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THE RISK OF PULMONARY DISEASE AND OTHER HEALTH HAZARDS AMONG SMALL SCALE STONE QUARRY WORKERS: A STUDY AT MIOTSO IN THE NINGO-PRAMPRAM DISTRICT OF GHANA

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ABSTRACT

The evaluation of occupational health and safety hazards among quarry workers are relevant because of the number of high-risk activities involved. Ghana has witnessed various quarry accidents and health complaints associated with quarrying activities which have not been addressed. A cross sectional descriptive study was therefore conducted aimed at assessing the occupational health related problems of Miotso quarry workers in the Ningo-Prampram district of Ghana. Simple random sampling was employed in the selection of the respondents from a population of adult quarry workers. Data on socio-demographic profiles and health related conditions were obtained. The study sort to relate the duration of time spent in the quarry with the incidence of pulmonary problems and other health conditions. Results indicated that the frequency of carrying out the quarrying activities was between 4 to 6 days and majority of the respondents carried out activities on a 24 h schedule. Ninety percent of the respondents did not use protective clothing whilst at work. Respondents, 63.3%, 45% and 58% reported of symptoms of persistent coughs, shortness of breath and chest pains respectively. Other health related conditions reported included; muscle pain (91.7%), weight loss (83.3%), fatigue (96.7%), skin irritations (30%) and eye irritation (53.3%). X ray diffraction analysis of rock samples from the quarry site revealed the presence of crystalline silica, aluminum silicate hydroxide, potassium silicate hydroxide and quartz which are known to cause respiratory problems over prolonged exposure.

INTRODUCTION

Rock and stone quarrying is a global phenomenon and has been of concern everywhere in the world including the advanced countries. Largely a poverty driven activity, small scale mineral extraction is a source of income to the less educated, unemployed, migrant and landless populations in remote areas (Labonne *et al*., 1999). Stone quarry may be sited in areas where there are no residences or settler communities. In Ghana, there are a number of small scale stone quarry sites which are located in various rural areas of the country. An example is the stone quarry site at Miotso in the Ningo-Prampram district of Ghana. The workers found at this quarry are mostly the indigenes of Ningo-Prampram. Majority of these people live far below the standard of living as many workers are uneducated, school dropouts, victims from broken homes, orphans and lack financial support of any form to secure better jobs. Work within the quarry industry is both physically and mentally demanding. Although sources of air pollutants mostly include power plants and cement factories, pollution from quarries is also high (Olusegun *et al*., 2013). Developed countries adopt and enforce adequate precautions and health safety standards to safeguard the health of their workers but in developing countries like Ghana, unfortunately this is not the case. People work at such quarries without any safety protective wear. Safety standards are very low hence exposing the workers to occupational diseases especially those affecting the respiratory system such as; occupational asthma, black lung disease (coal worker's pneumoconiosis), Chronic Obstructive Pulmonary disease, mesothelioma and silicosis. Exposure to substances like flock and silica can cause lung disease, whereas exposure to carcinogens like asbestos and beryllium can cause lung cancer. Work related injuries, prolonged disabilities, illnesses and deaths (NIOSH, 2002) have resulted from quarrying activities due to the physical nature of the work, coupled with poor work health and safety standards. Occupational hazards associated with the quarry

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workers are well researched internationally, however, little is known about occupational health hazards in the African quarry industry (Smallwood and Ehrlich, 2001) This study therefore sought to assess the occupational health and safety hazards associated with quarry activities amongst quarry workers at Miotso in the Ningo-Prampram district of Ghana.

MATERIALS AND METHODS

Study Population

The study was conducted from the month of September, 2015 to May, 2016. The study population comprised of all stone quarry in Miotso from the ages of 10 to 60 years who voluntarily consented to the study. Quarry workers who had worked within the quarry for less than one month, below 10 years and above 60 years of age and workers were exempted from the study.

Data collection procedure

Since the quarry is small, a total of 60 workers were interviewed. A structured questionnaire was designed and the pilot study was conducted from the study site to ensure that the questions were clear, the contents suitable, understandable and there was sequence in the flow of questions. The pilot data was not included in the actual study but was only used to pre-test and validate the questionnaire. Data obtained was related to; socio-demographic information of respondents such as age, sex, marital status and level of education; duration spent on site, years of experience and income level; basic symptoms of pulmonary diseases and other occupational health problems experienced by the stone crackers. Preliminary analysis of the data was done to ensure that all variables were in a workable form before full analysis was done. Confidentiality was assured in the collection of data from respondents.

Sampling frame

All the quarry workers were the study population and each of the quarry workers was considered as a study unit. The study applied simple random sampling technique to ensure that each quarry worker had an equal chance of being selected for the study.

Data Processing and Analysis

Description of the study population characteristics was done using Statistical Package for Social Studies (SPSS 16) and involved the use of frequency table and dispersion. This allowed easier and further analysis. Analysis of both the dependent and independent variables for health related problems of quarrying was done using cross tables of SPSS for association.

Study limitations

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

Testing for the presence of substances in rock that cause pulmonary diseases

Rock samples were tested for the presence of chemicals capable of causing pulmonary disease using the X –Ray diffraction machine. The X-Ray powder diffraction is a rapid analytical technique primarily used for phase identification of a crystalline material and can provide information on unit cell dimensions. The analyzed material was finely ground, homogenized and average bulk composition determined.

