STATUS OF OCCUPATIONAL SAFETY AND HEALTH OF SOAPSTONE MINE WORKERS IN TABAKA, KISII COUNTY, KENYA

MEDRINE JELIMO YATOR

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Medrine Jelimo Yator

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DECLARATION

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

Signature……Date……..

Medrine Jelimo Yator

This thesis has been submitted for examination with our approval as the University Supervisors

Signature……Date……..

Dr. Charles Mburu, Ph.D

JKUAT, Kenya

Signature……Date……..

Dr. Benson Karanja, Ph.D.

JKUAT, Kenya

DEDICATION

I dedicate this work to my late dad Enock Cheserem, my mum Esther Cheserem, my husband Douglas Nyairo, children Adrian Viva and Aiden Kent, and my siblings for their love and continued support during the study.

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May God richly bless all of you

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ACRONYMS AND ABBREVIATIONS

DOSHS	Directorate of Occupational Safety and Health Services
EIA	Environmental Impact Assessments
EMCA	Environmental Management and Coordination Act
GoK	Government of Kenya
HAS	Health and Safety Administration
HAVS	Hand-Arm i Vibration i Syndrome
HSE	Health and Safety Executive
ILC	International Labour Conference
ILO	International Labour Organization
KHIS	Kenya Health Information System
KNBS	Kenya National Bureau of Statistics
MCA	Mineral Council of Australia
NITTS	Noise induced temporary threshold shift
NEMA	National Environment Management Authority
OEL	Occupational Exposure Limits
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Act

PPE	Personal Protective Equipment
SPSS	Statistical Package for Social Sciences
USA	United States of America
WHO	World Health Organization
WIBA	Work Injury Benefit Act

ABSTRACT

Mining is an industry that significantly contributes to the improvement of economic growth and development in many countries. The global rates of occupational injuries, illnesses and fatalities associated with mining are alarming. The international Labour Organization (ILO) estimates that quarrying activities accounts for 8% of the world work related fatalities. Quarrying in Kenya creates employment opportunities, support local construction and a major source of national economy. Kisii County is enriched with soapstone resources in Tabaka which are mined and carved to form different sculptures that are sold both locally and internationally. Despite the enactment of legal and institutional frameworks many workers in different sectors work in the presence of occupational hazards which lead to huge burden of accidents, and occupational injuries. The objective of the study was to assess status of occupational health and safety of soapstone mine workers in Tabaka, Kisii County. The research adopted cross sectional design from a population of 222 soapstone mine workers from five selected registered self-help groups involved in mining and carving of soapstone products. A sample of 174 was proportionately randomly selected from the five self-help groups. Structured questionnaires were used to collect data on nature and frequency of accidents and awareness on prevention measures on occupational hazards. An interview was conducted with the quarry managers and key informants involved in occupational safety and health. An observational checklist was used to record how quarry activities were performed. The study further measured the level of exposure of noise produced using sound level meter. Data collected was cleaned, coded, tabulated and subjected to statistical analysis using SPSS version 21.0. It was established that 43.1% of the miners were involved in the main activity of cutting of soapstone into different sizes and shapes. The type of injury experienced most was cuts 51.7% caused by working tools 27% with hands 32.8% being the most injured part of the body. More than half, 58.6% of the miners were aware mining has occupational hazards but were not trained 63.8% to identify occupation hazards. Respondents were aware of use of protective equipment 55.2% but 53.3% had not been trained on occupational health and safety with 53.4%. soapstone miners not reporting the accidents. Drilling recorded an average of 53.2±6.5, crushing 61.4±3.2, and hauling of trucks at 48.8±1.2 in the noise level measurements. The study revealed statistical significance on training and identification of hazards ($p=0.000$), source of OSH safety at workplace and awareness on prevention of occupation injuries ($p=0.000$), wearing PPE ($p=0.000$), type of PPE ($p=0.017$) and trainer of OSH with awareness on prevention of occupation injuries. The study concluded that there are occupational health and safety hazards associated with soapstone quarry activities in Tabaka, the respondents could identify occupational health and safety hazards and related effects of soapstone quarrying activities. However, soapstone mine workers lacked awareness on prevention of injuries and occupation safety. The Directorate of Occupational Health and Safety (DOSH), NEMA, and County Government of Kisii should enforce Occupational Safety and Health Act and soapstone mine workers should comply to the existing Occupational Safety and Health regulations prevent and control occupational health hazards and related injuries in the sector.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Mining industry plays an important role in the improvement of countries economic growth and influences sustainable development (Pavolová *et al*.,2022). The world rates of occupational injuries, illnesses and fatalities are still alarming **(**Kainat & Shahzadi, 2021). According to the U.S Bureau of Labor Statistics, (2023) mining fatalities rose by 21.8 percent from 2020 to 2021 with fatal injury rate for the overall mining industry in 2021 being 14.2 per 100,000. The mining sector accounted for approximately 3.7% of global GDP in 2019, with the value of mineral production exceeding $600 billion USD (Ayuk *et al.,* 2020). It is estimated that approximately 13 million people participate in small scale mining activities influencing livelihood of 80-100 million people in developing world (Hilson & Maconachie, 2020). About 75% of the global labour force lives in developing countries but approximately 5-10% have accessibility to occupational health and safety services (Kumar *et al.,* 2016). Despite its contribution, mining industry has been blamed for high rates of fatality and accidents. Occupational Health and Safety encompasses all aspects of health and safety concerns in a workplace with emphasis towards primary prevention of hazards.

According to International Labour Organization (ILO) and World Health Organization (WHO), occupational safety and health is a fundamental right of workers all over the world. Occupational Health and Safety aims to protect the health, safety, and welfare of workers in order to promote a safe working environment. Kenya has achieved significant progress in occupational safety and health through the promulgation of the new Constitution of Kenya and the enactment of the Occupational Health and Safety Act No 15 of 2008 (Mitullah & Wachira, 2011). Despite the enactment of legal and institutional frameworks that address various work safety and health related issues, many workers in

different sectors work in the presence of occupational hazards which lead to huge burden of accidents, injuries and occupational injuries (Kumar *et al.,* 2016).

Quarrying has one of the highest work-related injuries and illnesses of all occupational groups (HSE, 2018). The injuries occur due to the unhealthy nature of the industry couples with poor workplace health and safety standards and legislation. The quarrying activities in Kenya has been having high public dissatisfaction because of how the activities are undertaken and the increasing disasters that bury miners (NEMA 2015). Even though Environmental Impact Assessments (EIAs) are conducted before the beginning of quarrying, mitigation and actual process of mining is not followed (Eshiwani, 2014). The basic knowledge of safety requirements and the importance of using Personal Protective Equipment (PPE) is poorly comprehended in small scale mining (Hilson & Maconachie, 2020). The reduction of risks, the improvement of safety, and the prevention of accidents needs to be key and should receive attention from the employers, employees and the relevant authorities (Mabe, 2023).

Kisii county is enriched with soapstone resources in Tabaka which are mined and carved to form different sculptures. Tabaka soapstone miners and handicrafts are known all over the world for artistic prowess over the years (Rumbe, 2021). However, the individuals who participate in the various mining processes often lack the training, skills, and knowledge needed to practice safely (Hilson, 2012). The great demand for soapstone products both locally and internationally coupled with low-income levels, increasing unemployment rate, and poverty makes small-scale soapstone mining an attractive venture for many to engage in. The small-scale mining sector provides employment for a large proportion of unemployed individuals in Tabaka, Kisii County. The exploitation of the soapstone deposits in Kenya, is characterized by the usage of relatively simple tools. The industry is often undercapitalized and occurs within informal settings generally characterized by intense manpower with rudimentary equipment such as shovels, pickaxes, and poor methods of extraction, some operators have engaged the use of excavators, bulldozers, and other sophisticated equipment (Rumbe, 2021).

The mining is done informally and in small scale with no clear policies or guidelines. By the virtue of this, informal mining poses even more hazards than what may be found in a highly-organized and/or regulated large-scale operation (Eshiwani, 2014). The International Labour Organization estimates that non-fatal accidents are 6-7 times more common in informal mining operations when compared to large-scale operations. Small-scale miners are confronted with numerous hazards often resulting in varying degrees of injuries and fatalities. Some of the high-risk operations cited in mining include blasting without training and pneumatic drilling and curving without dust control (Mabe, 2023). The mine owners or organization usually have the responsibility of providing for the safety of the miners. The major health hazards in mining operations include exposure to dust which may cause pneumonia, vibration from machinery, consequences of poor ventilation (heat and humidity), and effects of over-exertion, inadequate workspace and inappropriate equipment (Ngure & Kinuthuia, 2020). Constant headaches, joint disorders, visual problems and dermatological, muscular, and orthopaedic ailments are among the effects of mining operations (Hall *et al*., 2022).

1.2 Statement of the Problem

Soapstone mining is an economic activity and source of livelihood for many people in Kisii (Akama & Onyambu, 2020). Lack of safety and health measures and poor implementation of OSH policy cause occupational health and safety problems with high rate of injuries, incapacitation, and fatalities (Wachira, 2017). Lack of data and underreporting of incidents in small scale mining distorts mining's safety record and makes it harder to detect and improve potential hazards (World Bank, 2020). Soapstone mining operations cause slope instability resulting in quarry accidents that cause injuries and death to miners. Too often, the preventable incidents of landslides burying miners catch the public awareness and the language that criminalizes illegal miners and reports of fatalities are normalized without effecting long term committed actions. For instance, two miners died and others hospitalized in Bonchari, Kisii county after the quarry collapse in 2018 (HSE, 2018). According to Kisii County department of environment, most of the mines are privately owned, unregulated and operate in unsafe and dangerous

conditions without any periodic independent evaluation on the status of the mines as required by law. As a result, the miners work in physically demanding environment and are exposed to hazards such as noise, dusts, heat among others. Tabaka ward had the highest incidence cases of above 5 years of 9,277 of upper respiratory tract infections, 339 eye infections, and 379 ear infections in 2019 compared to other five wards in the sub county (KHIS, 2019). This may be contributed to soapstone mining activities. The informal nature of how soapstone mining activities are conducted was the key motivation of assessing the status of occupation safety and health of soapstone mine workers in Tabaka.

1.3 Justification

There is little information on the status and practices of soapstone quarrying activities in Tabaka. Data obtained from the department of Environment in Kisii County show that many mines still operate in unregulated and disorganized manner. Hence, it was important to carry out a research on status of occupational safety and health with a view of making recommendations that will provide relevant information that can be used to formulate better strategies in soapstone mining in Kisii County, since the industry provides gainful employment to a large number of residents in Kisii region. The study findings will be useful in providing the miners and handicrafts relevant information on status of occupational safety and health hazards at the mine sites and provide recommendations to prevent accidents and injuries that lead to fatalities and incapacitation. Additionally, the outcome of the findings will contribute to the existing body of academia on the researched topic in Tabaka, South Mugirango Sub County.

1.4 Objectives

1.4.1 Main Objective

To assess the status of occupational safety and health of soapstone mine workers in Tabaka, Kisii County, Kenya.

1.4.2 Specific Objectives

i. To establish nature and frequency of accidents and injuries among the soapstone mine workers in Tabaka, Kisii County.
ii. To identify and measure occupational health and safety hazards experienced by soapstone mine workers in Tabaka, Kisii County.
iii. To determine the level of awareness on prevention of injuries among soapstone mine workers in Tabaka, Kisii County.

1.5 Research Questions

i. What is the nature and frequency of accidents and injuries among the soapstone mine workers in Tabaka, Kisii County?
ii. What are the occupational health and safety hazards experienced by soapstone mine workers in Tabaka, Kisii County?
iii. What is the level of awareness on prevention of injuries among soapstone mine workers in Tabaka, Kisii County?

1.6 Scope of the Study

The focus of the study was assessing status of occupational safety and health in soapstone mining industry in Tabaka, Kisii County. The in-depth research data was collected in locational quarrying aspects within Tabaka where mining and carving takes place. The data was collected between November 2022 and January 2023.

1.7 Study Limitations

A number of limitations were experienced while conducting the study. Some of the soapstone quarry workers were not willing to participate in the study due to the fear that the information gathered will be a disadvantage to them. For instance, the information could lead to closure of the mines. As a result, the researcher had to spend more time assuring the respondents that the research was majorly for academic purposes. The

researcher faced financial and time constraints worsened by the global economic challenges that slow down the data collection process. However, proper planning and consideration was exercised to ensure the study was as empirical as possible.

