

## Proposal Guideline for Preventive Measures toward Occupational Health Hazards for Quarries Workers

Ferial Fouad Melika<sup>(1)</sup>, Fatma Gomaa Mohamed Amer<sup>(2)</sup>

(1) Assistant Professor of Community Health Nursing, Faculty of Nursing-Ain Shams University Egypt.

(2) Lecturer of Community Health Nursing, Faculty of Nursing-Ain Shams University Egypt

### Abstract

**Background:** Workers in quarries who engage in the excavation, cutting, and crushing of stones or rocks are exposed to various hazards, including noise, falls, dust, and explosions. **Aim:** The study aimed to propose guidelines for preventive measures toward occupational health hazards for quarries workers. **Study design:** A descriptive analytical study was utilized to conduct this study. **Subject:** A purposeful sample consisted of 302 male workers in limestone quarries. **Setting:** This study was conducted in the quarries of Tourah affiliated to Tourah Portland Cement Company in south of Cairo. **Tools:** Composed of 3 tools.: **I tool:** An interviewing questionnaire form. **II tool:** Observational Check list about compliance of personal protective equipment. **III tool:** Medical record. **Results:** 59.9% of workers their aged ranged from 25< 40 years old, 51.0% work 7 to 8 hours a day, the most common occupational health hazards were dust pollution, noise pollution, and weather hotness, while 83.1% of them complained of wounds, and 70.5% body pain, also 72.8% of them diagnosed with musculoskeletal diseases. 49% chronic bronchitis and 44.4% silicosis while the workers who compliance with personal protective equipment represent only 18.2% of total workers. **Conclusion:** The study demonstrated the existence of a statistically significant relationship between exposure to occupational hazards and compliance with personal protective equipment and statistically significant relationship between workers' knowledge and practices towards prevention of occupational hazards and the incidence of work injuries among them with p value < 0.001. **Recommendation:** Activating the proposal guideline for preventive measures toward occupational health hazards to raise awareness of quarry workers.

**Keywords:** Quarries workers, Occupational Health Hazards, Proposal guidelines

### Introduction

Quarries workers exposed to potential hazards such dust, noise, falls, and explosions when excavating, cutting, and breaking minerals or rock are extensively exposed to these risks. (USLEGAL, 2019).

The associated occupational hazards of quarries and consequent effects on health of workers and host communities are enormous such as air pollution. For example, heavy-duty machinery, plants, and trucks on site in quarries will lead to the release of fumes, smoke, and dust. Dusts are one of the major hazards to health due to their ability to reach the lower part of the lung (the alveoli) which cause respiratory problems such as asthma attacks, chronic bronchitis, silicosis, and lung function impairment, caused by the inhalation of airborne machine or blast dust and debris (Iloet al., 2018).

The Occupational Safety and Health Administration (OSHA) specified six main categories of occupational hazards: Safety which includes any condition, substance, or object that can injure a worker, like working from heights,

slips, trips, and falls in addition machinery with moving parts, or exposed electrical wiring (Mohammed & Tamrin, 2017). Chemicals such as hazardous chemicals and toxins, including environmental smoke, cleaning products, acids, pesticides, carbon monoxide, and flammable substances (Bureau of Labor Statistics, 2018). Biological like blood, fungi, mold, viruses, animal droppings, and insect bites. Physical like radiation, extreme weather, and noise. Ergonomic hazards like poor posture, heavy lifting, and improper workstation. Finally, workload hazards such as workplace violence, discrimination, lack of respect, sexual harassment, and other conditions are hazardous to mental, emotional, and physical health (Martinelli, 2019).

Occupational health safety is an area concerned with the development, promotion, and maintenance of the workplace environment, policies and programs that ensure the mental, physical, and emotional well-being of employees, as well as keeping the workplace environment relatively free from actual or potential hazards that could injure employees (Nyirenda et al., 2015). According to the International Labor

Organization (ILO) reported that the main aim of all the activities and programs are preventing hazards, protecting from exposure, and maintaining the highest level of health and safety among workers in any workplace (**National institute for occupational safety and health, NIOSH, 2014**).

There is no doubt that occupational hazards of quarries workers can be controlled through a variety of methods. It is important to recognize hazards and health aside safety problems in the workplace. There are five general categories of control measures: elimination, substitution, engineering controls, administrative controls, and use of personal protective equipment (PPE) such as respirators, ear plugs, heavy duty gloves, helmet, goggles, safety belts, safety boots, overalls, and face shield. A combination of methods usually provides a safer and healthier workplace than relying on only one method. Usage of PPE should be the last choice in control measures (**Fabián et al., 2017**).

To prevent workplace injuries and illnesses, occupational health nurses assess workplaces to identify possible hazards. These nurses also educate workers on how to prevent accidents and injuries. They may suggest changes in procedures or develop other ways to make workplaces safer and comply with the Occupational Safety and Health Act or OSHA standards (**Rodríguez et al., 2015 and D'Orso et al., 2017**).

Providing nursing care intervention for workers who get hurt or ill due to workplace hazards is considered another important responsibility of occupational health nurses such as providing first aid to emergencies tending to injuries, examining to early detection of any disease, administering medication, and performing rehabilitation therapy after certain injuries (**La Torre et al., 2020**).

The proposal guideline is a formal, written plan or suggestion that quarry workers are encouraged to consider and decide upon in order to reduce occupational health risks. These guidelines are intended to help those workers detect workplace dangers, maintain workplace safety, and protect them from exposure to injuries by utilizing PPE. The suggested guidelines are meant to be used by any quarry workers who find them useful in all situations relating to the numerous occupational dangers exposed to them

as a practical information resource (**De Merich, et al., 2018**).

#### Significant of the study

There are more than 31.5 million people working in Egypt, according to a 2018 World Bank estimate. According to the Egyptian constitution, the state is in responsible for ensuring the welfare and safety of its citizens, including those who work. However, according to ILO statistics just released, over 273,000 workers were injured in or otherwise impacted by workplace accidents in 2015 (**Said, et al., 2019**). While the total number of occupational injury cases for the first half of 2019, manufacturing activity reached 6869 cases, or 53.5% of all injuries, and 6227 cases, or 90.7% of all injuries among male workers. While falls by people represent for the largest portion of work injury causes (31.3%), errors or item collisions account for 26.7% (**CAPMAS, 2020**).

It noticed that Occupational health and protection from work-related disorders is not a priority in many developing countries because of several other competing health issues. Evidence has shown that occupational hazards have existed for a long time and require attention and awareness to be prevented, and protect workers from related complications (**Pathak, 2019**).

