OCCUPATIONAL HEALTH AND SAFETY HAZARDS ASSOCIATED WITH QUARRYING ACTIVITIES; A CASE OF MUTONGA QUARRY, MERU COUNTY, KENYA.

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Occupational health and safety hazards associated with quarrying activities; A case of Mutonga Quarry, Meru County, Kenya.

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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 work is dedicated to the entire family of Cosmas Kigomo Maacai for their love and support.

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LIST OF ABBREVIATIONS AND ACRONYMS

BCG- Bacille Calmette Guerin

DOT- Directly Observed Treatment

DVD- Digital Versatile Disk

ERC - Ethical Review Committee

ESAW- European Statistics on Accidents at Work

EU- European Union

HAVS- Hand Arm Vibration Syndrome

HIV/AIDS- Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome

HSE - Health & Safety Executive.

IEC- Information, Education, and Communication

ICF- Informed Consent Form

KEMRI- Kenya Medical Research Institute

L.N. - Legal Notice

MIAG- Mines Inspection Agency of Greece

Ms. - Microsoft

NEMA- National Environment Management Authority

NIHL - Noise-induced hearing loss

NIOSH- National Institute for Occupational Safety and Health

OSH - Occupational Health and Safety

OSHA- Occupational Safety and Health Act

PPE- Personal Protective Equipment

SSC - Scientific Steering Committee

TB- Tuberculosis

USEPA- United States Environmental Protection Agency

WBV- Whole Body Vibration

WHO ILO- World Health Organization International Labour Organization

WIBA- Work Injury Benefits Act

DEFINITION OF TERMS

Accident -	a sudden event, such as an accident or a natural catastrophe, that causes great damage or loss of life.
Disaster -	a sudden event, such as an accident or a natural catastrophe, that causes great damage or loss of life.
Emergency -	situation that poses an immediate risk to health.
Emergency services -	emergency facilities and equipment in a quarry to support rescue procedures for self-rescue by workers and rescue by emergency responder.
Health problem -	a state in which a person is unable to function normally and without pain.
Hazard -	a situation that poses a level of threat to life or health.
Insurance cover -	protective measures binding a party to idemnity against specific loss inreturn for premiumss paid.
Occupation -	a person's usual or principal work, especially as a means of earning a living.
Quarry -	a type of open-pit mine from which rock material are extracted.
Quarry Worker -	a person employed by a quarry operator to carry out quarrying activities.
Small scale Quarry	informal manually operated quarry sites.
Quarry Pit -	a surface excavation allocated to an operator within a quarry site for extracting building stone, construction aggregate, sand and gravel.
Quarry Site -	a cluster of quarry pits within a locality.
Quarry Owner -	an individual who owns or has leased a quarry site to an operator.
Quarry Operator -	an individual who has been leased a quarry pit for the purposes of extracting building stone, construction aggregate, sand, and gravel.

ABSTRACT

Rock quarrying is one of the common but most dangerous industries to work in relative to other industries globally. The workers are exposed to a variety of health hazards. The evaluation of occupational health and safety hazards among the quarry workers are relevant because of the number of high-risk activities involved. Kenya has witnessed various quarry accidents and health complaints associated with quarrying activities which have not been addressed. The hazardous nature of quarrying activities at the Mutonga quarry in Meru county came into light when activities had to be stopped by the then area's District Commissioner because of fears associated with landslides that had occurred in the area within the quarry site as a results of heavy rains but the inherent occupational health and safety hazards were overlooked due to inadequate information on their magnitude. According to National Environmental Management Authority (NEMA) quarrying in Kenya suffers from a number of constraints including lack of basic knowledge on safety precautions, poor working conditions, low socio-economic status, lack of clear quarrying legislation and environmental degradation that call for special attention. Some workers get maimed, others become chronically ill, while some die. These occupational health and safety hazards are more pronounced in manual quarry operations as is the case at the Mutonga quarry. Quarrying activities in Mutonga, as well as many other quarries around the country are therefore hazardous to the quarry workers and the magnitude of occupational health and safety hazards in Kenya is not known. This cross sectional descriptive study was therefore aimed at assessing the occupational health related problems of Mutonga quarry workers in Meru county Kenya, their health seeking behaviour and the available health care options. Simple random sampling was employed in the selection of the respondents from a population of adult quarry workers. Questionnaires were used to collect data on socio-demographic profiles, their skills and quarrying activities, exposure to health hazards and available preventive and promotive health care. The quarry workers (408) who met the selection criteria and gave consent were interviewed at the quarry site with the help of trained field assistants. A data base was created and descriptive analysis was done.

Statistical analysis was carried out using Chi square to test for association among variables and logistic regression was carried out to model occupational health hazard associated with quarrying activities and the results presented using tables. The average age group of the respondents was 34 years. There was a higher proportion of males (87%, 355) compared to females (13%, 53). The results revealed that (23%, 94) of the respondents indicated that they were cutting rock blocks into specific sizes, (13%, 53) excavating, (12%, 47) loading rocks into lorries and trucks. The respondents on contract terms were (49.5%, 202), while 43.6% were casual labourers. The results too indicated the frequencies of carrying out the quarrying activities was (74.3 %, 303) between 5-6 days and (76%, 310) of the respondents indicated they carried out the activities on a full day time schedule. The only form of training reported by all respondents was observational (on job training). Upto (87.3%) of the respondents indicated that there was presence of dangerous aspects of the work in the quarry that can harm their health. Some of the hazards involved with the quarrying activities carried out by the respondents were indicated as: manual handling of heavy loads, being hit by the tools, exposure to dust and falling of rock block. Some of the harms suffered by the respondents in the quarry while on duty were contusion with intact skin surface, pain/problem in nose, throat, sinuses, back, shoulder and neck. The trained respondents on safety precautions were 86.8%, 74.8% of the respondents did not use protective clothing while at work. Relationship between gender and occupational hazards was statistically significant (χ^2, = 79.921, df(1), P=0.000). Level of education was a significant factor to occupational hazards (χ^2 (1) = 12.015, df(1), P=0.007). Marital status and area of residence in the study was not a significant factor to occupational hazards. The study show that use of protective clothing was statistically associated with occupational health hazards (P<0.002). Who provided the protective equipement (PPE) (P<0.004) and whether the respondents were insured (P<0.021) were also statistically associated with occupational health hazards. Results further revealed that the respondents injured in the last one month were statistically associated with occupational health hazards (P<0.028). In light of the findings, appropriate strategies that focus on mitigating

occupational health and safety hazards associated with quarrying activities will help ease the burden that they have on the health sector as a whole. This is because they pose great threat not only to public health but also economic growth at local, national and global levels. The results led to a conclusion that respondents had occupational health and safety problems associated with quarrying activities. The study recommends the authorities should ensure that the quarry management and quarry workers adhere to regulations on occupational health and safety. This provides for the rights of every person to fair labour practices, reasonable working conditions, and a clean, healthy environment. The government should also ensure that all places carrying out mining activities are well researched on and communicate to the public on the laws and regulations to be adhered to, thus, enhance safety of human beings and environment.

CHAPTER ONE
INTRODUCTION

1.1 Background Information

Globally, rock quarrying is very common but also one of the most dangerous industries to work in (HSE, 2002; Okafor, 2006) and as stated by the European Agency for Safety and Health at Work (2008), the quarry workers are twice as likely to be killed in an accident at work as construction workers, and 13 times more likely to die at work as those in manufacturing industries. The World Health Organization (ILO, 2005) noted with concern that 1.7 million people worldwide die annually of work related injuries and illnesses. The Mines Inspection Agency of Greece (MIAG) recorded a 37.7 fatality rate (number of fatal accidents per 100,000 workers) for the overall quarrying sector between 1988 and 2002. In France about 44% of all fatal accidents in 2002 were related to quarrying while in Germany, between 1999 and 2003, 48% of all accidents reported were from the quarrying sector (ILO, 2005). It is because of the high number of incidence of accidents, injuries, illnesses and fatalities throughout the world that the quarrying industry has often been termed as particularly 'unhealthy industry' (Smallwood and Haupt, 2000).

In the EU (excluding Greece and Northern Ireland), some 8.1 % of those aged 15 to 64 years that worked or had previously worked in the quarries reported a work-related health problem in the 12 months prior to a Labour Force Survey 2007 adhoc module on accidents at work and work-related health problems; this was equivalent to approximately 23 million persons (ESAW, 2007). Results from the survey showed that the occurrence of work-related health problems generally increased with age, but the rate of increase slowed down for workers aged between 55 to 64 years due to these workers leaving the workforce early. Workers with a low level of education reported more often than their educated counterpart. In particular, this group of workers was more often identified with musculo-skeletal health problems as their most serious work-related health problem, whereas persons with higher levels of education most often identified stress, depression or anxiety as their main work-

related health problem. Furthermore, manual workers reported more often work-related health problems than non-manual workers. Work-related health problems mostly occurred in agriculture, mining and quarrying sectors. Thirteen percent (13%) of workers in the mining and quarrying sectors reported most often health problems during the same period of the survey with back problems (28%), neck, shoulder, arm or hand problems (19%), and stress, depression or anxiety (14%); musculo-skeletal problems were reported most often as the main work-related health problem (59.8 %).

Work within the quarry industry is both physically and mentally demanding. The schedule of work hours, blocks of days on and off presents health problems. A report by the Australian Institute of Mining and Metallurgy (2012) gave the attrition rate as one in three within the first 12 months (Duffy, 2012). According to the findings of a research by Ahmed *et al.* (2000) 8% mines and industrial workers in Australia reported dislocation, 4% fracture of vertebrae column, 6% traumatic amputation, 12% open wounds, 28% contusion with intact skin surface and the most prevalent injury was sprains and strains, accounting for over 40% of all injuries. The injured workers attempted self-care, accessed the local medical services or waited until they flew home. According to Foster *et al.* (2007) research on First Aid and Medical Treatment for the injured in Australia it indicated that at quarries and other surface mines, persons injured received less than adequate first aid, they were also inappropriately transported to hospital risking their health or worsening the injury with potential serious consequences and majority of the mine workers were untrained in first aid.

A significant proportion of health problems and fatalities in the quarrying sector in Africa are associated with manual operations, (Chigonda, 2010) and the health problems among the quarry workers are relevant because of the number of high-risk activities involved, and the peripatetic nature of the workforce. The principal airborne hazards in the mining industry include several types of particulates,

naturally occurring gases, engine exhaust fumes and some chemical vapours; the principal physical hazards are noise, segmental vibration, heat, changes in barometric pressure and ionizing radiation. These occur in varying combinations depending on the mine or quarry, its depth, the composition of the ore and surrounding rock, and the method(s) of mining. There is also risk of transmitting some infectious diseases such as Tuberculosis, Hepatitis (B and E), and the Human-Immunodeficiency Virus (HIV) among some groups of miners who live together in isolated locations. Miners' exposure varies with the quarrying activity carried out, its proximity to the source of hazards and the effectiveness of hazard control methods.

Quarrying products are increasingly demanded for industrial, domestic, agricultural and other purposes so as to satisfy the needs of the rapidly growing population. Quarrying operations generally involve removal of over burden, drilling, blasting and crushing of rock materials. The various impacts produced by these operations are both size and locations dependent. Manifestations of specific impacts are on the air, water, soil, earth surface, flora and fauna, and human beings (Areola, 1991; Enger,Smith & Buckaroo 2000). Apart from land degradation, other negative impacts of quarrying includes swamp creation, deterioration of ground water, erosion of soil, noise and percussions from rock blasting, generation of dust, smoke and fumes; production of noxious gases and ground vibration. Suspended particulate matter is quite outstanding among all pollutants emanating from quarrying operations (USEPA, 2008).

The quarrying situation in Kenya can be mirrored from quarrying environments elsewhere however, the magnitude of the health related problems in Kenya is not well known. According to NEMA (2010) quarrying in Kenya suffers from a number of constraints including lack of basic knowledge, safety precautions, poor working conditions, low socio-economic status, lack of clear quarrying legislation and environmental degradation which all require special attention. Some workers get maimed, others chronically ill, while some die.

1.2 Study site

Mutonga quarry is in Meru County of Kenya. It is located 0°05' 00" S and 0° 27' 00" S; 37° 57'0 0" E and 37° 57' 00" E and covers an estimated length of about 10 kilometers (Figure 1.1) adjacent to the Mutonga River. According to the government report on the management of quarrying activities in Kenya of the year 2010 by NEMA, it's the biggest quarry in Kenya and has 7000 manual quarry workers, the highest number of quarry workers as compared to other quarries countrywide and has several quarry pits. The Mutonga quarry is adjacent to the Mutonga River with the land sloping generally to the Southeast direction. The physiographic of the area consists of scarps formed by the extensive quarry activities going on in the area. Mutonga River is recognized for its diverse reverie flora and fauna. The area surrounding the river offers a serene climate and natural beauty. Its freshwater is both ecologically and economically valuable to residents of the area. One of its social economic values is that it provides water for domestic and agricultural use to people within its surroundings. The main land use types in the area can be categorized into agriculture and stone quarrying. The quarry is mainly located near the deep river valleys where granite deposits have been detected. The main product of the quarrying activities is building stones.

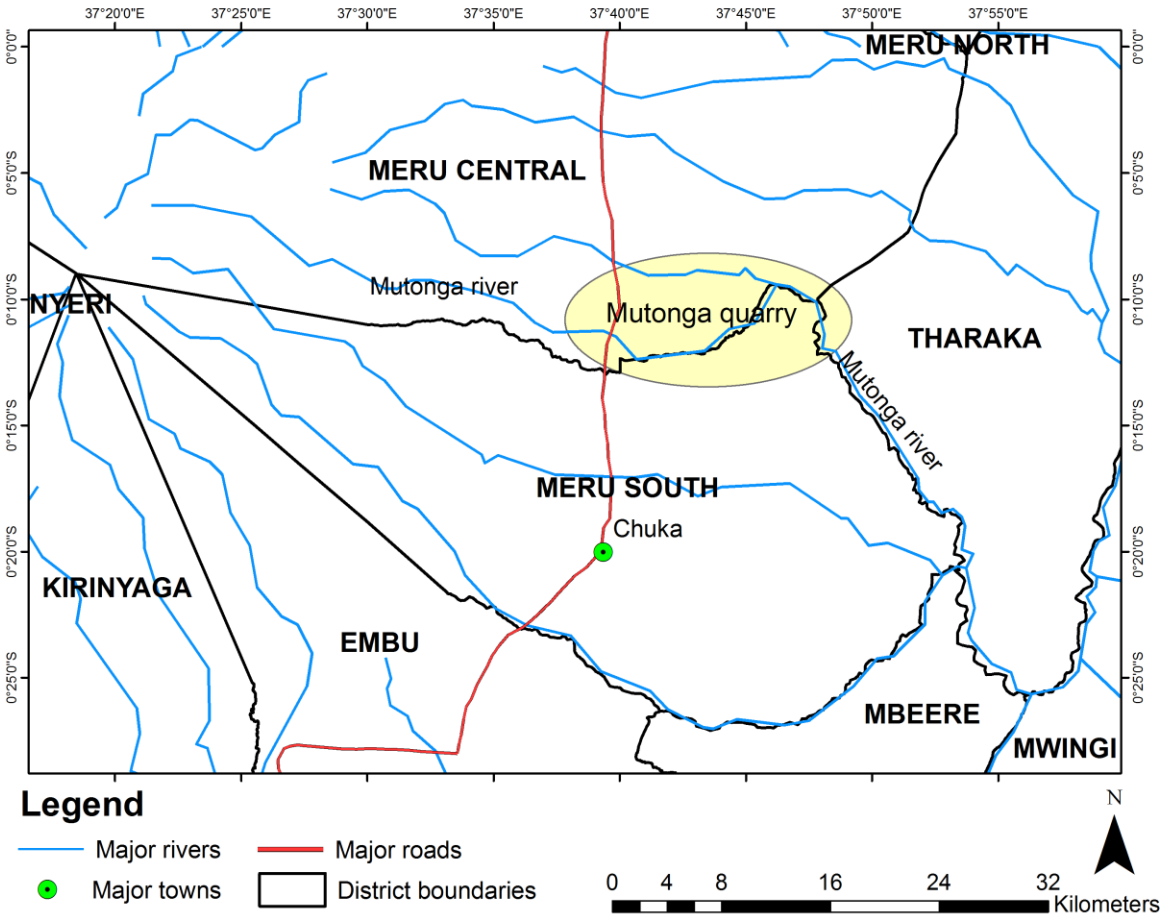

Figure 1.1: Mutonga Quarry

1.3 Problem statement

Quarrying has a reputation for being a particularly unhealthy industry (HSE, 2002) because its rate of work-related injuries and illness is one of the highest of all occupational groups worldwide. The work-related injuries, illnesses and deaths have resulted from quarrying activities due to the physical nature of the work involved, coupled with poor workplace health and safety standards. Occupational health and safety hazards are more pronounced in manual quarry operations as is the case at the Mutonga quarry in Meru County. As noted by NEMA (2010), there has been growing public dissatisfaction in the manner in which quarrying activities are undertaken in the country. The country has witnessed various quarry accidents and

complaints associated with quarrying activities. There have been several reported accidents in Mutonga. Quarrying activities in Mutonga quarry, for instance, five people died instantly and six others hospitalised after quarry walls collapsed in the year 2005 (Muriithi, 2011). The hazardous nature of quarrying activities at the Mutonga quarries came into light when activities had to be stopped by the then area's District Commissioner because of fears associated with landslides that had occurred in the area within the quarry-site as a results of heavy rains (Muriithi, 2011) but the inherent health problems were overlooked due to inadequate information on the magnitude of occupational health related problems. This study therefore sought to assess the occupational health and safety hazards associated with quarrying activities amongst the quarry workers in Mutonga quarry.