1.8 Conceptual Framework

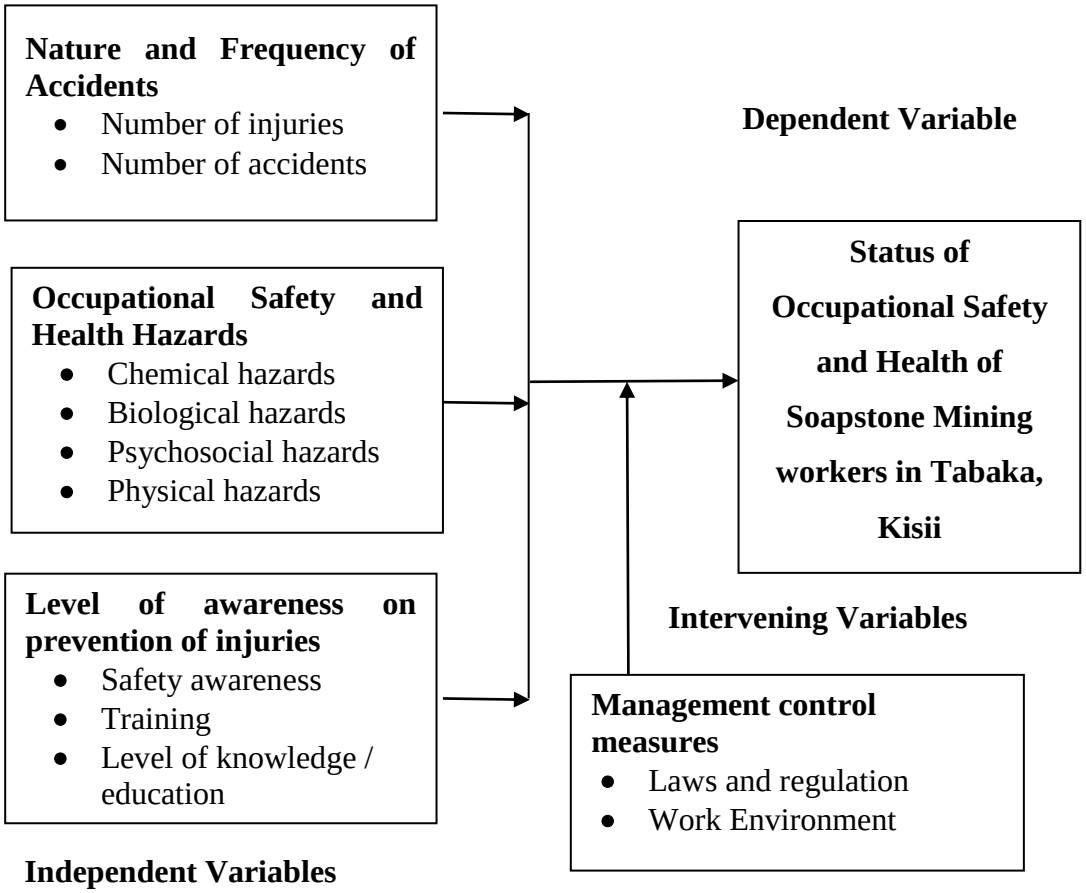


Figure 1.1: Conceptual Framework

Source: (Author, 2023)

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Principles

2.1.1 Quarrying Process

A quarry is an open-pit type of a mine where minerals and rocks are extracted. Soapstone is a remarkable metamorphic mineral rock with high content of talc making it soft, heat-resistant, and durable **(**Kainat & Shahzadi, 2021). It is formed through pressure and heat in presence of inflexed fluid buried in peridotites that metamorphosed into talc and its composition depends on the parent rock mineral and the conditions of the environment. Soapstone quarrying is an open cast mining method that extracts rock boulders existing on or below the land surface (Rumbe, 2021). The quarrying process involves the removal of rock deposits close to the earth surface using light excavation equipment. The work processes include removal of soil, channelling and wedging, cutting of rocks, crushing and transfer of rock boulders to carving sites. Its softness makes soapstone ideal for carving, which is done using hand tools such as chisels, knives, and hoes. Thereafter, the carved product is polished using different grades of sandpapers to enhance a smooth finish, painted, and dyed with different patterns depending on artists. Carvers choose suitable stones depending on hardness, size, and colour depending on the final product they want to produce. Visual inspection, flaking, and sounding of soapstone using iron machete are methods used to determine the strength of the stones (Akama & Onyambu, 2020).

Extraction of rocks in order to extract materials result in noise pollution, air pollution, and damage to the biodiversity (Sharma *et al.,* 2018). Excavation of the mineral, blasting methods, the use of powered machines, and the transportation of the materials generate significant amount of noise that can affect the health status of the workers and the people living around the quarry. Dust from the quarries especially during the dry season is a

major source of air pollution, which is a nuisance in its deposition on surfaces and cause effects on health (Hall *et al*., 2022). The severity of dusts on health depend on factors such as local microclimate conditions, size of the dust particles, chemistry, and concentration of dust particles in the ambient air. For instance, coal mines generate acidic dusts while limestone quarries produce alkaline dusts that cause different respiratory diseases (Hilson & Maconachie, 2020).

2.1.2 Occupational Safety and Health Hazards in Mining

The hazards encountered at quarries include physical hazards such as extreme temperature, vibration, falls, trips and ergonomic hazards such as manual handling, poorly designed tools, and repetitive work (GoK, 2007c). Manual handling of rocks is common in quarries causing the most common injuries at the workplace. Mechanization and automation is fundamental in reducing traditional hazards involved in manual handling since back injuries continue to affect many workers at the workplace. Effective training on proper handling methods and the use of mechanical devices will significantly decrease the number and severity of injuries and other ergonomic issues (GoK, 2007c). Elimination of hazards can be reduced through organizational measures, engineering controls, use of barriers to isolate hazardous substances, and administrative controls to minimize hazards through redesigning of safe work systems.

Quarrying activities result in generation of dusts that cause respiratory diseases among quarry workers (Hilson & Maconachie, 2020). Pneumoconiosis refers to a wide variety of lung diseases due to prolonged exposure to dusts causing shortness of breath, coughing, and chest tightness. Inhalation of silica dusts with pure crystalline forms common in most quarries result in dangerous pneumoconiosis called silicosis **(**Kainat & Shahzadi, 2021). Blasting of rocks with crystalline silica expose the quarry miners to the disease. Prolonged exposure to crystalline dusts cause chronic obstructive pulmonary disease (Hall *et al*., 2022). Dust is not only connected to a wide variety of respiratory complications to humans because the particulates enter the breathing system but its deposits also cause skin and eye problems (Akama & Onyambu, 2020).

Noise is any unwanted sound that can adversely affect the health of an individual by damaging hearing and evoking psychological, physiological, and pathological reactions. Similarly, noise pollution is defined as unwanted electromagnetic signal that causes displeasing effect and interferes with communication, comfort, and health (Sharma *et al.,* 2018). The negative effects can be classified in three groups; acoustic trauma, temporary hearing ls, and permanent hearing loss. The psychological effect of noise is expressed in the forms of annoyance, anger, stress, difficulty in resting, and concentration disorders (Kumar *et al.,* 2016). The health effects related with noise pollution can be classified as auditory and non-auditory whereby non-auditory effects include behavioural effects, stress, physiological, and safety concerns while auditory effects are like temporary hearing loss, permanent hearing loss, tinnitus (ringing or buzzing in the ear), and acoustic trauma, which is sudden hearing damage caused by an outburst that damage the tympanic membrane or ossicular chain (Ayuk *et al*., 2020).

Occupational noise exposure is the main problem that cause noise-induced hearing loss for many workers. Noise induced temporary threshold shift (NITTS) occurs due to exposure to a high level of noise. Kirchner (2016) discovered that 10 decibels average at 2000Hz, 3000Hz and 4000Hz can induce hearing loss of human beings. According to WHO, about 1.1 million globally are at the risk of hearing liabilities due to persistent exposures to precarious sound levels at a noisy environment. However, gradual recovery occurs when the affected individual spends time in a quiet place. On the other hand, noise induced permanent threshold shift (NIPTS) occurs as high levels of noise exposure continues until when its substantial to affect routine chores. At such point, permanent and irreversible hearing damage has occurred which is difficult to treat (Ayuk et al., 2020). In quarries, piece of rocks penetrating the ear drum, and noise caused by blasting and explosions of rocks can contribute to hearing loss. According to the Legal Notice No. 61 of Environment Management and Coordination (Noise and excessive vibration pollution Control) Regulation 2009, the maximum permissible noise levels for mines and quarries is 114dB(A) and minimum is 95 dB(A).

2.1.3 Nature and Frequency of Accidents and Injuries in Mining Activities

Small-scale miners use crude techniques and work under disorganized, labour-intensive, dangerous, and unlawful conditions which contribute to accidents and injuries such as fractures, burns (contusions), back/chest injuries, cuts (lacerations), and neck injuries (WHO, 2016; Long *et al*., 2015; Calys-Tagoe *et al*., 2015; Perfect, 2017; Cuvelier, 2014). According Wangela (2019), digging shafts, hand pulling the rope with full ore out of shaft, panning, crashing, and grounding lead to injuries. The common body locations injured are upper limbs, and head causing back injuries, fractures, cuts, bruises, and swellings. In Philippines, up to 35% of quarry workers are injured at work due to prolonged digging, sitting in awkward positions, bending, and carrying heavy loads resulting in excruciating and persistent injuries that cause back pain (Leung & Lu, 2016). In San Simon mining in Bolivia, Ghana commonly reported injuries among the miners were fractures, neck injuries, and back injuries with upper limbs being injured most in the body parts (Salman *et al*., 2015). The lower limbs were more prevalent to injuries due to falling and approximately 3% of the injuries result in death (Long *et al*., 2015).

Occupational health and safety hazards affect large number of workers with approximately 30-50% reporting hazardous chemical, physical, biological exposures or ergonomic factors that affect working capacity. Moreover, an equal number of workers suffer psychological overload that results in stress symptoms (Hilson & Maconachie, 2020). Developing countries experience occupational accidents and injuries caused by organic and mineral dusts, toxic metals, solvents, chemicals, physical factors like noise and vibration and biological hazards such as viruses and bacterial infections (Pavolová *et al*.,2022). Ergonomic challenges such as poor mining methods cause injuries, accidents, and musculoskeletal disorders (Akama & Onyambu, 2020). According to WHO and ILO principles every worker has a right to a safe and healthy work environment that allow socially and economically productive life. The most effective strategy of hazardous conditions is primary prevention approach for control and elimination (Cuvelier, 2014).

Kenya just like many developing nations experience numerous dangers and challenges in mining industry. Evidence from numerous studies in the country show that miners face a plethora of dangers characterized by falling rocks, roof collapse, fires, explosions, entrapment, mobile equipment accidents, noise, dusts, vibrations among others (Wanjiku, 2015: Eshiwani, 2014) The injuries that occur in a mine depend on the characteristics of the mine environment and work practices and individual behaviour based on personality traits and psychological state (Alexander, 2016).

2.1.4 Awareness on Prevention of Mining Hazards

Oxford Advanced Learner's dictionary defines having knowledge as being interested in knowing about something. Mineral Council of Australia (MCA) defines safety awareness as being constantly aware of the possibility of an injury at all times. According to World Health Organization 2015, more than one billion people live with disabilities with the majority from low and middle-income countries with significant proportion including those working in mines and industries. Despite increased awareness and various research practices trying to reduce the magnitude of danger of mining industry, injury-related reputation is still higher compared to other industries (WHO, 2015). This implies that workers should constantly be aware of possibility of any injury at the workplace and behave safely of specific risks and use appropriate protective measures (Ndege, 2016).

Safety training and awareness on hazard and risk identification and assessment on an ongoing basis is critical in workers' safety and health (Pavolová *et al*., 2022). Hierarchical order implements the protective and preventive measures through; elimination of hazards that is achieved at the design stage, engineering controls that minimize hazards at source, substitution of less hazardous substances, use of barriers to isolate hazardous areas, administrative control measures to minimize hazards through safe work systems (Hilson & Maconachie, 2020). In conditions where hazards cannot be controlled, the employer should provide personal protective equipment and implement measures for use and maintenance (Barasa, 2014). Among the most

important PPE in mining operations are face protection devices, safety shoes, gloves, helmet, and aprons among others (OSHA, 2007).

The aspect of occupational health and safety in the majority of countries in developing world has not been implemented effectively even though its work related injuries and disease burden have great detrimental effect. This is attributed to high level of illiteracy, poverty, lack of effective training to workers on occupational health and safety (ILO, 2014). According to Ethiopia labour statistics development program (2014) strengthening and improving the environment at the workplace is fundamental in enhancing efficiency of occupational health and safety. According to Ministry of Health and Social Welfare-Liberia 2014, knowledge of workers on work-related injuries that can cause disabilities is fundamental in preventing long-term disablement that affect the quality of life of miners and productivity of mining companies. Alexander (2016), revealed that miners and ground workers in Yekaba, Liberia had poor level of awareness and knowledge on mining and work-related hazards. Safety training that integrate traditional and effective approaches on knowledge and skills of hazards, their effects, and counter techniques plays a fundamental role in prevention of hazards. The employer has the responsibility of ensuring that all workers have knowledge and correct technical background of hazards present at work through training, information constitutes, and instruction.

2.2 Legal Framework

2.2.1 International Laws

The protection of workers against diseases, sickness, or injuries at the workplace is embodied in International Labour Organization (ILO) as a key element of occupational safety and health. Since the creation of ILO in 1919, its standards and instruments are concerned with issues related with OSH components such as employment, child labour, labour statistics, informal economy, labour inspection, gender mainstreaming, and the world of work. The International Labour Conference (ILC) defines main elements that

bring measurable improvements in safety and health and recommends the development of promotional framework and new instruments for occupational safety and health. The Convention advocates for prioritization of health and safety in national agendas based on two fundamental concepts of the development and maintenance of preventive safety and health working environment and the application of management systems approach. The code of practice, Recommendations, and Conventions of ILO make up instruments and standards of OSH that embody all provisions, technical guidance, and principles that guide policy makers, enterprises, legislators, labour inspectors and all those concerned in the implementation of practical measures that protect and promote safety and health of workers.

2.2.1.1 Examples of Major ILO Instruments on OSH

Approximately 188 Conventions and 199 Recommendations adopted between 1919 and 2007 by the International Labour Conference deals directly and indirectly on matters related to occupational safety and health.

2.2.1.2 Working Environment (Air Pollution, Noise and Vibration) Convention (No.148), and Recommendation (No.156), 1977.

The general provisions of the articles outline the appropriate measures that should be undertaken for the prevention, protection, and control of occupation hazards due to air pollution, noise, and vibration. Employers shall comply to the technical standards, code of practise, and the prescribe measures and ensure workers adhere to the safety procedures. Exposure limits at the working environment shall be based on updated international and national data to prevent harmful factors at the workplace.

2.2.1.3 Safety and Health in Mines Convention (No.176) and Recommendation (No. 183), 1995.

The instrument recognizes the need to prevent any fatalities, injuries or ill health that are affecting workers, the public or damages the environment from mining activities. The

articles of the convention illustrate the roles of the national laws and regulations in designating competent authority that regulates and monitors various aspects of safety and health in mines. The employer has a responsibility in preventive and protective measures at the mines in eliminating, controlling, and minimizing risks and ensuring that personal protective equipment is provided where risks remain. The workers should also cooperate with employers to promote safety and health mines. The provisions of the Convention supplemented Recommendations that provide guidance on preventive and protective measures at the mines and the need to undertake hazard assessment, risk analysis, and implementation of appropriate systems to manage risks.