Nevertheless, occupational health hazards are still common health problems where the work-related diseases and injuries are responsible for the deaths of 1.9 million people in 2016, according to the first joint estimates from the World Health Organization (WHO) and International Labor Organization (ILO). The Global Monitoring Report indicated that the majority of work-related deaths were due to respiratory and cardiovascular disease. Occupational injuries caused 19 per cent of deaths. (**World Health Organization (WHO) 2020**).

In order to mitigate this, it is important for workers to understand the potential health and safety risks. Additionally, it is important for them to know what different occupational hazards, safety measures in their workplace, and first aids in case of accidents to decrease its incidence and complications by following the guidance of this program which designed to prevent, control, reduce or eliminate occupational hazards and risks have been developed.

### Aim of study

The aim of this study was to propose guideline for preventive measures toward occupational health hazards for quarries workers through:

1. Identifying workers' knowledge about occupational health hazards
2. Detecting workers' practices toward preventive measures of occupational health hazards
3. Assessing quarries workers' health status.
4. Propose guideline program for preventive measures toward occupational health hazards for quarries workers.

### Research Questions:

- 1) What are the common occupational hazards of quarries workers?
- 2) Is there a relation between quarries workers occupational hazards exposure and compliance of PPE?
- 3) Are there relations between work injuries of quarries workers and their knowledge and practices about occupational health?

### Subjects and Methods

#### I. Research design:

A descriptive analytical study was utilized to describe the health conditions of quarries workers in order to propose a guideline for preventive measures toward occupational health hazards for them.

#### Setting:

The study was conducted in the quarries of Tourah affiliated to the Suez Cement Company Group, which owns four companies in Suze, Katamia, Tourah, and Helwan. The Tourah Portland Cement Company was selected, which is the first cement company in Egypt, and owns the oldest limestone quarry, which was used in the production of the stones of the three pyramids. Also, Tourah Cement was the first company in Egypt to follow the dry method in the cement industry which is located on an area of 10,000,000 square meters in the Tourah area (south of Cairo).

#### Subjects:

A purposeful sample was used to conduct this study. The total number of workers was 1400. The represented sample was calculated by

sample size equation with estimated proportion= 50%, desired precision of estimate =0.05, and confidence level 0.95. Which consisted of 302 total sample size male workers randomly selected from five distinct levels of cement production in Tourah Company which are high risk for occupational health hazards through cement manufacturing process as crushing, grinding, raw meal preparation, and kiln burning. According to the following criteria:

**Inclusion criteria:** All quarries' workers from the previous mentioned levels lines of cement production work in limestone quarry place and the most exposure to occupational health hazards.

**Exclusion criteria:** The workers who already have hereditary and/or congenital disorders were excluded.

#### Tools of data collection:

After reviewing the published textbooks and research, study tools were prepared in Arabic language to collect data, which consisted of three tools as follow:

**First tool:** An Interviewing Questionnaire Form: That was designed by the researchers according to workers' educational level and consisted of three parts:

**Part I:** To assess the socio-demographic characteristics of quarries' workers which consisted of 4 closed questions such as age, marital status, level of education, and family income.

**Part II:** This part assesses work data of quarries workers which consisted of 4 closed ended questions as work duty, workload, experience years, and training program received.

**Part III:** This part to assess quarries' workers knowledge about occupational safety and health hazards which consisted of 10 closed ended questions such as types of occupational health hazards, workplace hazards, personal protective equipment (PPE) types and importance, plus the preventive measures towards occupational health hazards.

#### Scoring design for Knowledge:

The Scoring System for workers' knowledge are correct answers took "1" score and incorrect

answers took zero. The total knowledge items scores were summed-up and converted into percent score; and categorized as satisfactory if the percent score was 60% or more and unsatisfactory if less than 60%.

**Part IV:** This part assesses quarries workers' reported practices about preventive measures of occupational hazards which consisted of three sections 36 questions. *I section* (13 items): the use of PPE, such as causes of not using PPE, the measures taken if PPE is torn or lost, causes of removing PPE during work. *II section* (8 items): Preventive measures during work process such as cover the crushers by sheet-metal screens, using a wetting system for crushed material, covering the material with tarpaulins while it is being hauled by vehicles, provide barriers or shelter from the wind to prevent air currents from lifting particulate into the atmosphere, apply appropriate maintenance for machines, cover all electric wires. *III section* (15 items): Preventive measures for general health such as cessation of smoking, eating healthy diet, and practicing healthy lifestyle.

#### Scoring design of practices:

The total practices items score ranged from zero to "1", each item takes one mark if done and zero if not done then all items' scores were summed-up and the total marks converted into percent score which classified into adequate if the percent score was 60% or more and inadequate if less than 60%.

**Second tool:** Observational check list about compliance of PPE:

This tool designed to assesses quarries workers' compliance of using of PPE such as respirators, ear plugs, heavy duty gloves, helmet, goggles, safety belts, safety boots, overalls, face shield, and welding helmet, at beginning of work, and during the process as preventive measures of occupational health hazards.

#### Scoring system:

The total score for each item on the checklist ranged from 0 for a "No" response to 1 for a "Yes" response. All items were added together and translated to a percentage, which was then divided into two categories: PPE

compliance, if a score of 60% or higher, and noncompliance, if a score of less than 60%.

#### **Third tool:** Medical record:

This tool assesses quarries workers' medical health history which consisted of five sections by forty nine closed ended questions such as: Smoking habits, occupational hazards exposed through last 12 months, types of hazards exposed to such as (dust pollution, noise pollution, weather (hotness), fly rocks accidents, shock from an electric line, slipping on the floor, pinch by the breaker, machine slipping, workload hazards, tripping over pallets, fall from a ledge, blast from a hydraulic line, and blast from an air hose), Medical diagnosis of occupational diseases such as (chronic bronchitis, silicosis, bronchial asthma, pneumoconiosis, COPD, emphysema, Musculo-skeletal diseases, hearing loss, and dermatitis), occupational accidents, or work injuries such as (if injured in workplace before, types of injuries, wound, fracture, bleeding, electric shock, pain (Fatigue), eye irritation, skin inflammation, loss of consciousness, asthma, and heatstroke), Current complaints and signs appeared such as (weight loss, body pain (tenderness), fatigue (general condition), impaired hearing, eye itching, nasal discharge, sore throat, occasioned cough, persistent cough, mild dyspnea, severe dyspnea, chest pain, upper limb injuries, lower limb injuries, and skin rashes).

**Scoring system:** This part consisted of 49 items each item scored zero for answer of "No" and 1 score for "yes" answer.

## II. Administrative Design

An official permission directed from the dean of faculty of nursing Ain Shams University to the director of the "Tourah Portland Cement Company" (TPCC) to get an approval for data collection to conduct this study.