RESULTS

Identification of chemical compounds in rock samples

X-Ray diffraction was used to test for the presence of suspected compounds known to be the primary causes of pulmonary diseases among stone quarry workers. The suspected compounds include; crystalline silica, asbestos, flock, quartz and Beryllium. However, the test revealed the presence of the following compound; Silicon oxide, Aluminium Silicate Hydroxide, Potassium Silicate Hydroxide and Quartz.

Demographic characteristics of the respondents

Sex of Respondents

From the total sample population of 60 respondents, 34 persons, representing more than half of the sample size were females, the other 26 being males. The gender distribution of respondents from the stone quarry site revealed 57% females and 43% males.

Marital Status

Figure 8 shows marital status of respondents from Miotso stone quarry site. From the chart, 68% were singles and the remaining 32% were married.

Number of Children

The figure 9 shows the number of children of respondents. Out of the entire number, a valid percentage of 35% had no children, followed by respondents with one child had a percentage of 3.3, 1.7% had 2 children, 13.3% had 3 children, 16.7% of the respondents had 4 children, 6.7% of the respondents had 5 children, 11.75 of the respondents had 9 children and 1.7% had 13 children.

Educational Background

From the data collected it was observed that the respondents generally were uneducated and those who had the opportunity of formal education had a low level of education. The percentage of respondents who had no formal education was 53 whereas the remaining 47% had received only basic education: (most of which had stopped schooling at the basic level of basic education).

Personal Protective Equipment

The results from the study showed that majority of the respondents did not use personal protective equipment (PPEs) such as gloves, goggles, hat, nose masks which minimizes

their exposure to hazards of quarrying. The population that did not use any PPEs was 90%. The remaining 10% used only one of the PPEs.

The Effect of Hours Spent on field on the prevalence Symptoms of pulmonary diseases

Cough

Most of the workers who spent less than four hours at the site were children/teenagers who helped their parents after school. The adult workers spent at least eight hours and a maximum of twelve hours. About 37% of the workers had no persistent cough. The remaining 63% experienced mild and severe persistent cough.

Chest pain

Quarry workers who spent a maximum of 4 hours at the site did not complain of chest pain. Workers who spent 8 hours and above experienced chest pain. Those who spent averagely 10 hours experienced mild to severe pain with just a few reporting no pain in chest.

Back pain and Muscle ache

The chart shows that even children who spent 3 hours at the quarry site daily experience muscle ache. The work required carrying heavy loads and sitting under the scorching sun for long hours to crush stones. The rocks are very hard and required a lot of energy to crush them into desirable sizes. This puts a lot of strain on the muscles. The longer the time one spends each day, the more the strain on the muscles and the severity of the pain.

The occurrence of fever was seen to with time spent on the field doing quarry activities as shown in Fig. 9 below

Shortness of breath

Fig. 10 shows the increase in the severity of shortness of breath with increased time spent on the field doing quarry activities

Weight loss

Weight loss was also observed to increase in severity as respondents spend longer hours on the field doing quarry activities as shown in Fig 6.

Fatigue

Fatigue was observed to increase with the number of hours spent on the field. This was obvious since more energy is exerted as one spends more time on the field.

The Influence of Years of Experience on Prevalence of Symptoms

Cough

The graph represents the relation between years of experience and the tendency of coughing. The respondents reduced as the years increased. There was an average distribution of mild and severe cough across the years. The respondents who experienced no persistent cough over the years was 36%. However, 41% and 23% of the workers experienced mild and severe coughs respectively.

Chest pain

The graph below shows that the workers who had worked for less than three years had no chest pain. Those who had worked for four to nine years experienced mild chest pain. However, workers who had experience beyond nine years experienced severe chest pain. Forty-one percent experienced no chest pain.

Shortness of breath

The chart shows that irrespective of the number of years of experience, the workers felt short breath during quarry activities.

Weight loss

The chart shows that the nature of the works leads to weight loss from the first year.

Fatigue

Only three percent of the study population reported no fatigue. The remaining ninety-seven percent complained of fatigue.

Percentage of workers suffering from occupational illness

Results from the study indicated that, majority of the quarry workers experienced muscle and back pain and fatigue. Pulmonary diseases experienced mostly include persistent cough, chest pains and shortness of breath. Fig. 13.