1.4 Justification

Occupational hazards associated with the quarry workers are well researched internationally; however little is known about occupational health in the African quarrying industry (Smallwood and Ehrlich, 2001) while the cumulative quarrying hazards continue to constitute the largest category of occupational diseases and often result in prolonged disabilities (NIOSH, 2002). The quarry workers are exposed to a variety of health hazards thus, the health problems among quarry workers are relevant because of the number of high-risk activities involved, and the peripatetic nature of the workforce. In Sub-Saharan Africa public health problems of child mortality, malaria, water quality and HIV/AIDS have overshadowed occupational health problems with a vast majority of contemporary research based on the above public health problems (Spee, 2006) and the research that comes close to the plight of quarry workers is hedged upon urban industries, forgetting quarry workers whose plight goes unnoticed until a calamity occurs. To combat the health related problems associated with quarrying activities, understanding the bio-data of the quarry workers and the conditions of the working environment is important, because regardless of the apparent risks, they still venture to work within the quarries. According to NEMA (2010) the Mutonga quarry was the biggest quarry in Kenya and had the

highest number of manual quarry workers as compared to other quarries country wide, hence it has a high reliability of data collection, which a general population of other quarries can be inferred from.

1.5 Research questions

1. What types of quarrying activities are conducted at Mutonga quarry, Meru County?
2. What are the occupational health problems associated with the quarry workers in the last one month?
3. What is the health seeking behaviour of the quarry workers and the available health care options?
4. What health promoting services are available to the quarry workers?

1.6 Main objective

To assess the occupational health and safety hazards associated with quarrying activities in Mutonga Quarry, Kenya.

1.7 Specific objectives

1. To profile the types of quarrying activities conducted at Mutonga quarry, Meru County.
2. To identify the occupational health and safety hazards experienced by Mutonga quarry workers.
3. To determine the health seeking behaviour of the quarry workers and the available health care options.
4. To establish the health promoting care available to the quarry workers.

CHAPTER TWO
LITERATURE REVEIW

2.1 Introduction

This chapter presents a literature review of the occupational health related problems associated with quarrying activities of quarry workers, their health seeking behavior and the health promoting services and care available to the quarry workers.

2.2 Quarrying activities

A quarry is a type of open-pit mine from which rock or minerals are extracted. The quarries are generally used for extracting building materials, such as dimension stone, construction aggregate, riprap, sand, and gravel. To get the rock out of the earth, drilling and blasting is very important. In a dry quarry, to undergo blasting, first the holes are drilled in the earth and explosives are placed inside. The explosive are detonated to provide energy for the most efficient blasting. The blasts that occur when the explosive are set off do free the stone from the quarry wall. The free stone from the quarry wall are loaded by large haul trucks and moved to the rock crusher where they are crushed and divided into different sizes. Depending on the size of the output the rock may be put through different and smaller sizes of crushers one or more times. As the rocks pass through the crushers, they are moved around the processing plant on conveyor belts. After crushing, comes screening. As the rocks are broken down to smaller sizes, screens are done to separate the rocks into piles that are the same size. Some screens are larger to allow the bigger rocks to pass through. The smaller screens lets only the small rocks through for rocks to get from one place to another at the plant, they travel on long continuously moving conveyor belts. The conveyors help move rocks in an economical way saving money and time and the storing of the rocks, can be huge piles of rock with some of stockpiles as much as 30 feet high and 300 feet around. Finally the rock is loaded in to trucks for transportation to where they are needed for use (Vulcan Materials Company, 2005)

Quarries in level areas with shallow groundwater or which are located close to surface water often have engineering problems with drainage. Generally the water is removed by pumping while the quarry is operational, but for high inflows more complex approaches may be required. As a quarry becomes deeper, water inflows generally increase and it also becomes more expensive to lift the water higher during removal - this can become the limiting factor in quarry depth. Where rock quarries penetrate the water table, the quarries commonly are dewatered by collection and pumping of the ground water. The rock is then mined by the procedures used in a dry quarry. Some operators may prefer not to dewater the quarry, or the inflow may be too great to be pumped. In such operations, the quarries are allowed to fill with water. The rock is drilled and blasted, and the rubble is extracted from under the water using draglines, clamshells, or other equipment. The aggregate may be processed wet or may be placed in windrows and allowed to dry before processing (Langer, 2001). The quarrying activities in Africa are associated with manual operations (Chigonda, 2010).

2.3 Occupational health hazards in quarries

Rock quarrying and stone crushing is a global phenomenon, and has been the cause of concern everywhere in the world, including the developed countries. Quarrying activity is a necessity that provides much of the materials used in traditional hard flooring, such as granite, limestone, marble, sandstone, slate and even just clay to make ceramic tiles. However, like many other man-made activities (anthropogenic factors), quarrying activities cause significant impact on health and the environment (Okafor, 2006), for example, it is often necessary to blast rocks with explosives in order to extract material for processing but this method of extraction gives rise to noise pollution, air pollution, vibration and damage to biodiversity and habitat destruction.

Rock quarrying is a very common occupation but also one of the most dangerous industry to work in relative to other industries (HSE, 2002; Okafor, 2006) and as

stated by the European Agency for Safety and Health at Work (2008), the quarry workers are twice as likely to be killed in an accident at work as construction workers, and 13 times more likely to die at work as those in manufacturing industries. The World Health Organization (ILO, 2005) noted with concern that 1.7 million people worldwide die annually of work related injuries and illnesses. The Mines Inspection Agency of Greece (MIAG) recorded a 37.7 fatality rate (number of fatal accidents per 100,000 workers) for the overall quarrying sector between 1988 and 2002. In France about 44% of all fatal accidents in 2002 were related to quarrying while in Germany, between 1999 and 2003, 48% of all accidents reported were from the quarrying sector. It is because of the high number of incidence of accidents, injuries, illnesses and fatalities throughout the world that the quarrying industry has often been termed to be particularly 'unhealthy industry' (Smallwood and Haupt, 2000).

In the EU (excluding Greece and Northern Ireland), some 8.1 % of those aged 15 to 64 that worked or had previously worked reported a work-related health problem in the 12 months prior to a Labour Force Survey 2007 adhoc module on accidents at work and work-related health problems; this was equivalent to approximately 23 million persons (ESAW, 2007). Results from the survey showed that the occurrence of work-related health problems generally increased with age, but the rate of increase slowed down for workers aged 55 to 64 years due to these workers leaving the workforce early. Workers with a low level of education reported work-related health problems more often than their colleagues. In particular, this group of workers was more often identified with musculo-skeletal health problems as their most serious work-related health problem, whereas persons with higher levels of education most often identified stress, depression or anxiety as their main work-related health problem. Furthermore, manual workers more often reported work-related health problems than non- manual workers. Work-related health problems mostly occurred in agriculture, mining and quarrying sectors. Upto 13% of workers in the mining and quarrying sectors reported health problems during the same period of the survey

with back problems (28%), neck, shoulder, arm or hand problems (19%), and stress, depression or anxiety (14%); musculo-skeletal problems were most often reported as the main work-related health problem (59.8 %).

The schedule of work hours, blocks of days on and then off, while being beneficial in some respects also presents problems. A report from the Australian Institute of Mining and Metallurgy gave the attrition rate as one in three within the first 12 months (Duffy, 2012). According to the findings of a research by Ahmed *et al.* (2000) 8% mines and industrial workers in Australia reported dislocation, 4% fracture of vertebrae column, 6% traumatic amputation, 12% open wounds, 28% contusion with intact skin surface and the most prevalent injury was sprains and strains, accounting for over 40% of all injuries.

Quarrying operations generate large quantities of dust that cause a variety of respiratory diseases amongst quarry workers. Pneumoconiosis, the general term given to a range of lung diseases caused by breathing dusts, typically causes chest tightness, shortness of breath and coughing (Encyclopædia Britannica, 2011). Under continued exposure it may develop into chronic bronchitis or emphysema (NCBI, 2010, 2011). Silicosis is the most likely form of pneumoconiosis and is dangerous to mine and quarry workers. Silicosis is contracted by breathing respirable silica dust in one of its pure crystalline forms. As a result, crushing or blasting rocks with crystalline silica present is likely to leave nearby workers at a high risk of contracting the disease. According to the findings of a study conducted by Nwibo *et al.* (2012) in Ebonyi State, Nigeria to determine the prevalence of respiratory problems and lung function impairment among quarry workers; the respiratory problems found were chest pain (47.6%), occasional cough (40.7%), occasional shortness of breath (6.5%) and wheezing (5.2%). A similar study by Olusegun *et al.* (2009) on the impact of granite quarrying on the health of workers in Abeokuta Ogun State, Nigeria established that, 26% of the workers suffered predominantly from cough, 20% from catarrh and 15% from sinusitis.

Crystalline silica has long been a serious hazard in quarrying with the risk of silicosis and has been subject to considerable investigation. Prolonged exposure to crystalline silica can also cause chronic obstructive pulmonary disease (Mannetje *et al.* 2002). A study conducted in Zambia by Mulenga *et al.* (2005) to examine annual cases of silicosis and tuberculosis in Zambian quarry workers including comparison of periods before 1960 and after 1992 the Occupational Health and Safety Research Bureau of Zambia reported 2,114 cases from 1945 to 2002. Of these, 22.7% were silicosis, 65.4% TB, and the remaining 11.9% silico-tuberculosis. According to Michelo *et al.* (2009), 165 injuries and 20 fatalities were recorded in Zambia with rock fall as the major cause of injuries.

The use of hand-held vibrating tools in quarries causes a health problem known as Hand–Arm Vibration Syndrome (HAVS) whose symptoms include tingling, numbness, loss of grip strength and pain. Nyantubu *et al.* (2007) conducted a study at a selected quarry site in South Africa where 156 workers with occupational exposure to vibration, and 140 workers with no exposure to vibration were randomly selected for study. The results showed that the prevalence of HAVS in vibration-exposed workers was 15%, with a mean latent period of 5 to 6 years compared to the non-exposed with 5% prevalence. The two groups however gave a history of exposure to rock drills.

Noise-induced hearing loss is also a common health problem associated with quarrying and according to Futatsuka *et al.* (2005), noise is mostly produced by either impact or vibration. This happens at the stone crushing unit, when boulders are crushed and transported along conveyors, at the boulder loading point when boulders are fed into receiving pit, and at the sieves when the gravel is sorted. Noise can have the following effects on the health of workers and owners: Distortion of sounds (hearing something, but not understanding) ,Temporary or permanent hearing loss, A continual ringing in the ears for which there is no cure ("tinnitus" in medical terms)

Quickened pulse rate, increased blood, pressure and a narrowing of the blood vessels, abnormal secretions of hormones, muscle tensing, nervousness, sleeplessness and fatigue.

Quarrying is also associated with eyes infection. Koffuor *et al.* (2012) investigated the effect of the working environment on the oculo-visual health of some sand and stone mine workers in Ghana. A cross-sectional survey involving 247 sand and stone mine workers and 250 non-mine workers was conducted between February 2010 and May 2011. External ocular assessments and distance visual acuity measurements were performed. While 45.7% of mine workers used either sunglasses or safety goggles, none of non-mine workers wore safety goggles; a few (8.8%) occasionally wore sunglasses. A significant proportion ($P \leq 0.0001$) of non-mine workers (59.2%) did not show ocular symptoms relative to the sand and stone miners. The vast majority ($P \leq 0.0001$) of non-mine workers (75.2%) had no visible ocular findings compared to the sand and stone miners (32.4%). Among quarry workers, pterygium (24.3%), pingueculae (5.7%), inflammed eyes (18.2%), and scleral pigmentation 13.8% were significant ($P \leq 0.0001$) findings which were not the case with non-mine workers. Visual acuity was however not significantly different ($P > 0.05$) with only approximately 5% from both categories recording moderate to very low (6/18 - 6/60) acuities. Although the working environment in the sand and stone mines seems to have no effect on visual acuity, it has detrimental effect on ocular structure which eventually could affect vision. Using appropriate ocular protectives and regular ocular examinations would be beneficial.

Nwaugo *et al.* (2008) conducted a study on fungal contamination of eye lenses and frames of patients attending optometry clinic at Abia State University, Uturu, Nigeria and established that the occupation of the subjects influenced the prevalence of the fungal contamination of the spectacles screened. This is because those individuals who were engaged in stone quarrying activities had the highest contamination of 24.21% and wore no eye protection gear. One of the biggest negative impacts of

quarrying on the environment is the damage to biodiversity (Anand, 2006). Biodiversity essentially refers to the range of living species, including fish, insects, invertebrates, reptiles, birds, mammals, plants, fungi and even micro-organisms. Biodiversity conservation is important as all species are interlinked, even if this is not immediately visible or even known, and our survival depends on this fine balance that exists within nature. Both positive and adverse societal impacts of modern manufacturing technologies have great consequences on economics, health, safety and environment in general (Anand, 2006).

Quarrying carries the potential of destroying habitats and the species they support (Mabogunje, 2008). Even if the habitats are not directly removed by excavation, they can be indirectly affected and damaged by environmental impacts such as changes to ground water or surface water that causes some habitats to dry out or others to become flooded. Even noise pollution can have a significant impact on some species and affect their successful reproduction. Nevertheless, with careful planning and management, it is possible to minimize the effect on biodiversity and in fact, quarries can also provide a good opportunity to create new habitats or to restore existing ones (Tanko, 2007).

Like many other man-made activities, quarrying involves the production of significant amounts of waste. Some types of quarries do not produce large amounts of permanent waste, such as sand and gravel quarries, whereas others will produce significant amounts of waste material such as clay and silt (Wang, 2007). The good news is that they are generally inert and non-hazardous, unlike the waste from many other processes. However, there is still potential impact on health particularly with water contamination. Plants are major components of the ecosystem – a complex interaction between the biotic and abiotic entities of the environment. The industry, unfortunately discharge dust that settles not only on land, plants and trees but also on surface waters used for drinking and other domestic applications by the community (Osha, 2006). The green plants especially, by virtue of their photosynthetic activities

occupy an important position in the existence of life because of their ability to maintain a balance in the volume of Oxygen and Carbon dioxide which leads to the purification of the environment. They supply man with food, drugs, fibres, fuel, building and other raw materials and serve as ornamentals. The plants, by their activities, influence and determine to a large extent, the type of fauna to be expected and any change or tilt in their composition either vegetation, affects the animal life in terms of food, shelter, security and comfort. Such vegetation changes are the main concern of environmental botanists and ecologists in recent years who have advocated the careful and cautious approach to activities promoting such changes (Wang, 2007).

The quarrying industry in Kenya is an important sector that supports the country's infrastructural development. Similarly, the quarrying activity has various positive impacts on rural economies that cannot be ignored. In Meru for example, a single quarry known as Kiambogo in Mitunguu has a combined workforce of two thousand (2000) workers producing about thirty lorries (30) of building stones per day and each worker earning about three hundred shillings (Kshs. 300) per day. The local Authorities also benefit from collection of cess from the operators and transporters (NEMA, 2010). From these observations it is clear that this industry is a major employer, source of income and positively impacting on the general economic activities of the area. The quarry workers in Kenya are mainly people who are not likely to get formal employment and this is usually the only source of livelihood. The industry also plays a critical role in the provision of building material in the ever growing construction industry. However, quarrying in Kenya suffers from a number of constraints including lack of basic knowledge, safety precautions, poor working conditions, low socio-economic status, lack of clear quarrying legislation and environmental degradation that call for special attention.

2.4 Health seeking behavior and health care for quarry workers

Tuberculosis (TB) is one of the most globally serious public health problems. About one third of the global population has been infected with *Mycobacterium tuberculosis*. With the increasing prevalence of HIV infection the problem of TB is likely to be compounded in the years to come. The worker community in sand and stone quarries represents a high-risk group for TB due to their exposure to floating silica particles in the working environment, smoking habits, alcoholism, staying near mining area, socio cultural practices, low socio-economic conditions and illiteracy. Yadav, *et al* (2006) conducted a study to test the knowledge and attitude of sand-stone quarry workers of Jodhpur in India on tuberculosis. In this study, 19 sand-stone quarry sites were selected randomly in Jodhpur district from which 376 quarry workers were interviewed who consented to participate in the study. Their literacy rate was 28.5%. More than half (50.5%) had heard about tuberculosis from neighbours, friends (42.6%) and family members (37.2%). Only 1.6% knew that Tuberculosis was caused by germs and 45.2% respondents had misconception that TB was a hereditary disease. Literates were more aware than illiterates about symptoms of tuberculosis. Only 6.9% knew about the need of treatment for 6-8 months and 0.8% knew about the use of BCG vaccine for prevention of tuberculosis. Tendency to discriminate TB patients was evident as 72.6% respondents opined to isolate TB patients from the family and 80.6% opined to avoid sharing food with these patients. The study concluded that extensive health education directed towards bringing a change in attitude among sandstone quarry workers was needed to create awareness and remove myths about tuberculosis in such groups of people in the community.

