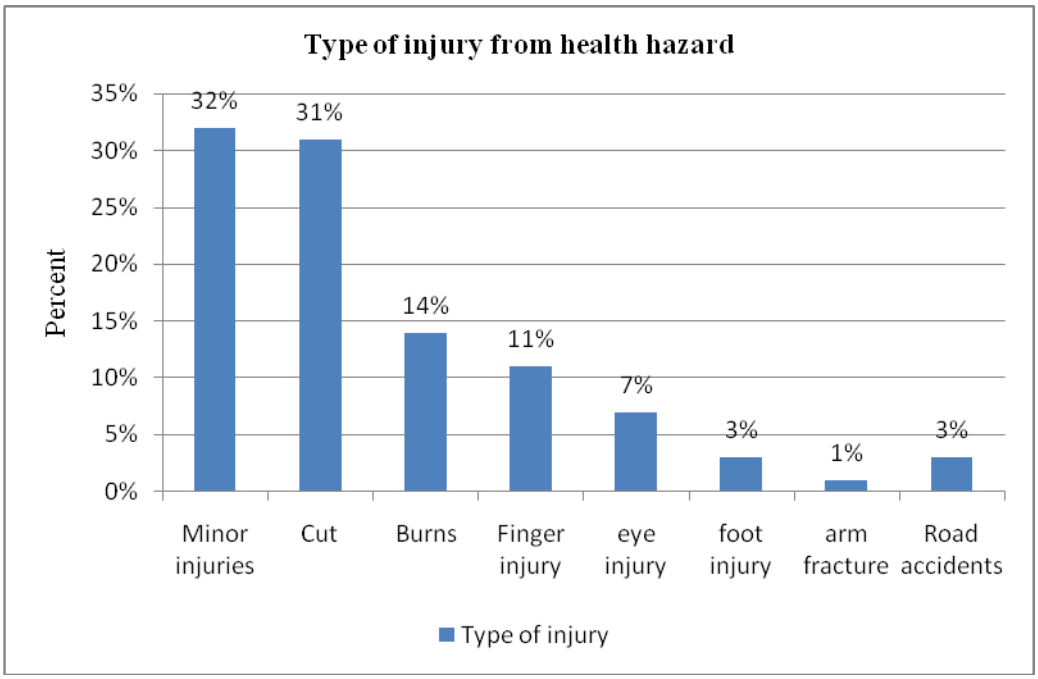

Figure 18: Health hazard injuries affecting workers in the workplace.

4.1.6.2 Accidents occurrence in the three industries.

Figure 19 showed that 28 % of the workers in the steel rolling mills had suffered workplace accidents. The study found that there was a progressive increase of accidents in a group. The figure also established that 36% of those who had worked between 5 to 10 years suffered accidents while 24% of workers that had worked between 3 years to 5 years got injured. Workers that had worked for 5 to 10 years were the most at 41% compared to the others as per figure 14 and thus the reason for high percentage of 36 percent.

The study showed that the longer a worker stays in the industry the more likely they are to get injured. The study also revealed that one was less likely to get injured in D Steel Roll Mills then A Steel Roll Mills and finally G Steel Plant Ltd.