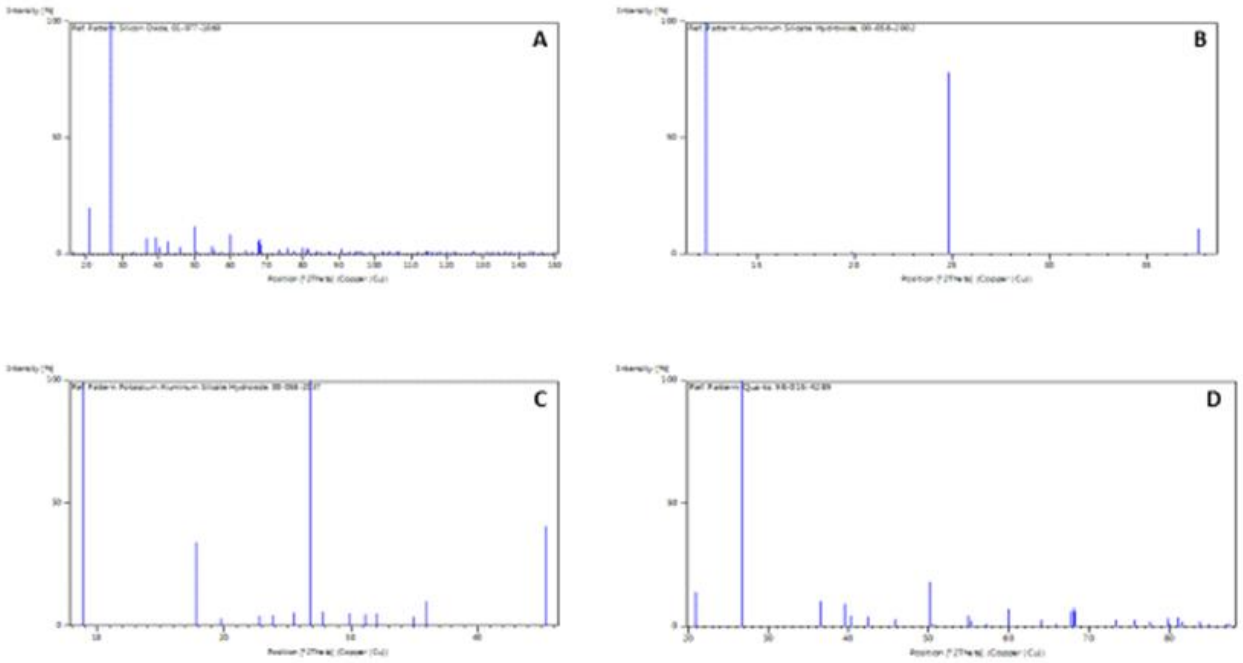
DISCUSSION

Quarrying Activities

Results revealed that majority of the respondents were just involved in the cutting of rock blocks into smaller sizes. Also, the frequency of carrying out the quarrying activities was between 4 to 6 days and majority of the respondents indicated they carried out the activities on a full day time schedule. These activities were carried out in order to meet the need for raw materials by the local building and construction industry. These findings are consistent with studies conducted by Vulcan Materials Company, (2005) which asserts that rock quarrying and stone crushing is a necessity that provides much of the materials used in traditional hard flooring such as granite, limestone, marble, sandstone, slate and even just clay to make ceramic tiles. Majority of the respondents indicated they had not receive any training on extracting and crushing of rocks smaller sizes. This indicated that most of the quarry workers lack technical education in quarrying.

Occupational Health Hazards

The second objective of the study was to identify the occupational health hazards faced by Miotso quarry workers. Results revealed that there was presence of dangerous aspects of the work that could harm their health. Some of the hazards involved with the quarrying activities carried out by the respondents were; manual handling of heavy loads, being hit by the tools in the course of extracting and crushing the rocks, exposure to dust and falling of rock block.



A; Silicon oxide **B;** Aluminium silicate Hydroxide **C;** Potassium Aluminium Silicate Hydroxide **D;** Quartz

Fig. 1. Stick patterns of chemicals identified in rock samples by X-ray diffraction