Malini Kar and Logaraj (2010) did a population based cross-sectional study to assess the awareness, attitude, and treatment seeking behaviour regarding TB in rural Tamil Nadu. Out of 1985 people interviewed, 56% had heard of TB, but 80% were not aware of the cause and mode of spread of TB. Television was reported to be the main source of information (45%). Only 34% people were aware that treatment for TB

was available free of cost. Less than 10% people felt the need to maintain confidentiality, if contracted TB. More than 80% people preferred to visit Government hospital, if developed TB, whereas 54% actually sought treatment from government hospital for cough of more than three weeks.

India has the highest number of TB cases in the world (Malini Kar & Logaraj, 2010). After implementation of Revised National TB Control Programme using Directly Observed Therapy (DOTS) strategy, cure rate dramatically improved from 30% to more than 85% and has been consistently maintained at a satisfactory level. However, attainment of minimum level of case detection rate of 70% in order to have any long term impact in terms of reduction in incidence and prevalence rates has been proved to be a hard task. Information, Education, and Communication (IEC) is an integral and important strategy of the programme to create awareness among public, health care providers and policy makers. As the programme advocates passive case detection method, level of awareness regarding the common symptoms of TB plays the key role in timely seeking treatment. Similarly, the message regarding availability of free diagnosis and treatment facility for TB in government and selected private health centres needs to be widely known by general public, if we expect them to come forward to access the facility (Malini Kar & Logaraj, 2010).

A study by Ahmed *et al.* (2000) showed that 8% mines and industrial workers in Australia reported dislocation, 4% fracture of vertebrae column, 6% traumatic amputation, 12% open wounds, 28% contusion with intact skin surface and the most prevalent injury was sprains and strains, accounting for over 40% of all injuries. The injured workers attempted self-care, accessed the local medical services or waited until they flew home. According to a Foster *et al.* (2007) research on First Aid and Medical Treatment for the Injured in Australia indicated that at quarries and other surface mines, persons injured received less than adequate first aid, they were also inappropriately transported to hospital risking their health or worsening the injury

with potential serious consequences and majority of the mine workers were untrained in first aid.

According to WHO-ILO (2001), the prevention of occupational diseases calls for a multi-disciplinary approach. While health hazards should be controlled at source by engineering measures such as enclosure and effective ventilation, there are other complementary control measures including administrative control, use of suitable personal protective equipment (PPE), education, training and supervision of workers, environmental monitoring and health surveillance. Medical examination is a common means of conducting health surveillance whereby the health status of persons is monitored to determine departures from normal health, WHO-ILO (2000), so as to identify potential problem areas and the effectiveness of existing preventive strategies. Many occupational diseases are chronic in nature, having minimal early signs and may be difficult to treat or even incurable e.g. noise induced hearing loss (NIHL) and pneumoconiosis. Regular medical examination of workers who are exposed to particular health hazards at work can detect abnormalities or diseases at the early stage so that timely treatment can be given to increase the prospect of cure and reduce the cost of care.

To reduce health risks due to exposure to chemical and physical agents, both collective and individual preventive measures are currently adopted, together with the implementation of medical surveillance programmes that provide clinical evaluation at least once a year. In addition to health history and physical examination, specific laboratory tests are carried out every one or two years, such as spirometry and chest radiography in quarrymen exposed to dust, fumes, and gas, audiometry in those exposed to noise, and cold test with measurement of finger systolic blood pressure in users of vibratory tools (International Organization for Standardization, 1996).

To reduce exposure to loud noise when using pneumatic hammers, tools equipped with devices that reduce noise are being introduced. The LAeq associated with the use of silenced pneumatic hammers is about 103 dB. Moreover, the workers are trained to use hearing protectors against the noise produced during drilling or when operating close to sources of excessive noise. To reduce exposure to hand transmitted vibration, it is necessary to replace the older hammers with tools equipped with mechanical dumping devices. The frequency weighted acceleration magnitude of vibration produced by hammers equipped with anti-vibration devices varies from 4.5 to 8.5 ms^{-2} r.m.s. Anti-vibration gloves are not efficient in decreasing the transmission of hammer vibration to the hands, even though they protect from low temperatures and, as opposed to traditional gloves, do not impede movement (International Organization for Standardization, 1996).

To reduce exposure to whole body vibration (WBV) from industrial vehicles, such as loaders and excavators, the most recently built vehicles have ergonomic seats and are equipped with safety devices and shock isolating mountings. In such vehicles, the frequency weighted acceleration magnitude of vibration measured in the dominant axis ranges from 0.3 to 0.6 ms^{-2} r.m.s. To reduce exposure to inhalable dust, prevention measures include scrupulous wet cutting, cleaning of the work area by clearing away the mud by hand or with a mini-loader, and wetting the quarry floor and the access roads, especially in the drier seasons. During these operations, workers wear adequate personal protective equipment devices to protect respiratory airways and lungs (International Organization for Standardization, 1996).

With regard to exposure to diesel exhaust fumes and gases from the currently used vehicles, there are no reduction systems available on the market proven to be effective and easy to use. The use of integrated systems with oxidising catalytic converters and ceramic filters has recently started. Underground sites have been equipped with ventilation systems, adjustable according to the advancement of the exploitation. In some cases it has been possible to increase the natural ventilation by

adequately widening the emergency exits or by creating special openings (sometimes, though, this has worsened the climatic conditions inside, especially in the winter months, and has increased the discomfort of the workers). Organisational measures are adopted to prevent, as much as possible, the presence of workers on the quarry floor during the transit of vehicles. Sometimes during exploitation, due to the limited height under the vault, drivers of vehicles without cabs must wear suitable protective breathing equipment. To prevent sunstroke, organizational measures are regularly adopted to avoid work shifts during the hottest hours of the day during the summer season, and adequate clothing and suitable eye protection (unbreakable glasses with filter lenses) are provided. Manual handling of heavy loads is common in every work phase. The workers, who are specifically trained in safe handling practices, avoid handling of excessively heavy loads by using loaders or excavators to transport the various pieces of equipment, such as cables, hammers, jacks, cushions, etc. On some sites, where it is necessary to install derricks, the latter are also used to move heavy loads (International Organization for Standardization, 1996).

2.5 Regulation on occupational hazards in the mining sector

Kenya promulgated a new Constitution in August 2010. The constitution includes a chapter on the Bill of Rights, which provides for the rights and fundamental freedom of all citizens. Although the Constitution does not address occupational health and safety (OSH) specifically, it provides for the rights of every person to fair labour practices, reasonable working conditions, and a clean and healthy environment. The OSH services in Kenya are governed by two pieces of legislation: the Occupational Safety and Health Act, 2007 (OSHA 2007) and the Work Injury Benefits Act, 2007 (WIBA, 2007). The purpose of OSHA 2007, is to secure the safety, health and welfare of people at work, and to protect those not at work from risks to their safety and health arising from, or in connection with, the activities of people at work.

The purpose of WIBA (2007), is to provide compensation to employees for work-related injuries and diseases contracted in the course of their employment, and for connected purposes. According to The Laws of Kenya there are several regulations and subsidiary laws that deal with OSH issues, e.g. The Factories (First Aid) Rules, L.N. No. 160/1977; these Rules apply to workplaces, and require the occupier to put in place appropriate measures to ensure that those injured at work receive necessary medical attention. The Rules specify the contents of the first-aid box in accordance with the number of workers, and the training of first-aiders. The Factories (Eye Protection) Rules, L.N. No. 44/1978; these Rules apply to workplaces, and require the occupier to protect their employees against exposure that is injurious to the eyes. The Quarries Regulations (1999) are intended to protect the health and safety of people working at a quarry and others who may be affected by quarrying activities. These regulations apply to both employers and the self-employed and are also intended to safeguard people not working at the quarry (e.g. those living, passing or working nearby, or visiting, for example to buy materials). It is important to remember that a legal duty under one of these Regulations cannot be passed on to someone else by means of a contract. For example, an operator who appoints a contractor as explosives supervisor still has the ultimate legal responsibility under regulation 25 to ensure that explosives work is carried out safely.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Study Design

This was a cross-sectional descriptive study that collected data on occupational health and safety hazards associated with quarrying activities amongst the quarry workers in Mutonga quarry, Meru County.

3.2 Study population

The study population comprised all the quarry workers and the quarry manager of the Mutonga quarry.

3.2.1 Inclusion criteria

The quarry workers who met the following inclusion criteria were selected for the study:

- Those who had worked within the Mutonga quarry for more than one month,
- Those who were 18 to 60 years of age (retirement in Kenya is 60 years).
- Those who voluntarily consented to be in the study.

3.2.2 Exclusion criteria

Quarry workers who were exempted from the study were:

- Those who had worked within the Mutonga quarry for less than one month,
- Those who were below 18 years of age and above 60 years of age and
- Those who declined to consent to be in the study.

3.3 Sampling frame

The study aimed at assessing the occupational health and safety hazards of quarry workers, their health seeking behavior and the available health care options at Mutonga quarry which is a single extensive quarry. All the quarry workers were the study population (N) and each of the quarry workers was considered as a study unit. The study applied simple random sampling technique due to the large number of the

quarry workers and to ensure that each quarry worker had an equal chance of being selected for the study.

3.4 Sample and sampling technique

The following formula for estimating the sample size descriptive studies was used:

$$\mathbf{n = (Z^2_{1-\alpha/2}\, P\,(1-P)/d^{2)}}$$ (Fisher *et al.*, 1996) ……. (1)

where,

n = sample size

$\mathbf{Z^2_{1-\alpha/2}}$ = confidence interval which was taken as 95% giving a standard value of 1.96

P = estimated proportion, its anticipated that 50% of quarry workers reported an event due to their work.

d = desired precision, taken as 5%

$$\mathbf{n = Z^2_{1-\alpha/2}\, P\,(1-P)/d^2} \text{ …….. (2)}$$

$$\mathbf{n} = 1.96^2 * .50(1-.50)/.05^2$$

$$\mathbf{n} = 384,$$

After adjusting the sample size for refusals with the refusal rate taken as 10%.

n=384/ (1-10%) = 427.

The adjustment for refusals aimed at addressing the chance that some respondent would have declined to take part in the research hence the study targeted 427 respondents so as to achieve the required minimum sample size of 384. The following steps were carried out:

3. 4.1 defining the population

In this study, the population (N) was the quarry workers at Mutonga quarry. The population which is the total number of the quarry workers was obtained from the quarry manager's workers records. Since the interest of the study was the quarry workers, the sampling frame was also the population.

3.4.2 Listing the population

To select a sample of 427 quarry workers, a list of all the quarry workers at Mutonga was established from the quarry manager's record. Coded numbers were used in place of the names of the quarry workers.

3.4.3 Assigning numbers to the units

A consecutive number from 1 to N (the population- all the quarry workers) was assigned to the list of quarry workers obtained from the quarry manager.

3.4.4 Establishing the random numbers

A list of random numbers was generated using the online true number generator before selecting the sample of 427 quarry workers from the total list of quarry workers.

3.4.5 Selecting the sample

The 427 random numbers were selected from the random number table. The 427 random numbers selected formed the sample which was the number of the quarry workers to be invited to take part in the research.

3.5 Instruments

Data was collected over a period of two months using a semi-structured questionnaire. All questionnaires were in the English language, which is the national official language but the interviewer translated the questions to Kiswahili for those who were not in a position to comprehend. A questionnaire targeting the quarry workers and an in-depth interview for the quarry manager were used as the primary data collection tools. One on one interview was conducted in the field with the help of four trained field workers. Before going to the field, the field assistants were taken through a one day training to equip them with the data collection tools and also to understand the whole concept. The in depth interview for the quarry manager was conducted using a questionnaire as a guide and to probe after data collection from the quarry workers. Out of the entire workforce, a total of 427 workers were sampled

but only 408 respondents filled the questionnaire. Simple random sampling was employed in picking the respondents. Information to be sought included, *inter alia*, age, marital status, level of education, job description, place of residence, working conditions, workplace health and safety, occupational health related problems associated with quarrying activities, exposure factors of quarrying activities, the recent health problems of the quarry workers within the last one month, health seeking behavior of the quarry workers and the health promoting care within the quarry.

Secondary data on the health problems of the quarry workers was obtained from the 'quarry incidence record' with permision from the quarry manager. The information sought was summary statistics of health problems such as the injuries, illnesses and deaths of quarry workers within the last one month. In the summary statistics, no names or registrations of the quarry workers was used hence no one can trace the owner of the records. The principal investigator then created a password protected data base of both the primary and secondary data sets with Ms. Access 2010.

3.6 Pilot test

The questionnaire was pilot tested on 10 quarry workers from the Njiiru quarry in Embakasi Nairobi County to ensure that the questions were clear, the contents suitable, understandable and there wass sequence in the flow of questions. The questionnaire was then refined for final use . The pilot data was not included in the actual study but was only used to pre-test and validate the questionnaire.

3.7 Data collection procedure

Every questionnaire was cross-checked by the principal investigator before the research assistants could proceed to the next interview to ensure completeness of data. Where information was missing the interviewer revisited the respondent for further information unless they had initially declined to disclose. After data collection, double entry procreation was done using Ms. Access 2010. Coding and

verification of the data was done for easy manipulation. Preliminary analysis of the data was done to ensure that all variables were in a workable form before full analysis was done. The data was backed-up in electronic storage devices like DVDS, flash discs and computer hard drives to ensure safety in-case of system breakdown. The data storage was password protected and only the research team was able to access it. Data collected was strictly confidential and all information was filed and all files kept under lock and key in a cabinet. Access to data collected was authorized by the principle investigator.

3.8 Data processing and analysis

This was approached in three levels:

- Description of the study population characteristics. This was done using Statistical Package for Social Studies and involved use of frequency tables, measures of central tendency and dispersion. This allowed easier further analysis.
- Bivariate analysis of both the dependent and independent variables for health related problems of quarrying was done using Chi square test for association.
- Multivariate analysis to model occupational health hazard was done using logistic regression and the findings were presented in tables.

3.9 Ethical considerations

The project was presented to the Centre for Public Health Research, Scientific Steering Committee (SSC)-KEMRI and the National/KEMRI Ethical Review Board for approval before it was implemented. Permission to collect data was sought from relevant local administration authorities and quarry manager. To obtain consent for participation from the interviewees, the field assistants explained the nature of the study, its purpose, procedures, expected duration, the benefits and risks of participation, rights to privacy and confidentiality. A review and discussion of the consent was then done by the field assistant and the potential interviewee where she/he was encouraged to ask questions. The potential interviewee was then given

the opportunity to review the consent alone or was given more time to consult then voluntarily sign to consent. If a participant was unable to read or if the field assistant was concerned of his/her reading comprehension then the consent was read to him/her. If the potential interviewee spoke and understood English or Kiswahili, but did not read and write, they were enrolled in the study by making their mark (thumb print) on the consent document.

The secondary data of the quarry workers was obtained from the 'quarry incidence record' and 'quarry worker's register' with permision from the quarry manager. The information sought from the 'quarry incidence record' was summary statistics on the health problems such as the injuries, illnesses and deaths of quarry workers within the last one month of the quarry workers and no names of the quarry workers was used hence no one can trace the owner of the records. The list of all the quarry workers that was established from the quarry manager's register used coded numbers in place of the names or registration numbers of the quarry workers for confidentiality.

This study had no physical harm to the respondents however, there was a risk sharing some personal or confidential information by chance. The study was entirely based on the principle of voluntary participation where no coercion or intimidation was used to obtain any information. Data collected was strictly confidential and all information collected was filed and all files kept under lock and key in a cabinet. The data was backed-up in electronic storage devices to ensure safety in-case of system breakdown. The data storage was password protected and only the research team was able to access it after an authorization by the principle investigator.

This study was beneficial in that new information was to be obtained in light of the extent of knowledge in regards to the occupational health related problems associated with quarrying activities. This study provided a guide to concerned ministries and individuals to the kind of polices that can be implemented to promote better

occupational health and safety of quarry workers. The community also stood to benefit as they would be more sensitive to the issue of occupational health and safety. The study findings upon approval by the relevant authorities were submitted to a peer reviewed journal for publishing to reach a greater audience.

3.10 Expected application of results

The study's results are expected to be applied within the mining and quarrying industry in Kenya. Due to the lacking information on the exposure factors and health problems associated with quarrying activities, it was hoped that the local authorities and the management of quarries and mines in Kenya would take a more proactive approach to address the health and safety concerns of its workers. It was envisaged that the findings of the study would guide policy makers and community leaders on polices that can be implemented to promote better occupational health and safety for quarry worker.