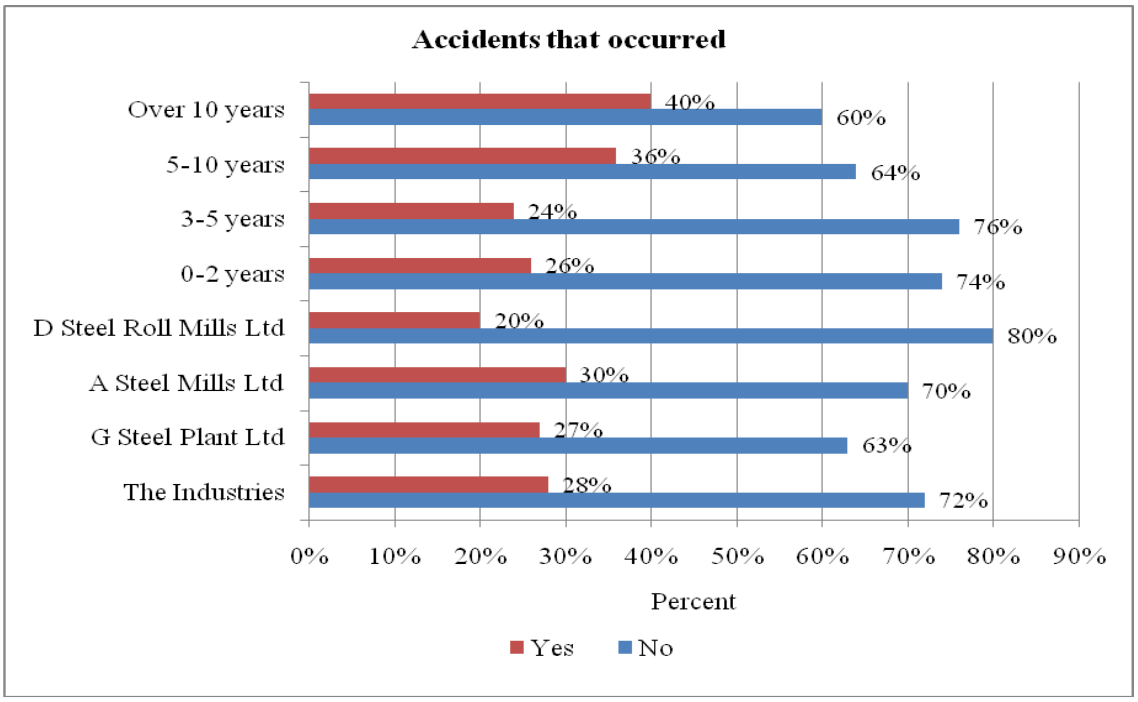

Figure 19: Accidents occurrence in the different age groups and the industries.

4.1.6.3 Management response to accidents that occur at work.

When accidents occur the management is expected to investigate and find the cause as well as prevention of similar accidents in the future. Accidents are likley to occur when hazards have not been identified or workers are unaware of them. Figure 20 shows that 59% of the accidents occurring in the three industries were investigated. D Steel Roll Mills Ltd had 72% of its accidents investigated. The same figure shows that G Steel Plant Ltd investigated 53% and A Steel Mills Ltd 52% (figure 20).

The industry investigated 72 % of the accidents that had injured workers in the ages between 35 years to 44 as indicated in the figure (20). The same figure shows that on 58% of accidents occuring to those between 18 years to 24 years have been investigated as compared to 56% of the accidents affecting those between 25 years to 34 years.

The study showed that D Steel Roll Mills Ltd was taking more action on accidents that had occurred in its industrial operation that the other two industries.

Investigation of accidents was intended to determine the cause and ensure the hazard that caused the accident is eliminated or minimized. The management is expected to improve on its hazard awareness strategies though training and enforcement of safe work procedures.