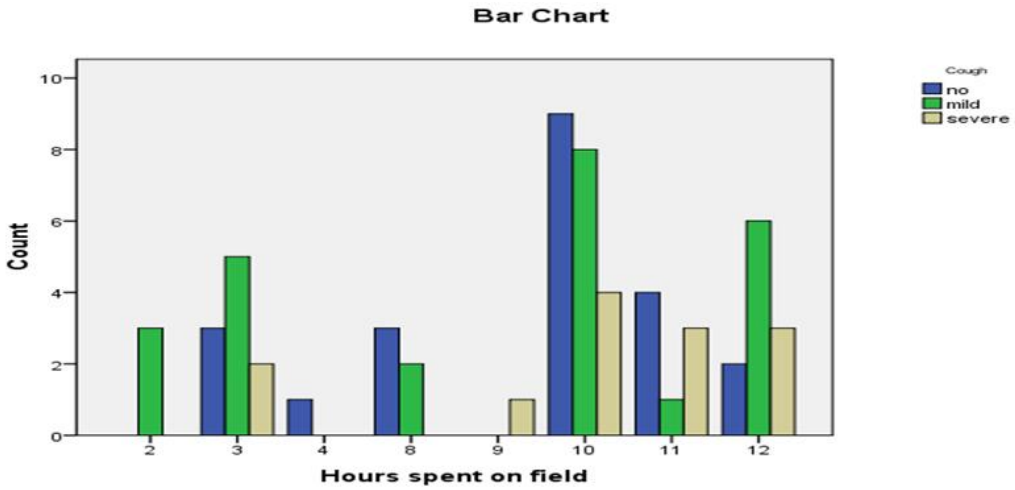


Fig. 2. A Cross Tabulation of Hours Spent on Field against Cough

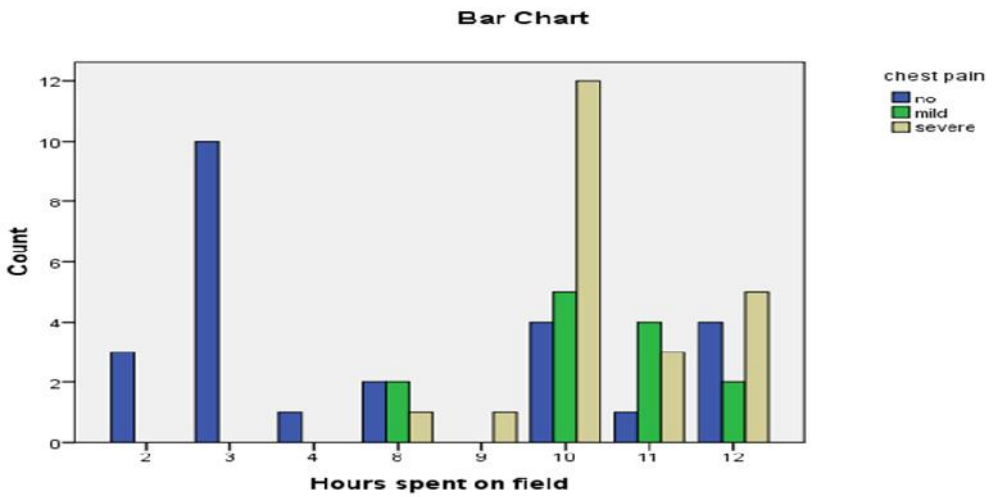


Fig. 3. A Cross Tabulation of Hours against Chest Pain

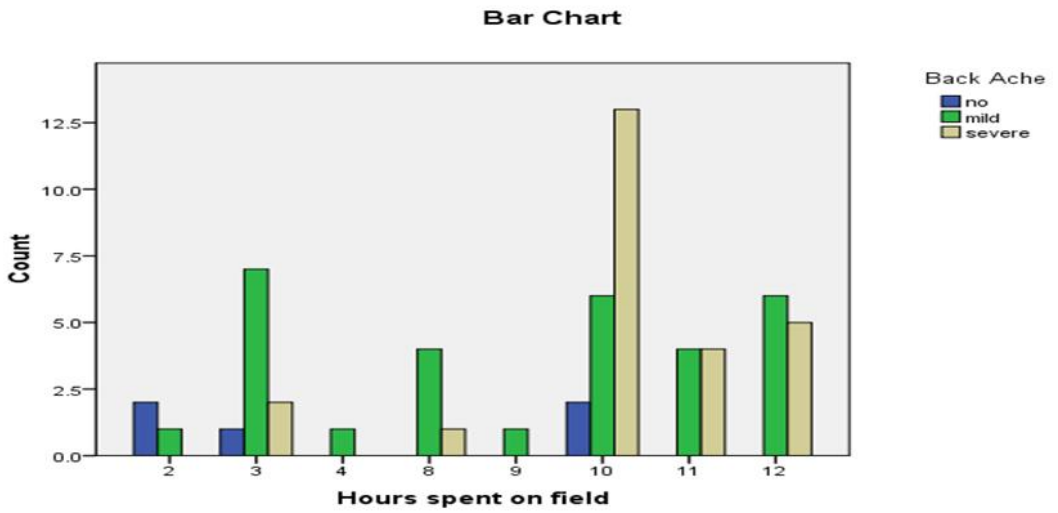


Fig. 4. A Cross Tabulation of Hours against Back Ache Fever

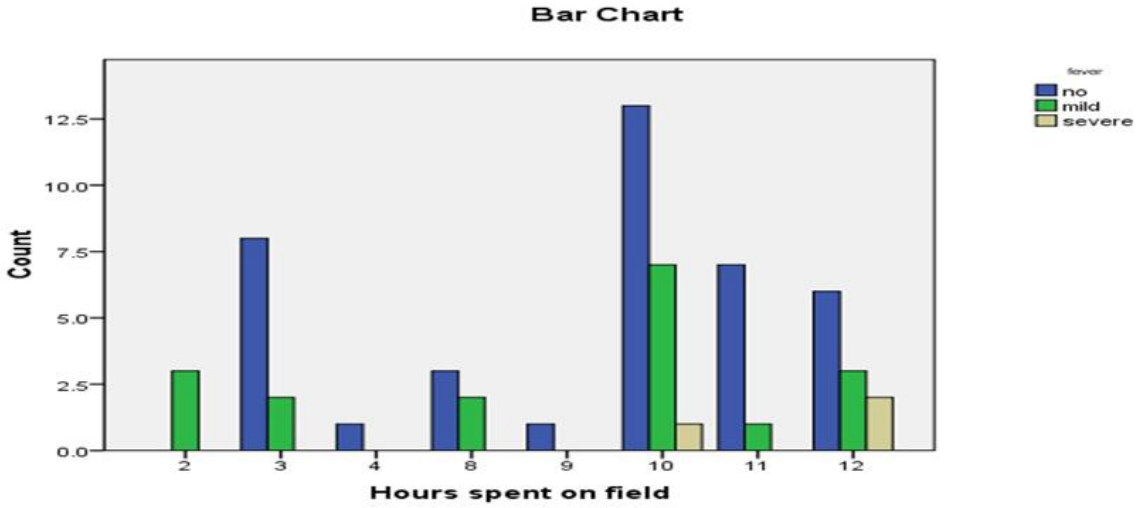


Fig. 5. A Cross Tabulation of Hours against Fever

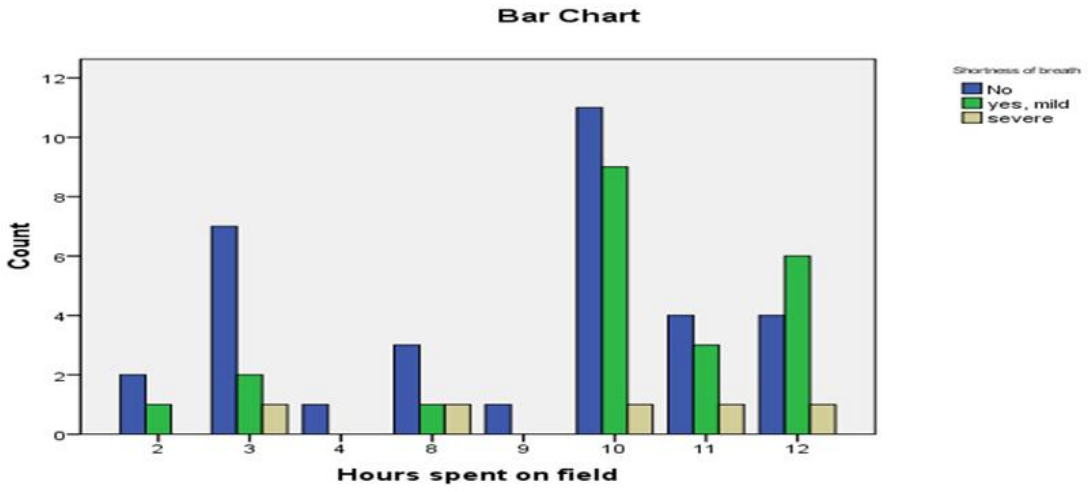


Fig. 6. A Cross Tabulation of Hours against Shortness of Breath

This is in line with other findings which indicates that a significant proportion of health problems and fatalities in the quarrying sector in Africa are associated with manual operations, (Chigonda, 2010). The findings also agree with those by Michelo *et al*, (2009), who reported 165 injuries and 20 fatalities in Zambia with rock fall as the major cause of injuries. Some of the harms suffered by the respondents in the quarry while on duty included; contusion with intact skin surface, pain in the nose, throat, sinuses, back, shoulder and neck. The study findings are consistent with those in Encyclopædia Britannica, (2011) which asserted that quarrying operations generate large quantities of dust that cause a variety

of respiratory diseases amongst quarry workers. Pneumoconiosis, the general term given to a range of lung diseases caused by breathing dusts, typically causes chest tightness, shortness of breath and coughing; and also consistent with survey report (ESAW, 2007) that manual workers reported work-related health problems than non-manual workers.

Other studies have also determined the prevalence of respiratory problems and lung function impairment among quarry workers. Problems such as; chest pain, occasional cough, occasional shortness of breath and wheezing have been reported by Olusegun, *et al.* (2009) as the impact of granite quarrying on the health of workers in Abeokuta Ogun State, Nigeria.