### I. Operational design:

The study accomplished by passed through different phases included: preparatory phase, pilot study and field work phase.

#### Preparatory phase:

A review of the past and current available related literature covering all aspects of the research subject using the available textbooks, journals, articles and nursing journals, internet publications. In order to get evidence based on the

research problem, as well as, to design the study tools for data collection.

#### A. Pilot study:

It was conducted on 30 quarries workers representing 10% of the total study sample. The aim of the pilot study was to evaluate clarity, visibility, applicability, and content validity, as well as the time required to fulfill the developed tools. According to the obtained results, no modifications were done by researchers then the pilot study sample included in the study sample.

#### Content validity:

The tools were tested through three expertise from the community health nursing department, Faculty of Nursing, Ain Shams University and two occupational physicians from National Center for Occupational Safety and Health Studies Cairo - Heliopolis.

#### The tool reliability

The Cronbach alpha coefficient test and Pearson correlation were used to create the reliability test of the developed tool such as knowledge, practices, and checklist of PPE compliance which demonstrated a good construct internal consistency as follow 0.895, 0.852, 0.864 respectively.

#### Field Work:

The actual process of collecting data for quarries workers' data collection was carried out in the period from October to December 2019 two days weekly nearly about 6 hours daily (Mondays and Thursdays) in order to observe quarries workers in different situations. The researchers interviewed the company administrators and the other coordinators teamwork who helped in data collection to save time and to also gain the trust of workers through determined the break time of each worker to availability chance of collecting data without any effect on production time. The researchers explained the aim of the study to every one of the workers and time for interviewed tools took about maximum 20 minutes and observational checklist of PPE compliance took 40 minutes for each one. In addition, 10 minutes for the investigation of medical record for each worker.

#### Statistical design:

Data was analyzed using the Statistical Package for Social Science (SPSS) version 20. Qualitative data was presented as number and

percent. Relations between different qualitative variables were tested using test ( $\chi^2$ ). Probability (p-value) < 0.05 was considered significant and < 0.001 was considered highly significant.

#### Results

**Table (1):** presents that 59.9% of workers their aged ranged from 25 < 40 years old while 31.8 % their aged ranged from 35 < 45 with the mean age  $34.1 \pm 3.5$  and 51.7 % of them had can read and write, 8.3% were highly educated and 77.8% were married but 81.5% of them their family income was insufficient.

**Table (2):** demonstrates that few quarry workers are employed in stone blasting, as excavating operator, as breaker operator, and manual crushing for 7%, 8.9%, 9.9%, and 15.9, respectively, while 33.4% of them are employed in loading and transporting limestone rocks. More than half of them (51.0%) work 7 to 8 hours a day while 16.5% of them work more than 8 hours. Apparently 49% of workers had experience in this job from 1 to 5 years while 18.5% of them had experience in this job for more than 10 years. However, 46.0% received an occupational safety and health training program and 39.4% received first aid training.

**Figure (1):** illustrates that the most common occupational health hazards which quarries workers exposed to in workplace were dust pollution, noise pollution, weather hotness, and fly rocks accidents for 94.3%, 84.8%, 72.8%, and 41.7% respectively. Also 22.5% of workers were exposed to shock from electric line and slipping on the floor while 19.5% of them complained of pinch by the breaker.

**Figure (2):** regarding the common work injuries among quarries workers this figure illustrates that 83.1% of quarries workers complained of wounds, 70.5% complained of body pain (fatigue), 62.9% complained of heatstroke, and 52.6% complained of eye irritation. Also 40.7% of them had skin inflammation and 32.1% of them had fractures.

**Figure (3):** According to the common diseases associated with occupational hazards among quarries workers the figure illustrates that 72.8% of them diagnosed with musculoskeletal diseases. 49% chronic bronchitis, 44.4% silicosis, 39.7% dermatitis, and 26.5% bronchial asthma.

While 11.3% of them were diagnosed with pneumoconiosis, emphysema, and hearing loss.

**Table (3):** presents that most of quarries workers (94.3%) exposed to at least one of occupational hazards and 97% of them were smokers, 72.8%, 71.9%, 70.5%, and 71.9% of them suffered from body pain (tenderness), fatigue, impaired hearing, and upper limb injuries respectively. While lower limb injuries were found in 65.6% of them during physical examination while 62.9% of them suffered from severe dyspnea with persistent cough for 49%.

**Table (4)** demonstrates that majority of quarries workers (81.5%) had unsatisfactory total knowledge about occupational safety and health as occupational health hazards and workplace hazards for 53.3% and 60.6% of them respectively, while 51.3 % had no information about PPE.

**Figure (4):** clarifies that majority of quarries workers (80.5%) did not have adequate practices

for total level about preventive measures of occupational hazards related to the use of PPE for 24.8%, preventive measures during work process for 27.2%, and preventive measures for general health for 22.8%.

**Table (5):** proved that workers who were compliance with PPE represent 18.2% and those exposed to only a small percentage (14.6) of occupational hazards and vice versa, the noncompliance workers with PPE exposed to high percentage (79.8%) of occupational health hazards, as well there was significant statistical relation between occupational hazards exposure and compliance of PPE with  $p$  value  $< 0.001$ .

**Table (6):** proved that the quarries workers who had unsatisfactory knowledge and inadequate practices were suffering from highest percentage of work injuries for 75.8% and 67.5% respectively, which reflect that there were statistically significant relations between total knowledge/ practices of workers and their work injuries with  $p$  value  $< 0.001$ .

**Table (1):** Distribution of study sample of quarries workers according to their Socio-Demographic Characteristics(n=302).

Socio-Demographic	no	%
<b>Age (years):</b>		
25: < 35	181	59.9
35: < 45	96	31.8
45: < 60	25	8.3
<b>Mean± SD=34.1 ± 3.3</b>		
<b>Educational level:</b>		
Read and write	156	51.7
Basic education	52	17.2
High school	69	22.8
University education	25	8.3
<b>Marital status:</b>		
Single	24	7.9
Married	235	77.8
Divorced	33	11.0
Widow	10	3.3
<b>Family income</b>		
Sufficient	56	18.5
Insufficient	246	81.5

**Table (2):** Distribution of quarries workers according to their work duty, workload, experience, and training program (n=302).

Work data	No	%
<b>Work Duty</b>		
Stone Blasting,	21	7.0
Excavating operator	27	8.9
Stockpiling the limestone rocks	20	6.6
Loading and transporting the limestone rocks	101	33.4
Breaker operator	10	3.3
Manual Crushing	123	40.7
<b>Workload/day</b>		
<7 hours	98	32.5
7:8 hours	154	51.0
9 hours	50	16.5
<b>Experience years</b>		
1: < 5 years	148	49.0
5: < 10 years	98	32.5
≥10	56	18.5
<b>Receiving of training program</b>		
● Occupational health and safety program	139	46.0
● First aid program	119	39.4
● No	44	14.6

**Figure (1):** Distribution of quarries workers according to their exposure to occupational health hazards in the workplace (n=302).