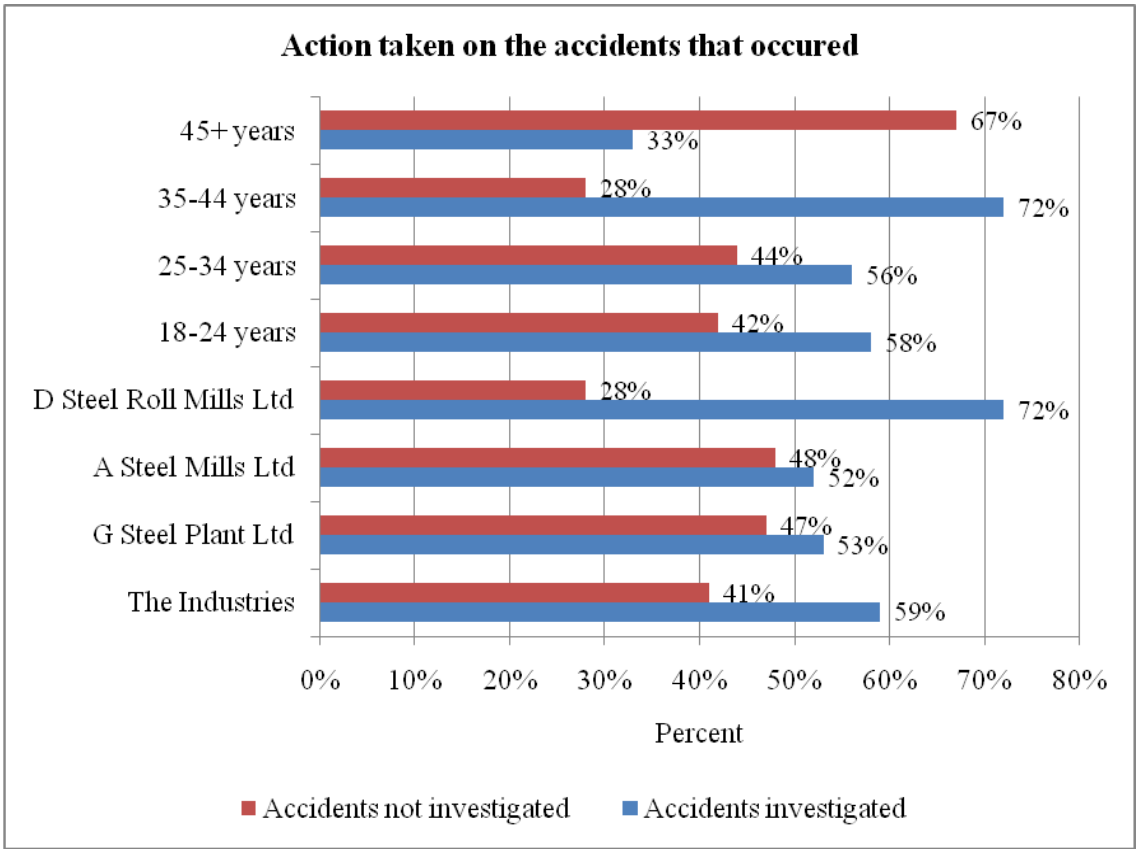

Figure 20: Management response to accidents that occurred to worker in the workplace.

Table 10: Action taken on accidents by the management

Category	Observed	Expected	Residual
Investigated	23	55	-32
Not investigated	33	1	32
Total	56		

Chi square = 1,042.618 degree of freedom = 1

Asymptotic significance = 0.000

The Asymptotic significance of 0.002 is less than 0.05 and thus the management should direct their efforts on investigating the accidents occuring. The aim of action taken by the management of the three companies is to see that accidents are prevented in the future to zero level.

4.1.7 Ignoring of safe work procedure by workers.

There was an indication in Figure 21 that 66% of the workers ignored safe work procedures in the industries due to work pressure. D Steel Roll Mills workers had 73% of its workers ignoring work procedures due to work pressure followed by A Steel Mills Ltd that had 70 %.

Failure by the industries to enforce safe work procedures made 27% of their workers ignore the procedures. G Steel Plant Ltd had 38% of its workers ignore safe procedures due to lack of enforce while A Steel Mills ltd had 27% as shown by figure (21).

Workers that had worked for over 10 years ignored working procedures due to lack of enforcement as indicated by figure (21). The same figure also shows workers who had worked for up to 2 years and between 3 to 5 years ignored safe work procedures due to work pressure and lack of enforcement.

The study established that work procedures failed to be followed due to work pressure mainly followed by lack of enforcement. It is important that management plan their work to avoid pressurising the workers. Work pressure may also have contributed to the supervisors failing to enforce safe work procedures.

When workers ignore safe work procedures they are very likely to be exposed to hazard. Ignoring of safe work procedure may involve a worker not using the provided protective

clothing such as hand gloves or goggles. The consequence failing to follow an established method of carrying out an activity would result in injuries.