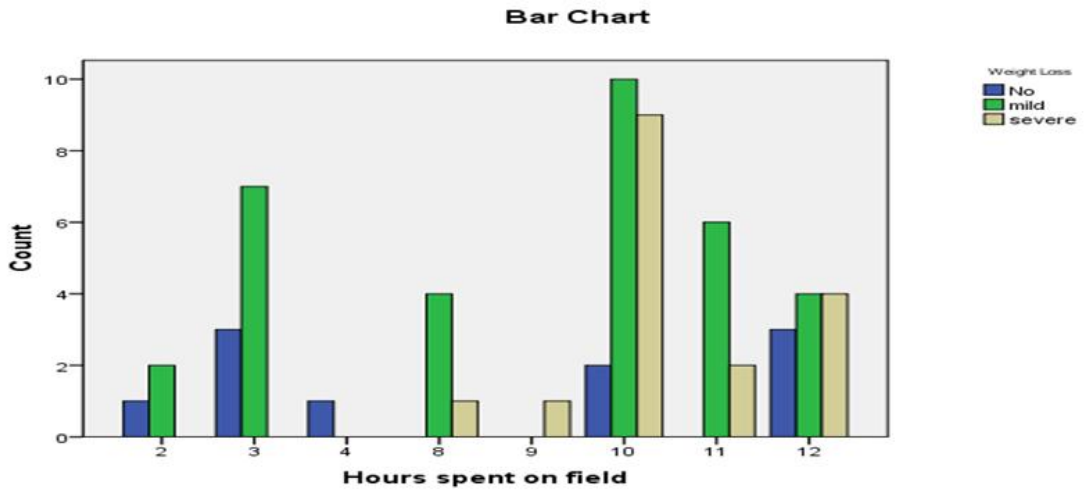


Fig. 6. A Cross Tabulation of Hours against Weight Loss

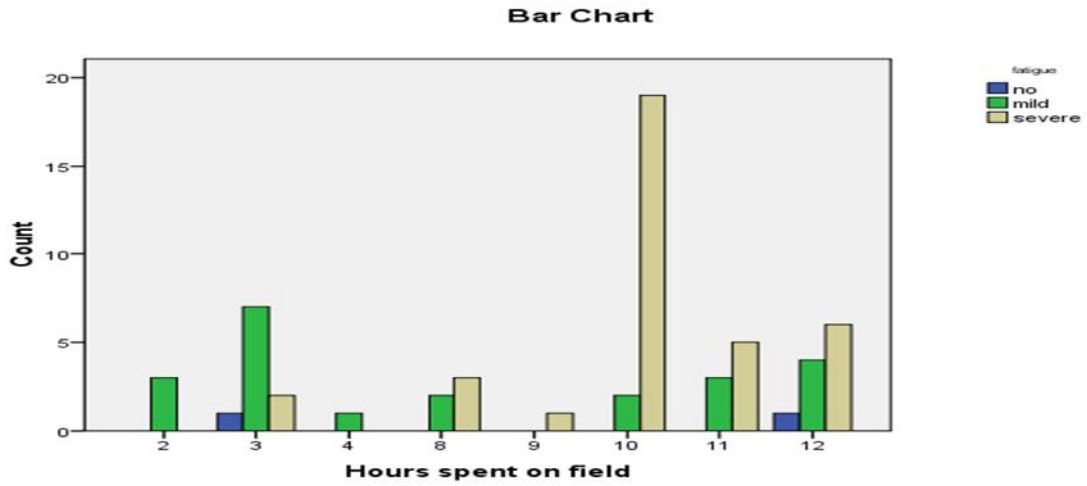


Fig.7. A Cross Tabulation of Hours against Fatigue

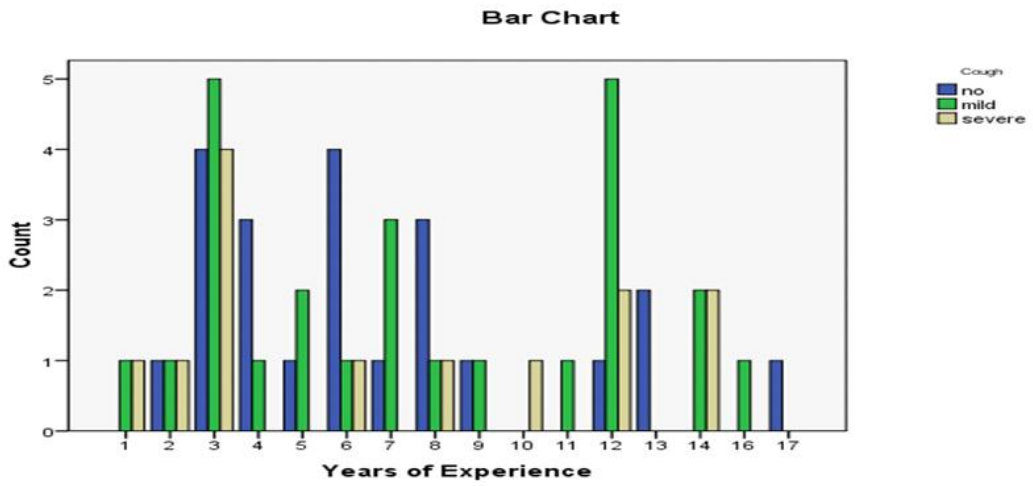


Fig. 8. A Cross Tabulation of Years of Experience against Cough

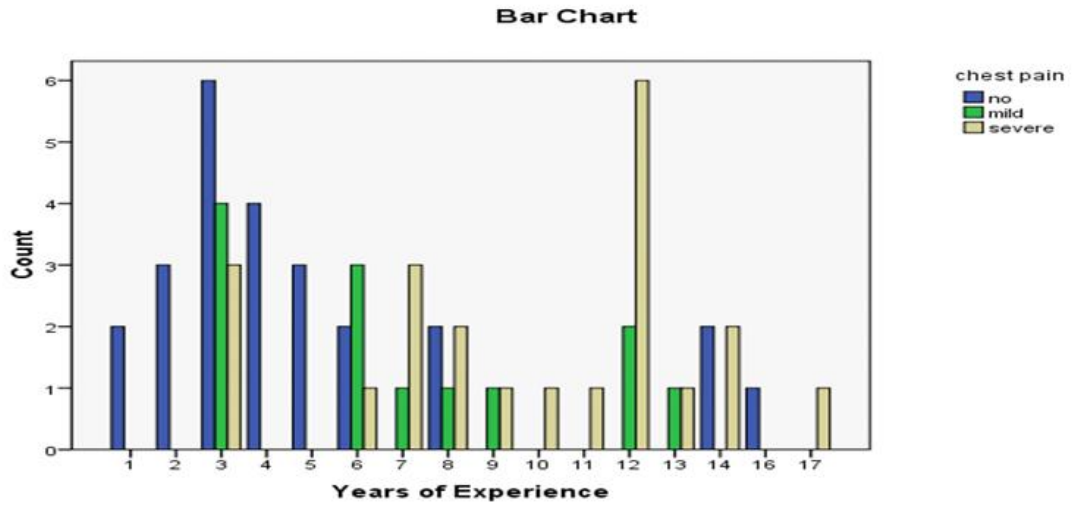


Fig. 9. A Cross Tabulation of Years of Experience against Chest Pain

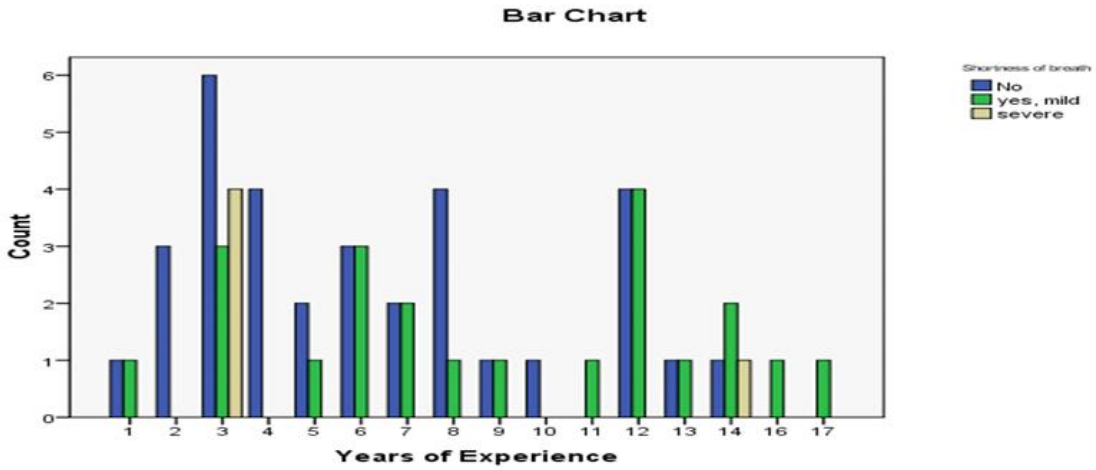


Fig.10. A Cross Tabulation of Years of Experience against Shortness of Breath

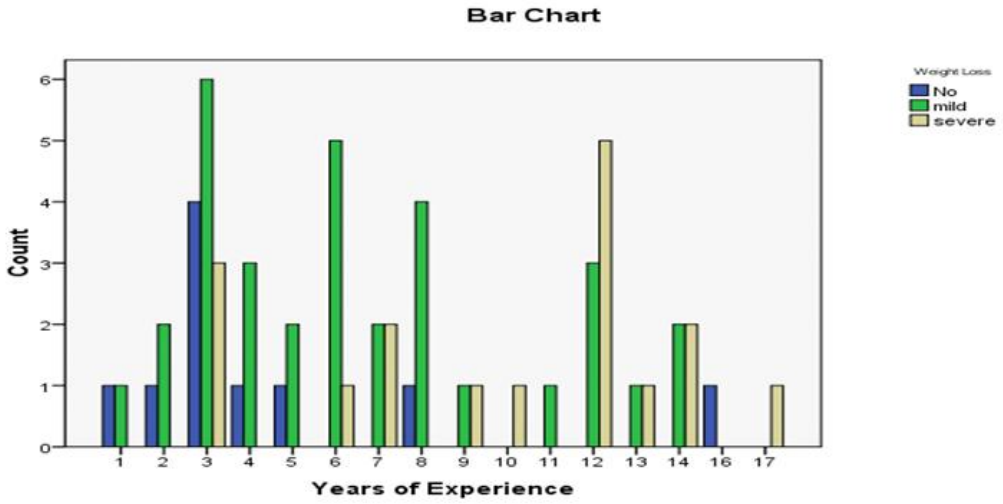


Fig. 11. A Cross Tabulation of Years of Experience against Weight Loss

Crystalline silica has most often been reported as the main work-related health problem. Prolong exposure to crystalline silica has been linked with chronic obstructive pulmonary disease Mannetje *et al*, (2002). The data collected revealed that 90% of the workers used no form of protection, hence were prone to all possible occupational hazards. Studies conducted by Koffuor *et al*, (2012) on the effect of working environment on oculo-visual health on sand and stone workers in Ghana has shown that majority of these workers do not use personal protection equipment (PPEs) hence showed symptoms of poor ocular health. Over 70% of the workers responded positively to the listed symptoms of pulmonary diseases indicating the likelihood of developing a chronic lung infection after prolonged exposure to dust at the quarry is high. The laboratory results for the test for presence of toxic substances in the rock sample were positive for silica containing

compounds and quartz which are harmful when inhaled over a long period of time. Over 90% of the population had worked for three years and above and were prone to lung infection. Also, the longer the period one spends at quarry, the more one gets exposed to these particles and the higher the likelihood of an infection.

unemployed or earned insufficient income to take full responsibility at home. Averagely, each worker earned an amount of 190 cedis ($ 48) for a truck of stones which took nearly 4 weeks to obtain. These workers therefore depend on this amount to support themselves and their families.