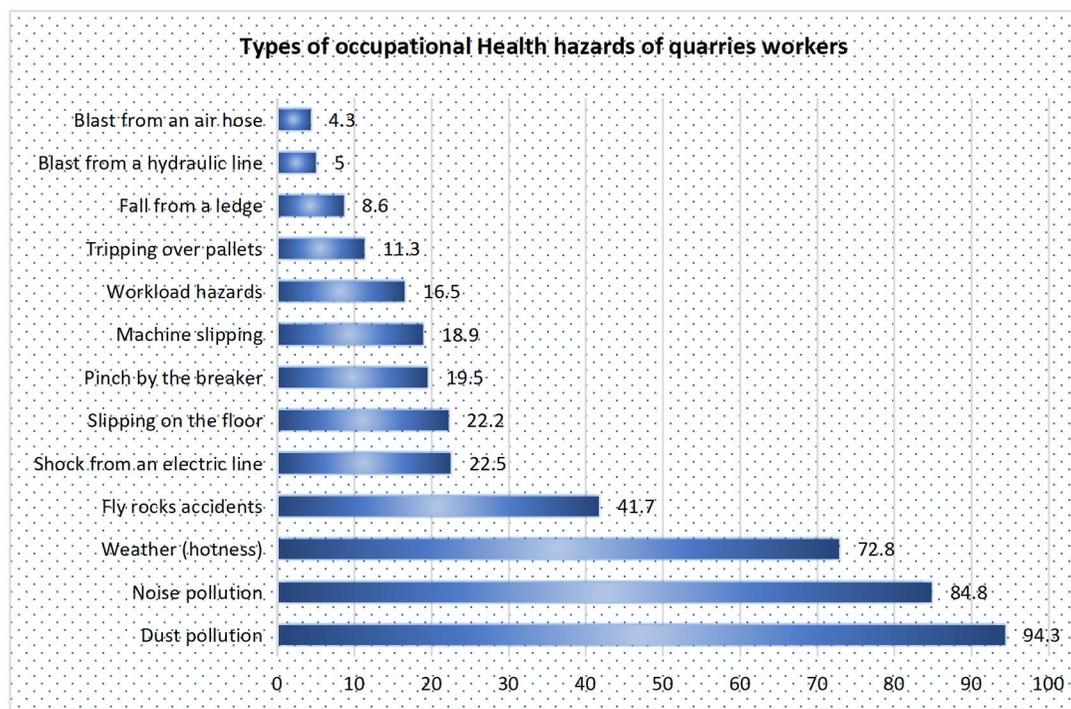


Figure (2): Distribution of quarries workers according to their work injuries associated to occupational hazards (n=302).

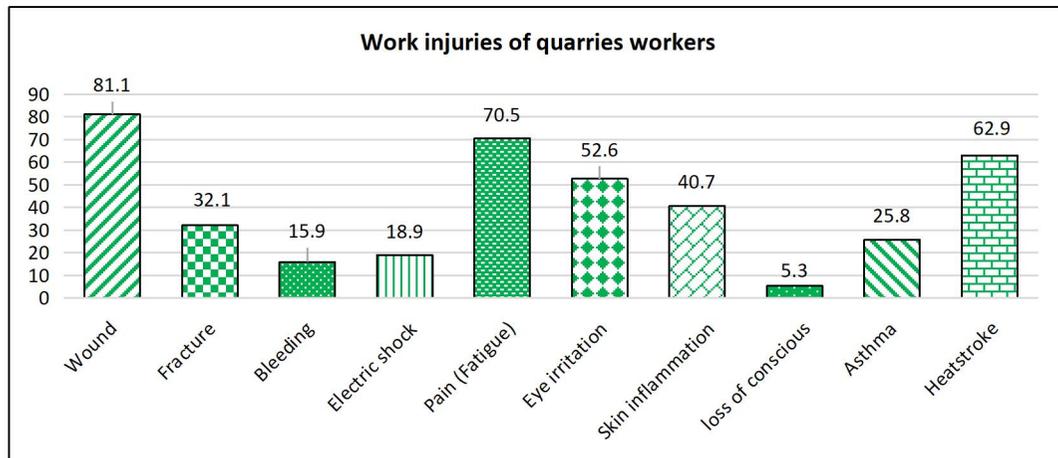


Figure (3): Distribution of the quarries workers according to their diseases associated with occupational hazards (n=302).

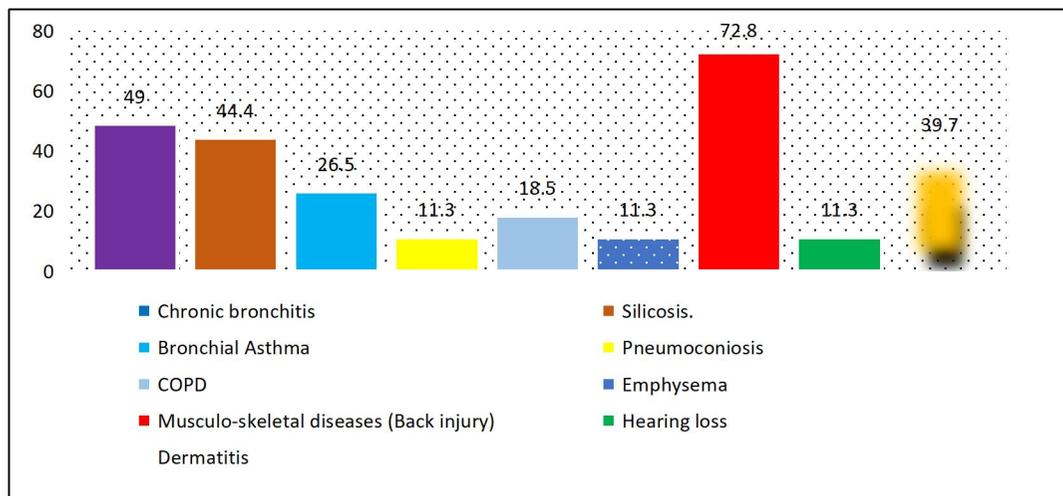


Table (3): Distribution of quarry workers according to their medical history: (n=302).