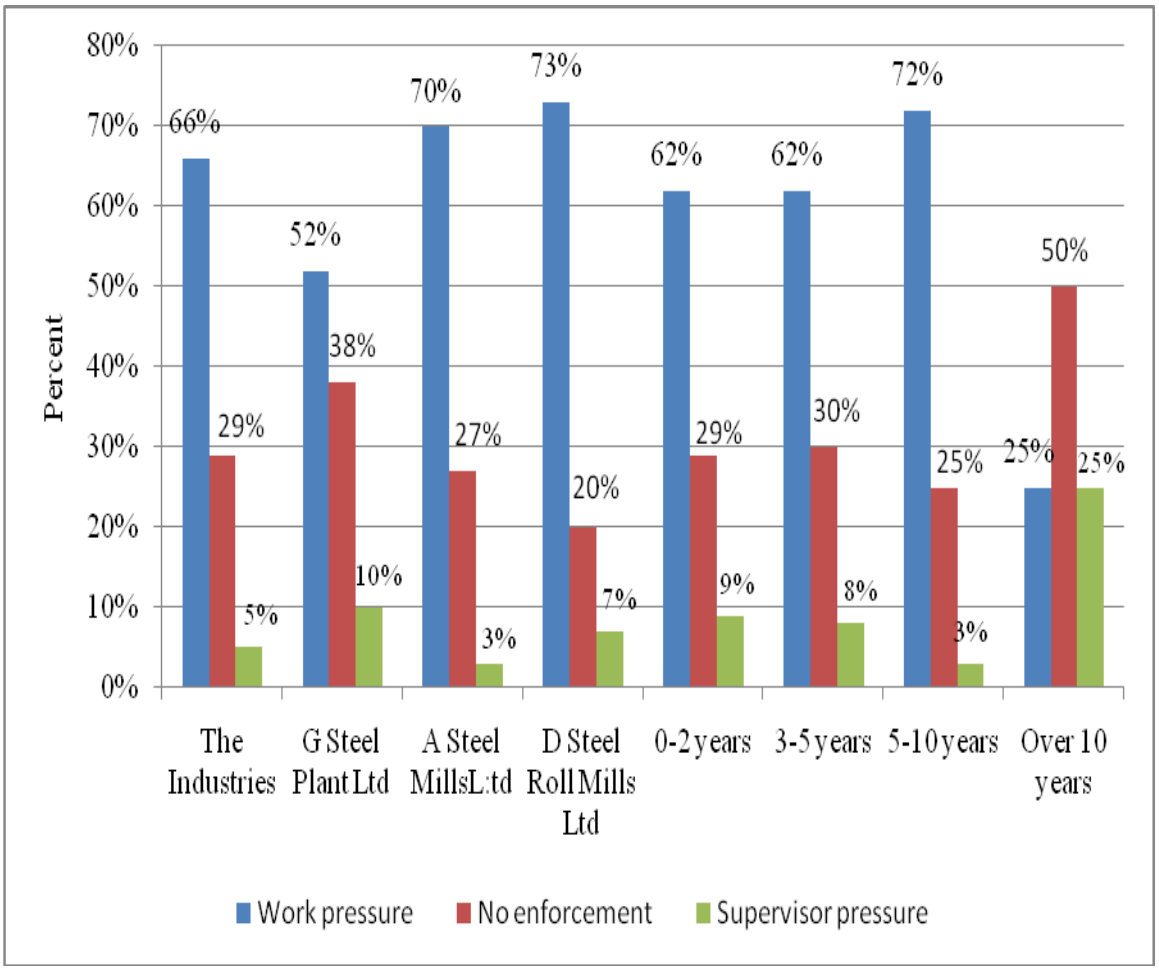

Figure 21: Workers reason of ignoring safe work procedures at work.

Table 11: Reason given by workers who ignore safe work procedures.

	Total	Accident suffered	
		Yes	No
Base	241	47	194
	100%	100%	!00%
Supervisor Pressure	13	4	9
	5%	9%	5%
Work pressure	159	28	131
	66%	60%	68%
No enforcement	69	15	54
	29%	32%	28%

When carrying out cross tabulation of workers who ignore work procedures, work pressure caused more accidents followed by lack of enforcement. The rolling mills should focus on reducing work load and enforce procedures in order to reduce accidents. The management of the steel rolling mills should address this human behaviour to reduce workers who get injured because of ignoring safe work procedures.

4.1.8 Emergency action plan awareness by the workers.

An 89% of the workers in the industries are aware of the emergency action plan. The same figure shows A Steel Mills Ltd had 92% of its workers aware of emergency action procedures, while D Steel Roll Mill Ltd had 89%. G Steel Plant Ltd had 86% of its workers aware of the emergency action procedure.

The study showed that A Steel Mills Ltd had had most of its workers aware of emergency action in case of any emergency such as fire.

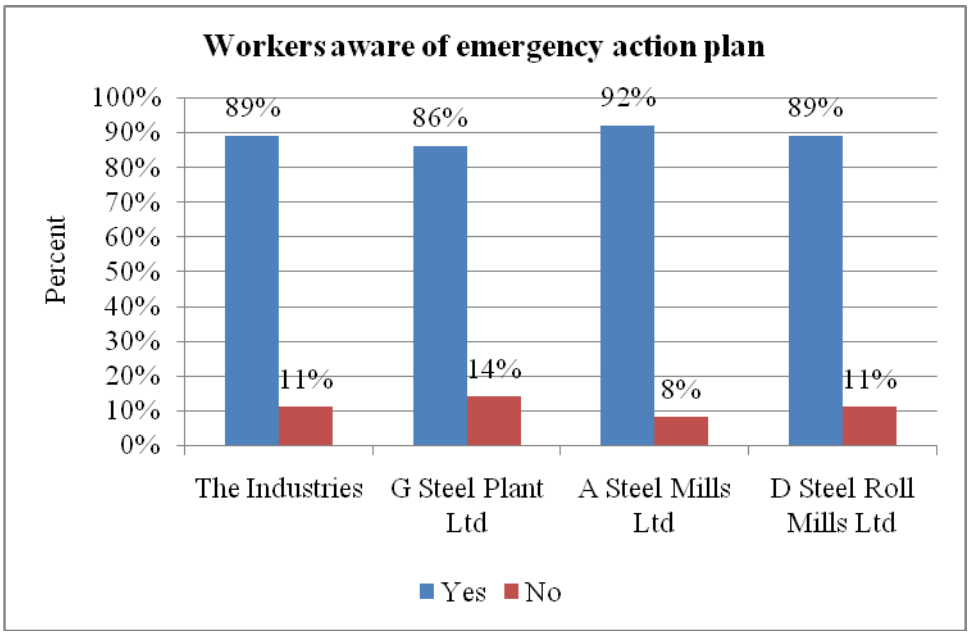

Figure 22: Workers aware of emergency action plan at work.