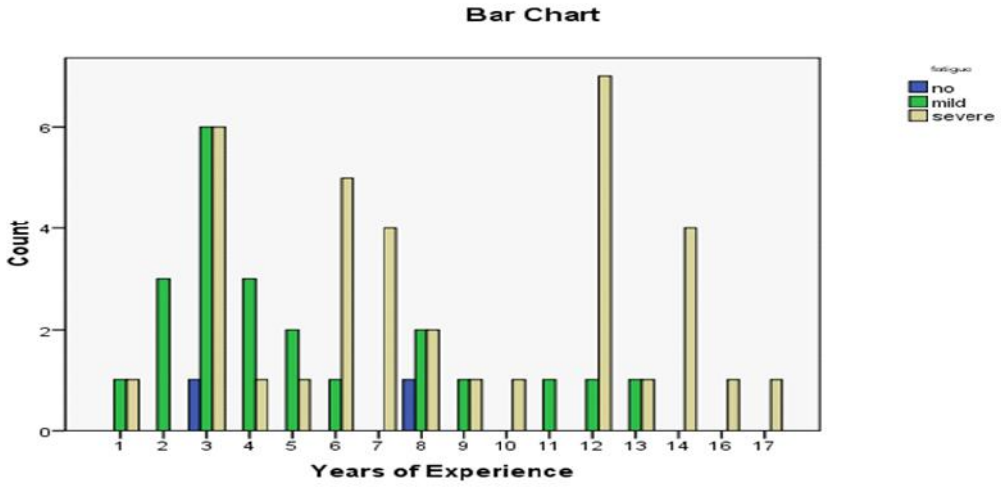


Fig. 12. A Cross Tabulation of Years of Experience against Fatigue

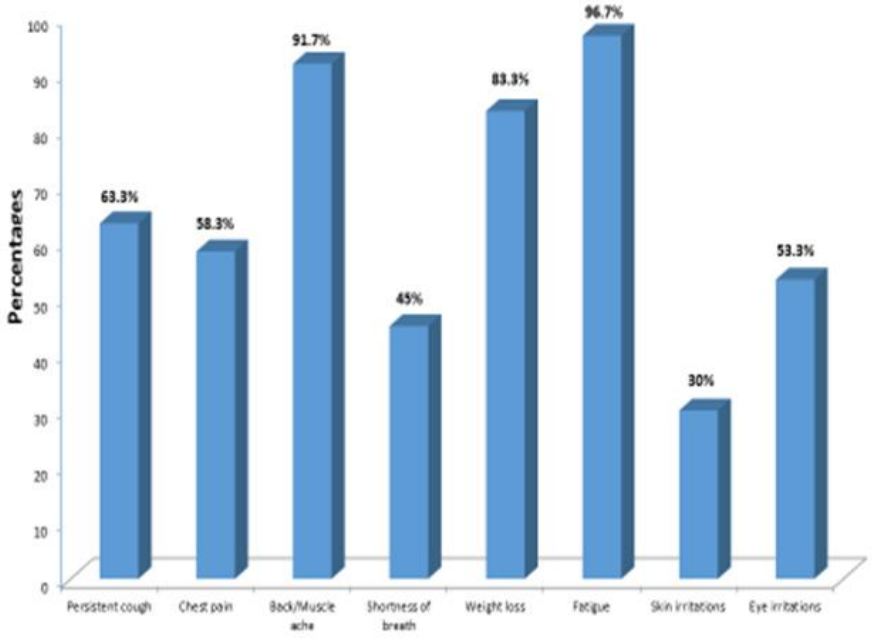


Fig. 13. Percentage of workers suffering from symptoms of occupational illnesses

Most workers who had been on site for over six years complained of severe symptoms indicating that exposure of workers to these hazards for a long period of time is highly risky. However, there were few workers who showed no signs of infections despite their years of exposure. This could be due to inconsistency at work since most of the quarry workers were self-employed and did not have to report to work daily or at a specific time. Some workers revealed that they reported to work when demands for stones were high. A one-on-one interview with the workers revealed that the quarry workers were all aware of the occupational hazards they were exposed to but had to continue because that was their only source of income. From the study, it was indicated that 68.3% of the respondents were single parents who catered for at least three children who were at the basic level of education. The remaining 31.7% who are married, had spouses who were

Most of the workers cook at the site under unhygienic conditions as well. There is therefore the need to emphasize the use of PPEs by these workers and make them available since both education and availability of PPEs will help reduce the burden of occupational health hazards as indicated by Wanjiku *et al.,* (2014). Government should also increase social intervention schemes and also regulate the quarry sector properly.

Conclusion

It can be concluded from this study that the workers at the quarry live in very poor and unsafe conditions. Also, there are chemical compounds present in the rocks that are harmful to the health of the workers once inhaled over a long period of time. This therefore puts the workers at the quarry at risk of

pulmonary and other occupational health related diseases. The quarry workers at Miotso were insufficiently equipped with the occupational safety knowledge and personal protective equipment to comprehensively mitigate the occupational health and safety hazards they are exposed to. Health promotion should be encouraged, social intervention policies by government and proper regulations should be implemented to help improve the lives of the workers

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Conflict of interest

Authors declare they have no competing interests

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