3.11 Study limitations

Since this research was based on a case study within which a general population of other quarries can be inferred to, it is limited for broader generalizations hence additional empirical evaluations from other quarries are needed to duplicate the study's findings in varying surroundings and contexts.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the results of the study. In regards to this case study demographic and descriptive statistics are used to present then results in tables. The interpretation and discussion of the data analysis is in the form of frequencies and descriptive statistics. The data has been analyzed and presented based on the objectives of the study.

4.2 Quarrying activities

The first objective of the study was to profile the types of quarrying activities conducted at Mutonga quarry. The demographic information is presented in (Table 4.1) and the quarrying activities in (Table 4.2). The average age group of the respondents was 34 years. There was a higher proportion of males (87%, 355) compared to females (13%, 53) working in the quarry. Upto (53.2%, 217) of the respondents were living elsewhere from Mutonga while (46.8%, 191) lived in Mutonga, (62.5%) of the respondents had attained primary education, and (52.9%) of the respondents were married, (10.3%) were a separated or divorced.

Table 4.1: Distribution of respondents according to gender, education, marital status, residence area and age.

Age			**Marital status**		
Category	Frequency	Percentage	Category	Frequency	Percentage
18-25years	98	24	Single	131	32.1
26-35 years	148	36.3	Married	216	52.9
36-45 years	126	30.9	Separated/ Divorced	42	10.3
46-60 years	36	8.8	Widower	19	4.7
Total	408	100%	Total	408	100%

Gender			**Residence**		
Category	Frequency	Percentage	Category	Frequency	Percentage
Male	355	87.0%	Mutonga	191	46.8%
Female	53	13.0%	Elsewhere	217	53.2%
Total	408	100%	Total	408	100%

Highest education level		
Category	Frequency	Percentage
None	15	3.7
Primary	255	62.5
Secondary	122	29.9
College	16	3.9
Total	408	100%

Table 4.2 presents the type of quarrying activities carried out at Mutonga quarry in Meru. The results revealed that (23%, 94) of the respondents were cutting rock blocks into specific sizes and15% loading rocks into Lorries and trucks. The respondents on contract terms were (49.5%, 202) while 43.6% were casual labourers. The frequencies of carrying out the quarrying activities show (74.3%) of the respondents to be between 5 to 6 days and (76%) of the respondents indicated they carried out the activities on a full day time schedule. The total number of respondents (408) reported to have no formal training in quarrying activities and advocated for was observational/ on job training.

Table 4.2: Distribution of responses on quarry activity, work terms, work schedule, frequency of carrying out the activity and mode of training offered.

		F	%
Quarry activity	Excavation	53	13
	Stone broker	14	3.4
	Food vendor	11	2.7
	Drilling	43	10.5
	Cutting rock blocks into specific sizes	94	23
	Lifting cut rocks from quarry pits	47	11.6
	Loading rocks into lorries/trucks	61	15
	Removing crushed rock aggregates from quarry pit	51	12.5
	Draining water from the quarry pit	18	4.4
	Cooking for quarry workers	16	3.9
	Total	408	100
		F	%
Frequency of carrying out the activity	Daily	26	6.4
	5-6 days	303	74.3
	2-4 days	66	16.1
	Once a week	13	3.2
	Total	408	100
		F	%
Mode of learning on how to carry out the activity	On job training/ Observation	408	100
	Total	408	100
		F	%
Work terms	Causal	178	43.6
	Contract	202	49.5
	Permanent	28	6.9
	Total	408	100
		F	%
Work schedule	Morning shift	51	12.5
	Afternoon shift	39	9.6
	Full day-time	310	76
	Irregular shift	8	1.9
	Total	408	100

4.3 Exposure to health hazards

The second objective of the study was to identify the occupational health and safety hazards experienced by Mutonga quarry workers. The respondents were asked to

indicate whether working in the quarry exposed them to health hazards. Table 4.3 reveals that 87.3% of the respondents indicated that there was presence of dangerous aspects of the work in the quarry that can harm their health. Some of the hazards involved with the quarrying activities carried out by the respondents were indicated as: manual handling of heavy loads, being hit by the tools, exposure to dust and falling of rock block. Some of the harms suffered by the respondents in the quarry while on duty were contusion with intact skin surface, pain/problem in nose, throat, sinuses, back, shoulder and neck (Table 4.3).

Table 4.3: Distribution of responses on exposure to health hazards.

		F	%
Presence of dangerous aspects in the respondent quarry activity	No	52	12.7
	Yes	356	87.3
	Total	408	100
		F	%
Hazards involved with the quarry activity carried out by the respondent	None	42	10.3
	Falls from height	6	1.4
	Falling rock block	27	6.6
	Fumes	10	2.5
	Slips/trips	10	2.5
	Dust	51	12.5
	Manual handling of heavy loads	173	42.4
	Cuts	15	3.7
	Being hit by the tools	60	14.7
	Stagnant water	14	3.4
	Total	408	100
		F	%
Harm suffered by respondent while carrying out quarrying activity	None	48	11.8
	Pain/problem in nose, throat, sinuses	37	9.1
	Skin diseases or infections	8	2
	Dislocation	10	2.5
	Cut/open wound	12	2.5
	Contusion with intact skin surface	121	29.7
	Fractures	10	2.5
	Mosquito bites	8	2
	Breathing difficulties or lung pain	8	2
	Pain/problem in neck	17	4.2
	Pain/problem in shoulder	57	14
	Pain/problem in arm, wrist, hand	9	2.2
	Pain/problem in the back	42	10.3
	Pain/problem in the feet/legs	10	2.5
	Eye strain or eye problem	11	2.7
	Total	408	100

4.4 Health promotive measures and health seeking behaviour

The study sought to determine the preventive measures and health seeking behavior of the quarry workers. The results are presented in table 4.4 and table 4.5. The results indicate that 86.8% of the respondents had been trained on safety precautions, 74.8% indicated that they did not use protective clothing while at work and those who used they only used gloves, overall and gumboots. The respondents indicated the reasons for not using protective clothing as being too expensive to buy and the protective clothing were not provided by the employer. A majority (60.8%) of the respondents indicated that they were not trained on first aid methods and practices, though in the quarry there were trained individuals to offer first aid in case of emergencies. Majority 65.2% of the respondents were insured and the most appropriate way emergencies were handled was through giving first aid to the casualty.

Table 4.4: Health promotion measures by respondents

		F	%
Use of protective clothing (PPE)	No	305	74.8
	Yes	103	25.2
	Total	408	100
Type of PPE used	None	310	76
	Gloves	38	9.3
	Overall	30	7.4
	Gumboots	22	5.3
	Old/dirty cloth	8	2.0
	Total	408	100
Source of PPE used by respondent	Employer	0	0
	Employee/quarry worker	100	24.5
	No provider	308	75.5
	Total	408	100
Reasons why quarry workers don't use PPE	Don't know what is PPE	18	4.4
	Not available in the local area	18	4.4
	No need to use them	58	14.2
	Not provided by employer	137	33.6
	Expensive to buy	177	43.4
	Total	408	100
Training on quarrying safety precautions	No	354	86.6
	Yes	54	13.2
	Total	408	100
Trained in first aid	No	248	60.8
	Yes	160	39.2
	Total	408	100
First aid providers in quarry	No first aid provider	5	1.2
	Trained individual	403	98.8
	Total	408	100
Emergency services available	No	6	1.5
	Yes	402	98.5
	Total	408	100
ways emergencies are handled	Giving first aid to victim	222	54.4
	Taking victim to hospital	157	38.5
	Calling Meru Red cross	29	7.1
	Total	408	100
Respondent had insurance cover	No	142	34.8
	Yes	266	65.2
	Total	408	100

Table 4.4 above shows that the respondents had poor health seeking behavior and this is supported by the study findings in Table 4.5 below. A majority (74.3%) of the respondents indicated that they had suffered an injury in the quarry for the last one month; however the respondents did not report the injuries and majority (45.09%) did not seek any kind of treatment while injured. The respondents indicated that they did not receive regular medical examination while working at the quarry.

Table 4.5: Health seeking behaviour

		F	%
Injury in the last one month	No	105	25.7
	Yes	303	74.3
	Total	408	100
Reported injury	No	269	65.9
	Not injured	105	25.7
	Yes	34	8.3
	Total	408	100
Respondents sought treatment while injured	No	184	45.09
	Not injured	105	24.3
	Yes	119	29.2
	Total	408	100
Place sought treatment	Not injured	105	25.7
	Self-care	187	45.83
	Local private hospital	99	24.3
	Local government hospital	17	4.2
	Total	408	408
Respondent receives regular medical check ups	No	397	97.3
	Yes	11	2.7
	Total	408	100
Had a medical checkup in last month	No	398	97.5
	Yes	10	2.5
	Total	408	100
Medical examination performed	None	400	98
	General physical examination	8	2
	Total	408	100

4.5 Factors associated with being Ill at the quarry

The respondents were asked to indicate the factors associated by having health problems at the quarry. Results indicated that majority 63.7% of the respondents indicated that blasting was associated by having health problems, 74.8% indicated drilling was associated with having health problems and 56.4% indicated that

shaping stones was associated with having health problems. However 53.2% of the respondents indicated that loading the trucks with rocks was not associated with having health problems (Table 4.6).

Table 4.6: Factors associated with being ill at quarry

Statement		Frequency	Percent
Is blasting associated with having health problems at quarry	No	148	36.3
	Yes	260	63.7
	Total	408	100
Is drilling associated with having health problems at quarry	No	103	25.2
	Yes	305	74.8
	Total	408	100
Is shaping stones associated with having problems at quarry	No	178	43.6
	Yes	230	56.4
	Total	408	100
Is loading trucks associated with having health problems at quarry	No	217	53.2
	Yes	191	46.8
	Total	408	100

4.6 Bivariate analysis

4.6.1 Relationship between demographics characteristics and occupational hazards

Relationship between gender and occupational hazards are statistically significant (χ^2, = 79.921, df(1), P=0.000). Level of education was a significant factor to occupational hazards (χ^2 (1) = 12.015, df(1), P=0.007). Marital status and area of residence in the study was not a significant factor to occupational hazards (Table 4.7).

Table 4.7: A cross tabulation of demographic characteristics against occupational hazards

		Occupational hazards		
		Yes	No	Chi-square
Gender	Male	330	25	
	Female	26	27	79.921(p=0.000)
Marital status	Single	112	19	
	Married	191	25	
	Divorced/ separated	35	7	
	Widower	18	1	2.168(p=0.538)
Education	None	15	0	
	Primary	221	34	
	Secondary	110	12	
	College	10	6	12.015(p=0.007)
Residence	Mutonga	169	22	
	Elsewhere	187	30	0.486(p=0.486)

4.7 Multivariate analysis

Binary logistic regression was used to model occupational health hazard.

4.7.1 Relationship between health promoting measures and occupational health hazard

Table 4.8 shows that use of protective clothing was statistically associated with occupational health hazards (P<0.002). Who provided the protective clothing (PPE) (P<0.004) and whether the respondents was insured (P<0.021) were also statistically associated with occupational health hazards.

Table 4.8: Logistic regression predicting occurrence of health hazards using preventive measures such as use of protective clothing, first aid provider

Variable	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I. for EXP(B)	
							Lower	Upper
Trained on safety precautions	0.011	0.631	0	1	0.986	0.989	0.287	3.409
Uses PPE	-3.97	1.312	9.151	1	0.002	52.99	4.046	693.92
PPE used	0.196	0.248	0.625	1	0.429	1.217	0.748	1.979
PPE provider	-3.797	1.325	8.209	1	0.004	0.022	0.002	0.301
First aid trained	0.763	0.393	3.772	1	0.052	2.144	0.993	4.631
First aid provider	0.357	0.94	0.144	1	0.704	1.429	0.226	9.025
Emergency services available at quarry	-0.129	1.132	0.013	1	0.91	1.137	0.124	10.455
Insured	-0.732	0.317	5.332	1	0.021	2.079	1.117	3.868
Constant	0.736	1.423	0.267	1	0.605	2.087		

4.7.2 Relationship between health seeking behavior and occupational health Hazard

Table 4.9 shows that the respondents injured in the last one month were statistically associated with occupational health hazards (P<0.028).

Table 4.9: Logistic regression predicting occurrence of health hazards using health seeking behaviour

Variable	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I. for EXP(B)	
							Lower	Upper
Injured in last one month	-2.172	0.991	4.801	1	0.028	8.772	1.257	61.194
Injury booked	-0.474	0.645	0.539	1	0.463	0.623	0.176	2.205
Sought treatment while injured in last one month	-0.586	0.685	0.732	1	0.392	0.556	0.145	2.132
Type of treatment sought	-0.535	0.396	1.826	1	0.177	0.585	0.269	1.273
Regular medical examination	5.087	4.124	1.522	1	0.217	0.006	0	20.002
Examined in last one month	-2.114	1.888	1.254	1	0.263	8.282	0.205	334.78
Medical exam	1.054	1.298	0.659	1	0.417	2.868	0.225	36.504
Constant	2.5	0.996	6.297	1	0.012	12.188		

CHAPTER FIVE
DISCUSSION

5.1 Introduction

This chapter presents the findings of the study and the relevant discussions. The study sought to assess the occupational health related problems of Mutonga quarry workers, their health seeking behaviour and the available health care options. The discussion is done in line with the objectives of the study based on the output of the descriptive and inferential statistical analyses.

5.2 Response Rate

An overall response rate of 100 % (408/408) was achieved in the study. This means that the results are adequately representative of the target population from which it was drawn.

5.3 Quarrying Activities

The first objective of the study was to profile the types of quarrying activities conducted at Mutonga quarry. Results revealed that majority (23%, 94) of the respondents indicated that they were cutting rock blocks into specific sizes and others loading rocks into lorries and trucks. A majority (49.5%, 202) of the respondents were on contract terms while 43.6% were casual labourers. Results too indicated the frequencies of carrying out the quarrying activities was (74.3%) between 5-6 days and majority (49.5%) of the respondents indicated they carried out the activities on a full day time schedule. These activities are carried out in order to meet the need of raw materials by the building and construction industry. The findings are consistent with (Vulcan Materials Company, 2005) who asserts that rock quarrying and stone crushing is a necessity that provides much of the materials used in traditional hard flooring, such as granite, limestone, marble, sandstone, slate and even just clay to make ceramic tiles. The respondents were asked to indicate if they had attained any form of training on the quarry activities, majority (98%, 400) indicated they were not trained and the only form of training that was advocated for was observational/ on job training. This agrees with the NEMA (2010) report that the Kenya quarry population lacks technical education on quarrying.

5.4 Occupational health Hazards

The second objective of the study was to identify the occupational health hazards faced by Mutonga quarry workers. Results revealed that 87.3% of the respondents indicated that there was presence of dangerous aspects of the work in the quarry that could harm their health. Some of the hazards involved with the quarrying activities carried out by the respondents were manual handling of heavy loads, being hit by the tools, exposure to dust and falling of rock block. This is in line with the findings that a significant proportion of health problems and fatalities in the quarrying sector in Africa are associated with manual operations, (Chigonda, 2010). The findings also agree with those by Michelo *et al.* (2009), who reported 165 injuries and 20 fatalities in Zambia with rock fall as the major cause of injuries. Some of the harms suffered by the respondents in the quarry while on duty are contusion with intact skin surface, pain/problem in nose, throat, sinuses, back, shoulder and neck. The study findings are consistent with those in Encyclopædia Britannica (2011) which asserted that quarrying operations generate large quantities of dust that cause a variety of respiratory diseases amongst quarry workers. Pneumoconiosis, the general term given to a range of lung diseases caused by breathing dusts, typically causes chest tightness, shortness of breath and coughing); and also consistent with (ESAW, 2007) survey report that manual workers reported more often work-related health problems than non-manual workers with 13% of workers in the mining and quarrying sectors reporting back problems, neck, shoulder, arm or hand problems - musculo-skeletal problems were reported most often as the main work-related health problem (59.8 %); and also in agreement to the findings of a study conducted by Nwibo *et al.* (2012) in Ebonyi State, Nigeria to determine the prevalence of respiratory problems and lung function impairment among quarry workers; the respiratory problems found were chest pain (47.6%), occasional cough (40.7%), occasional shortness of breath (6.5%) and wheezing (5.2%); and a similar study by Olusegun, *et al.* (2009) on the impact of granite quarrying on the health of workers in Abeokuta Ogun State, Nigeria established that, 26% of the workers suffered predominantly from cough, 20% from catarrh and 15% from sinusitis. Crystalline silica has long been a serious

hazard in quarrying with the risk of silicosis and has been subject to considerable investigation. Prolonged exposure to crystalline silica can also cause chronic obstructive pulmonary disease Mannetje *et al.* (2002).

The use of hand-held vibrating tools in quarries causes a health problem known as Hand–Arm Vibration Syndrome (HAVS) whose symptoms include tingling, numbness, loss of grip strength and pain. Nyantubu *et al.* (2007) conducted a study at a selected quarry site in South Africa where 156 workers with occupational exposure to vibration, and 140 workers with no exposure to vibration were randomly selected for study. The results showed that the prevalence of HAVS in vibration-exposed workers was 15%, with a mean latent period of 5 to 6 years compared to the non-exposed comparison 5% prevalence. The two groups however gave a history of exposure to rock drills.