4.1.9 Workers cause of concern at the workplace.

Figure 23 shows that 70 % of the workers in the three industries feared having no pay while 62% feared occupational injury. The same figure shows that 57% and 55% of the workers feared unemployment and occupational diseases respectively. A Steel Mills Ltd had 94% of its workers fearing no pay and occupational injury while 100% of its workers feared both unemployment and occupational diseases. D Steel Roll Mills Ltd workers showed least concern of the four issues that had been raised. Figure 23 shows that 30% and 23% of the D Steel Roll Mills Ltd workers are concerned of occupational injury and occupational diseases respectively.

The study showed that workers in A Steel Mills Ltd were the most concerned on occupational injuries and diseases followed by the workers of G Steel Plant Ltd.

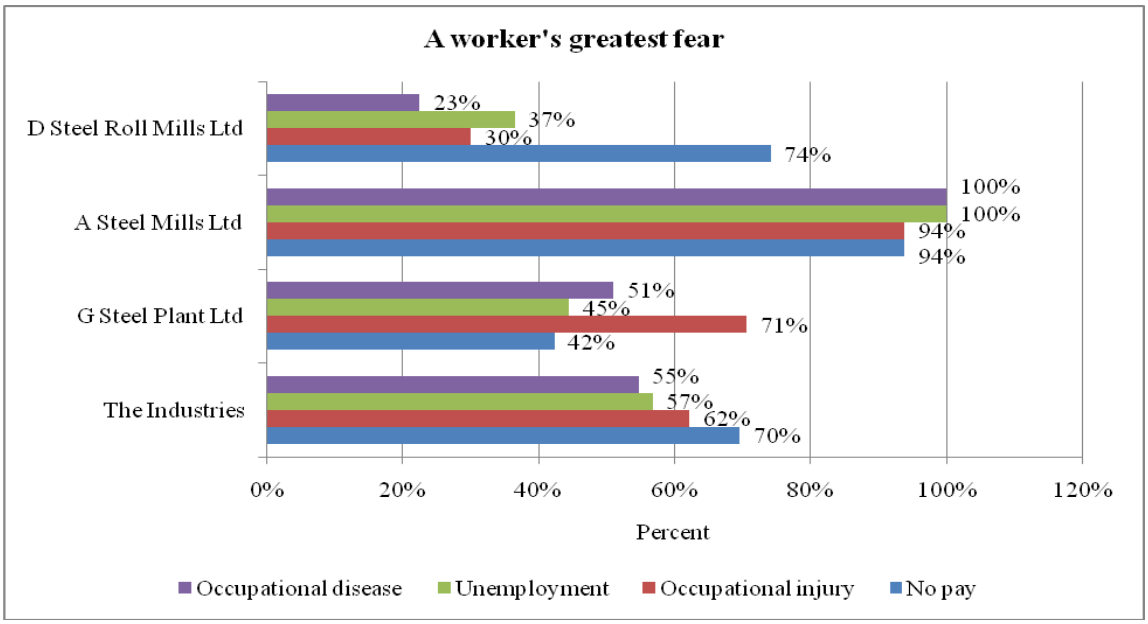

Figure 23: Workers cause of concern while at work.

Table 12: Workers concern and accident occurrence.

	Total	Accident suffered	
		Yes	No
BASE	225	45	180
	100%	100%	100%
Unemployment	112	17	96
	50%	38%	53%
Occupational diseases	103	16	87
	46%	36%	48%
Occupational injury	129	18	111
	57%	40%	62%
No pay	142	23	119
	63%	51%	66%

From the study more workers feard no pay than the other options. Workers who feared no pay contributed highest to accidents occuring at work. The organisations need to address the concern of the workers so they have a proper perspective on the importance of safety and health.

4.1.10 Workers perception on the importance safety and health at work.

A large 89% of the workers in the industries preferred safety and health compared to having a job. The same figure shows that 95% of the G Steel Plant Ltd workers considered safety more important while 89% of D Steel Roll Mills Ltd had the same opinion. From the figure, 83% A Steel Mill Ltd workers' hold a similar opinion of safety and health being important as compared to work.