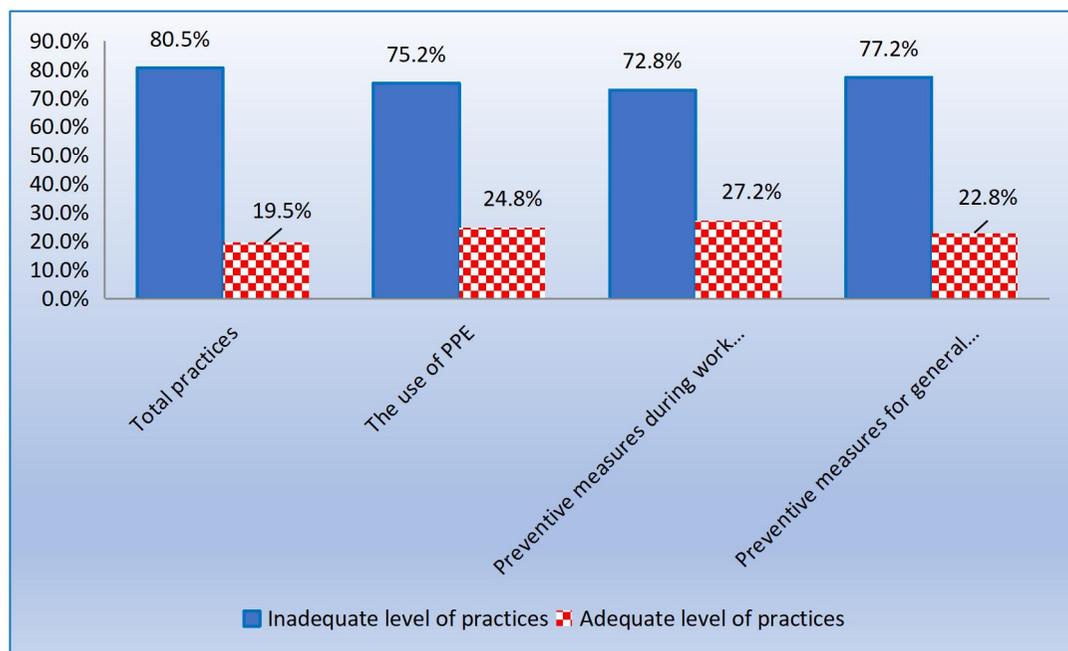
Medical history*	Frequency	%
Exposed to health hazards	285	94.3
Have any injury associated to occupational hazards	245	81.1
Smoking	293	97.0
Weight loss	158	52.3
Body pain (tenderness)	220	72.8
Fatigue (general condition)	217	71.9
Impaired hearing	213	70.5
Eye itching	161	53.3
Nasal discharge	45	14.9
Sore throat	76	25.2
Occasioned cough	85	28.1
Persistent cough	148	49.0
Mild dyspnea	48	15.9
Severe dyspnea	190	62.9
Chest pain	79	26.2
Upper limb injuries	217	71.9
Lower limb injuries	198	65.6
Skin rashes	157	52.0

\*Answers are not mutually exclusive

**Table (4):** Distribution of quarries workers according to their total knowledge about occupational safety and health hazards, and PPE (n=302).

Items	Satisfactory		Unsatisfactory	
	No	%	No	%
Occupational health hazards	141	46.7	161	53.3
Workplace hazards	119	39.4	183	60.6
Personal protective equipment (PPE)	147	48.7	155	51.3
Preventive measures toward occupational health hazards in quarry	62	20.5	240	79.5
<b>Total knowledge</b>	56	18.5	246	81.5

**Figure (4):** Distribution of quarries workers according to their total practices about preventive measures of occupational hazards (n=302).



**Table (5):** The relation between quarries workers occupational hazards exposure and compliance of PPE (n=302).

Exposure of occupational hazards	Compliance of PPE (n=55)		Noncompliance of PPE (n=247)		chi square test	
	No	%	No	%	$\chi^2$	P value
Exposed	44	14.6	241	79.8	26.1432	< .00001*
Unexposed	11	3.6	6	2.0		
<b>Total</b>	55	18.2	247	81.8	302	100

**Table (6):** The relations between work injuries of quarries workers and their knowledge and practices about occupational health(n=302).

Work injuries	Total Knowledge				Total practices				Total
	Satisfactory	Unsatisfactory	Chi-square test		Adequate	Inadequate	Chi-square test		
	No (%)	N0 (%)	$\chi^2$	P value	No (%)	N0 (%)	$\chi^2$	P value	
Yes	16 (5.3)	229 (75.8)	124.0084	< .00001*	41 (13.6)	204 (67.5)	6.482	.01089*	245 (81.1)
No	40 (13.2)	17 (5.6)			18 (6.0)	39 (12.9)			57 (18.9)
<b>Total No (%)</b>	56 (18.5)	246 (81.5)			59 (19.5)	243 (80.5)			302 (100)

## Discussion

Controlling exposure to occupational hazards among quarry workers such as exposure to silica dust remains a challenge. Even with the use of dust minimization techniques, respiratory protection may be required during fracturing tasks. Implementation of effective occupational health and safety controls such as compliance with personal protective equipment is also essential to reduce exposure among quarry workers (**Bello Anila, et al., 2019**).

In 2016, the Occupational Safety and Health Authority had previously issued new rules and regulations regulating occupational exposure to hazards for quarry workers, such as exposure to crystalline silica, by setting a minimum permissible exposure limit and including a number of new provisions for exposure assessment, medical monitoring, dust control, and adherence to personal protective equipment for respiratory protection (**OSHA, 2016**). The aim of this study was to propose guidelines for preventive measures toward occupational health hazards for quarries workers.

The study showed that more than half of workers their aged ranged from 25 < 40 years old while a third of them their aged ranged from 35 < 45 with the mean age  $34.1 \pm 3.5$ . which is congruent to study result by **Ezisi, et al., (2017)**, who reported that in their study on quarries workers in Nigeria, majority of the workers were aged 21–40 years worked in quarry and 31–40 years in stone processing plant. Most of these presently work as laborers with mean age  $34.38 \pm 11.19$ .

The current study demonstrated that few quarry workers are employed in stone blasting, as excavating operator, and as breaker operator, while a third of them were employed in loading and transporting limestone rocks and less than half in manual crushing. Wich corresponding with **Ekong et al., (2020)**, who reported that in their study on 435 quarries workers in Nigeria, 24.4% respondents operate the loading activity and plant operation activity, 95 respondents carry out the crushing activity at 47.3%, 9% performed the maintenance activity, while 2% did the weigh bridge activity.

This result clarified that more than half of quarries workers worked from 7 to 8 hours daily while fifth of them worked 9 hours. From

researchers' point of view that most work is done by manual labor, so it could take a lot more time and effort to produce the same outcomes than in developed nations that have undergone some kind of modernization or mechanization. This high number of work hours may be attributed to increased workload, and this led to high exposure of workers to workplace hazards.