2.2.2 Occupational Safety and Health Law in Kenya

According to International Labour Organization, the employer is responsible in showing leadership and commitment to compliance of OSH activities in the organization, by ensuring there are appropriate arrangements for the establishment of an OSH management system that should contain the major elements of policy, organizing, planning and implementation, evaluation and action for improvement. Every citizen in Kenya has a right to fair labour practices, reasonable working conditions, and a clean and healthy environment (Constitution of Kenya, 2010 Articles 69). The enactment of the Occupational Safety and Health Act (OSHA) and the Work Injury Benefits Act (WIBA) in 2007 as the principal laws that provide guidelines and governs OSH, became the foundation of investigation and analysis of occupational accidents and diseases. The primary role 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 (OSHA, 2007). On the other hand, WIBA, 2007, provides compensation to employees for work related injuries and diseases contracted in the course duty or any related activities.

Under the Work Injury Benefits Act (WIBA) 2007 in Kenya, injuries sustained in the workplace can be categorized into minor, major, and severe injuries based on their severity and impact on the worker. Minor accidents or injuries are first aid cases that do

not cause loss of working hours Major injuries are more serious, necessitating significant medical treatment and extended recovery time and do not typically result in permanent disability resulting to more than three days off duty while Severe injuries result in long-term or permanent disability, requiring extensive and prolonged medical care significantly impacting the individual's quality of life and ability to work, often leading to permanent impairment.

The safety and health laws depend on enforcement as a driving factor that promotes compliance. Poor coordination in the Directorate of Occupational Safety and Health (DOSH) and lack of political will to fully enact safety and health based on ILO standards has led to lack of reliable data on occupational accidents and diseases of the workers in the country (Channing, 2013). ILO has tried to create safety and health awareness by promoting safe, decent, and healthy workplace environment through convention No. 155, which is one of the major blueprints that deal with occupational safety and health of workers. Even though Kenya has not ratified the convention, the recommendations have been incorporated in OSHA. According to Article 16 of OSHA 2007, employers need to ensure work place, machinery, equipment and processes under their control are safe and not posing risk to the health of the worker. Chemical, physical and biological substances and agents should be controlled by ensuring measures are put in place for the worker protection (ILO-OSH, 2001b). Workers are mandated by the law to cooperate with employers by observing health and safety standards of their own and those of others by removing and reporting workplace hazards.

2.2.3 Other Laws that deal with OSH Issues in Kenya

2.2.3.1 Mining Act 2016

The act establishes state Mining Corporation, Directorate of Mines, and legislative framework that improves the development of the mining sector and mineral exploitation. It recognizes the small-scale mining and artisanal operations and advocates for clear

processes and safe operations that allow communities to work in safer environment as they benefit from the minerals in their lands.

2.2.3.2 The Factories and Other Places of Work (Noise Prevention and Control) Rules, L.N. No. 25/2005

These rules apply to workplaces where activities result in noise levels that could impair or damage employees' hearing ability. They specify the permissible levels of noise, and require the occupier to carry out noise measurements, develop a noise prevention programme to reduce noise levels, and provide hearing protection (GoK, 2007c). Noise exposure limits should not exceed limits to prevent risk of noise induced hearing loss. Where noise levels exposures in mechanization section exceeds the continuous equivalent of eighty-five decibels for eight hours, an effective noise control and hearing conservation program shall be developed (GoK, 2007c). Before hearing protectors are given, workers require training in fitting, selection, use, care, and maintenance of appropriate hearing protectors (GoK, 2007b). Mitigating measures require monitoring of the effectiveness of the control methods used to ensure, Noise Induced Hearing Loss does not result in failure of Personal Protective Appliances in use or other modes of control in place (GoK, 2005).

2.2.3.3 Factories and Other Places of Work (Hazardous Substances) Rules, L.N. No. 60/2007

These rules apply to workplaces where workers are likely to be exposed to hazardous substances. They require the occupier to prevent employees from exposure to such substances by putting various control measures in place, or, where these are not reasonably practical, to ensure that personal protective equipment (PPE) is provided. They prescribe occupational exposure limits (OEL) for hazardous chemical substances, safe handling, use and disposal of hazardous substances (GOK, 2007b)

2.2.3.4 The Factories and Other Places of Work (Medical Examination) Rules, L.N. No. 24/2005

These rules apply to workplaces where employees are engaged in occupations that expose them to hazards that might harm their health. They specify occupations requiring medical examinations, and the types of examination of employees at the employer's cost. According to the medical examinations rules, workers in manufacturing units are to undergo medical examinations if they are exposed to specific occupational health hazards for the purposes of preventing and controlling occupational diseases (GoK, 2007c).

2.3 Previous Works Related to Study

Perfect (2017), provided a comprehensive analysis on copper and cobalt mines at Lupoti, Katanga Province in Democratic Republic of Congo. The researcher conducted quarry safety measures involving 180 miners where they demonstrated that bruises contributed (50.2%), cuts (44.4%) while fractures being the least with 5.4%. The study further highlighted that upper limbs (arms and hands) were the most injured body part (50.5%), while the lower limb (legs, knee and feet) constituted (29.3%), head (12.8%), while other parts 7.4% of the injuries.

Ayoo and Moronge (2019), conducted a study on occupational safety compliance in small-scale gold mines in Siaya County. Her concern was the illegal and informal nature of the small-scale mines and the failure of Mining Act No. 12 of 2016 and Convention No. 176 on Safety and Health of Mines to regulate small-scale mines just like the large-scale mining sector. The study aimed at exposing factors influencing non-compliance and safety issues in small-scale mines. She found out that there were salient variations in the level of knowledge of occupational safety among children and adults' miners, attributed to the significant differences in the level of knowledge and awareness on importance of using protective gear. 10.8% of miners under the age of 18 years were not aware of the importance of personal protective equipment while 5.4% of miners aged

between 18-50 years believed that PPEs were not required in mining. The research opted for legalization of such mines to enhance improved safety and compliance

An investigation by Tilji (2018) on effects of soapstone quarrying on the socio-economic and geomorphic activities in Tabaka, Kisii County focused on the alteration of the landscape and the occurrence of geomorphic processes during soapstone mining activities. The study highlighted the slope processes, uses of soapstone residues, and the relationship between quarrying and farming. Her intention was to understand the geomorphic processes in soapstone quarrying where findings indicated that soapstone quarrying took up to 22% of farmland and it accelerated weathering and soil erosion

Tsuma (2017) conducted a study on artisan miners in Taita-Taveta County on strategic practices that influence the implementation of small-scale mining projects. Tsuma investigated on how leadership strategies, community participation, and technology influence effective implementation of artisan mining. The study aimed at ways that could strengthen the competitive advantage of quarry workers to increase level of production. The findings revealed that 76.4% of the respondents believed that effective strategies influence the performance of small-scale mining in Kenya. The research did not focus on any injuries experienced by the quarry workers.

Wanjiku (2015) carried out a study in Mutonga Quarry, in Meru County on occupational health and safety hazards associated with quarrying activities with the intention to determine occupational health problems, health seeking behaviors, and availability of health promotional services for the quarry workers. The research was concerned with the plight of quarry workers because majority of research focused on public health problems such as Malaria, HIV/AIDS, child mortality etc. It revealed that 74.8% of quarry workers were not using protective clothing at the workplace. The respondents claimed that the employer did not provide the PPEs and that the protective gear were too expensive for them to afford with their little income. Some of the mineworkers could only access gloves, gumboots, and use old cloths as aprons.

An investigation by Eshiwani (2014) on effects of quarrying activities on the environment in Embakasi District, Nairobi, revealed that quarrying activities result into negative effects such as land degradation. The researcher found out that there were several complaints about dust, vibration, and noise pollution that contributed to health problems such as respiratory infections, chest problems, hearing problems, coughing, and eye infection among others. The study also focused on effective implementation of Occupational Safety and Health Act and the use of mitigation measures to reduce the effects of quarrying to the environment. It was noted that the use of mild explosives, electric detonators, shock tubes, and planting trees play a vital contribution in ensuring that the effects of quarrying activities are reduced.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Design

This study adopted cross-sectional study design that integrated both the qualitative and quantitative paradigms in data collection methods. According to Yin (2018) descriptive cross sectional research design determines the way things are at a point in time and it is used when the data being collected to describe persons, organizations, settings or phenomena.

3.2 Study Area and Population

The study was undertaken in Tabaka sub-location, Gucha South, in Kisii County. It is situated approximately, 360 Km West of Nairobi and about 113km from Kisumu south east of Lake Victoria (http://www.softkenya.com, 2012). The region lies between Latitude 0045'S to 0046.7'S and longitude 3403.6'Eto340.40'E (Njoroge *et al.*, 2015). The target population for the study was soapstone mine workers and carvers involved in soapstone activities and managers who provided more in depth information to help answer the research questions. The Kenya Population and Household Census of 2019, estimates the population of Tabaka as 34,650 people with 8,327 households. Based on the data available in the department of Environment and Natural Resources in Kisii County, registered self-help groups are organized groups involved directly in soapstone activities such as mining, carving, finishing, and marketing from quarry sites in Tabaka. Hence, the study utilized the population of soapstone operators in self-help groups.

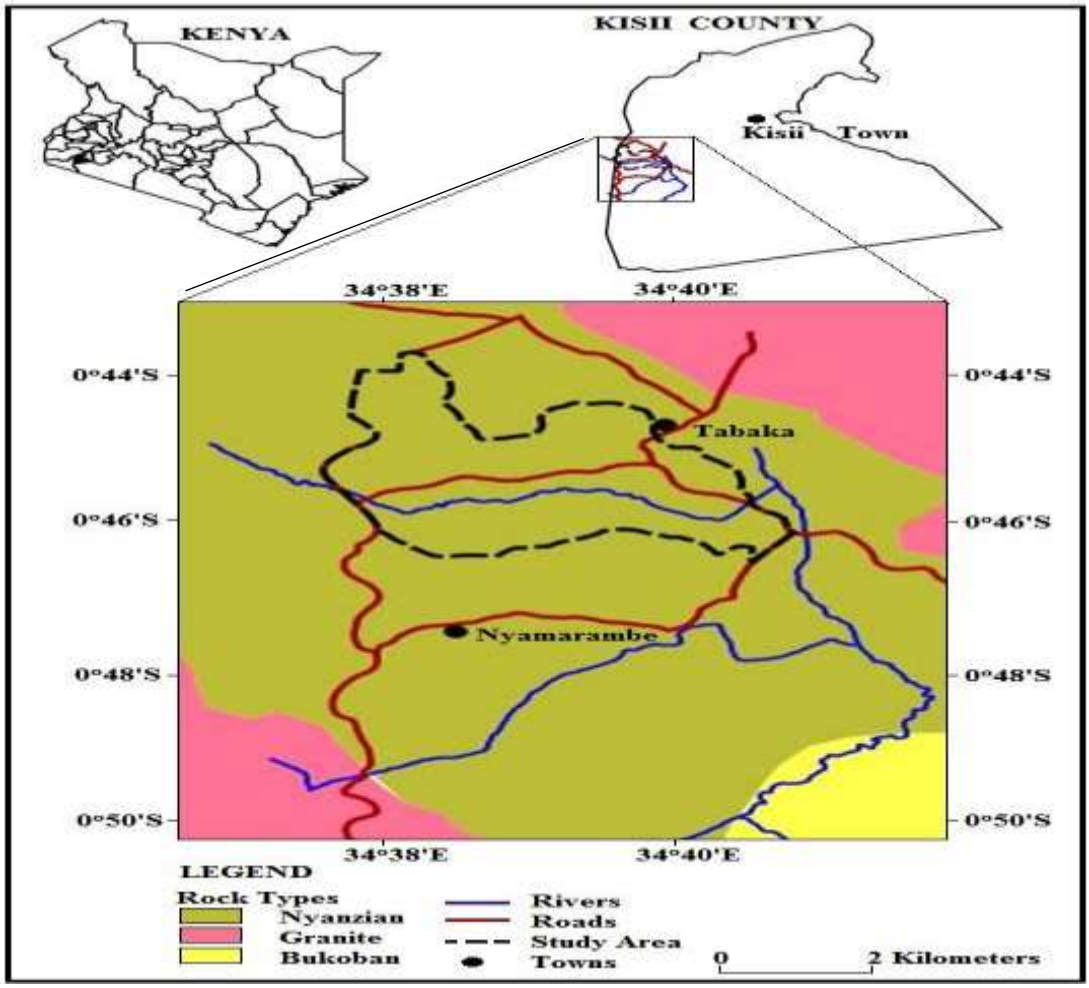


Figure 3.1: Map of Tabaka, Kisii County

Source. (Philips, 2017)

Table 3.1: Study Population

	Group Name	Total Members
1.	Smolart Self Help Group	55
2.	Top Designers Self Help Group	43
3.	ISA Self Help group	40
4.	Tabaka Chigware Youth Group	43
5.	Terazzo Africa Self Help Group	41
6.	**Total**	**222**

Source: Department of Energy, Water, Environment and Natural Resources, Kisii County (2022)

3.3 Sampling Method

This study employed stratified sampling method, which divided the population into strata, and then a given number of cases was selected randomly from each population sub groups. The objective of using simple random sampling was to select a unit out of population so that each person in the population has a chance of being selected and included in the study. The sampling technique dealt with a manageable size to enable the study obtain detailed information at an affordable cost in relation to finance, time, and human resource (Mugenda & Mugenda, 2003). The sample was obtained from Smolart Self Help Group, Top Designers Self Help Group, ISA Self Help group, Terrazzo Africa Self Help Group, and Tabaka Chigware Youth Group with a population that add to 222 members. The registered self-help groups are directly involved in mining, carving, finishing, and marketing of soapstone products and they interact directly with the community and different stakeholders. The quarries are Nyabigena, Rionchomba, Riamayaka, and Nyatike. The managers of the groups negotiate with owners of the farms with soapstone on cost of extracting rocks from their farms before they mine and transform to different designs and shapes.

3.4 Sample Size Determination

Sampling is a process of choosing a sub-group from a population to participate in the study. Using a manageable size of the sample enables the study to derive detailed data at an affordable cost in terms of human resources, finance and time (Mugenda & Mugenda, 2003). Ngechu (2004) notes that stratified proportionate random sampling produces estimates of greater precision of overall parameters and ensures representative sample is derived.