The figure showed that safety and health is more important to the workers than having a job.

Since most of the workers saw safety and health as important they would be expected to appreciate hazard awareness creation through the trainings and following of safe work procedures. The impact of understanding the consequences of hazards encountered at work would be a likely hood of reduction exposure.

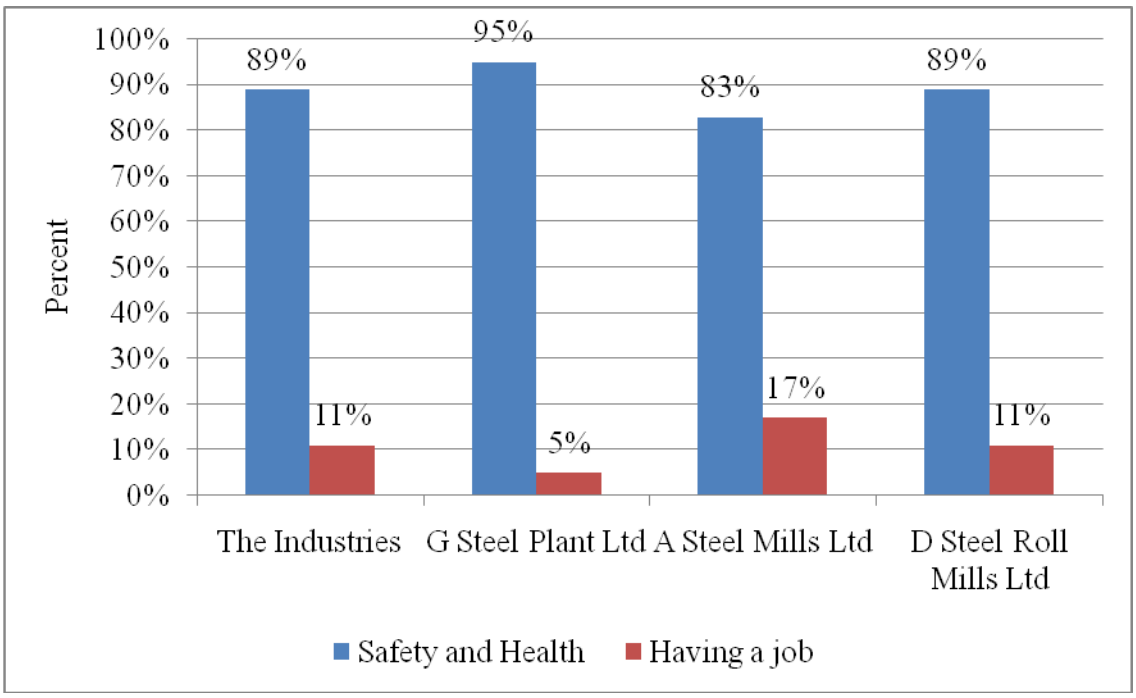

Figure 24: Workers perception on safety and health importance at work.

4.1.11 Workers view on who is responsible for safety and health in the workplace.

Table 13 shows that 36% of the workers agreed that an employee was responsible for his or her own safety and health, while 39% of workers believed that the employer was responsible. The same table shows 20% of the workers believe that the health and safety committee is responsible for the safety and health at work. Table 13 also shows that only 5% of the workers believe that the government was responsible for the safety and health of a worker at work.

The study showed that more workers believed they were responsible for their own safety and health.

When workers accept responsibility of their own safety, they are less likely to engage in activities that will lead to hazard exposure. It is expected that they will cooperate with

management which has the responsibility of ensuring safety at work. It is seen that steel rolling mill workers has such a group that may assist to influence in creating a positive safety and health culture.

Table 13: Workers opinion on who is responsible for safety and health of workers.