Also, these workers work only during daylight hours because they are in open air places, and therefore the maximum number of hours for the day is 9 hours then sunset begins, which also exposes them to the risks of exposure to extreme temperatures during daylight hours and heat stroke as in figure 2.

Regarding the experience years, the study demonstrated that half of workers had experience in this job from 1 to 5 years while less fifth of them had experience in this job for more than 10 years. That is similar with **Ekong et al., (2020)**, who said that the majority of the respondents (111) had worked 0-5 years, 82 had worked 6-10 years, 5 had worked 11-15 years and 3 had worked above 15 years in the stone quarry. Also identical with study reported by **Ovenseri-Ogbomo et al., (2012)**.

The study revealed that the majority of study samples of quarries workers did not use PPE during the work process. This result similar with **Ahadzi, et al., (2020)**, who conduct their study on 524 stone quarry workers in Ghana and found that the majority of stone quarry workers in Ghana do not wear PPE at work. Also congruent with study report of **Ekong et al., (2020)**, who said that majority of quarries workers did not use PPE while just 15.4% often used it.

This is the inverse of the finding by **Sufiyan and Ogunleye (2012)**, who indicated that 89.2% of the respondents use safety protective devices, which is quite high. The safety protective devices most commonly used by those respondents were hand/finger gloves (83.3%) eye goggles (77.3%), and face masks (10.6%). While none of them used overalls.

This result illustrated that the most common occupational health hazards which quarries workers exposed to in workplace were dust pollution, noise pollution. This result congruent with report of study by **Sandhya and Krishnan (2020)** who said that dust is the most common

and the most extensive air pollutant from a quarry which produced after crushing stones. while the noise pollution produced from quarrying operations and its associated activities like blasting, loading, machineries, stone crushing, and transportation. 72.2% of respondents stated that based on their opinion of exposure, dust pollution was very serious while 82.5% of them said noise pollution was very serious.

Also, it is consistent with other studies from different countries reported exposure to high levels of noise pollution at the workplace. This includes the study by **Ismail et al., (2013)**, among quarry workers in Malaysia, where sound levels exceeded the level that may cause noise-induced hearing loss to the workers.

Regarding the work injuries the result revealed that the majority of workers suffered from work injuries. While the common injuries among quarries workers were wounds, and pain (fatigue) and more than half of them complained of heatstroke, and eye irritation. While less than half of them complained of skin irritation and fractures. This result of study congruent with that study by **Sehsah and Atya, (2020)** which reported that 64.3% of workers had at least one accident in the last 12 months. Also corresponding with other studies in Egypt by **Abbas, et al., (2013)** and **Mohamed, (2017)**, who found that prevalence of occupational accidents among construction workers was 73.2% and 46.2% respectively.

The current study revealed that half of workers suffered from chronic bronchitis, silicosis, and a fifth of them had bronchial asthma. during physical examination while about half of them suffered from severe dyspnea with persistent cough. Also, half of them complained of eye irritation. and skin inflammation.

This disagrees with a study carried out by **Olusegun et al., (2009)**, on the impact of granite stone quarrying on the health of workers in Abeokuta Ogun State, Nigeria where it was observed that, 26% of the workers suffered predominantly from cough. 20% suffered from common cold catarrh and 15% from sinusitis. However, it agrees as 91.5% of workers experience skin irritation at work while 81 respondents 40.3% suffer eye irritation. While this is a different finding from the study by **Charles Kwame, (2016)**, where eye irritations

were reported in 14.9% of them and skin irritations in only 10.8% of respondents.

The current study demonstrated that the majority of quarries workers had unsatisfactory total knowledge about occupational safety and health and inadequate level of total practices about preventive measures toward work injuries. But this disagrees with a study by **Mukhtar et al., (2019)**, on workers and said that most of the workers had a high degree of knowledge (95.7%), a positive attitude (70.0%), and fair practices (50.0%) on occupational safety and health.

This inconsistency between the results of these studies could be the result of various factors, including the degree of development of each country, the availability of occupational health and safety facilities, the nature of the tasks and working conditions involved the characteristics of the working population, and the degree of adherence to safety measures.

Regarding the compliance of PPE the current study showed that most of workers were uncompiled with respirators, ear plugs, heavy duty gloves, helmet, goggles, safety belts, safety boots, overalls and they also attributed this to the reason for the unavailability of equipment, as it impedes their movement and causes shortness of breath during exertion for more than half of them. These study findings are compatible with **Ezisi et al., (2017)** who said that although 98.7% of the workforce rejected to use PPE for a variety of reasons, all workers were aware of the necessity of doing so. About 74.6% of those who did not use it ascribed it to its unavailability, 10.4% to its high cost, and 10.2% to the discomfort it caused when used.

The present study proved that noncompliance workers with PPE exposed to high percentage of occupational health hazards, as well there was significant statistical relation between occupational hazards exposure and compliance of PPE with  $p$  value  $< 0.001$ . This outcome is equivalent to study conducted by **Tadesse and Israel (2016)**, who reported that the leading and third most common reasons for injuries among construction workers are a lack of safety awareness and PPE usage. Additionally, **Lette et al., (2018)** found that construction workers are 3.6 times more likely to sustain an injury caused by occupational hazards if PPE is not used.

As the study indicated the quarries workers who had unsatisfactory knowledge and inadequate practices were suffering from highest percentage of work injuries for 75.8% and 67.5% respectively, which reflect that there were statistically significant relations between total knowledge/ practices of workers and their work injuries with  $p$  value  $< 0.001$ .

Which similar to **Dita et al., (2019)**; who discovered that there is a 0.824 ( $p$  0.001) association between knowledge of occupational accidents and safe work practices. This number shows a strong correlation between workers' knowledge of workplace accidents and safe work practices. The study of **Doloksaribu (2015)**, which discovered that knowledge about workplace accidents affects perceptions of controlling accident risks, is also comparable.

All occupational hazards-related diseases could be preventable when the appropriate exposure control measures are applied and protecting workers by raising their awareness about preventive measures of occupational hazards during work process, compliance of PPE, and healthy lifestyle by applying the proposal guidelines about preventive measures toward occupational health hazards.

### Conclusion

The study proved that the most common occupational hazards which quarries workers exposed to in workplace was dust pollution, noise pollution, weather hotness, and fly rocks accidents for most of them and one fifth of them were exposed to electric shock, slipping on the floor, and pinch by the breaker while majority of them suffered from work injuries like wounds, pain, fatigue, and heatstroke while less than half of them had skin inflammation and fractures. In addition, more than two thirds of workers were diagnosed with musculoskeletal diseases, and less than half of them with chronic bronchitis, and silicosis.