5.5 Health seeking behavior and health care for quarry workers

The study sought to determine the health promotive measures and health seeking behaviour of the quarry workers. Results indicate that 86.8% of the respondents had been trained on safety precautions, 74.8% indicated that they do not use protective clothing while at work and those who used they only used gloves, overall, gumboots and old clothes. The respondents indicated the reasons for not using protective clothing as being too expensive to buy, the protective clothing were not provided by the employer and that there was no need to use them. The study findings disagree with the regulations of International Organization for Standardization (1996) who reported that to reduce health risks due to exposure to chemical and physical agents, both collective and individual preventive measures are currently adopted, together with the implementation of medical surveillance programmes that provide clinical evaluation at least once a year.

In addition to health history and physical examination, specific laboratory tests are recommended by International Organization for Standardization (2011) to be carried out every one or two years, such as spirometry and chest radiography in quarrymen exposed to dust, fumes, and gas, audiometry in those exposed to noise, and cold test

with measurement of finger systolic blood pressure in users of vibratory tools. To reduce exposure to inhalable dust, prevention measures include scrupulous wet cutting, cleaning of the work area by clearing away the mud by hand or with a mini-loader, and wetting the quarry floor and the access roads, especially in the drier seasons. During these operations, workers wear adequate personal protective equipment devices to protect respiratory airways and lungs.

A majority (60.8%) of the respondents indicated that they were not trained on first aid methods and practices, though in the quarry there was a trained individual to offer first aid in case of emergencies. Majority 65.2% of the respondents were insured and the most appropriate way emergencies were handled was through giving first aid to the casualty. The study findings indicated that the respondents had poor health seeking behaviour. A majority (74.3%) of the respondents indicated that they had suffered an injury in the quarry for the last one month; however the respondents did not report the injuries and did not seek any kind of treatment while injured. The respondents indicated that they did not receive regular medical examination while working at the quarry.

International Organization for Standardization (1996) agrees with WHO-ILO (2001) that prevention of occupational diseases calls for a multi-disciplinary approach. While health hazards should be controlled at source by engineering measures such as enclosure and effective ventilation, there are other complementary control measures including administrative control, use of suitable personal protective equipment (PPE), education, training and supervision of workers, environmental monitoring and health surveillance. Medical examination is a common means of conducting health surveillance whereby the health status of persons is monitored to determine departures from normal health, WHO-ILO (2000), so as to identify potential problem areas and the effectiveness of existing preventive strategies. Many occupational diseases are chronic in nature, having minimal early signs and may be difficult to treat or even incurable e.g. noise induced hearing loss (NIHL) and pneumoconiosis. Regular medical examination of workers who are exposed to particular health

hazards at work can detect abnormalities or diseases at the early stage so that timely treatment can be given to increase the prospect of cure and reduce the cost of care. This further agrees with Malini Kar and Logaraj (2010) who did a population based cross-sectional study to assess the awareness, attitude, and treatment seeking behaviour regarding TB in rural Tamil Nadu.

CHAPTER SIX
CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents conclusions and recommendations from the study findings built from the study objectives.

6.2 Conclusions

- It can be concluded from this study that there are occupational health and safety hazards associated with quarrying activities at Mutonga quarry.
- The respondents shown awareness of the presence of occupational health and safety hazards and the related problems associated with quarrying activities.
- The study also concludes that high proportion of the respondents sought to taking care of themselves (self-remedy) in case of health problem or emergencies compared to accessing treatment in local health facilities.
- The quarry workers at Mutonga were insufficiently equipped with the occupational safety knowledge and PPE to comprehensively mitigate the occupational health and safety hazards.

6.3 Recommendations

To reduce occupational health related problems associated with quarrying activities amongst the quarry workers, the following collective and individual health promotive measures should be adopted:-

- The quarry owners and managers should ensure that they adhere to regulations on occupational hazards which provides for the rights of every person to fair labour practices, reasonable working conditions, and a clean and healthy environment.
- Since manual handling of heavy loads is common in every work phase and quarry activity, the workers should be educated and trained in safe handling practices to avoid manual handling of excessively heavy loads by resorting to the use of loaders or excavators to transport the various pieces of equipment,

such as cables, hammers, jacks, cushions, and rock blocks. They should also be made aware of the health promotive measures such as use of protective clothing and equipment which should be provided by the quarry management and quarry owners.

- There should be implementation of medical surveillance programmes that provide clinical evaluation at least once a year for the quarry workers. In addition to health history and physical examination, specific laboratory tests should be carried out every one year, such as spirometry and chest radiography in quarry workers exposed to dust, fumes, and gas, audiometry in those exposed to noise, and cold test with measurement of finger systolic blood pressure in users of vibratory tools so as to identify potential health problem and the effectiveness of existing preventive strategies. This is important because many occupational diseases are chronic in nature, having minimal early signs and may be difficult to treat or even incurable, in particular, noise induced hearing loss (NIHL) and pneumoconiosis. The regular medical examination of the workers who are exposed to particular health hazards at work can detect abnormalities or diseases at the early stage so that timely treatment can be given to increase the prospect of cure and reduce the cost of care.
- The government should also ensure that all places carrying out quarrying and mining activities are well researched on and communicated to the public on the laws and regulations to be adhered to in order to enhance safety of human beings and environment. The prevention of occupational health related problems associated with quarrying activities calls for a multi-disciplinary approach such as controlling health hazards at source by instituting measures; use of administrative control, use of suitable personal protective equipment (PPE), education, training and supervision of workers, environmental monitoring and health surveillance.

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APPENDICES

Appendix 1: Informed Consent Form

TITLE: AN ASSESSMENT OF OCCUPATIONAL HEALTH RELATED PROBLEMS ASSOCIATED WITH QUARRYING ACTIVITIES IN KENYA: A CASE STUDY OF MUTONGA QUARRY, MERU COUNTY.

RESEARCHERS STATEMENT

I am Maryrose Wambui Wanjiku a student at Jomo Kenyatta University of Agriculture and Technology. I am doing research on occupational health related problems associated with quarrying activities. I am going to invite you to be part of this research. You do not have to decide today whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research. Please ask me to stop any time as we go through the information and I will take time to explain. If you have questions later, feel free to ask them to me.

PURPOSE

The aim of this study is to assess the health related problems associated with quarrying activities amongst the quarry workers in Mutonga quarry and is purely academic in partial fulfillment for the award of Master of Science Degree in Public Health.

STUDY PROCEDURE

This research will involve your participation in answering loosely structured questionnaire that will take about one hour to complete. You are being invited to take part in this research because we feel that your input as a quarry worker will

contribute much to our knowledge in occupational health related problems associated with quarrying activities. If you wish to participate, the chief researcher requests that you give permission by signing the consent form.

RISKS

No physical harm will come to you as you take part in the research however, there is a risk that you may share some personal or confidential information by chance, or that you may feel uncomfortable talking about some of the topics. However, we do not wish for this to happen. You do not have to answer any question or take part in the research if you feel the questions are too personal or if talking about them makes you uncomfortable.

BENEFITS

Your participation is likely to help us find out more about occupational health related problems associated with quarrying activities and also guide policy makers and community leaders on polices that can be implemented to promote better occupational health and safety for quarry worker.

CONFIDENTIALITY

We will not be sharing information about you to anyone outside of the research team. The information that we collect from this research will be kept private. Any information about you will have a number on it instead of your name. Only the researcher will know what your number is and we will lock that information up with a lock and key. It will not be shared with or given to anyone who is not part of the research team.

VOLUNTARY

Your participation in this research is entirely voluntary. It is your choice whether to participate or not. You may change your mind later and stop participating even if you had agreed earlier. If you withdraw your information will be confiscated so that no other person can have access to it.

CONTACT INFORMATION

If you have any questions or concerns about the study or in the event of a study related injury you may contact me:

MARYROSE WAMBUI WANJIKU

or my supervisors**:**

DR. CHARLES MBAKAYA,

KENYA MEDICAL RESEARCH INSTITUTE,

CENTRE FOR PUBLIC HEALTH AND RESEARCH,

PROF. CIIRA KIYUKIA,

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY,

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KEMRI ETHICS REVIEW COMMITTEE,

P.O. BOX 54840-00200,

NAIROBI.

TELEPHONE NUMBERS 020-2722541, 0722205901, 0733400003

EMAIL:erc-secratariat@kemri.org

PARTICIPANT STATEMENT

I have read the foregoing information and have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study

Name of participant…….

Signature/thumb print ……

Date ……

Name of witness ……

Signature o witness……..

RESEARCHER STATEMENT

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands all information. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily**.** A copy of this ICF has been provided to the participant**.**

Name of Researcher …… Signature…..……..

Date……

Appendix 2: Kiswahili translated consent form

UTAFITI KUHUSU SHIDA ZINAZOHUSIANA NA SHUGHULI ZA CHIMBO NCHINI KENYA: UCHUNGUZI KATIKA CHIMBO LA MUTONGA KATIKA KAUNTI YA MERU.

KAULI YA MTAFITI

Jina langu ni Maryrose Wambui mwanafunzi katika Chuo Kikuu Cha Jomo Kenyatta.Ninafanya utafiti kuhusu matatizo ya kiafya yanayohusiana na shughuli za chimbo. Ninakualika uwe mmoja wapo wa utafiti huu na si lazima ufanye uamuzi leo ili kuhusika.Kabla ya kufanya uamuzi huu, ni vyema uzungumze na mtu yeyote kuhusu utafiti huu.

Una uhuru wa kunikatiza au kuuliza swali lolote na nitakueleza kwa kina usipoelewa.

LENGO LA UTAFITI

Madhumuni ya utafiti huu ni kuchanganua matatizo yanayoletwa na shughuli za chimbo miongoni mwa wafanyikazi katika chimbo la Mutonga. Aidha, nia ya utafiti huu ni mojawapo ya mahitaji ya kufuzu kwa Shahada ya Uzamili ya Sayansi ya Afya ya Umma.

UTARATIBU WA UTAFITI

Utafiti huu utakushirikisha kwa kuyajibu maswali kadhaa kwa muda usiozidi saa moja. Unahusiswa kwa utafiti hususani kwa kuwa mchango wako kama mfanyikazi katika chimbo hili utatusaidia pakubwa kuelewa kwa kina matatizo ya kiafya yanayosababishwa na shughuli za chimbo. Iwapo unakubali kuhusishwa Mtafiti mkuu anakusihi uhakikishe kwa kutia sahihi kwenye fomu ya kibali.

ADHARI/HATARI

Hakuna tishio lolote au madhara yoyote ya kimwili yatakayokukumba kwa kuhusika kwa kushiriki katika utafiti huu, lakini utakumbana na maswala ya kibinafsi na kisiri. Una haki na uhuru wa kukataa kujibu maswala unayohisi yanaadhiri maisha yako ya kibinafsi na si nia yetu kwamba itendeke hivyo.

MANUFAA

Kushiriki kwako kwa utafiti huu kutasidia katika ari yetu ya kuchanganua matatizo ya kiafya yanayosababishwa na shughuli za chimbo na vilevile kuelekeza washika dau na viongozi wa jamii kubuni sera zitakazoboresha afya na usalama wa mfanyikazi wa chimbo.

USIRI

Matokeo, majibu au maswala yoyote yatakayotokana na utafiti huu hayatatolewa kwa mtu yeyote nje ya timu ya utafiti huu. Lolote tutakalokusanya kwenye utafiti huu, litakuwa la siri na swala lolote lile linalokuhusu litakua na nambari ya siri baadala ya jina lako. Ni mtafiti tuu atakayekuwa na nambari hizi na mtu yeyote asiyehusika na utafiti huu hataweza wala kuruhusiwa kupata na kutumia swala lolote la utafiti huu.

HIARI

Kushiriki kwako kwenye utafiti huu ni kwa hiari na ni chaguo lako kushiriki au kukataa. Unaweza kubadili mawazo yako baadaye hata kama ulikua umekubali hapo awali na hutalazimishwa kushiriki. Ukiamua kuondoa mchango wako, maswala yote uliochangia yatakua ya siri na mtu mwingine hatayapata wala kuyatumia.

ANWANI

Ukiwa na maswali au maelezo yoyote kuhusu utafiti huu au kisa chochote kinachohusiana na utafiti huu, wasiliana nami kwa anwani ifuatayo:

MARYROSE WANJIKU WAMBUI,

Au wasimamizi wa utafiti huu:

Dr. CHARLES MBAKAYA,

KENYA MEDICAL RESEARCH INSTITUTE, CENTRE FOR PUBLIC HEALTH RESEARCH,

PROF. CIIRA KIYUKIA,

JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY, COLLEGE OF HEALTH SCIENCES,

MR. LAWRENCE MUTHAMI,

KENYA MEDICAL RESEACH INSTITUTE, CENTRE FOR PUBLIC HEALTH RESEARCH.

KEMRI ETHICS REVIEW COMMITTEE ,

S.L.P 54840-00200, NAIROBI.

NAMBARI YA SIMU-020-2722541, 0722205901, 0733400003

BARUA PEPE:erc-secretariat@kemri.org

KAULI YA MSHIRIKI

Nimesoma habari hii na nimekuwa na nafasi ya kuuliza maswali kuihusu na maswali yote nilioulizia nimejibiwa na kuridhika. Nakiri kwa hiari kuwa mshiriki katika utafiti huu.

Jina la mshiriki.....

Sahihi……..

Tarehe……....

Jina la shahidi……

Sahihi ya shahidi……

Tarehe……....

KAULI YA MTAFITI

Nimesoma kwa usahihi karatasi ya maelezo kwa mshiriki mtarajiwa, na kwa kadri ya uwezo wangu na kuhakikisha kwamba mshiriki anaelewa kila habari. Ninathibitisha kwamba mshiriki alipewa nafasi ya kuuliza maswali kuhusu utafiti huu, na maswali yote yaliyoulizwa na mshiriki nikayajibu kwa usahihi kadri ya uwezo wangu. Ninathibitisha kwamba mshiriki binafsi hajashurutishwa katika kutoa idhini, na ridhaa imetolewa kwa uhuru na hiari. Nakala ya hii imetolewa kwa mshiriki.

Jina la mtafiti……

Sahihi ya mtafiti ……

Tarehe……....

Appendix 3: Questionnaire for the quarry workers

Questionnaire S/NO_____

AN ASSESSMENT OF OCCUPATIONAL HEALTH RELATED PROBLEMS ASSOCIATED WITH QUARRYING ACTIVITIES IN KENYA: A CASE STUDY OF MUTONGA QUARRY, MERU COUNTY.

Questionnaire for the quarry workers

Interviewer name_____

Date_____

(Read and ask respondent to sign informed consent form before proceeding with interview)**.**

Section 1: Socio-demographic profile

1. Age [in complete years] _____

2.Gender:

Male=1 Female=2

3. Marital status:

Single=1, Married=2, Divorced/separated=3, Widow/widower=4

4. Where do you live?

Within Mutonga=1, Elsewhere, specify _____

5. Highest Education Level: None=0, Primary=1, Secondary=2, College=3

Section 2: Quarrying Activities

6.a) Please explain to me the activity *(work)* that you do in the quarry? _____

_____

6.b) Which of the following best describes your work terms in the quarry?

Casual =1, permanent=2, contract=3

7. For how long have you carried out the activity? [Duration in months]_____

8. How often do you work in the quarry?

Daily =1, 5-6 days=2, 2-4 days =3, Once a week=4

9.a) Which of the following best describes your usual work schedule in the quarry?

Full-day-time= 1, Morning shift=2 Afternoon shift3, Night shift=4, Irregular shift=5[ ]

9.b) How many hours do you work in a day?(time in hours)_____

10. How did you learn how to do this activity?

_____

_____

11. Have you received any kind of training for the activity?

Yes =1 No=0

If yes state the training.

_____

_____

Section 3: Exposure to Health Hazards

12a) Is there any aspect(s) of your work in the quarry that is dangerous or harms your health?

Yes =1 No=0

b) If yes, please give one main dangerous aspect of your work _____

c) What harm does it do to you ?_____

13a). Have you ever suffered any accidental injury while at work in the last one month?

Yes=1 No=0

b) If yes, please explain_____

14. The list below is of specific health problems, have you had any of them? If yes were they caused by your work and how?

Have you suffered any…….	Work related? (yes/no)	If yes, how is it related to your work?
..pain or problems in your throat, nose or sinuses?		
..breathing difficulties or lung pain (e.g. asthma, TB, pneumonia)		
.. hearing loss		
..pain or problems in you neck, shoulder, arm, wrist or hand		
..pain or problems in your back		
..pain or problems in your legs or feet		
eye strain or eye problems		
..skin diseases or infections		

Other, specify the problem(s)

_____

Section 4:-Preventive and health promotive care

15. Have you ever been trained on safety precautions Yes=1, No=0

16.a) Do you use personal protective gears/equipment while carrying out the activity you stated in question (6)?