The sample size was calculated using *Slovin* (1960) formula

$$n = \frac{\mathbf{N}}{1 + N(e)^2}$$

Where

n- desired sample Size

N-Population size

e-Degree of accuracy/confidence interval (margin of error), expressed as 5% (0.05)

$$n = \frac{222}{1 + 222(0.05)^2}$$

=143

The sample size was adjusted with refusal taken as 18% to cater for the respondents who decline to take part in the research and ease allocation of strata formed.

$$n = \frac{143}{(1 - 18\%)}$$

= 174

Proportionate stratified random sampling was used to assign samples to the five self-help groups involved in mining activities as follows: The population of the soapstone quarry workers was obtained from the records of the quarry's managers. Coded numbers were used in place of soapstone miners. A list of random numbers was generated using randbetween function in Microsoft Excel true number generator before selecting the required sample in each stratum.

Table 3.2: Proportionate Allocation of Sample Size

Group Name	**Strata population(s)**	**Proportion per stratum (p) = s/N x n**
Smolart Self Help Group	55	43
Top Designers Self Help Group	43	34
ISA Self Help group	40	31
Tabaka Chigware Youth Group	43	34
Terazzo Africa Self Help Group	41	32
Total	**222**	**174**

The chairpersons of the groups were purposively sampled as key informants for oral interviews. This ensured high objectivity in sample selection was achieved by giving each item in the target population an equal chance of being selected and included in the final sample drawn.

3.5 Research Instruments

Data was collected using standardized semi-structured questionnaires, in-depth interviews guide, and observational checklist as primary collection tools. According to Kothari (2004), questionnaires are free from the bias of the interviewer and allow answers to be in respondents' own words. The questionnaires sought perception of the soapstone miners concerning various variables such as common occupational hazards, accidents and injuries, and safety. Interview guide was used to collect data from managers in charge of the groups involved in soapstone activities who provided more insight on occupational safety compliance. The managers were interviewed individually.

Observation checklist was useful in noting observed occupational safety issues and conditions that could cause harm.

Two research assistants from department of Water, Environment, Energy, and Natural resources in Kisii County were recruited since they were trained on the use of the noise meter. Noise level monitoring was carried out using calibrated digital Sound level meter model SL720. Level of sound measurements were recorded from purposely randomly selected noise sources of quarrying activities of drilling, crushing, and hauling of trucks.

3.6 Data Processing and Analysis

Data were collected, screened, sorted, and thereafter analysed using Statistical Package for Social Services version 21. The coded data was analysed both quantitatively and qualitatively. The results were presented in terms of tables and figures. Bivariate analysis of variables using Chi-square test of association was used for testing statistical significance. A p value less than 0.05 was considered statistically significant at 95% confidence interval.

3.7 Data Validation

The data that was collected from the questionnaires were checked for incompleteness and inconsistencies before analysis using Statistical Package for Social Services version 21. The supervisors helped in checking the data for errors, accuracy, and biases that could compromise the integrity of the research findings ensuring that the conclusions drawn are based on accurate and reliable information.

3.8 Ethical Review

Permission and introductory letter to do data collection were obtained from Ethical Review Committee (ERC) of Kenyatta University, research permit and research authorization from National Commission for Science, Technology and Innovation (NACOSTI) and the relevant local administration of Kisii County and the soapstone

operators. To obtain consent, the researcher explained the nature, purpose, and rights to privacy and confidentiality to the respondents. Principle of voluntary participation with no coercion or intimidation and coded numbers instead of names were used to enhance confidentiality and protect identity of participants. All information collected were filed and kept under lock and key cabinet to enhance privacy, confidentiality and security.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Response Rate

A total of 174 quarry workers were targeted out of which all the questionnaires were filled and returned. Therefore, the response rate was sufficient representation and reliable for data analysis.

4.2 Socio-Demographic Characteristics of the Respondents

Table 4.1: Sociodemographic Characteristics of the Respondents

Variable	Category	Frequency	Percent %
Gender	Male	129	74.1
	Female	45	25.9
Age	18-35	52	29.9
	36-50	114	65.5
	>50	8	4.6
Education	No formal education	3	1.5
	Primary	103	59.2
	Secondary	40	23
	Tertiary	28	16.1
Marital status	Single	6	51.7
	Married	153	76.9
	Separated	14	8
	Widowed	1	0.6

The socio-demographic analysis shows that majority of the respondents were male 129 (74.1%) and female were 45(25.9%) with the majority 114(65.5%) being the age-group of 36-50**.** This means that most of the respondents were male aged from 36-50. This could be attributed by the perception that quarry activities were considered men's job. During the interview sessions, one of the soapstone quarry manager pointed out that most female were involved in carving and marketing and there was a perception from the society that women found quarry activities to be strenuous and labour intensive. The finding also implies that the most active reproductive age was involved in mining

activities. This study supports the findings of Arasa *et al*., (2020) that the male dominate artisanal mining activities at 65.17%. However, it contradicts findings of Beth (2018) that small-scale gold mines in Siaya is female dominated.

About 3(1.7%) of the miners had no formal education, 103(59.2%) had primary education, 40(20.1%) had secondary education and 28(16.1%) had tertiary education as the highest level of education. This demonstrated that the sector attracted workers with a blend of knowledge and skills. Furthermore, it was observed that soapstone quarrying activities did not require advanced skills since most of the work was informal. Many soapstone mine workers may have lacked finances to further their education and secure better jobs. The findings also indicated 6(3.4%) were single, 153(87.9%) were married, 14(8.1%) had separated and 1(0.6%) were widowed. This implied that majority of the respondents were family individuals with responsibilities of dependents which could be the major reason for their engagement in soapstone activities. The results concur with Ayoo and Moronge (2019), research findings of majority of (60.1%) of the artisan gold mining being married.

4.3 Nature and Frequency of Accidents and Injuries

4.3.1 Soapstone Mining Activities

The findings as indicated below shows that the main mining activity of expertise was cutting of stones 75(43.1%), vegetation clearing 4(2.3%), removal of top soil 15(8.6%), extraction of stones 44(25.3%), and carving at 36(20.7%). This implies that majority of miners were specialized in cutting of stones which determine the size and shape of the sculptures that were to be carved. The findings were in tandem with the results of Eshiwani (2014) and Kibii (2020) that several operations in quarries are performed as a results of workers engaging in many activities

Figure 4.1: Soapstone Mining Activities

4.3.2 Nature of Soapstone Injuries

Table 4.2: Nature of Injuries of Soapstone Mine Workers

Variable	Category	Frequency	Percent %
Type of injury	Cuts	90	51.7
	Fractures	44	25.3
	Bruises	28	16.1
	Back/chest injuries	12	6.9
Cause of injury	Struck/hit by rock	45	25.9
	Sharp rock edges	43	24.7
	Fall	18	10.3
	Working tools/Machinery	47	27
	Lifting heavy load	10	5.7
	Cutting of rocks	11	6.3
Part of body injured	Head	57	32.8
	Hand	71	40.8
	Arm	11	5.5
	Back/chest	21	10.6
	Legs/knee/feet	14	7.0

The type of injury experienced most was cuts at 90(51.7%), fractures 44(25.3%), bruises 28 (16.1%), and back/chest injuries at 12 (6.9%). Majority of the of the respondents identified injuries as caused by being struck/hit by rock 45(25.9%), sharp rock edges 43(24.7%), falls at 18(10.3%), working tools/machinery at 47(27%), lifting heavy load at 10(2.9%) and cutting of rocks 11(6.3%).

The injuries that soapstone miners encountered affected hand at 71(40.8%), head 57(32.8%), back/chest 21(12.1%), legs/knee/feet 14(8%) and at arm 11(6.3%). The injuries on the body parts could be attributed to ergonomic hazards and manual works in quarries. This is similar findings to that of Ayoo and Moronge (2019) that safety threats among miners were working tools (20%), falling/sliding (14.7%), falling rocks (26.3%) and results of Ahmad (2017) that mining sector workers experience back problems, neck, arm and hand problems. These safety issues contribute to the nature of the occupational injury ranging from minor injuries to severe cases that cause death.

Plate 4.1: Cutting and Carving of Soapstone

4.3.3 Frequency of Accidents and Injuries

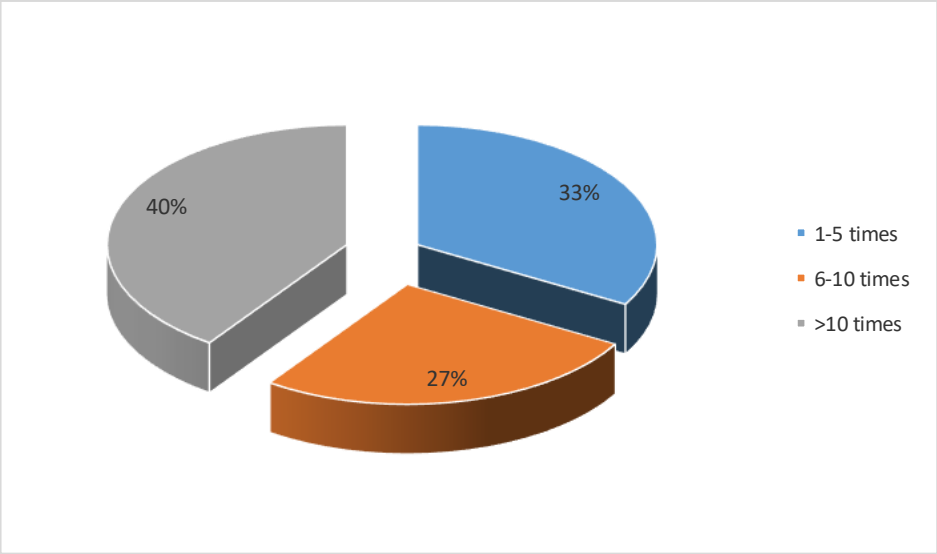


Figure 4.2: Frequency of Accidents

Majority 70 (40%) of the of the respondents were injured more than 10 times in the past 12 months with 58(33%) been injured 1-5 times. According to Singo *et al*., (2022), the prevalence of injuries increases with working hours and decrease with months of experience. The results contrast Makokha (2021) findings where 55.27% reported to have not been injured in a year.

4.3.4 Severity and Reporting of accidents

Table 4.3: Severity and Reporting of Accidents

Variable	Category	Frequency	Percentage
Severity of accidents	Minor	119	79.3
	Major	21	14.6
	Severe	9	6
Report accidents/Injuries	Yes	81	44.6
	No	93	53.4

The findings of the research indicated that majority of the miners responded to have experienced minor injuries at 119(79.3%) at work that only required first aid cases compared to major injuries that required more than three days off duty and severe cases with potential of causing permanent disability. On accidents reporting, majority of the respondents at 93(53.4%) did not report accidents/incidents compared to 81 (46.6%) who reported. Despite the high potential effects and magnitude of the injuries, most mine workers did not report which could be attributed to fear associated with noncompliance to OSH regulations, sanctions and possible closure of the mine sites. The findings relate to those of Singo *et al*., (2022) where minority 140 (35%) of the miners reported accidents in small-scale gold mining in Zimbabwe with slips, trips, and falls and hit by tools being the most reported accidents. To ensure that mining operation are performed in a safe environment, it is important to implement the necessary laid down measures of occupation safety and health of occupational hazards to reduce injuries at the workplace (Ayuk *et al.*, 2020).

4.4 Occupational Health and Safety Hazards

4.4.1 Awareness and Training to Identify and Measure Occupational Hazards

Table 4.4: Awareness and Training to Identify and Measure Occupational Hazards

Variable	Category	Frequency	Percent %
Aware of mining hazards	Yes	102	58.6
	No	72	41.4
Trained to identify hazards	Yes	63	36.2
	No	111	63.8

The findings indicated that majority of the respondents 102(58.6%) were aware that mining has occupational health and safety hazards while 72(41.4%) were not aware since majority of the respondents had not been trained to identify hazards at the workplace at 111(63.8%) and only 63(36.2%) had been trained. This could be attributed to majority of the respondents having formal education and relied on observational and acquired skills. According to Aliabadi *et al.*, (2019) safety training programs play a crucial role in improving workers' knowledge about hazards of workplace. Quarry workers need proper training to increase techniques that enhanced efficiency and environmental integrity (Arasa *et al*., 2020).

4.4.2 Tools Used in Quarrying

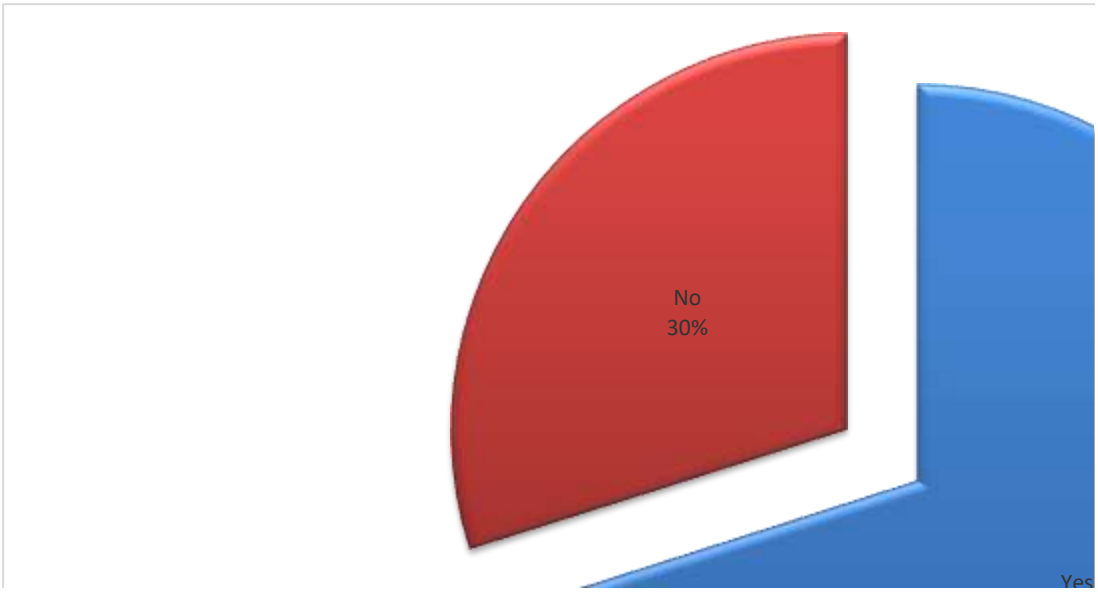


Figure 4.3: Use of Quality Tools

Majority of the respondents believed they use quality working tools at 122(70.1%) compared to 52(29.9%) that did not. It was observed that most of the respondents used rudimentary hand tools in cutting and carving of soapstone such as chisel, *pangas*, sledgehammer and hack saws which could be attributed to the nature of operation which

were manual and in small scale. According to Human Right Watch (2011) in Bamako mining operations, use of tools as heavy sledgehammers in pounding rocks lead to back, arm, hand and chest injuries. Kibii (2020), pointed out that improvement of quality tools was the simplest strategy to improve productivity, safety, and health in small scale stone quarry sector in Kenya.