Response	Frequency	Percent
Employer	91	39%
Employee	85	36%
Safety and Health Committee	48	20%
Government	12	5%
Total	239	100%

4.1.12 Safety and health attention given by employer at work.

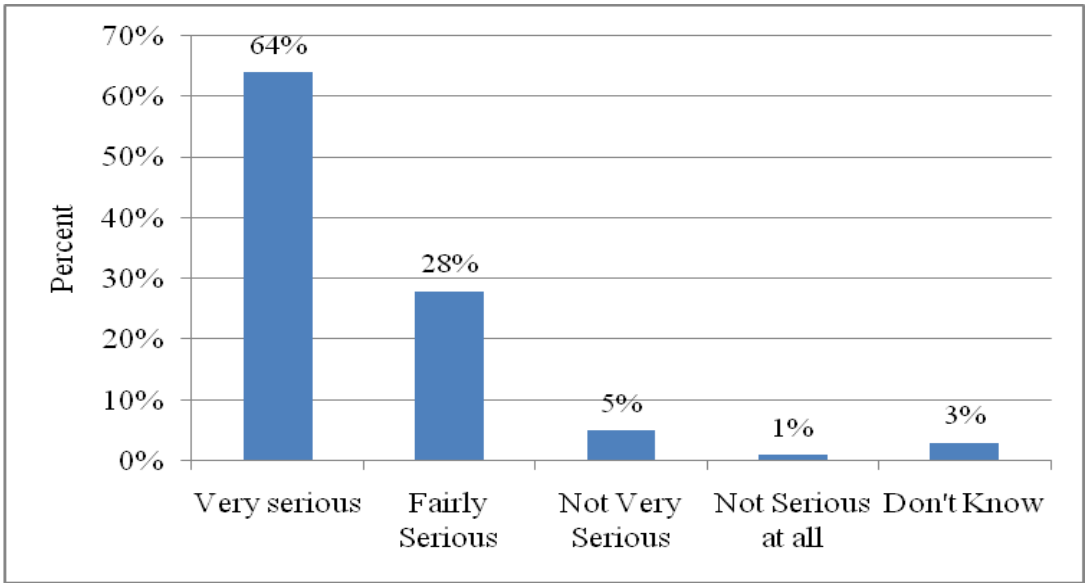

Figure 25: Workers view on attention given to safety and health by their employer.

There was safety and health seriousness as shown in figure 25 where 64% of the workers indicated their employers were very serious on safety and health issues followed by 28% saying fairly serious.

The study showed that more workers believed that the industry shows seriousness on safety and health at work.

Table 14: Human factors that may be associated with hazardous exposure.

		Significance	Chi square	P-value
Training on personal protective equipment.	Companies	X	1.209	0.546
	Age	X	9.842	0.02
	Gender	Fisher's exact valuation (X)	__	0.292
	Education	X	3.892	0.421
Safework procedures	Companies	٧	21.508	0.000
	Age	X	2.382	0.497
	Gender	Fischer's exact valuation (X)	__	0.491
	Education	٧	16.57	0.002

X = Significance at $\alpha = 0.05$ chi square assumptions were violated.

٧ = Significance at $\alpha = 0.05$ chi square assumptions are valid.

Table 15: Training of safework procedures in the companies

Company	Trained on safework procedures	
	Yes	No
G Steel Plant Ltd	63%	37%
A Steel Mills Ltd	91%	9%
D Steel Roll Mills Ltd	84%	16%

Table 16: Level of worker education and training on safework procedure.

	Trained on safework procedures	
	Yes	No
No education	95%	5%
Primary	90%	10%
Secondary	76%	24%
High school	63%	37%
College	65%	35%

From the cross tabulation table 14 the study revealed that there was an association of safe work procedure and the companies. The table 15 indicates A Steel Mills had 91% of its workers trained on safe work procedures while D Steel Roll Mills Ltd had 84%. G Steel Plant Ltd had the least number of workers trained on safework procedures and there likely to be exposed to hazards.

The study revealed that there was association of safework procedure and the companies. The study also established that there was an association of workers' level of education and safework procedure training as shown by table 14 and table 16. Workers that were least trained on safework procedures were those with college level of education. The management of the three organizations would best be adviced to also train workers with college education on safework procedures, as they likely to be in managerial positions and in charge of workers.

There was no association on training on personal protective equipment with the company, age, gender and level of education due to violation of chi-squard assumprions.

5.0 CHAPTER FIVE

5.1 CONCLUSIONS AND RECOMMENDATIONS

5.1.1 Conclusions

In order to establish the first objective the research question: "what controls has the management put in place to protect workers from hazard exposure?" The management controls in the steel rolling mills were determined through examining the aspects of safety and health management as advocated by the OSHA and the ILO Safety and Health Management Guidelines of 2001. The following aspects were to be established; safety and health policy, safe work procedures, responsibility and accountability established through training. The study established that all the three steel rolling mills had safety and health policies in place with 95% of the workers being aware of its presence (figure 15).