The study demonstrated the existence of a statistically significant relation between exposure to occupational hazards and compliance with personal protective equipment with a value of  $p$  0.001, and a statistically significant relation between workers' knowledge and practices towards prevention of occupational hazards and the incidence of work injuries among them.

### Recommendations

The results of this study recommended that:

1. Activating the proposal guideline for preventive measures toward occupational health hazards to raise awareness of quarry workers to prevent and reduce work injuries.
2. On job training for quarries workers about first aid of workplace injuries which are common in limestone quarries.
3. Ensuring availability of personal protective equipment and following up on their use by quarries workers in all limestone quarries in Egypt.
4. Further research about rehabilitation programs for workers with chronic respiratory and musculoskeletal diseases.

### The proposal guideline

Based on findings of the present study, The guideline about preventive measures toward occupational health hazards for quarries workers has been proposed.

**General Objectives:** Raise awareness of quarries workers about occupational health hazards and occupational safety in the workplace.

### Specific Objectives (Contents of the Program):

At the end of this proposal guidelines program the quarries workers should be able to:

- Define the terms of occupational health and safety hazards, injury, occupational diseases, and occupational hazards management.
- Discuss the importance of occupational health and safety at the workplace.
- Identify different types of health hazards typically found in quarries as physical, chemical, ergonomic, and workload hazards.
- Recognize the pattern of occupational health management.
- List the importance of PPE.
- Identify types of PPE needed in quarries activities.
- Discuss relation between type of PPE and occupational health hazards at quarry workplace.
- Create a healthy and safe quarry, by use the SLAM technique as (Stop – Look – Assess – Manage)

- Identify the different preventive measures during the work process.

## References

- Abbas RA, Mohamed MZ, Ghareeb NS. (2013):** non-fatal occupational injuries and safety climate: a cross-sectional study of construction building workers in Mit-Ghamr city, Dakahlia Governorate, Egypt. *Open J SafSci Technol.* 2013; 3:69–79. doi: 10.4236/ojsst.2013.34009. [Google Scholar]
- AhadziDzifa Francis, Afitiri Abdul-Rahaman, Ekumah Bernard, Kanatey Verona, and Afedzi Abdullah, (2020):** Self-reported disease symptoms of stone quarry workers exposed to silica dust in Ghana. *Health Sci Rep.* 2020;3: e189. wileyonlinelibrary.com/journal/ hsr2 pages 1: 11 [https:// doi. org/ 10.1002/hsr2.189](https://doi.org/10.1002/hsr2.189).
- Bello Anila, Mugford Christopher, Murray Amanda, Shepherd Susan, and Susan R. (2019):** Woskie1Characterization of Occupational Exposures to Respirable Silica and Dust in Demolition, Crushing, and Chipping Activities. *Annals of Work Exposures and Health*, 2019, Vol. 63, No. 1, 34–44 doi: 10.1093/annweh/wxy089 Advance Access publication 31 October 2018 Original Article.
- Bureau of Labor Statistics (BLS). (2018).** National Census of Fatal Occupational Injuries in 2017. Retrieved from [https:// www. bls. gov/news.release/pdf/cfoi.pdf](https://www.bls.gov/news.release/pdf/cfoi.pdf)
- CAPMAS., (2020):** Central Agency for Public Mobilization and Statistics is the official statistical agency of Egypt that collects, processes, analyzes, and disseminates statistical data and conducts the census. [https://www.capmas.gov.eg/Admin/News/PressRelease/202042812332international%20 day.2019.pdf](https://www.capmas.gov.eg/Admin/News/PressRelease/202042812332international%20day.2019.pdf)
- Charles Kwame, R. Gyamfi, Issac Amankwaa, Frank Sekyere and Daniel Boateng (2016):** ‘Noise Exposure and Hearing Capabilities of Quarry Workers in Ghana: A cross sectional study’ Hindawi Publishing Corporation *Journal of Environmental and Public Health* Volume 2016, Article ID 7054276, 7 pages [http://dx. doi. org/ 10. 1155/ 2016/ 7054276](http://dx.doi.org/10.1155/2016/7054276).
- De Merich D., Gnoni M.G., Malorgio B., Micheli G.J.L., Piga G., Rosso A., Sala G., Tornese F. (2018):** A new model proposal for occupational health and safety management in small and medium enterprises, Conference: XXIII Summer School “Francesco Turco” – Industrial Systems Engineering At: Palermo.
- Dita M., Atmojo T B., Sari Y., and Susilawati T N. (2019):** The Correlation Between Knowledge About Occupational Accidents and Safe Work Behaviors Among Employees at the Production Division of PT X Indonesia DOI: 10.18502/ks.v4i12.4165.
- Doloksaribu J A., (2015):** The relationship of knowledge about workplace accidents with the perception of controlling the risk of work accidents on employees in the Gajah Baru Premier Oil Indonesia platform Jakarta: EsaUnggul University p 3-20
- D’Orso MI, Invernizzi I, Di Mauro S, Cesana G. G Ital Med Lav Ergon (2017):** Occupational health nurse's role in health surveillance and workers' education: national and international stat]. 2017 Jan;38(4):269-274. PMID: 29916609 Review. Italian.
- Ekong Akaninyene Edet, Ezeokoro Chikere, Nwaichi Eucharia Oluchi, and Realman Evans Obele, (2020):** Occupational Health and Safety Management in Selected Stone Quarries in Akamkpa, Cross River State, Nigeria. *Current Journal of Applied Science and Technology* 39(34): 107-122, 2020; Article no. CJAST.61628 ISSN: 2457-1024 (Past name: *British Journal of Applied Science & Technology*, Past ISSN: 2231-0843, NLM ID: 101664541).
- Ezisi C. N., Eze B. I. , Okoye I O. , and Arinze, (2017):**Correlates of Stone Quarry Workers' Awareness of Work-related Ocular Health Hazards and Utilization of Protective Eye Devices: Findings in Southeastern Nigeria *Indian J Occup Environ Med.* 2017 May-Aug; 21(2): 51–55. PMID: PMC5844131
- Fabián Alberto, Gloria Isabel and Joaquín Catalá Alís (2017):** Occupational safety and health in construction: a review of applications and trends, occupational safety,