4.4.3 Identification of Hazards by Soapstone Mine Workers

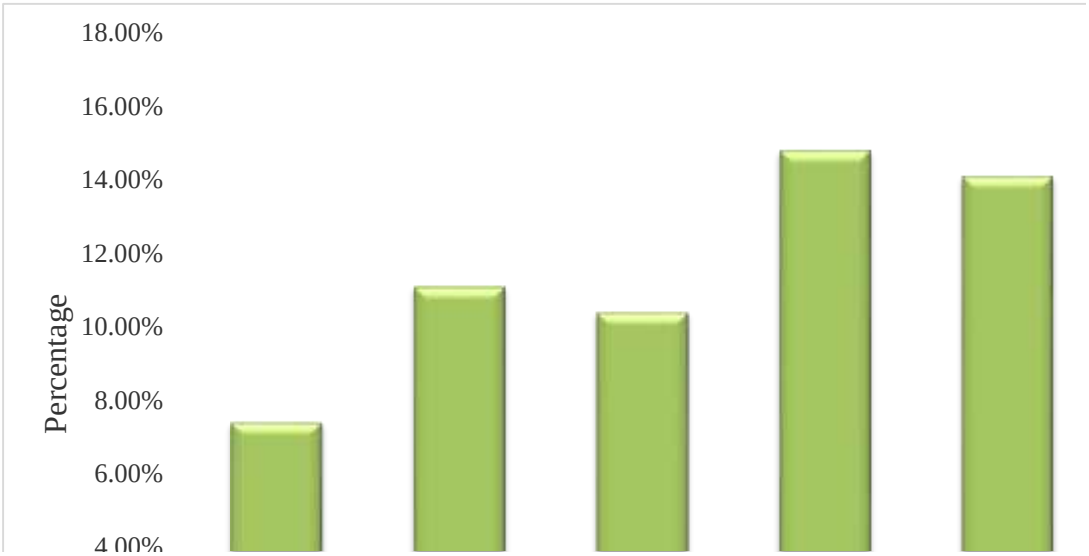


Figure 4.4: Occupation Hazards at Mine Sites

The soapstone mine workers identified hazards as falling of rocks 10(7.4%), sharp rock edges at 15(11.1%), dust 14(10.4%), falls/slips 20(14.8%), working tools 19(14.1%), lifting of heavy loads 22(16.3%), noise 17(12.6%), cuts 18(13.3%). Even though soapstone quarry workers could identify hazards, mediating factors such as inadequate knowledge of risk of mining operations, failure to use PPE, use of poor equipment among others contribute to underlying cause of safety issues that led to minor, major, and severe injuries and associated infections and illness. These findings are in line with Wanjiku *et al*., (2015) that quarry activities expose Mutonga quarry miners to hazards such as manual handling of rocks, exposure to dust and falling rocks. Leung & Lu,

(2016) established in Philippines that the most cited safety issues were tripping, falling, inappropriate blasting operations, rocks, hit from rocks, and shaft tunnel.

4.4.4 Level of Noise Produced in Different Mining Activities

Table 4.5: Noise Generated by Mining Activities

Quarry Activity	Mean dB(A)	Std. Deviation
Drilling	53.2	6.5
Crushing	61.4	3.2
Hauling of truck	48.8	1.2

Different measurements of noise were taken from various areas of soapstone quarry activities using a calibrated sound level meter. The activities measured were drilling, crushing and hauling of tracks. Drilling was used to break large compact soapstone into smaller pieces which produced the highest amount of noise with a maximum 82.2 dB(A) with mean of 53.2±6.5. Fortunately, drilling activities were intermittent operations that occur within a short period of time due to the softness of the soapstone. According to the factories and other places of work (noise prevention and control) rules 2005, No worker shall be exposed to noise level in excess of the (a) continuous equivalent of ninety dB(A) in eight hours within any twenty-four hours duration, one hundred and forty dB(A) peak sound level at any given time and where noise is intermittent, noise exposure shall not exceed the sum of the partial noise exposure equivalent continuous sound level of ninety dB(A) in eight hours duration within any twenty-four hours duration. Key informants highlighted on how blasting was illegal and no license was awarded since soapstone was mainly small scale. However, it was observed that soapstone quarry activities require strict safety policies and implementation to protect quarry workers and surrounding households. Mitigation measures of noise generated can be reduced by targeting the activity producing most noise. For instance, drilling can be done at night. Hauling noise levels of trucks transporting soapstone products was high at 75 dB(A) with the major sound sources being the exhaust and air inlet for the engine. These findings concur with results of Kulabako (2019) on noise produced at Stirling

quarry where blasting as a technique of loosening stone produce noise that impacted workers, residents and both domestic animals and wildlife.

4.4.5 Respondents View on Health Conditions Experienced after Working in Mines

Table 4.6: Health Conditions Experienced after Working in Mines

Effects to Mine workers	Frequency	Percentage
Respiratory problems	152	87.4%
Loss of hearing,	52	29.9%
Skin irritations/itching,	7	4%
Heat stress,	12	6.9%
Concentration disorders,	1	0.6%
Tinnitus (ringing in the ear),	36	18.8%
Eye infections	64	33.3%
Skin infections	13	6.8%

In spite of the fact that the investigation did not set up a component to find out health impacts among respondents was completely due to soapstone quarry activities, the study sought to find out the conditions the miners thought it could relate to working in the mine sites and the results revealed that majority 152 (87.4%) relate to respiratory problems, 52(29.9%) loss of hearing, 7(4%) skin irritations/itching, 12(6.9%) heat stress, 1(0.6%) concentration disorders, 36(18.8%) tinnitus (ringing in the ear), 64(33.3%) eye infections and 13(6.8%) skin infections. It could be inferred from the respondents that they consider soapstone quarry operations as health and safety hazard with potential impact on health outcomes.

From the interviews conducted, soapstone quarrying activities can result in respiratory problems due to the produced dust. Tools used, falling and flying rocks cause injuries that result in infections and disabilities. Unfilled holes after quarrying act as breeding sites for vectors that transmit various ailments such as mosquitoes that bite and cause skin irritation and can transmit malaria. The findings agree with the views of stone quarrying workers in Tenges, Baringo County that quarrying has associated risk to occupational health and safety of people and the response of health care workers that

they received an average of 5 patients with physical injuries and 10 patients with chest related problems on a monthly basis of people associated with quarrying operations (Kibii, 2020).

The findings also support the results of Eshiwani (2014) that respiratory infections, eye infections, malaria, chest problems, allergy, and common cold as the most prevalent health problems experienced by stone quarry workers and who lived near quarry zones and Wangela (2019) that stone quarrying activities leads to health related problems such as coughing, ear infections, eye infections, malaria, breathing problems and pneumonia. The findings are in line with Encyclopedia Britannica (2011) that quarrying operations generate large quantities of dust that cause a variety of respiratory diseases amongst quarry workers.

Analysis of the Kenya Health Information System (KHIS) indicated highest cases of 615(22.5%) eye infections and 654(36.2%) ear infections and 14,571(29.3%) of upper respiratory infections (KHIS, 2022) in Tabaka ward compared to other 6 wards of the sub county which could be attributed to soapstone activities.

4.4.6 Bivariate Analysis of Identification of Occupational Hazards

Table 4.7: Chi-Square Test of Association of Mining Hazards and Identification

		Aware to identify OSH Hazards		**Chi Square, p value, df**
Variable	**Category**	**Yes (%)**	**No (%)**	
Trained on how to identify hazards	Yes	58(56.9%)	5(6.9%)	$\chi 2=45.534$
	No	44(43.1%)	67(93.1%)	p=0.000, df=1
Type of Identified occupational hazards	Falling rocks	3(5.8%)	7(8.4%)	$\chi 2=6.104$
	Sharp rock edges	7(13.5%)	8(9.6%)	p=0.528, df=7
	Falls/slips	4(7.7%)	10(12%)	
	Dust	5(9.6%)	15(18.1%)	

		Aware to identify OSH Hazards		Chi Square, p value, df
Variable	**Category**	**Yes (%)**	**No (%)**	
	Working tools	10(19.2%)	9(10.8%)	
	Lifting heavy loads	9(17.3%)	13(15.7%)	
	cuts	5(9.6%)	12(14.5%)	
	Noise	9(17.3%)	9(10.8%)	
Loss of hearing	Yes	33(32.4%)	69(67.6%)	$\chi 2=4.772$
	No	69(26.4%	50(69.4%)	
				p=0.092, df=2
Respiratory Problems	Yes	88(86.3%)	64(88.9%)	$\chi 2=0.2612$
	No	14(13.7%)	8(11.1%)	
				p=0.609, df=1
Skin irritation	Yes	2(2%)	5(6.9%)	$\chi 2=2.715$
	No	100(98%)	67(93.1%)	
				p=0.099, df=1
Heat stress	Yes	7(6.9%)	5(6.9%)	$\chi 2=0.000$
	No	95(93.1%)	67(93.1%)	
				p=0.983, df=1
Concentration disorders	Yes	1(1%)	0(0%)	$\chi 2=0.710$
	No	101(99%)	72(100%)	
				p=0.399, df=1
Tinnitus	Yes	27(26.5%)	3(4.2%)	$\chi 2=14.715$
	No	75(73.5%)	69(95.8%)	
				p=0.000, df=1
Eye infections	Yes	33(32.4%)	23(31.9%0	$\chi 2=0.003$
	No	69(67.6%)	49(68.1%)	
				p=0.955, df=1
Skin infections	Yes	9(8.8%)	2(2.8%)	$\chi 2=2.605$
	No	93(91.2%)	70(97.2%)	
				p=0.107, df=1

A bivariate analysis indicated that trained to identify occupational hazards ($\chi^2=45.534$, df=1, p=0.000) and experiencing tinnitus (ringing of the ear) were statistically significant to being aware to identify occupational health hazards. Training soapstone mine workers creates awareness of occupational health and safety and enable them be able to identify hazards and use appropriate protective equipment to reduce the health

impact of the hazards. Its viable to ensure that effective training is carried out to enhance safe work environment.

4.5 Level of Awareness on Prevention of Occupational Injuries

4.5.1 Awareness on Prevention of Injuries

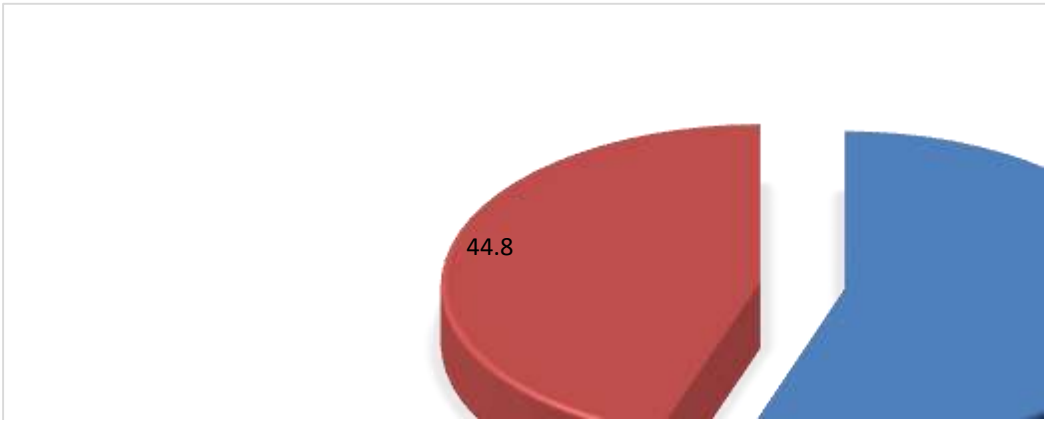


Figure 4.5: Awareness on Prevention of Injuries

The study findings indicated that 96(55.2%) of the respondents have heard about prevention of injuries at the workplace compared to 78(44.8%) of the respondents. According to Occupational Safety and Health Act 2007, employment of a worker in any process that may cause ill health or bodily injury is prohibited unless worker has been fully instructed about the hazards involved and precautions that must be observed. Worker should be properly trained or required to work under supervision of experienced persons to prevent injuries. This contrast with the findings of Beth (2018) of majority gold miners 78.9% in Siaya County lacking awareness about occupation safety. Makokha (2021) noted that majority of mine workers are ignorant and do not follow instructions even for their own safety.

4.5.2 Source of Information

Table 4.8: Source of Information

Variable	Category	Frequency	Percentage
Source of information	Mine site manager	4	2.3
	Radio/TV	6	3.4
	Friend/family	4	2.3
	Fellow miner	21	12.1
	Newspaper	10	5.7
	Training	60	34.5
	Experience	69	39.7

The major source of information was through experience 69(39.7%) and training at 60(34.5%) and fellow miners at 21(12.1%). According to Occupational Safety and Health Act 2007, employer should ensure that all the workers receive appropriate instructions regarding safety and health risks including emergency procedures during their activities at the workplace and actions to be taken in case of an emergency. This finding concurs with Chepchumba (2020) that the main source of information of occupational hazards are colleagues (45.2%) and personal experience (32.6%). This shows that more awareness on occupation safety is needed. MacEachen & Kosny, (2016) also noted that the compliance rates with regulations among small enterprises is majorly affected by inaccessibility of the regulation and the inability to comprehend regulatory requirements. Inaccessibility impacts awareness and knowledge which affect compliance.