Yes =1, No=0

b) If yes, list the personal protective gears/equipment you use

_____

c) What is the ownership of the personal protective gears/equipment you use.

own (personal)=1, provided by employer=2

other type of ownership please specify_____

d) If no, please state the reason(s) you don't use personal protective gears/equipment.

_____

_____

_____

17. Do you have any first-aid training?

Yes=1, No=0

18.a) Are emergency services available in the quarry?

Yes =1, No=0

b) If yes, who provide the emergency service?

The management=1, Trained individuals (quarry workers) =2

[ ]

c) Others, please specify

_____

19. Please explain how emergences are handled in the quarry

_____

_____

_____

20. Do you have an insurance cover? Yes =1 No=0

Section 5: Health Seeking Behavior

21.a) In the past one month have you been injured on the quarrying activity [as stated in question 6]?

Yes =1, No=0

b). If yes, please fill in the following table.

Quarrying activity stated in (6)	Part of body injured	Nature of injury	Action taken

c.) was the injury reported for recording in the incidence record

yes -=1 No=2

22. a) Did you seek treatment when you were ill or injured within the last one month.

Yes=1, No=0

b. If yes, where do you seek the service from?

Self-care=1, Local health institutions=2, Tradition healers=3

Other(s), please specify ……

23. Have you been receiving regular medical examination while working at the quarry?

Yes=1, No=0

24.a) In the last one month have you had a medical examination?

Yes=1, No=0

b) If yes [question 24a], please explain

_____

_____

_____

I have come to the end of my questions do you have any comments about your health and safety at work, or how it can be improved? _____Thank you

Appendix 4: Kiswahili translated questionnaire for the quarry workers

Hojaji Nambari_____

UTAFITI KUHUSU SHIDA ZINAZOHUSIANA NA SHUGHULI ZA CHIMBO NCHINI KENYA: UCHUNGUZI KATIKA CHIMBO LA MUTONGA KATIKA KAUNTI YA MERU.

HOJAJI KWA WAFANYIKAZI WA CHIMBO

Jina la mhojiwa_____

Tarehe_____

(Soma kisha umwombe mhojiwa kutia sahihi fomu ya kukubali kabla ya kuendelea na mahojiano).

Sehemu ya kwanza: Wasifu wa Mhojiwa

1. Umri [miaka] _____

2. Jinsia: Mume =1 Mke =2

3. Umeolewa?

Bado =1. Ndio =2. Nimetalakiwa =3 Mjane =4

4. Unaishi wapi?

Mutonga na Janibu zake=1, Kwingineko: Fafanua _____

5. Kiwango cha juu cha elimu: Aso-elimu =0, Shule ya Msingi=1, Shule ya Upili=2, Chuo=3

Sehemu ya pili: Shughuli katika chimbo

6. a) Naomba unieleze kazi unayofanya katika chimbo

_____

b.Ni lipi kati ya yafuatayo yanaeleza vyema mapatano yako ya kazi kwenye chimbo?

Kawaida = 1, Kudumu= 2 , Kandarasi = 3

7. Umeifanya kazi hiyo kwa muda gani? [Muda katika miezi] _____

8. Wewe huja katika chimbo mara ngapi?

Kila siku =1, Siku 5-6 =2, Siku 2-4 =3, Mara moja kwa juma =4

9. Ni ipi kati ya yafuatayo inaelezea mwafaka kuhusu ratiba yako ya kazi katika chimbo?

Siku nzima= 1, Zamu ya Asubuhi=2 Zamu ya Alasiri, Zamu ya Usiku=4, Zamu isiyo na mpangilio=5

10. Ni vipi ulijifunza kuhusu kazi unayoifanya?

11. Je, umepokea mafunzo yoyote kuhusu kazi unayofanya?

Ndio =1 La=0

Ikiwa jibu lako ni yakinifu basi tolea ufafanuzi.

_____

_____

Sehemu ya Tatu: Yatokanayo na athari za kiafya

12a) Je, kuna tukio lolote katika chimbo ambalo ni hatari au linadhuru afya yako?

Ndio =1 , La=0

b) Ikiwa jibu lako ni yakinifu, fafanua _____

c) Je, tukio hilo linakusababishia madhara yapi ? _____

13a). Je, umewahi kukumbana na ajali yoyote ukiwa kazini katika kipindi cha mwezi mmoja uliopita?

Ndio=1 La=0

b) Ikiwa jibu lako ni ndio, tafadhali fafanua_____

_____

14. Orodha iliyopo hapa chini ni ya matatizo ya kiafya, je, umewahi kukumbwa na yoyote ile? Na ikiwa jibu lako ni yakinifu, yalisababishwa na kazi yako au yalisababishwa vipi?

Jaza jedwali iliyopo hapa chini

Je, umeadhirika kwa yoyote ile…….

Je umeadhurika na……	Kuhusiana na kazi? (Ndio/La)	Ikiwa jibu lako ni yakinifu, inahusiana vipi na kazi yako?
Uchungu au matatizo katika koo au pua lako		

Matatizo ya kupumua au maumivu katika mapafu (kama vile pumu, kifua kikuu au nyumonia)		
Upungufu wa uwezo wa kusikia		
Maumivu au matatizo katika shingo, mabega, mkono		
Matatizo au maumivu ya mgongo		
Maumivu au matatizo kwenye mguu		
Ugumu au Matatizo ya kuona		
Magonjwa au maambukizi ya ngozi		

Nyinginezo: fafanua tatizo

_____

Sehemu ya nne: Uzuiaji wa madhara na Uboreshaji wa afya

15. Je, umeshawahi kupokea mafunzo yeyote kuhusu namna ya kujikinga na ajali?

Ndio=1, La=0

16.a) Je, wewe hutumia vifaa vyovyote vya kujikinga ajali uanpofanya kazi ulizozitaja katika swali la 6?

Ndio =1, La=0

b) Ikiwa jibu lako ni yakinifu, je, wewe hutumia vifaa vipi au kujikinga vipi?

_____

c) Ikiwa ni kanushi, basi toa sababu zianazopelekea wewe kutojikinga.

_____

_____

17. Je, umepokea mafunzo yoyote kuhusu huduma ya kwanza? Ndio=1, La=0

18.a) Je, kuna huduma za dharura katika chimbo?

Ndio =1, La=0

b) Ikiwa jibu lako ni yakinifu, nani hutoa huduma hizo za dharura?

Wasimamizi=1, Waliopokea mafunzo (Wafanyikazi wa chimbo) =2

c) Nyinginezo, tafadhali fafanua

_____

19. Tafadhali eleza jinsi matukio ya dharura hushughulikiwa katika chimbo.

_____

20. Je una bima? Ndio=2 la=0

Sehemu ya Tano: Harakati za kutafuta huduma za kiafya

21.a) Je, katika kipindi cha mwezi mmoja uliopita, umewahi kuadhirika ukifanya kazi katika chimbo [kama ilivyotajwa katika swali la 6?

Ndio=1, La=0

b). Ikiwa jibu lako ni yakinifu, tafadhali jaza jedwali ifuatayo:

Shughuli katika chimbo [kama ilivyotajwa katika 6]	Sehemu ya mwili iliyoadhirika	Hali ya dhara na hatua iliyochukuliwa

c) Je, adhari hilo liliripotiwa na kunakiliwa kwenye rekodi ya matukio?

Ndio=1, La=0

22. a) Je, ulitafuta huduma za matibabu ulipoadhirika au ulipokuwa mgonjwa katika kipindi cha mwezi mmoja uliopita?

Ndio=1, La=0

b. Ikiwa jibu lako ni yakinifu, je, ulitafuta huduma hizo kutoka wapi?

Huduma ya kibinafsi=1, Taasisi za kiafya zilizo karibu=2, wahudumu wa kiutamaduni=3

Nyinginezo: tafadhali fafanua ……

23. Je, umekuwa ukifanyiwa uchunguzi wa kiafya wa mara kwa mara unapofanya kazi katika chimbo?

Ndio=1,La=0

24.a) Je, umepokea uchunguzi wowote wa kiafya katika kipindi cha mwezi mmoja uliopita?

Ndio=1, La=0

b) Ikiwa jibu lako ni yakinifu [swali la 24a], tafadhali tolea maelezo

_____

Nimehitimisha maswali, je una maoni yoyote kuhusu hali yako ya kiafya na namna ya kujikinga au namna ya kuboresha mazingira yako ya kazi?

_____

Shukrani

Appendix 5: Questionnaire for the quarry site manager

Questionnaire S/NO_____

OCCUPATINAL HEALTH RELATED PROBLEMS ASSOCIATED WITH QUARRYING ACTIVITIES IN KENYA: A CASE STUDY OF MUTONGA QUARRY, MERU COUNTY.

Questionnaire for the quarry site manager

Interview Date: _____

Interviewers, name: _____

Do you think the quarry activities are injurious to the workers? yes/no

If yes, how?

In your own opinion does one has to have special skill(s) to work in a quarry? Yes/no

Why?

What do you do when a worker is injured while working at the quarry?

Is it necessary to have Personal Protective Equipment at the quarry? yes/no

Why?

What measures do you take to ensure safety for the quarry workers?

What is the level of emergency preparedness at the quarry?

Is there need to carry out regular health check- ups for the quarry workers?

What is the level of emergency preparedness at the quarry?

Thank you

Appendix 6: Kiswahili translated qquestionnaire for the quarry site manager

Hojaji Nambari_____

UTAFITI KUHUSU SHIDA ZINAZOHUSIANA NA SHUGHULI ZA CHIMBO NCHINI KENYA: UCHUNGUZI KATIKA CHIMBO LA MUTONGA KATIKA KAUNTI YA MERU.

Hojaji la msimamizi katika chimbo

Tarehe ya Mahojiano: _____

Jina la anayehoji :_____

1.Je, shughuli za chimbo zina madhara kwa wafanyikazi?{Ndio au La}

Kama ni ndio,vipi?

2.Kwa maoni yako,ni vyema mtu kuwa na ujuzi wowote ili kufanya kazi katika chimbo?{Ndio au La} Kwa nini?

3.Je,mnafanya nini mfanyikazi anapoumia chimboni?

4.Je,ni vyema kuwa na vifaa vya usalama chimboni?

5.Ni hatua gani mnazochukua ili kuhakikisha usalama kwa wafanyakazi wa chimbo?

6. Ni maandalizi gani ya dharura mlio nayo katika chimbo kukabiliana na mikasa?

7. Je, kuna haja ya kuwafanyia uchunguzi wa kiafya wafanyakazi wa chimbo mara kwa mara?

8. Maandalizi ya dharura katika chimbo niyakiwango kipi?

SHUKRANI/ASANTE

Appendix 7: KEMRI Science Committee Clearance Letter

KENYA MEDICAL RESEARCH INSTITUTE

KEMRI/SSC/1015

21st March, 2013

Director, CPHR
NAIROBI

RE: SSC No. 2459 (Revised) – An assessment of occupational health related problems associated with quarrying activities in Kenya: A case study of Mutonga Quarry, Meru County

I am pleased to inform you that the above mentioned proposal, in which you are the PI, was discussed by the KEMRI Scientific Steering Committee (SSC) during its 309th meeting held on 12th March, 2013 and has been approved for implementation by the SSC.

Kindly submit 4 copies of the revised protocol to SSC within 2 weeks from the date of this letter i.e., 4th April, 2013.

We advise that work on this project can only start when SSC approval is received.

Secretary, SSC

Appendix 8: KEMRI Ethical Clearance Letter

KENYA MEDICAL RESEARCH INSTITUTE

KEMRI/RES/7/3/1 July 01, 2013

TO: MARYROSE NWANGUC NWADIBIA
PRINCIPAL INVESTIGATOR

THROUGH: DR. YEVE KIMANI
DIRECTOR, CPHR
NAIROBI

Dear Madam,

RE: SSC PROTOCOL NO. 2405 : REVISED (4th SUBMISSION): AN ASSESSMENT OF OCCUPATIONAL HEALTH RELATED PROBLEMS ASSOCIATED WITH QUARRYING ACTIVITIES IN KENYA: A CASE STUDY OF MATUNGA QUARRY, MERU COUNTY

Reference is made to your letter dated June 21st, 2013. The ERC Secretariat acknowledges receipt of the Revised Study Protocol on 25th June 2013.

This is to inform you that ERC Review Committee (ERC) reviewed the document KEMRI stated and it satisfied that issues raised during the 224th meeting held on 21st May 2013 have been adequately addressed.

The study is granted approval for implementation effective today 1st July 2013. Please note that approval for conduct of the study automatically expires on June 30, 2014. If recruitment is continuous with the data collection or analysis beyond this date, please submit an application for continuing approval to the ERC Secretariat on May 16, 2014.

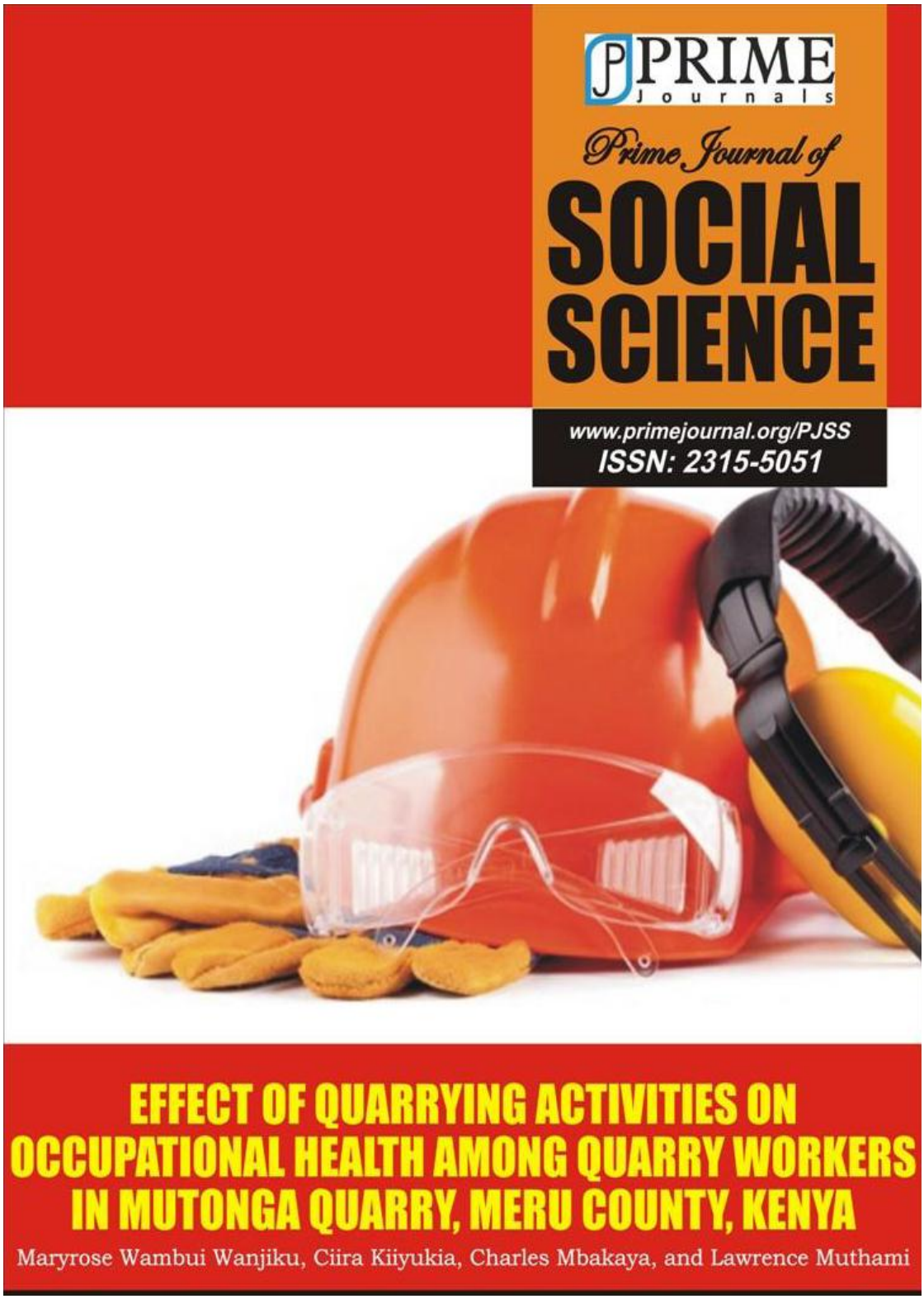
Any unanticipated problem resulting the implementation of this protocol should be brought to the attention of ERC. You are also required to submit any proposed changes to this protocol to the ERC prior to the initiation and advise the ERC when the study is completed or discontinued.