- and health in construction. [https:// www. who. int/ news/ item/16-09-2021-who-ilo-almost-2-million-people-die-from-work-related-causes-each-year](https://www.who.int/news/item/16-09-2021-who-ilo-almost-2-million-people-die-from-work-related-causes-each-year).
- Ilo CI, Njoku PO, Nwimo IO, Elom NA, Orji SA. (2018):** Workers' Compliance with Measures for Safe Environment in Quarry Industries in Abakaliki Town of Ebonyi State, Nigeria. *Chemical Engineering Transactions*. 2018; 63:661-666.
- Ismail A. F, A. Daud, Z. Ismail, and B. Abdullah, (2013):** "Noise induced hearing loss among quarry workers in a north-eastern state of Malaysia: a study on knowledge, attitude and practice," *Oman Medical Journal*, vol. 28, no. 5, pp. 331–336.
- La Torre G, D'Andrea F, Lecce G, Di Muzio M, Chiarini M, M L Pulimeno A., (2020):** The Occupational Health Nurse and his/her role in the prevention of work-related diseases: results of an observational study. *Occupational Health Nurse in Italy*. Affiliations expand, PMID: 31713572 DOI: 10.7416/ai.2020.2325. *Ann Ig* 2020; 32(1): 3-15.
- Lette A, Ambelu A, Getahun T, Mekonen S. (2018):** A survey of work-related injuries among building construction workers in southwestern Ethiopia. *Int J Ind Ergon*. 2018; 68:57–64. doi: 10.1016/ j. ergon. 2018. 06.010. [Google Scholar]
- Martinelli K (2019):** A Guide to the Most Common Workplace Hazards. Available at <https://www.highspeedtraining.co.uk/hub/hazards-in-the-workplace/>
- Mohamed HA. (2017):** Occupational hazards and their relationship with health problems among construction building workers at El Sherouk City. *Am J Nurs Res*. 2017; 5(3): 96–103. doi: 10.12691/AJNR-5-34. [Google Scholar]
- Mohammed, Y. D., & Tamrin, S. B. M. (2017).** A Study Pattern of Construction Occupation Disease and Nationality of the Workers. *International Journal of Advanced Engineering and Management Research*, Vol. 2(Issue 3), 784 - 797. Retrieved from [http://www.ijaemr.com/uploads/ijaemr\\_01\\_122.pdf](http://www.ijaemr.com/uploads/ijaemr_01_122.pdf).
- Mukhtar, M.Y.M.; Yusof, A.M.; Isa, M.L.M. (2019)** Knowledge, attitude and practice on occupational safety and health among workers in petrochemical companies. In *Proceedings of the International Conference on Sustainable Design, Engineering, Management and Sciences (ICSDEMS 2019)*, Kuala Lumpur, Malaysia, 16–17 October 2019; Volume 436
- National institute for occupational safety and health, DHH (NIOSH) (2014) publication No. -150.** Located at: <http://www.cdc.gov/niosh/docs/2012-150/>.
- Nyirenda V, Chinniah Y, Agard B (2015).** Identifying Key Factors for an Occupational Health and Safety Risk estimation Tool in Small and Medium-size Enterprises. *IFAC Papers Online* 48, 541 – 6.
- Olusegun O., Adenuyi A, Adeola GT, (2009),** Impact of Granite Quarry on the Health of Workers and nearby residents in Abeokuta Ogun State, Nigeria, *Ethiopian Journal of Environmental Studies, and Management*. 2009;2(1):15-26.
- OSHA. (2016)** Federal register: occupational exposure to respirable crystalline silica; final rule. Available at [https:// www. osha. gov/ FedReg\\_oshapdf/FED20160325B.pdf](https://www.osha.gov/FedReg_oshapdf/FED20160325B.pdf)
- Ovenseri-OgbomoGO, Ocansey S, Abu EK, Kyei S, Boadi-Kusi SB., (2012):** Oculo-Visual Findings among Industrial Mine Workers at Goldfields Ghana Limited, Tarkwa. *Ophthalmol Eye Dis*. 2012; 4:35–42. [PMC free article] [PubMed] [Google Scholar].
- Pathak N., (2019):**Occupational Health Hazards occupational health safety management, POSTED OCTOBER 24, 2019, access at <https://www.jliedu.com/blog/occupational-health-hazards/> PMID: 29540966doi: 10.4103/ ijoem. IJOEM\_171\_16.
- Rodríguez-Jareño MC, Molinero E, de Montserrat J, Vallès A, Aymerich M. Gac Sanit (2015):** How much do workers' health examinations add to health and safety at the workplace? Occupational preventive usefulness of routine health examinations. 2015 Jul-Aug;29(4):266-73. doi: 10.1016/j.

gaceta. 2014.11.001. Epub 2014 Dec 17. PMID: 25535028.

**Sehsah R A and Ateya M I (2020):** Personal protective equipment (PPE) use and its relation to accidents among construction workers, *Med Lav.* 2020; 111(4): 285–295. Published online 2020 Aug 31. doi: 10.23749/mdl.v11i4.9398, open access [www.lamedicinadellavoro.it](http://www.lamedicinadellavoro.it).

**Sandhya P and Krishnan Neha., (2020):** Environmental and Health impact of Quarry mining among Quarry workers and Residents: Evidence from Sample Survey, *International Journal of Advanced Multidisciplinary Research* ISSN: 2393-8870, [www.ijarm.com](http://www.ijarm.com). DOI: 10.22192/ijarm Volume 7, Issue 5 -2020.

**Said N, Fahmy N, Hanafy O, and Elwan S, (2019):** Occupational Health and Safety Implementation Issues in Egypt. Published by The Public Policy HUB. The School of Global Affairs and Public Policy, The American University in Cairo <https://fount.aucegypt.edu/studenttxt/79>

**SufiyanMu'awiyah B., and Ogunleye Olushola O. (2012):** Awareness and compliance with use of safety protective devices and patterns of injury among quarry workers in Sabon-Gari Local Government Area, Kaduna state North-Western Nigeria. *Annals of Nigerian Medicine / Jul-Dec 2012 / Vol 6 | Issue 2.*

**Tadesse S, Israel D. (2016):** Occupational injuries among building construction workers in Addis Ababa, Ethiopia. *J Occup Med Toxicol.* 2016; 11:1–6. doi: 10.1186/s12995-016-0107-8. [PMC free article] [PubMed] [Google Scholar]

**USLEGAL. (2019).** Surface Mining Law and Legal Definition. Retrieved from <https://definitions.uslegal.com/s/surface-mining/>

**World Health Organization (2020):** WHO/ILO: Almost 2 million people die from work-related causes each year, 17 September 2021 **Joint News Release** Geneva, Reading time: 3 min (853 words).

**Zerguine H., Tamrin S, Jalaludin J. D (2017):** Evaluation of safety behavior and work-

related injuries among foreign construction workers in Malaysia [supplement] *Jpn. J. Ergon.* 2017;53: S580–S83. doi: 10.5100/jje.53.s580. [Google Scholar].