4.5.3 Awareness and Use of PPE among respondents

Table 4.9: Knowledge and Use of PPE

Variable	Category	Frequency	Percent %
Wear PPE	Yes	116	66.7
	No	58	33.3
Type of PPE	Protective helmets	43	37.1
	Face shields/masks	21	18.1
	Gloves	20	17.2
	Safety boots	19	16.4
	Aprons	13	11.2
Source of PPE	Bought for myself	71	61.2
	Given by family/friend	10	8.6
	No provider	35	30.2
Reason for not using	Not provided	12	20.7
PPE	Not required	10	17.2
	Not comfortable	13	22.4
	Not affordable	22	37.9
	Forget to use	1	1.7

The study revealed that majority of the respondents 116(66.7%) wore personal protective equipment when working compared to 58(33.3%) who did not. Protective helmets were the most use type of PPE at 62(30.5%), followed by face shields at 33(15.5%), gloves 30(14.4%), safety boots 25(5.2%) and aprons 24(6.3%). The respondents indicated that they bought for themselves the PPE 107(61.5%). For those who did not wore the PPE, majority claimed they were not affordable 55(27.6%), not comfortable 49(24.6%), not provided 35(20.1%), forgot to use at 7(3.5%) and not aware of importance at 2(1%).

Even though majority of the miners indicated the use of helmets (33.3%) and face shields (15.5%), the researcher observed the usage of protective equipment was poor. Majority claimed they could not afford (27.6%) the protective gears since they bought for themselves (61.5%). This could be attributed to the reason that most of the earnings are channelled for family upkeep. Administrative incompetence and noncompliance of Mining Act and Occupational Health and Safety Act, 2007 was observed.

A discussion with site managers, environmental officers and County Occupational Safety and Health Officer indicated that lack of formality in the sector had affected workers' safety. Temporary closure of mines occurred when severe accidents are reported but usually resumption of normal mining operations resume before proper investigation and mitigations are adhered. Mine site managers did not report accidents to County Director of Environment and County Occupational Safety and Health Officer because of possible closure of mines which affect the livelihood of many.

Additionally, the OSH inspectorate were limited with resources to provide adequate assistance in accident investigation, inspection, training, and implementation of OSH act,2007. This relate with findings of Calys-Tagoe *et al*., (2015) on impacts of under-resourced inspectorate on safety of small-scale mines in Tarkwa Mining in Ghana and findings of Ezisi *et al* (2017) that stone quarry workers were aware that they should wear protective equipment but most of them do not utilize.

Plate 4.2: Mine Workers without PPE

4.5.4 Trained on Basic Occupational Health and Safety

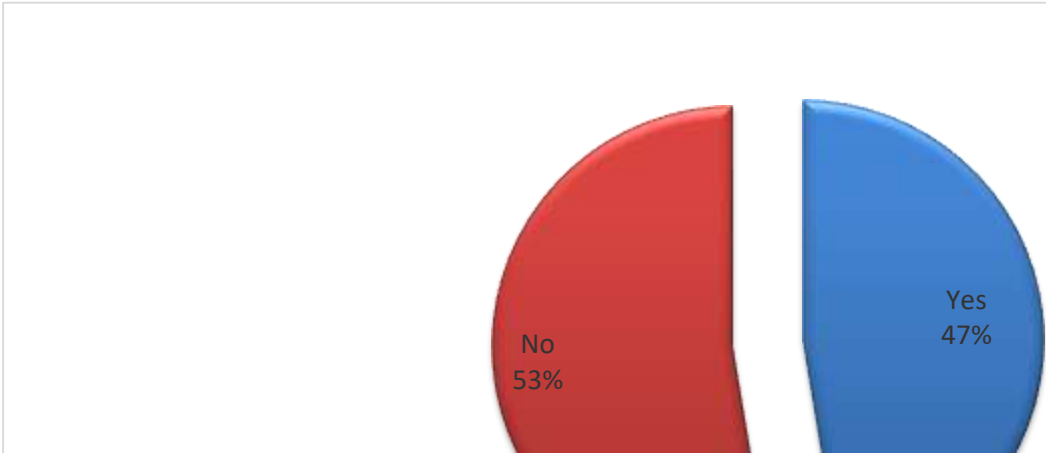


Figure 4.6: Trained on Occupational Safety

Majority of the respondents had not been trained on basic prevention measures and occupation safety at 91(52.3%) while 82(47.1%) had been trained. This shows that majority of the quarry workers were susceptible to occupational hazards and injuries at the workplace. This disagrees on International Organization for Standardization that to reduce health exposure, both individual and collective preventive measures should be adopted. According to International Labour Organization, multi-disciplinary approach should be used in prevention of occupational hazards and injuries. Health hazards should be controlled at source by engineering measures, administrative control, use of suitable personal protective equipment (PPE), education, training and supervision of workers, environmental monitoring and health surveillance. The findings relate with the quarry workers of Mutonga where majority 98% had not been trained but relied on observational and on job training (Wanjiku, 2015).

4.5.5 Trainer of Prevention of Injuries and Occupational Safety and Health

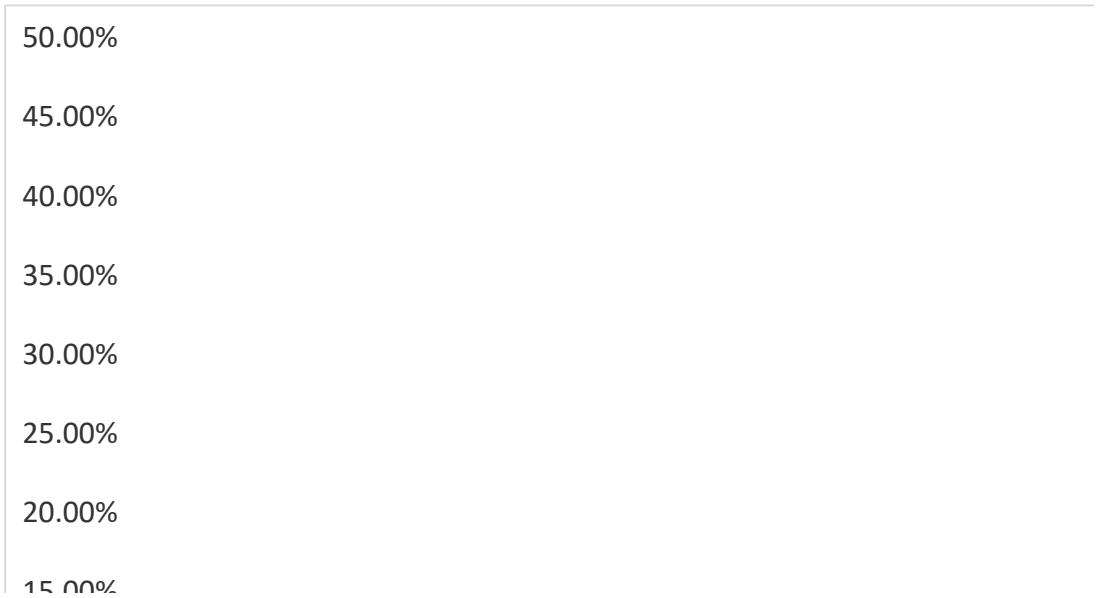


Figure 4.7: Trainer of Prevention of Injuries

NGO present within the region had trained most respondents at 90(45.2%) and health workers had trained them at 62(31.2%). Mine site manager at 4.5% and County OSH

office at 0.5%. An interview with the occupational health and safety officials showed that the department was understaffed with minimal allocation of resources that influenced effective training and sensitization of occupational health and safety laws. However, they work hand in hand with the NGOs that support creation of awareness to the quarry workers.

4.5.6 Bivariate Analysis on Awareness of Occupational Safety in Prevention of Injuries

Table 4.10: Association of Safety Equipment and Awareness of Prevention of Injuries

Variable	Category	Aware of prevention of occupation injuries		Chi Square, p value, df
		Yes (%)	No (%)	
Source of OSH safety at workplace	Mine site manager	4(4.2%)	0(0%)	χ^2=109.776 p=0.000, df=6
	Radio/Tv	0(0%)	6(7.7%)	
	Fellow miner	21(21.9%)	0(0%)	
	Family/friend	3(3.1%)	1(1.3%)	
	Newspaper	0(0%)	10(12.8%)	
	Training	55(57.3%)	5(6.4%)	
	Experience	13(13.5%)	56(22.2%)	
Wear PPE	Yes	75(78.1%)	41(52.6%)	χ^2=12.653 p=0.000, df=1
	No	21(21.9%)	37(47.4%)	
Type of PPE	Helmets	44(45.8%)	18(23.1%)	χ^2=12.103 p=0.017, df=4
	Glasses/face shields	15(15.6%)	18(23.1%)	
	Gloves	17(17.7%)	13(16.7%)	
	Safety boots	9(9.4%)	16(20.5%)	
	Aprons	11(11.5%)	13(16.7%)	
Source of PPE	Bought for self	70(72.9%)	37(47.4%)	χ^2=25.486 p=0.000, df=2
	Given by family/friend	11(11.5%)	2(2.6%)	
	Provided by manager	0(0%)	0(0%)	
	Other	15(15.6%)	39(50.0%)	
Reason of not using PPE	Not provided	23(65.7%)	12(15.4%)	χ^2=6.156 p=0.291, df=5
	Not required	17(17.7%)	9(11.5%)	
	Not comfortable	28(29.2%)	21(26.9%)	
	Not affordable	24(25.0%	31(39.7%)	
	Forget to use	3(3.1%)	4(5.1%)	
	Not aware of importance	1(1%)	1(1.3%)	
Trained on basic occupation safety	Yes	74(77.3%)	9(10.9%)	χ^2=77.363 p=0.000, df=2
	No	22(22.9%)	69(88.5%)	
Trainer of OSH	County OSH officer	1(1%)	0(0%)	χ^2=82.291 p=0.000, df=4
	Mine site manager	9(9.4%)	0(0%)	
	Safety consultant	11(11.5%)	1(1.3%)	
	Health worker	55(57.3%)	7(9.0%)	
	NGO	20(20.8%)	70(89.7%)	

A bivariate analysis showed that source of occupation safety information at the mines ($\chi 2=109.776$, $p=0.000$, $df=6$), wearing of PPE ($\chi 2=12.653$ $p=0.000$, $df=1$), type of PPE ($\chi 2=12.653$ $p=0.000$, $df=1$), source of PPE ($\chi 2=25.486$, $p=0.000$, $df=2$), ever been trained on OSH safety ($\chi 2=77.363$, $p=0.000$, $df=2$) and trainer of occupational safety ($\chi 2=82.291$, $p=0.000$, $df=4$) are statistically significant to a miner being aware of prevention of occupation injuries as indicated in the table below. The reason of not wearing protective equipment ($\chi 2=6.156$, $p=0.291$, $df=5$) was not statistically significant to being aware of occupation safety and prevention of injuries. The findings reveal the use of protective equipment has significance influence on awareness of occupation safety and health and prevention of injuries. There was need to adhere to Occupational Health and Safety Act, 2007 to enhance safe work environment.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study aimed to assess the status of occupational health and safety of soapstone mine workers in Tabaka, Kisii County, Kenya. The specific objectives that guided the study were; establishing nature and frequency of accidents and injuries, identify and measure significant occupational health and safety hazards, and determine the level of awareness on prevention of injuries among soapstone rock mining workers. It can be concluded from the study that;

i. There are occupational health and safety hazards associated with soapstone quarry activities in Tabaka, Kisii. High proportion of the soapstone mine workers were injured at work with nature of injuries being cuts, fractures, bruises, and back/chest injuries caused by working tools/machinery, lifting heavy load and cutting of rocks. The injuries affected hand and head and majority (93%) of the accidents were not reported.
ii. The study established that the respondents could identify occupational health and safety hazards and related effects of soapstone quarrying activities. 59.4% of soapstone mine workers were aware that mining has occupational hazards but have not been trained to identify the hazards at (65.1%) hence could not be able to prevent and curb the hazards and injuries.
iii. Soapstone mine workers lacked awareness on prevention of injuries and occupation safety. The miners were insufficiently equipped with personal protective equipment to prevent occupation injuries and accidents. Unaffordability of protective equipment was the main hindrance.

5.2 Recommendation

The NEMA, County Government, DOSH officials with other stakeholders should

i. Develop and implement framework for sensitization and enforcing of compliance of OSH regulations on small scale mining operations to reduce nature and frequencies of occupation hazards
ii. Use multi-disciplinary approach such as administrative control measures, education, periodic training, and supervision of technical guidelines to prevent and control occupational health related problems in the quarries
iii. Allocate budget and resources to create awareness and determine knowledge and awareness gaps to quarry workers and community on importance of prevention of occupation injuries
iv. support soapstone mine workers to adhere and comply to the Occupational Health Safety regulations and guidelines that prevent and control small scale mining health related problems.

5.3 Further Research

The study recommends for:

A study to investigate the health effects of soapstone mining activities among soapstone mine workers.

A study on individual and institutional factors influencing awareness and compliance with various occupational health and safety rules and regulations in soapstone quarrying activities.

REFERENCES

Ahmad, A. (2017). Awareness of workplace hazards and preventive measures among sandstone mineworkers in Rajasthan, India: A cross-sectional study. *Journal of Health and Social Sciences, 2*(1), 69-82.

Akama, J. S., & Onyambu, M. M. K. (2020). The role of the Gusii soapstone industry in promoting sustainable livelihoods: A historical perspective. *African Journal of Hospitality, Tourism and Leisure, 9*(1), 1-12.

Alexander, M. (2016). *Knowledge of mine workers on mine related hazards and prevention: a case study of mine workers at Arcelormittal Mining Company in Yekapa Nimba County republic of Liberia* (Doctoral dissertation).