Yours faithfully,

DR. ELIZABETH BUKUSI
ACTING SECRETARY,
KEMRI ETHICAL REVIEW COMMITTEE

In Search of Better Health

Appendix 9: Paper Publication in the Prime Journal of Social Science



Prime Journal of Social Science (PJSS)
ISSN: 2315-5051. Vol. 3(8), pp. 812-817, August 12th, 2014
www.primejournal.org/PJSS

Full Length Research Paper

Effect of quarrying activities on occupational health among quarry workers in Mutonga quarry, Meru County, Kenya

[1]Maryrose Wambui Wanjiku, [2]Ciira Kiiyukia, [3]Charles Mbakaya, and [3]Lawrence Muthami

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[2]Jomo Kenyatta University of Agriculture and Technology. Institute of Tropical medicine and Infectious Diseases
[3]Kenya Medical Research Institute. Centre for Public Health Research

Accepted 23rd, July 2014

The purpose of this study was to describe the types of quarrying activities, identify occupational health hazards faced by workers and establish the contribution of quarrying activities on occupational health hazards among workers of Mutonga quarry in Meru county of Kenya. The study adopted a cross sectional descriptive research design. Simple random sampling was employed in selection of the respondents from a population of adult quarry workers. Two sets of questionnaires, one targeting the workers at the quarry site and another for the quarry site owner or manager were used to collect data on socio-demographic profile of the workers, their skills and quarrying activities and exposure to health hazards. The results of the study revealed that the average age group for the majority of the respondents was 34 years. There was a higher proportion of males (87%, 355) compared to females (13%, 53). Majority of the respondents (53.2%, 217) were leaving elsewhere from Mutonga location while (46.8%, 191) lived in Mutonga location. A majority of the respondents were lowly educated (none and primary) while others were high school (secondary) graduates. Many of the respondents were also married with a few separated or divorced. The majority (23%, 94) of the respondents indicated that they were cutting rock blocks into specific sizes and others loading rocks into lorries and trucks. A majority (49.5%, 202) of the respondents were on contract terms while 43.6% were casual labourers. The results too indicated the frequencies of carrying out the quarrying activities to be between 5-6 days and majority of the respondents indicated they carried out the activities on a full day time schedule. Majority of the respondent (98%, 400) indicated they were not trained and the only form of training that was advocated for was observational/ on job training. 87.3% of the respondents indicated that there was presence of dangerous aspects of the work in the quarry that can harm their health. Some of the hazards involved with the quarrying activities carried out by the respondents were manual handling of heavy loads, being hit by the tools, exposure to dust and falling of rock block. Some of the harms suffered by the respondents in the quarry while on duty are contusion with intact skin surface, pain/problem in nose, throat, sinuses, back, shoulder and neck. It can be concluded from this study that majority of the respondents had moderate awareness about occupational health related problems associated with quarrying activities. However this awareness has not led to any changes in the occupational hazards management because respondents are not sufficiently equipped with the knowledge, protective clothing and equipment to comprehensively manage the hazards. The study recommends the governing authorities should ensure that the quarry management and quarry workers adhere to regulations on occupational health and safety which provides for the rights of every person to fair labour practices, reasonable working conditions, and a clean, healthy environment. The workers should be educated and trained in safe handling practices of excessively heavy loads by resorting to the use of loaders or excavators to transport the various pieces of equipment, such as cables, hammers, jacks, cushions and rock blocks.

Key words: Quarrying activities, occupational health hazards

INTRODUCTION

Background and research problem

Quarrying products are increasingly demanded for industrial, domestic, agricultural and other purposes so as to satisfy the needs of the rapidly growing population. Quarrying operations generally involve removal of over burden, drilling, blasting and crushing of rock materials. The various impacts produced by these operations are both size and locations dependent. Manifestations of specific impacts are on the air, water, soil, earth surface, floral and fauna, and human beings (Areola, 1991; Enger and Smith, 2002). Apart from land degradation, other negative impacts of quarrying includes swamp creation, deterioration of ground water, erosion of soil, noise and percussions from rock blasting, generation of dust, smoke and fumes; production of noxious gases and ground vibration. Suspended particulate matter is quite outstanding among all pollutants emanating from quarrying operations (USEPA, 2008).

Depending on the size of the output the rock may be put through different and smaller sizes of crushers one or more times. As the rocks pass through the crushers, they are moved around the processing plant on conveyor belts. After crushing, comes screening. As the rocks are broken down to smaller sizes, screens are done to

separate the rocks into piles that are the same size. Some screens are larger and then allow the bigger rocks to pass through. The smaller screens let only the small rocks through (Purohit and others, 1994).

Work within the quarry industry is both physically and mentally demanding. The schedule of work hours, blocks of days on and then off, while being beneficial in some respects also presents problems. A report from the Australian Institute of Mining and Metallurgy gave the attrition rate as one in three within the first 12 months (Duffy, 2012). According to the findings of a research by Norbert Wagner et al (2009) on the safety and health in the stone crushing industry carried out in stone crushing sites in Northern India (Bundelkhand), the main causes of injurywere: falls from heights, slips and trips, fires, traffic accidents inside and outside the plant, injury by heavy physical work and manual handling of heavy loads. A study by Ahmed et al (2001) showed that 8% mines and industrial workers in Australia reported dislocation, 4% fracture of vertebrae column, 6% traumatic amputation, 12% open wounds, 28% contusion with intact skin surface and the most prevalent injury was sprains and strains, accounting for over 40% of all injuries. The injured workers attempted self-care, accessed the local medical services or waited until they flew home.

A significant proportion of health problems and fatalities in the quarrying sector in Africa are associated with manual operations, (Chigonda, 2010) and the health problems among the quarry workers are relevant because of the number of high-risk activities involved, and the peripatetic nature of the workforce. The principal airborne hazards in the mining industry include several types of particulates, naturally occurring gases, engine exhaust and some chemical vapours; the principal physical hazards are noise, segmental vibration, heat, changes in barometric pressure and ionizing radiation. These occur in varying combinations depending on the mine or quarry, its depth, the composition of the ore and surrounding rock, and the method(s) of mining.

Quarrying has a reputation for being a particularly unhealthy industry (HSE, 2002) because its rate of work-related injuries and illness is one of the highest of all occupational groups worldwide. The work-related injuries, illnesses and deaths have resulted from quarrying activities due to the physical nature of the work involved, coupled with poor workplace health and safety standards. According to NEMA (2010) quarrying in Kenya suffers from a number of constraints including lack of basic knowledge on safety precautions, poor working conditions, low socio-economic status, lack of clear quarrying legislation and environmental degradation that call for special attention. Some workers get maimed, others chronically ill, while some die.

Quarrying operations generate large quantities of dust that cause a variety of respiratory diseases amongst quarry workers. Pneumoconiosis, the general term given to a range of lung diseases caused by breathing dusts, typically causes chest tightness, shortness of breath and coughing (Encyclopædia Britannica, 2011). Under continued exposure it may develop into chronic bronchitis (inflammation of the bronchi) or emphysema (destruction of lungs over time) (National Center for Biotechnology Information 2010, 2011). Silicosis is the most likely form of pneumoconiosis to be dangerous to mine and quarry workers. Silicosis is contracted by breathing respirable silica dust in one of its pure crystalline forms. As a result, crushing or blasting rocks with crystalline silica present is likely to leave nearby workers at a high risk of contracting the disease. According to the findings of a study conducted by Nwibo et al (2012) in Ebonyi State, Nigeria to determine the prevalence of respiratory problems and lung function impairment among quarry workers; the respiratory problems found were chest pain (47.6%), occasional cough (40.7%), occasional shortness of breath (6.5%) and wheezing (5.2%). A similar study by Olusegun, et al (2009) on the impact of granite quarrying on the health of workers in Abeokuta Ogun State, Nigeria established that, 26% of the workers suffered predominantly from cough, 20% from catarrh and 15% from sinusitis.

Research objectives

i. Todescribe the types of quarrying activities among workers of Mutonga quarry in Meru county of Kenya.
ii. To identify occupational health hazards faced by Mutonga quarry workers.
iii. To establish the contribution of quarrying activities on occupational health hazards among workers of Mutonga quarry in Meru county of Kenya.

METHODOLOGY

The study used a cross-sectional descriptive study to gather data on occupational health related problems associated with quarrying activities amongst the quarry workers in Mutonga quarry, Meru County.The study population was all the quarry workers and the quarry manager within the Mutonga quarry. Inclusion and exclusion criteria was used to get the target population where by only those who have worked within the Mutonga quarry for more than one month, were between the age of 18 to 55 years of age and who voluntarily consented to be in the study were included.A sample of 427 respondents was selected using simple random sampling technique due to the large number of the quarry workers and to ensure that each quarry worker had an equal chance of being selected for the study.

The study used both primary and secondary data. Primary data was collected using semi-structured questionnaire and in-depth interviews. Secondary data on the health problems of the quarry workers was obtained from the 'quarry incidence record' with permission from the quarry manager. After data collection, a double entry of

the same data was done using Ms. Access 2010 for accuracy purposes. Coding and verification of the data was done for easy manipulation, analysis and presentation. Preliminary analysis of the data was done to ensure that all variables are in a workable form before full analysis was done. The data was backed-up in electronic storage devices like DVDS, flash discs and computer hard drives to ensure safety in-case of system breakdown. The data storage was password protected and only the research team was able to access it. Data collected was strictly confidential and all information collected was filed and all files kept under lock and key in a cabinet. Access to data collected was authorized by the principle investigator. The data collected was stored until final submission of the thesis, its approval and the go ahead for graduation was given.

Data analysis was approached at three levels. To start with, was the description of the study population characteristics. This was done using SPSS version 20 and involved use of frequency tables and measures of central tendency and dispersion and allowed easier further analysis. Secondly was the, bivariate analysis of both the dependent and independent variables for health related problems of quarrying was done using Chi square test for association among the independent and dependent variables, the recorded/observed quarry workers health problems. Thirdly, was the multivariate analysis to model occupational health hazard which was done using logistic regression. The findings were presented in tables.

The study's results are expected to be applied within the mining and quarrying industry in Kenya. Due to the lacking information on the exposure factors and health problems associated with quarrying activities, it was hoped that the local authorities and the management of quarries and mines in Kenya would take a more proactive approach to address the health and safety concerns of its workers. Findings from the study guided policy makers and community leaders on polices that can be implemented to promote better occupational health and safety for quarry worker.

FINDINGS AND DISCUSSION

The objective of the study was to describe the types of quarrying activities, identify occupational health hazards faced by workers and establish the contribution of quarrying activities on occupational health hazards among workers of Mutonga quarry in Meru county of Kenya. Results revealed that majority (23%, 94) of the respondents indicated that they were cutting rock blocks into specific sizes and others loading rocks into lorries and trucks. A majority (49.5%, 202) of the respondents were on contract terms while 43.6% were casual labourers. The results too indicated the frequencies of carrying out the quarrying activities to be between 5-6 days and majority of the respondents indicated they carried out the activities on a full day time schedule. The respondents were asked to indicate if they have attained any form of training on the quarry activities, majority (98%, 400) indicated they were not trained and the only form of training that was advocated for was observational/ on job training. Results are on table 1.

The findings are consistent with those in Puhorit (1994) and Bauer (1991) who asserted that rock quarrying and stone crushing is a necessity that provides much of the materials used in traditional hard flooring, such as granite, limestone, marble, sandstone, slate and even just clay to make ceramic tiles.

Results also revealed that 87.3% of the respondents indicated that there was presence of dangerous aspects of the work in the quarry that can harm their health. Some of the hazards involved with the quarrying activities carried out by the respondents are manual handling of heavy loads, being hit by the tools, exposure to dust and falling of rock block. The findings agree with those in Michelo et al (2009), who reported 165 injuries and 20 fatalities in Zambia with rock fall as the major cause of injuries. Results are in table 2.

Relationship between gender and occupational hazards was statistically significant ($\chi 2$, = 79.921, df(1), P=0.000). Level of education was a significant factor to occupational hazards ($\chi 2$ (1) = 12.015, df(1), P=0.007). Marital status and area of residence in the study was not a significant factor to occupational hazards (Table 3).

CONCLUSION AND RECOMMENDATIONS

It can be concluded from this study that majority of the respondents reported to have had a health problem associated with a quarrying activity and had moderate awareness about occupational health related problems associated with quarrying activities. However this awareness has not led to any changes in the occupational hazards management because respondents are not sufficiently equipped with the knowledge, protective clothing and equipment to comprehensively manage the hazards.

The quarry owners and managers should ensure that they adhere to regulations on occupational hazards which provides for the rights of every person to fair labour practices, reasonable working conditions, and a clean and healthy environment.

Since manual handling of heavy loads is common in every work phase and quarry activity, the workers should be educated and trained in safe handling practices to avoid manual handling of excessively heavy loads by resorting to the use of loaders or excavators to transport the various pieces of equipment, such as cables, hammers, jacks, cushions, and rock blocks. They should also be made aware of the health promotive measures such as use of protective clothing and equipment which should be provided by the quarry management and quarry owners.

Table 1: Distribution of responses on Quarry activity, work terms, work schedule, frequency of carrying out the activity and mode of training offered.

		F	%
Quarry activity	Excavation	53	13
	Stone broker	14	3.4
	Food vendor	11	2.7
	Drilling	43	10.5
	Cutting rock blocks into specific sizes	94	23
	Lifting cut rocks from quarry pits	47	11.5
	Loading rocks into lorries/trucks	61	15
	Removing crushed rock aggregates from quarry pit	51	12.5
	Draining water from the quarry pit	18	4.4
	Cooking for quarry workers	16	3.9
	Total	408	100
Frequency of carrying out the activity	Daily	26	6.4
	5-6 days	303	74.3
	2-4 days	66	16.2
	Once a week	13	3.2
	Total	408	100
Mode of learning	On job training/ Observation	408	100
	Total	408	100
Work terms	Causal	178	43.6
	Contract	202	6.9
	Permanent	28	49.5
	Total	408	100
Work schedule	Morning shift	59	12.5
	Afternoon shift	39	9.6
	Full day-time	310	7.6
	Irregular shift	8	1.9
	Total	408	100
Training offered	No	400	98
	Yes	8	2
	Total	408	100

Table 2: Distribution of responses on exposure to health hazards

		f	%
Presence of dangerous aspects in the respondent quarry activity	No	52	12.7
	Yes	356	87.3
	Total	408	100
Hazards involved with the quarry activity carried out by the respondent	None	42	10.3
	Falls from height	6	1.4
	Falling rock block	27	6.6
	Fumes	10	2.5
	Slips/trips	10	2.5
	Dust	51	12.5
	Manual handling of heavy loads	173	42.4
	Cuts	15	3.7
	Being hit by the tools	60	14.7
	Stagnant water	14	13.4
	Total	408	100
Harm suffered by respondent while carrying out quarrying activity	None	48	11.8
	Pain/problem in nose, throat, sinuses	37	9.1
	Skin diseases or infections	8	2
	Dislocation	10	2.5
	Cut/open wound	12	2.9
	Contusion with intact skin surface	121	29.7
	Fractures	10	2.5
	Mosquito bites	8	2
	Breathing difficulties or lung pain	8	2
	Pain/problem in neck	17	4.2
	Pain/problem in shoulder	57	14
	Pain/problem in arm,wrist,hand	9	2.2
	Pain/problem in the back	42	10.3
	Pain/problem in the feet/legs	10	2.5
	Eye strain or eye problem	11	2.7
	Total	408	100

Table 3: A cross tabulation of Demographic Characteristics against Occupational Hazards.

		Occupational hazards		
		Yes	No	Chi-square
Gender	Male	330	25	
	Female	26	27	79.921(p=0.000)
Marital status	Single	112	19	
	Married	191	25	
	Divorced/ separated	35	7	
	Widow(er)	18	1	2.168(p=0.538)
Education	None	15	0	
	Primary	221	34	
	Secondary	110	12	
	College	10	6	12.015(p=0.007)
Residence	Mutonga	169	22	
	Elsewhere	187	30	0.486(p=0.486)

There should be implementation of medical surveillance programmes that provide clinical evaluation at least once a year for the quarry workers. In addition to health history and physical examination, specific laboratory tests should be carried out every one year, such as spirometry and chest radiography in quarry workers exposed to dust, fumes, and gas, audiometry in those exposed to noise, and cold test with measurement of finger systolic blood pressure in users of vibratory tools so as to identify potential health problem and the effectiveness of existing preventive strategies. This is important because many occupational diseases are chronic in nature, having minimal early signs and may be difficult to treat or even incurable, in particular, noise induced hearing loss and pneumoconiosis. The regular medical examination of the workers who are exposed to particular health hazards at work can detect abnormalities or diseases at the early stage so that timely treatment can be given to increase the prospect of cure and reduce the cost of care.

The government should also ensure that all places carrying out quarrying and mining activities are well researched on and communicated to the public on the laws and regulations to be adhered in order to enhance safety of human beings and environment.

The prevention of occupational health related problems associated with quarrying activities calls for a multi-disciplinary approach such as controlling health hazards at source by engineering measures; use of administrative control, use of suitable personal protective equipment (PPE), education, training and supervision of workers, environmental monitoring and health surveillance.