The second objective of this research was established through identifying some of the human factors that lead to a worker being exposed to hazards at their work station. Human factors involve how a worker interacts with his or her work environment. Some of the human factors in a workplace are: use and maintenance of safety equipment or personal protective equipment and safe work procedures originating from the management. Workers level of education, reason of failure to follow safe work procedures, view on importance of safety and health and how they perceived management on matters of safety and health was used to establish human factors that may result in workplace hazard exposure. From the study, it was established that there was an association of training on safework procedures in compnies and worker's level of

education. College level education workers were the least trained on safework procedure while it was expected they were the one's placed in charge of company safety and health.

The third objective of this research study established physical controls in place in order to protect workers from the workplace hazards. The code of practice established by the government of Kenya, to carry out safety and health audits was used to determine at the time visits in the steel rolling mills. During the walk through survey to determine the physical controls in place, it was observed that the dangerous moving parts of machinery were safeguarded. There was safeguarding by location in case of noise and high temperature. Workers were restricted to their areas of operations thus ensuring if there was to be any exposure it was only occurring to those in the hazardous areas. Where high temperatures were concerned the workers were working for two hours and then replaced by others. The research study established that there were physical controls in place to prevent worker exposure to work related hazards.

The fourth objective established the role played by the government to ensure workers were not exposed to hazards in steel rolling mills. The various records required under the OSHA were produced by the three organizations. It was established that the government was ensuring compliance of the Occupational Safety and Health Act

From the study the hypothesis that there is safety and health hazard awareness in Steel Rolling Mills in the Nairobi Metropolis City in Kenya was proved despite the fact that accidents occurring are significantly high.

5.1.2 Recommendations

Training needs to be improved so that the workers are aware of who is responsible of safety and health since the difference in percentage of those who believe on the employer and those who say the employee is responsible are not very much.

Management perceptions on the seriousness of safety and health is yet to be shown as the persons delegated with safety and health matters are from the human resource department. It would be better that someone more knowledgeable in technical work would be placed to be in charge of safety and health matters.

Proper induction training of new workers and adequate supervision would then be quire effective especially where a significant number of workers said they failed to follow procedures was due to work pressure.

It is recommended that the steel rolling mills automate processes that are quite hazardous especially at the furnace areas and the rolling mill sections.

The management also needs to invest on heat resistant personal protective clothing for the hot environment areas.

As far as documentation and legal compliance was concerned the steel rolling mills were noted to be creating hazard awareness but accident levels were significantly high as was reflected with 19.25% of the respondents although trained in safe work procedures still suffered accidents.

5.1.3 Further Studies

There is need for research on the effectiveness of professionals involved in occupational safety and health contributions towards preventing worker exposure in steel rolling mills. Those practising occupational medicine may be required to undergo some training on occupational hazards, their prevention from affecting workers and the management of occupational diseases.

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APPENDICIES

Appendix 1 - Questionnaire

1. Name …… Age……. Sex……

2. Name of employer……. employment status- permanent □ casual □ (tick)

3. Occupation……

4. What section/department do you work

   ……

5. What is the level of education?

   No Education □ Primary □ Secondary □ High School □ College □ University □ (tick)

6. How long have you worked in your current station…….…….

7. Is there a safety and health policy in this company? Yes □ No □

8. If yes do you have access to it? Yes □ No □

9. Are you aware of its provisions Yes □ No □

10. Have you been trained on workplace health hazards affecting your type of work?

    Yes □ No □

11. If yes, name the hazards ……

12. Are you provided with personal protective equipment?

    Yes □ No □

13. If yes, name those Personal Protective equipments……

14. Have you been trained on their use?

Yes □ No □

15. Are there any work procedures that you follow while working?

Yes □ No □

16. If yes have you received training on how to follow them?

. Yes □ No □

17. Have you ever suffered any accident?

Yes □ No □

18. If yes what type of accident was it? ……..

19. If yes was the accident investigated?

Yes □ No □

20. Is there an emergency action procedure in case of fire or any other emergency

Yes □ No □

21. If yes what is you role…….

22. Have you undergone any occupational medical examination?

Yes □ No □

23. If yes which one…….

24. What cause you to ignore or break safety procedures at work

- Supervisor pressure
- Work pressure
- No enforcement of procedure

25. What is your greatest fear as far as work is concerned

- Unemployment
- Occupational disease
- Occupational injury
- No pay

26. What is most important to you?

- Having a job
- Safety and health

27. Who do you think is responsible for ensuring safety and health at your workplace?

- Employer
- Employee
- Health and safety committee
- The government through the occupational safety and health officer.

28. How seriously does your employer take safety and health issues?

- Very seriously
- Fairly serious
- Not very serious
- Not serious at all
- Don’t know

Appendix 2 - Map showing the Study Location in Kenya