Aliabadi, M. M., Aghaei, H., Soltanian, A. R., & Nikravesh, A. (2019). Analysis of the severity of occupational injuries in the mining industry using a Bayesian network. *Epidemiology and health, 41*.

Arasa, R., Achuora, J., & Okello, C. (2020). Artisanal mining practices: A study of selected counties in Kenya.

Ayoo, B. A., & Moronge, J. (2019). Factors influencing compliance with occupational safety regulations and requirements among artisanal and small-scale miners in central sakwa ward, Siaya County. *Journal of Sustainability, Environment and Peace, 1*(1), 1-5.

Ayuk, E., Pedro, A., Ekins, P., Gatune, J., Milligan, B., Oberle, B. ... & Mancini, L. (2020). *Mineral Resource Governance in the 21st Century: Gearing extractive industries towards sustainable development*. International Resource Panel, United Nations Envio, Nairobi, Kenya.

Barasa, F. (2014). Community Participation in Development- A Social Economic Analysis of the Benefits of a Devolved Decision Making Process in Kenya. *International Journal on Current Trends in Research India*, 168–172

Beth, A. A. (2018). *Assessment Of Occupational Safety Compliance In Small-Scale Gold Mines In Siaya County, Kenya* (Doctoral dissertation, University of Nairobi).

Bureau of Labor Statistics, (2023) U.S. Department of Labor, *The Economics Daily*, Mining fatalities rose 21.8 percent from 2020 to 2021 Retrieved from https://www.bls.gov/opub/ted/2023/mining-fatalities-rose-21-8-percent-from-2020-to-2021.htm.

Calys-Tagoe, B. N., Ovadje, L., Clarke, E., Basu, N., & Robins, T. (2015). Injury profiles associated with artisanal and small-scale gold mining in Tarkwa, Ghana. *International journal of environmental research and public health*, *12*(7), 7922-7937.

Channing, J. (2013). *Safety at Work* (rev. ed.). Abingdon, Oxon: Rutledge Publishers.

Chepchumba, J. (2020). *Assessment of Occupational Hazard Awareness and Safety Measures among Quarry Workers in Bomet County, Kenya* (Doctoral dissertation).

Cuvelier, J. (2014). Work and masculinity in Katanga's artisanal mines. *Africa Spectrum*, *49*(2), 3-26.

Eshiwani, F. (2014). *Effects of quarrying activities on the environment in Nairobi County: a case study of Embakasi district* (Doctoral dissertation, University of Nairobi).

Encyclopedia Britannica (2011). Pneumoconiosis, Retrieved from http://www.britannica.com/EBchecked/topic/465474/pneumoconiosis>.European Agency for Safety and Health at Work - http://osha.europa.eu.

Ezisi, C. N., Eze, B. I., Okoye, O., & Arinze, O. (2017). Correlates of stone quarry workers' awareness of work-related ocular health hazards and utilization of protective eye devices: Findings in southeastern Nigeria. *Indian journal of occupational and environmental medicine*, *21*(2), 51-55.

Ministry of Labour and Social Affairs. Labour proclamation No. 377/2003. Federal Negarit Gazeta No .12, Addis Ababa, Ethiopia 2004; pp 2476-2477

Government of Kenya, (2019). Kenya Population and Household Census. Nairobi: National Statistical Bureau

Government of Kenya, (2009a). Mining Act Chapter 306 (1972); the Laws of Kenya. Nairobi: Government Printers

Government of Kenya, (2007). Occupational Safety and Health Act. Government Printers, Nairobi.

Government of Kenya, (2014). Ministry of Health, Occupational safety and health policy guidelines for the health sector in Kenya, July 2014. Government Printers, Nairobi.

Government of Kenya, (2004). The Factories and Other Places of Work (Safety and Health Committees) Rules, 2004, Legal Notice No.31. Nairobi: Government Printer.

Government of Kenya, (2005). The Factories and Other Places of Work (Medical Examination) Rules, 2005. Nairobi: Government Printer.

Government of Kenya, (2005). The Factories and Other Places of Work (Noise Prevention and Control) Rules, 2005, Legal Notice No. 25. Nairobi: Government Printer.

Government of Kenya, (2007). Occupational Safety and Health Act (OSHA) (2007), Nairobi: Government Printer.

Government of Kenya, (2007). The Factories and Other Places of Work (Fire Risk Reduction) Rules, 2007, Nairobi: Government Printer.

Government of Kenya, (2007). The Factories and Other Places of Work (Hazardous Substances) Rules, 2007, Nairobi: Government Printer.

Hall, S., Stacey, P., Pengelly, I., Stagg, S., Saunders, J., & Hambling, S. (2022). Characterizing and comparing emissions of dust, respirable crystalline silica, and volatile organic compounds from natural and artificial stones. *Annals of Work Exposures and Health*, *66*(2), 139-149.

Health and Safety Executive. (2018). Benefits of good health and safety. Retrieved from http://www.hse.gov.uk

Hilson, G., & Potter, C. (2005). Structural adjustment and subsistence industry: artisanal gold mining in Ghana. *Development and change*, *36*(1), 103-131. Retrieved from *http://www.ddiglobal.org/login/resources/struct-adjust-and-subsistence-industryartisanal-gold-mining-ghana.pdf.*

Hilson, G., & Maconachie, R. (2020). Artisanal and small-scale mining and the Sustainable Development Goals: Opportunities and new directions for sub-Saharan Africa. *Geoforum*, *111*, 125-141.

Kippenberg, J. (2011). *A poisonous mix: Child labor, mercury, and artisanal gold mining in Mali*. Human Rights Watch.

International Labor Organization (ILO) (1999). Social and Labour Issues in Small-Scale Mines. Report for discussion at the Tripartite Meeting on Social and Labour Issues in Small-scale Mines (1999).

International Labour Organization. (2001). Your health and safety at work: Introduction to occupational health and safety. Geneva: Bureau of Workers Activities

International Labour Organization (ILO) (2005). Number of Work Related Accidents and Illnesses Continues to Increase, ILO and WHO Join in call for Prevention Strategies Press Release.

Kainat, S., & Shahzadi, A. (2021). Managing Occupational Health and Safety in the Mining Industry. *Agriculture and Environment*, *2*(2), 17-22.

Kenya. Ministry of Labour., (2007) The Occupational Safety and Health Act Revised. Nairobi: National Council for Law Reporting.

Kenya National Bureau Statistics. (KNBS). (2019). Demographic Survey. Population Census (2019).

Kenya Health Information System (2019). KHIS for aggregate reporting and analysis Retrieved from https://hiskenya.org/dhis-web-reporting/index.action

Kenya Health Information System (2022). KHIS for aggregate reporting and analysis. Retrieved from https://hiskenya.org/dhis-web-reporting/index.action

Kibii, C. (2020). *Social and Environmental Effects of Stone Quarrying in Tuluongoi Sub Location, Tenges Division, Baringo County* (Doctoral dissertation, University of Nairobi).

Kirchner, J. W. (2016). Aggregation in environmental systems–Part 1: Seasonal tracer cycles quantify young water fractions, but not mean transit times, in spatially

heterogeneous catchments. *Hydrology and Earth System Sciences*, *20*(1), 279-297.

Kulabako, V. (2019). *Noise produced from mechanised quarrying and occupational hazards at stirling quarry* (Doctoral dissertation, Makerere University).

Kothari, C., (2004). *Research methodology: methods and techniques*. (2nd ed.). New Delhi: New Age International (P) Ltd.

Kumar, C. R., Verma, K. C., & Neetika, A. (2016). An assessment of the knowledge, attitudes and practices about the prevention of occupational hazards and utilization of safety measures among meat workers in a city of Haryana state of India. *Indian Journal of Applied Research*, *6*(3), 40-48.

Leung, A. M. R., & Lu, J. L. D. (2016). Environmental health and safety hazards of indigenous small-scale gold mining using cyanidation in the Philippines. *Environmental health insights*, *10*, EHI-S38459.

Long, R. N., Sun, K., & Neitzel, R. L. (2015). Injury risk factors in a small-scale gold mining community in Ghana's Upper East Region. *International journal of environmental research and public health*, *12*(8), 8744-8761.

Mabe, F. N. (2023). Small-scale mining policies in Ghana: Miners' knowledge, attitudes and practices. *Resources Policy*, *85*, 103924**.**

Mabika, B. (2018). Improving workers' safety and health in the Zimbabwean mining and quarrying industry.

MacEachen, E., & Kosny, A. (2016). Qualitative Evidence in Occupational Health. *Handbook of Qualitative Health Research for Evidence-Based Practice*, 225-241.

Makokha, W. R. (2021). *Determinants of Occupational Injuries among Workers in Artisanal and Small-Scale Gold Mining Activities in Kakamega County, Kenya* (Doctoral dissertation, Kenyatta University).

Mitullah, W. V., & Wachira, I. N. (2011). Informal labour in the construction industry in Kenya: A case study of Nairobi.

Mugenda, A., & Mugenda, O. (2003). *Research Methods, Qualitative and Quantitative Approaches*. Nairobi: Act Press

National Environment Management Authority (NEMA) **(2015).** Report of the taskforce on management of quarrying activities in Kenya. Government press. Nairobi.

National Institute for Occupational Safety and Health (NIOSH) (2000). Injuries, Illnesses, Hazardous Exposures in the Mining Industry, 1986–1995: A Surveillance Report., Washington DC: NIOSH

Ngechu, M. (2004). *Understanding the research process and methods. An introduction. Star bright Services,* Nairobi: Acts press.

Ngure, V., & Kinuthia, G. (2020). Health risk implications of lead, cadmium, zinc, and nickel for consumers of food items in Migori Gold mines, Kenya. *Journal of Geochemical Exploration*, *209*, 106430.

Njoroge, J. M., Akama, J., & Buyeke, L. (2015). The 'romance'of mining in light of tourism: A case study of soapstone in Tabaka, Kisii County, Kenya.

Ochieng, N. R. (2004). *Safety Awareness in Informal Construction Sector: a Case Study of Nairobi City* (Doctoral dissertation).

Nwibo, A. N., Ugwuja, E. I., Nwambeke, N. O., Emelumadu, O. F., & Ogbonnaya, L. U. (2012). Pulmonary problems among quarry workers of stone crushing industrial site at Umuoghara, Ebonyi State, Nigeria.

Occupational Safety and Health Act. (2007). Retrieved from http://www.kenyalaw.org

Pavolová, H., Čulková, K., Šimková, Z., Seňová, A., & Kudelas, D. (2022). Contribution of mining industry in chosen EU countries to the sustainability issues. *Sustainability*, *14*(7), 4177.

Perfect, E. (2017). Sustainable Mining for Long Term Poverty Alleviation in the Democratic Republic of the Congo.

Rumbe, O. G. (2021). *An Assessment of the Effects of Artisanal Mining in Tabaka, Kisii County, Kenya* (Doctoral dissertation, University of Nairobi).

Salman, T., Carrillo, F., & Soruco, C. (2015). Small-scale mining cooperatives and the state in Bolivia: Their histories, memories and negotiation strategies. *The extractive industries and society*, *2*(2), 360-367.

Singo, J., Isunju, J. B., Moyo, D., Bose-O'Reilly, S., Steckling-Muschack, N., & Mamuse, A. (2022). Accidents, injuries, and safety among artisanal and small-scale gold miners in Zimbabwe. *International journal of environmental research and public health*, *19*(14), 8663.

Sharma, A., Tiwari, D., & Bhatia, R. K. (2018). A Comparative Study of Noise Pollution during a Festive Days of Navratri and Normal Days in Jabalpur City. *International Research Journal of Engineering and Technology*, *5*(4), 658-664.

Chepchumba, T. T. (2018). Effects of Soapstone Quarrying on Geomorphic and Socio-Economic Activities in Tabaka Region, Kisii County-Kenya.

The Constitution of Kenya. (2010). Nairobi: Government press United States Environmental Protection Agency (USEPA) (2008). Region 4: Laboratory and

Field operations – PM 2.5: Objectives and History. Retrieved from en.wikipedia.org/wiki/particulate

Tsuma, V.N. (2017). Strategies Practices Influencing the Implementation of Small-Scale Mining Projects in Kenya. A case study of Artisan Miners in Taiva Taveta County.

Wachira, W. B. (2017). *Status of occupational safety and health in flour milling companies in Nairobi Kenya* (Doctoral dissertation, COHES, JKUAT).

Wangela, S. W. (2019). *Effects of Dimension Stone Quarrying Activities in Ndarugo Area of Kiambu County, Kenya* (Doctoral dissertation, University of Nairobi).

Wanjiku, M. W. (2015). *Occupational health and safety hazards associated with quarrying activities; A case of Mutonga Quarry, Meru County, Kenya* (Doctoral dissertation).

World Bank. (2008*).* World Bank on the Occasion of the West Africa Regional Mining Forum in Conakry, Guineaon February11–12, *2008.* Retrieved from http://siteresources.worldbank.org/INTOGMC/Resources/336099. Conakry, Guinea.

World Bank. (2020). *2020 State of the Artisanal and Small Scale Mining Sector*. Washington, D.C.: World Bank

WHO-ILO (2000). Occupational Health for workers in the informal sector' WHOILO Joint Effort on Occupational Health and Safety in Africa, 16-20 October 2002.

WHO-ILO (2001). The World Health Organization (WHO)/ International Labour Organization (ILO). Joint Effort on Occupational Health and Safety in Africa: Retrieved from http://www.sheafrica.info/Publications/JEAarticle2.pdf

Work Injury Benefit Act. (2007). Retrieved from http://www.kenyalaw.org.

Yin, R. K. (2018). *Case study research and applications* (Vol. 6). Thousand Oaks, CA: Sage.

APPENDICES

Appendix I: Informed Consent Form

My name is Medrine Jelimo Yator. I am Master student from Jomo Kenyatta University of Agriculture and Technology. I am conducting a study titled "Assessment of the status of occupational safety and health of soapstone rock mining workers in Tabaka, Kisii County." The information will be used purely for academic purpose.