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Appendix 10: Paper Publication in the Journal of Prime Research on Medicine

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Full Length Research Paper

Health seeking behavior and health care options available to quarry workers in Mutonga Quarry, Meru County, Kenya

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The purpose of this study was to determine the health seeking behavior of quarry workers and the available health care options and establish the health promoting care available to the quarry workers of Mutonga quarry in Meru county of Kenya. The study adopted a cross sectional descriptive research design. Simple random sampling was employed in selection of the respondents from a population of adult quarry workers. Two sets of questionnaires, one targeting the workers at the quarry site and another for the quarry site owner or manager were used to collect data on socio-demographic profile of the workers, their skills and quarrying activities and exposure to health hazards. The study results indicated that 86.8% of the respondents had been trained on safety precautions, 74.8% did not use protective clothing while at work and those who used they only used gloves, overall and gumboots. The respondents indicated the reasons for not using protective clothing as being too expensive to buy and the protective clothing were not provided by the employer. A majority (60.8%) of the respondents indicated that they were not trained on first aid methods and practices, though in the quarry there were trained individuals to offer first aid in case of emergencies. Majorities (65.2%) of the respondents were insured and the most appropriate way emergencies were handled was through giving first aid to the casualty. Majority (74.3%) of the respondents indicated that they had suffered an injury in the quarry for the last one month; however the respondents did not report the injuries and majority did not seek any kind of treatment while injured. The respondents indicated that they did not receive regular medical examination while working at the quarry. The study concludes that majority of the respondents had poor health seeking behaviour. This is because the respondents were taking care of themselves (self-remedy) in case of injuries and emergencies. The study recommends that workers in the quarry should be made aware of the preventive measures such as use of protective clothing and equipment. The government should also ensure that all places carrying out mining activities are well researched on and communicated to the public on the laws and regulations to be adhered to enhance safety of human beings and environment.

Key words: Health seeking behavior, health care options

INTRODUCTION

Background and research problem

Globally, rock quarrying is very common but also one of the most dangerous industry to work in relative to other industries (HSE, 2002; Okafor, 2006) and as stated by the European Agency for Safety and Health at Work (2008), the quarry workers are twice as likely to be killed in an accident at work as construction workers, and 13 times more likely to die at work as those in manufacturing industries. The World Health Organization (ILO, 2005) noted with concern that 1.7 million people worldwide die annually of work related injuries and illnesses. The Mines Inspection Agency of Greece (MIAG) recorded a 37.7 fatality rate (number of fatal accidents per 100,000 workers) for the overall quarrying sector between 1988 and 2002. In France about 44% of all fatal accidents in 2002 were related to quarrying while in Germany, between 1999 and 2003, 48% of all accidents reported were from the quarrying sector. It is because of the high number of incidence of accidents, injuries, illnesses and fatalities throughout the world that the quarrying industry has often been termed to be particularly 'unhealthy industry' (Smallwood and Haupt, 2000).

A significant proportion of health problems and fatalities in the quarrying sector in Africa are associated with manual operations, (Chigonda, 2010) and the health problems among the quarry workers are relevant because of the number of high-risk activities involved, and the peripatetic nature of the workforce. The principal

airborne hazards in the mining industry include several types of particulates, naturally occurring gases, engine exhaust and some chemical vapours; the principal physical hazards are noise, segmental vibration, heat, changes in barometric pressure and ionizing radiation. These occur in varying combinations depending on the mine or quarry, its depth, the composition of the ore and surrounding rock, and the method(s) of mining. Among some groups of miners who live together in isolated locations, there is also risk of transmitting some infectious diseases such as tuberculosis, hepatitis (B and E), and the human-immunodeficiency virus (HIV). Miners' exposure varies with the quarrying activity carried out, its proximity to the source of hazards and the effectiveness of hazard control methods.

According to a Foster et al (2007) research on First Aid and Medical Treatment for the Injured in Australia indicated that at quarries and other surface mines, persons injured received less than adequate first aid, they were also inappropriately transported to hospital risking their health or worsening the injury with potential serious consequences and majority of the mine workers were untrained in first aid.

Quarrying has a reputation for being a particularly unhealthy industry (HSE, 2002) because its rate of work-related injuries and illness is one of the highest of all occupational groups worldwide. The work-related injuries, illnesses and deaths have resulted from quarrying activities due to the physical nature of the work involved, coupled with poor workplace health and safety standards. According to NEMA (2010) quarrying in Kenya suffers from a number of constraints including lack of basic knowledge on safety precautions, poor working conditions, low socio-economic status, lack of clear quarrying legislation and environmental degradation that call for special attention. Some workers get maimed, others chronically ill, while some die.

These health related problems are more pronounced in manual quarry operations as is the case at the Mutonga quarry in Meru County. As noted by NEMA (2010), there has been growing public dissatisfaction in the manner in which quarrying activities are being undertaken in the country. The country has witnessed various quarry disasters and complaints associated with quarrying activities. The hazardous nature of quarrying activities at the Mutonga quarries came into light when activities had to be stopped by the area's district commissioner because of fears associated with landslides that had occurred in the area within the quarry as a results of heavy rains, but the inherent health problems were overlooked due to inadequate information on their magnitude (Muriithi, 2011).

According to WHO-ILO (2001), the prevention of occupational diseases calls for a multi-disciplinary approach. While health hazards should be controlled at source by engineering measures such as enclosure and effective ventilation, there are other complementary control measures including administrative control, use of suitable personal protective equipment (PPE), education, training and supervision of workers, environmental monitoring and health surveillance. Medical examination is a common means of conducting health surveillance whereby the health status of persons is monitored to determine departures from normal health, WHO-ILO (2000), so as to identify potential problem areas and the effectiveness of existing preventive strategies. Many occupational diseases are chronic in nature, having minimal early signs and may be difficult to treat or even incurable for example noise induced hearing loss and pneumoconiosis. Regular medical examination of workers who are exposed to particular health hazards at work can detect abnormalities or diseases at the early stage so that timely treatment can be given to increase the prospect of cure and reduce the cost of care.

Research objective

i. To determine the health seeking behavior of the quarry workers in Mutonga quarry in Meru county of Kenya.
ii. To establish the health care options available to the quarry workers of Mutonga quarry in Meru county of Kenya.

METHODOLOGY

The study used a cross-sectional descriptive study to gather data on occupational health related problems associated with quarrying activities amongst the quarry workers in Mutonga quarry, Meru County. The study population was all the quarry workers and the quarry manager within the Mutonga quarry. Inclusion and exclusion criteria was used to get the target population where by only those who have worked within the Mutonga quarry for more than one month, were between the age of 18 to 55 years of age and who voluntarily consented to be in the study were included. A sample of 427 respondents was selected using simple random sampling technique due to the large number of the quarry workers and to ensure that each quarry worker had an equal chance of being selected for the study.

The study used both primary and secondary data. Primary data was collected using semi-structured questionnaire and in-depth interviews. Secondary data on the health problems of the quarry workers was obtained from the 'quarry incidence record' with permision from the quarry manager. After data collection, a double entry of the same data was done using Ms. Access 2010 for accuracy purposes. Coding and verification of the data was done for easy manipulation, analysis and presentation. Preliminary analysis of the data was done to ensure that all variables are in a workable form before full analysis was done. The data was backed-up in electronic storage devices like DVDS, flash discs and computer hard drives to ensure safety in-case of system

breakdown. The data storage was password protected and only the research team was able to access it. Data collected was strictly confidential and all information collected was filed and all files kept under lock and key in a cabinet. Access to data collected was authorized by the principle investigator. The data collected was stored until final submission of the thesis, its approval and the go ahead for graduation was given.

Data analysis was approached at three levels. To start with, was the description of the study population characteristics. This was done using SPSS version 20 and involved use of frequency tables and measures of central tendency and dispersion and allowed easier further analysis. Secondly was the, bivariate analysis of both the dependent and independent variables for health related problems of quarrying was done using Chi square test for association among the independent and dependent variables, the recorded/observed quarry workers health problems. Thirdly, was the multivariate analysis to model occupational health hazard which was done using logistic regression. The findings were presented in tables.

The study's results are expected to be applied within the mining and quarrying industry in Kenya. Due to the lacking information on the exposure factors and health problems associated with quarrying activities, it was hoped that the local authorities and the management of quarries and mines in Kenya would take a more proactive approach to address the health and safety concerns of its workers. Findings from the study guided policy makers and community leaders on polices that can be implemented to promote better occupational health and safety for quarry worker.

FINDINGS AND DISCUSSION

The objective of the study was to determine the health seeking behavior of quarry workers and the available health care options and establish the health promoting care available to the quarry workers of Mutonga quarry in Meru county of Kenya. Results indicate that 86.8% of the respondents have been trained on safety precautions, 74.8% indicated that they do not use protective clothing while at work and those who used they only use gloves, overall and gumboots. The respondents indicated the reasons for not using protective clothing as being too expensive to buy and the protective clothing were not provided by the employer.

A majority (60.8%) of the respondents indicated that they were not trained on first aid methods and practices, though in the quarry there was a trained individual to offer first aid in case of emergencies. Majority (65.2%) of the respondents were insured and the most appropriate way emergencies were handled was through giving first aid to the casualty. Tables 1 and 2 show the results.

Table 1 shows that the respondents had poor health seeking behaviour. This is supported by the study findings in table 2. A majority (74.3%) of the respondents indicated that they had suffered an injury in the quarry for the last one month; however the respondents did not report the injuries and majority did not sought any kind of treatment while injured. The respondents indicated that they did not receive regular medical examination while working at the quarry.

The study findings disagree with those in International Organization for Standardization (1996) who reported that to reduce health risks due to exposure to chemical and physical agents, both collective and individual preventive measures are currently adopted, together with the implementation of medical surveillance programmes that provide clinical evaluation at least once a year. In addition to health history and physical examination, specific laboratory tests are carried out every one or two years, such as spirometry and chest radiography in quarrymen exposed to dust, fumes, and gas, audiometry in those exposed to noise, and cold test with measurement of finger systolic blood pressure in users of vibratory tools. To reduce exposure to inhalable dust, prevention measures include scrupulous wet cutting, cleaning of the work area by clearing away the mud by hand or with a mini-loader, and wetting the quarry floor and the access roads, especially in the drier seasons. During these operations, workers wear adequate personal protective equipment devices to protect respiratory airways and lungs

The findings also agree with those in WHO-ILO (2001) who asserted that prevention of occupational diseases calls for a multi-disciplinary approach. While health hazards should be controlled at source by engineering measures such as enclosure and effective ventilation, there are other complementary control measures including administrative control, use of suitable personal protective equipment (PPE), education, training and supervision of workers, environmental monitoring and health surveillance. Medical examination is a common means of conducting health surveillance whereby the health status of persons is monitored to determine departures from normal health, WHO-ILO (2000), so as to identify potential problem areas and the effectiveness of existing preventive strategies. Many occupational diseases are chronic in nature, having minimal early signs and may be difficult to treat or even incurable, for example, noise induced hearing loss and pneumoconiosis. Regular medical examination of workers who are exposed to particular health hazards at work can detect abnormalities or diseases at the early stage so that timely treatment can be given to increase the prospect of cure and reduce the cost of care.

The study further agree with those of Malini Kar and Logaraj (2010) who did a population based cross-sectional study that was carried out to assess the awareness, attitude, and treatment seeking behaviour regarding TB in rural Tamil Nadu. Out of 1985 people

Table 1: Health promotion

		f	%
Training on quarrying safety precautions	No	354	86.8
	Yes	54	13.2
	Total	408	100
Type of PPE Used	None	310	76
	Gloves	38	9.3
	Overall	30	7.4
	Gumboots	22	5.4
	Only dirty clot	10	2.0
	Total	408	100
Source of PPE used by respondent	No provider	308	74.5
	Employee/ quarry worker	100	24.5
	Total	408	100
First aid providers in quarry	No first aid provider	5	2.2
	Trained individual	403	98.8
	Total	408	100
Emergency services available	No	6	1.5
	Yes	402	98.5
	Total	408	100
Use of protective clothing	No	305	74.8
	Yes	103	25.2
	Total	408	100
Reasons why respondents don't use PPE	Don't know what is PPE	18	4.2
	Not available in local area	18	4.2
	No need to use them	58	14.2
	Not provided by employer	137	33.6
	Expensive to buy	177	43.4
	Total	408	100
Training in first Aid	No	248	60.8
	Yes	160	39.2
	Total	408	100
Ways emergencies are handled	Giving first aid to victim	222	54.4
	Taking victim to hospital	157	38.5
	Calling Meru red cross	29	7.1
	Total	408	100
Respondent has Insurance cover	No	142	34.2
	Yes	266	65.2
	Total	408	100

Table 2: Health seeking behaviour

		f	%
Injury in the last one month	No	105	25.7
	Yes	303	74.3
	Total	408	100
Respondent sought treatment while injured	No	190	46.6
	Not injured	99	24.3
	Yes	119	29.2
	Total	408	100
Receipt of regular medical check-ups	No	397	97.3
	Yes	11	2.7
	Total	408	100
Medical examination performed	None	400	98
	General physical examination	8	2
	Total	408	100
Reported injury	No	276	67.6
	Not injured	98	24
	Yes	34	8.3
	Total	408	100
Place treatment sought	Not injured	102	25
	Self care	190	46.6
	Local private hospital	99	24.3
	Local government hospital	17	4.2
	Total	408	100
Attended medical check-up in the last month	No	398	97.5
	Yes	10	2.5
	Total	408	100

Table 3: Logistic regression predicting occurrence of health hazards using preventive measures such as use of protective clothing, first aid provider

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Trained on safety precautions	0.011	0.631	0	1	0.986	1.011
Uses PPE	-3.97	1.312	9.151	1	0.002	0.019
PPE used	0.196	0.248	0.625	1	0.429	1.217
PPE provider	-3.797	1.325	8.209	1	0.004	0.022
First aid trained	0.763	0.393	3.772	1	0.052	2.144
First aid provider	0.357	0.94	0.144	1	0.704	1.429
Emergency services available at quarry	-0.129	1.132	0.013	1	0.91	0.879
Insured	-0.732	0.317	5.332	1	0.021	0.481
Constant	5.555	1.76	9.961	1	0.002	258.568

Table 4: Logistic Regression Predicting occurrence of health hazards using health seeking behaviour

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Injured in last one month	-2.172	0.991	4.801	1	0.028	0.114
Injury booked	-0.474	0.645	0.539	1	0.463	0.623
Sought treatment while injured in last one month	-0.586	0.685	0.732	1	0.392	0.556
Type of treatment sought	-0.535	0.396	1.826	1	0.177	0.585
Regular medical examination	5.087	4.124	1.522	1	0.217	161.927
Examined in last one month	-2.114	1.888	1.254	1	0.263	0.121
Medical exam	1.054	1.298	0.659	1	0.417	2.868
Constant	1.699	3.57	0.226	1	0.634	5.468

interviewed, 56% had heard of TB, but 80% were not aware of the cause and mode of spread of TB. Television was reported to be the main source of information (45%). Only 34% people were aware that treatment for TB was available free of cost. Less than 10% people felt the need to maintain confidentiality, if contracted TB. More than 80% people preferred to visit Government hospital, if developed TB, whereas 54% actually sought treatment from government hospital for cough of more than three weeks.

Table 3 shows that the respondents injured in the last one month were statistically associated with occupational health hazards (P<0.028).

Table 4 shows that the respondents injured in the last one month were statistically associated with occupational health hazards (P<0.028).

CONCLUSION AND RECOMMENDATIONS

It can be concluded from this study that majority of the respondents had poor health seeking behaviour. This is because the respondents were taking care of themselves (self remedy) in case of health problem or emergencies. The quarry owners and managers should ensure that they adhere to regulations on occupational hazards which provides for the rights of every person to fair labour practices, reasonable working conditions, and a clean and healthy environment.

Since manual handling of heavy loads is common in every work phase and quarry activity, the workers should be educated and trained in safe handling practices to avoid manual handling of excessively heavy loads by resorting to the use of loaders or excavators to transport the various pieces of equipment, such as cables, hammers, jacks, cushions, and rock blocks. They should also be made aware of the health promotive measures such as use of protective clothing and equipment which should be provided by the quarry management and quarry owners.

There should be implementation of medical surveillance programmes that provide clinical evaluation at least once a year for the quarry workers. In addition to health history and physical examination, specific laboratory tests should be carried out every one year, such as spirometry and chest radiography in quarry workers exposed to dust, fumes, and gas, audiometry in those exposed to noise, and cold test with measurement of finger systolic blood pressure in users of vibratory tools so as to identify potential health problem and the effectiveness of existing preventive strategies. This is important because many occupational diseases are chronic in nature, having minimal early signs and may be difficult to treat or even incurable, in particular, noise induced hearing loss and pneumoconiosis. The regular medical examination of the workers who are exposed to particular health hazards at work can detect abnormalities or diseases at the early stage so that timely treatment can be given to increase the prospect of cure and reduce the cost of care.

The government should also ensure that all places carrying out quarrying and mining activities are well researched on and communicated to the public on the laws and regulations to be adhered in order to enhance safety of human beings and environment.

The prevention of occupational health related problems associated with quarrying activities calls for a multi-disciplinary approach such as controlling health hazards

at source by engineering measures; use of administrative control, use of suitable personal protective equipment (PPE), education, training and supervision of workers, environmental monitoring and health surveillance.

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