Procedures to be followed

Participation in this study will require that I ask you some questions with the aim to find out the nature of accidents, injuries, occupational hazards, and level of awareness on preventive measures among soapstone mine workers.

Voluntarism

You have the right to refuse participation in this study. You will get the same services and care whether you agree to join the study or not and your decision will not change the care you will receive. Please remember the participation in this study is voluntarily. You may ask questions related to the study at any time.

You may refuse to respond to any questions and you may stop an interview at any time. You may also stop being in the study at any time without any consequences to the services you receive here or any other organization now or in the future.

Discomforts and Risks

Some of the questions you will be asked are on intimate subject and may be embarrassing or make you uncomfortable. If this happens, you may refuse to answer these questions if you so choose. You may also stop the interview at any time. The interview may take approximately half an hour of your time.

Benefits

If you participate in this study you will help us to learn status of occupational injuries in Tabaka mining site. The findings will help in making recommendations that can be used by different stakeholders to improve compliance of occupational safety and health in the mining industry.

Reward

There are no rewards or any payment to you if you participate.

Confidentiality

The interviews and filling questionnaires will be conducted within the site. Your name will not be recorded on the questionnaire. The questionnaires will be kept in a safe locked cabinet. Everything will be kept private and only shared with the study team.

Contact Information

If you have questions about the study call the Dr. Charles Mburu 0722 324 021 or Principal investigators Tel Nos: 0713685212. However, if you have questions about your rights as a study participant: You may contact Kenyatta University Ethical Review Committee Secretariat on chairman.kuerc@ku.ac.ke,

Participant's Statement

The above information regarding my participation in the study is clear to me. The study has been explained to me, I have been given a chance to ask questions, and my questions have been answered to my satisfaction. My participation in this study is voluntary. I understand that my records will be kept private and that I can leave the study at any time. I understand that I will still get the same care and medical treatment whether I

decide to leave the study or not and my decision will not change the care that I will receive from the clinic today or that I will get from any other clinic at any other time.

Name of Participant: _____

_____ _____

Signature or Thumbprint Date

_____ _____

Name of Representative/Witness (where necessary) Relationship to Subject

Investigators statement

I, the undersigned, have explained to the volunteer in a language s/he understands, the procedures to be followed in the study and the risks and benefits involved

_____ _____

Appendix II: Questionnaire for Participants of the Study (Kindly Pick One Answer)

General Information of the Respondents

- **Gender**: Female ( ) Male ( )
- **Age:** <18 ( ) 18-35 ( ) 36-50 ( ) >50 ( )
- **Highest level of education**: No formal schooling ( ) Primary ( ) Secondary ( ) Tertiary ( )
- **Marital Status**: Single ( ) Married ( ) Separated ( ) Divorced ( ) Widowed ( )

1. Indicate your main activity in the mining activities?
    - Vegetation clearing ( )
    - Removal of top soil ( )
    - Extraction of stones ( )
    - Cutting of stones ( )
    - Carving ( )
2. How long have you worked in the soapstone mining sector?
    - Less than 1 year ( )
    - 1-5 years ( )
    - 6-10 years ( )
    - 11-15 years ( )
    - More than 15 years ( )
3. Are you a member of a self-help group?

    Yes ( ) No ( )

4. If yes which group
    a) Smolart Self Help Group ( )
    b) Top Designers Self Help Group ( )
    c) ISA Self Help group ( )

d) Tabaka Chigware Youth Group ( )

e) Terazzo Africa Self Help Group ( )

Section A: Nature and Frequency of Accidents and Injuries

5. Have you ever been injured in the course of your work? Yes ( ) No ( )

   If yes complete part (a) and (b) below

   a) What was the type of injury?

   - Cuts ( )
   - Fractures ( )
   - Bruises ( )
   - Back/Chest injuries ( )

   b) What was the cause of the injury?

   - Struck/hit by rock ( )
   - Sharp rock edges ( )
   - Fall ( )
   - Working tools/Machinery ( )
   - Lifting heavy load ( )

   c) Which part of your body was injured?

   - Head ( )
   - Hand ( )
   - Arm ( )
   - Back/Chest ( )
   - Legs/Knee/Feet ( )

   d) What was the nature of the injury?

   - Minor (first aid cases) ( )
   - Major (More than three days off duty) ( )
   - Severe (serious cases that can cause permanent disability) ( )

6. Do you report accidents/incidents at work place?

   Yes ( ) No ( )

7. What is the frequency of accidents and injuries you have experience in the last 12 months?

   1-5 times ( ) 6-10 times ( ) More than 10 times ( )

Section B: Occupational Health and Safety Hazards

8. Are you aware that mining has occupational health and safety hazards?

   Yes ( ) No ( )

9. Have you been trained on how to identify hazards at your workplace?

   Yes ( ) No ( )

Identify hazards you know

10. a) falling rocks ( ) b) sharp rock edges( )

    c) Falls/slips ( ) d)dust ( )

    e) working tools ( ) f) lifting heavy loads( )

    g) cuts ( ) h)noise( )

11. After working in the mines have you experienced any of the following conditions that you didn't have and could relate to mining activities?

Have you suffered any….	Work Related? (Yes/No)
a) Loss of hearing	
b) Respiratory problems	
c) Skin irritation/Itching	
d) Heat stress	
e) Concentration disorders	
f) Tinnitus (Ringing in the ear)	
g) Eye infections	
h) Skin infections	

Section C: Level of Knowledge on Prevention of Occupational Injuries

12. Have you ever heard about occupational safety at your workplace?

    Yes ( ) No ( )

    If yes, where did you get the information? If no, please proceed to the next question

    - Mine Site Manager ( )
    - Radio/TV ( )

- Friend/ Family ( )
- Fellow miner ( )
- Social media ( )
- Newspaper ( )
- Training ( )

13. Do you have quality working tools/ equipment's that you require?

Yes ( ) No ( )

14. Do you wear personal protective equipment (PPE) when working? Yes ( ) No ( )

If yes complete part (a) and (b). If no, please proceed to question (c).

a) Type of PPE

- Protective helmets
- Protective glasses/Face shields
- Gloves

b) How did you get the PPE?

- Provided by site manager ( )
- Bought for myself ( )
- Given by a friend/family ( )

c) What is your reason of not using Personal Protective Equipment?

- Not provided ( )
- Not required ( )
- Not comfortable ( )
- Not affordable ( )
- Not aware of their importance ( )

15. Have you ever been trained on basic occupational safety requirements? Yes ( ) No( )

If yes, who was the trainer?

- County Director of Mines ( )
- County OSH Officer ( )

- Mine Site Manager ( )
- Safety consultant ( )
- NGO ( )

Appendix III: Interview Guide

Mine Site Managers/OSH Officers

- What are the common occupational health hazards at the mine sites?
- What are the common types of accidents and injuries?
- Do you report accidents and injuries?
- Do you conduct occupational safety training to the miners?
- Do you provide PPEs to your miners?
- What management control measures have you put in place to curb hazards?
- Do you have a person in charge of safety and health in your mining activities?

Appendix IV: Observation Checklist

Occupation Safety Issues	**Yes**	**No**
▪ Are there aspects in the physical environment that pose dangers to the mine?		
▪ Are miners interaction a recipe for injuries and accidents		
▪ Appropriate safety boots worn by miners		
▪ Appropriate gloves worn by miners		
▪ Miners using aprons and reflectors		
▪ Miners using safety glasses and earplugs		
▪ Shafts are properly guarded		
▪ Presence of miners with injuries		
▪ Presence of first aid box/equipment		
▪ Presence of quality working tools		

Appendix V: NACOSTI Research Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 331673

Date of Issue: 14/October/2022

RESEARCH LICENSE

This is to Certify that Ms., Medrine Jelimo Yator of Jomo Kenyatta University of Agriculture and Technology, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kisii on the topic: ASSESSMENT OF THE STATUS OF OCCUPATIONAL SAFETY AND HEALTH OF SOAPSTONE ROCK MINING WORKERS IN TABAKA, KISII COUNTY,KENYA. for the period ending : 14/October/2023.

License No: NACOSTI/P/22/20637

331673

Applicant Identification Number

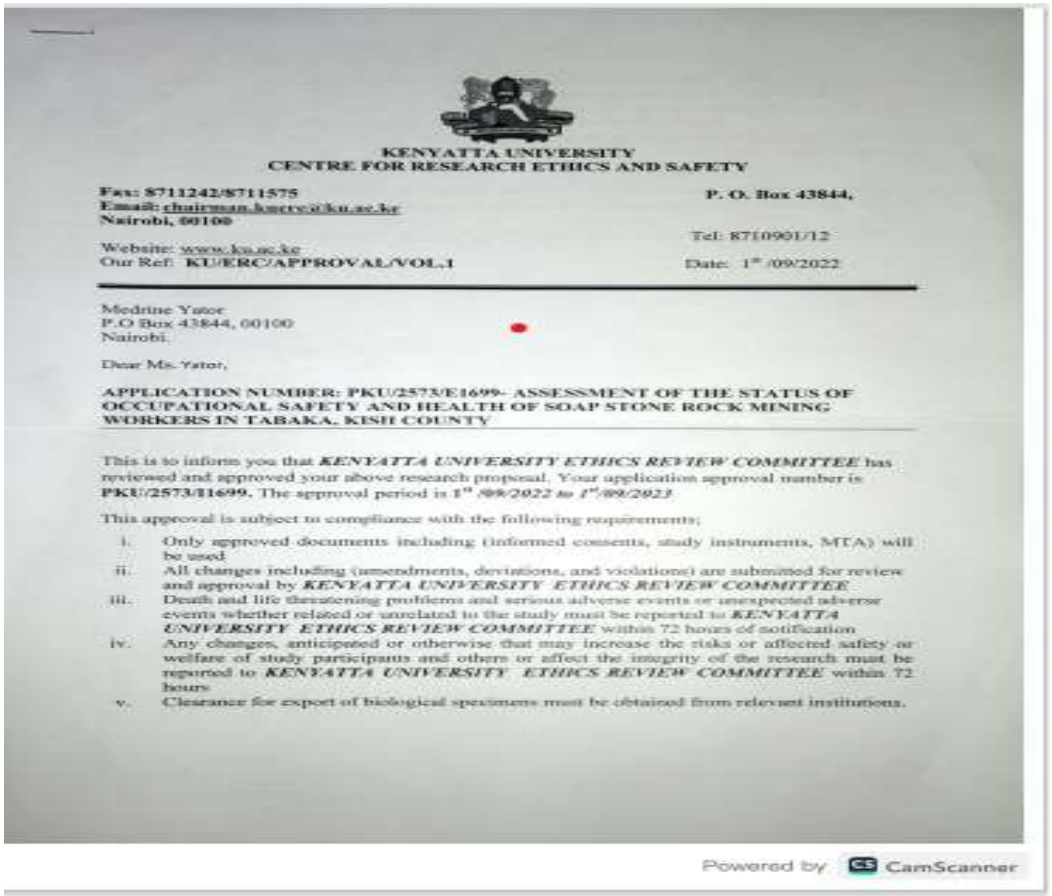
Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

Appendix VI: Ethics and Review Committee Approval



KENYATTA UNIVERSITY
CENTRE FOR RESEARCH ETHICS AND SAFETY

Fax: 8711242/8711575
Email: chairman.kuerc@ku.ac.ke
Nairobi, 00100

P. O. Box 43844,

Tel: 8710901/12

Website: www.ku.ac.ke
Our Ref: KU/ERC/APPROVAL/VOL.1

Date: 1st /09/2022

Medrine Yator
P.O Box 43844, 00100
Nairobi.

Dear Ms. Yator,

APPLICATION NUMBER: PKU/2573/E1699- ASSESSMENT OF THE STATUS OF OCCUPATIONAL SAFETY AND HEALTH OF SOAP STONE ROCK MINING WORKERS IN TABAKA, KISII COUNTY

This is to inform you that ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** has reviewed and approved your above research proposal. Your application approval number is **PKU/2573/E1699.** The approval period is *1st /09/2022 to 1st/09/2023*

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE***
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.

vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE***

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

To serve you better, researchers are kindly requested to access and complete a customer feedback form and sent it back online as you continue with research and upon completion of data collection found on the following website link: :(https://docs.google.com/forms/d/1y1WefDwvyz5h1oz_VIn0xbxg3sGdIDzMXFWNDsMrRPQ/edit?usp=sharing

Yours sincerely

KENYATTA UNIVERSITY
01 SEP 2022

Prof. Judith Kimiywe

Appendix VII: Kisii County Research Approval

KISII COUNTY GOVERNMENT

DEPARTMENT OF HEALTH SERVICES

Telegramme "Medical"
Telephone: (058) 31249
Email kisiicountypublichealth@gmail.com

When replying please quote:

COUNTY PUBLIC HEALTH OFFICE
KISII COUNTY
P.O.BOX 92
KISII

Ref: No...PH/TR/VOL 13/2022(171)

Date: 4th November, 2022

PHO IN-CHARGE
SOUTH MUGIRANGO

RE: RESEARCH/DATA COLLECTION

This is to confirm that **Medrine Jelimo Yator Reg. No: ENB331-C006-6292/2016** from **Jomo Kenyatta University of Agriculture and Technology** will be undertaking data collection on Research Topic **assessment of the status of occupational safety and health of soapstone rock mining workers in Tabaka, Kisii County, Kenya.**

Please assist her, collect the relevant information she requires, the data will be used purely for academic purposes.

Your assistance shall be highly appreciated.

COUNTY PUBLIC HEALTH OFFICER
04 NOV 2022
KISII COUNTY

WILSON NYAKWEBA-RESEARCH/STUDENT COODINATOR
For: COUNTY PUBLIC HEALTH OFFICER
KISII COUNTY

Appendix VIII: Publication

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ASSESSMENT OF THE STATUS OF OCCUPATIONAL SAFETY AND HEALTH OF SOAPSTONE MINE WORKERS IN TABAKA KISII COUNTY, KENYA

[1]MEDRINE JELIMO YATOR, [2]DR. CHARLES MBURU,
[3]DR. BENSON KARANJA

[1,2,3] JKUAT, Kenya

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