



## Workers' Awareness in Iron Mines Regarding Occupational Hazards at Bahariya Oasis

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### Abstract

**Background:** Iron mines present several occupational hazards that pose significant risks to the health and safety of miners. One of the primary hazards is exposure to respirable dust, which can lead to respiratory diseases as silicosis and pneumoconiosis. **Aim:** This study aimed to assess the workers' awareness in iron mines regarding occupational hazards at Bahariya Oasis. **Research design:** A descriptive design was used in this study. **Setting:** El -Gededa Iron mine area at Bahariya Oasis. **Sample:** A purposive sample included 110 workers in iron mines in Bahariya oasis. **Tool of data collection:** One tool included four parts, **1<sup>st</sup> part:** Demographic characteristic, **2<sup>nd</sup> part:** Medical history of workers, **3<sup>rd</sup> part:** Workers' knowledge about occupational hazards of iron mines, **4<sup>th</sup> part:** Worker's reported practice about prevention of occupational hazards from iron mine. **Results:** 60 % of the studied workers had poor knowledge. While 12 % of them had good knowledge. 55 % of studied workers had unsatisfactory reported practice. **Conclusion:** Less than two third of the studied workers had poor total knowledge about occupational hazards of iron mines, also more than half of them had unsatisfactory total reported practices regarding prevention of occupational hazards from iron mine. There is statistically significant relation between workers' demographic data, their total knowledge, and total reported practices regarding prevention of occupational hazards from iron mine. **Recommendations:** Provide health education program for workers about prevention of occupational hazards from iron mine.

**Keywords:** *Awareness, Bahariya Oasis, Iron Mines, Occupational Hazards, and Worker.*

### Introduction

Iron mines are critical for extracting iron ore, a vital raw material used predominantly in steel production. These mines can be open-pit or underground, depending on the location and depth of the ore deposits. Open-pit mines involve removing large surface areas to access the ore, whereas underground mines require tunneling and shaft sinking to reach deeper deposits. The mining process involves drilling, blasting, and transporting the ore for further processing (Surour, 2024).

Working in iron mines involves demanding and often dangerous tasks carried out by a dedicated and skilled workforce. Miners engage in drilling, blasting, and excavating to extract iron ore from the earth. These activities require precision and physical strength, as well as the ability to operate heavy machinery as drills, loaders, and haul trucks. Workers must be adept at handling explosives used in the blasting process to break up rock formations (Metwaly et al., 2023).

The largest iron mines-producing country is Australia, which had 880,000 workers in 2022, followed by Brazil and China as the second and third-highest iron mine which contain about 795,555 workers. Each year, there are almost a thousand times more non-fatal occupational injuries than fatal occupational injuries. Non-fatal injuries are estimated to affect 374 million workers annually, and many of these injuries have serious consequences for workers' earning capacity in the long term. In Egypt, at least there is around 26 iron mines with more than 9 thousand direct and indirect workers in it (El-Agha et al., 2024).

Occupational health hazards refer to workplace activities that have the potential to cause and increase the risk of injury or illness, it is experienced in the workplace and in many jobs, workers are exposed to a combination of potential hazards, and workers in every occupation can be faced with multitude of hazards in their workplace. Workers in iron mine



face several potential hazards that can significantly impact their health and safety. These hazards include respirable dust, heavy metal exposure, physical injuries, heat stress, noise exposure, chemical hazards, ergonomic hazards, explosives, vibration, and fatigue (*El-Ramady et al., 2024*).

Occupational safety and health standards must adhere to workers so that all mining workers are protected from disease and serious injury. Mining safety equipment includes personal protection equipment (PPE) as hard hats, footwear, protective clothing, breathing apparatus, ventilators, self-rescuers, underground communication, monitoring systems, mining radios and telephones, hazard detection devices, as proximity warning systems and gas detection units, fire protection apparatus, collision avoidance technology, powered haulage safety systems, atmospheric monitoring and air safety devices (*Abdelhalim et al., 2023*).

Workers' awareness of occupational hazards in iron mines is crucial for maintaining a safe and healthy work environment. This awareness involves understanding the various risks associated with mining activities to improve knowledge and practices, as exposure to respirable dust, heavy metals, and physical dangers like cave-ins and machinery accidents (*Nabil et al., 2023*). Training programs and continuous education are essential to equip workers with the knowledge and skills to identify and mitigate these hazards effectively. Regular safety drills, clear communication of safety protocols, and the proper use of PPE further enhance this awareness. By fostering a culture of safety and vigilance, mining companies can empower their workers to take proactive measures in protecting themselves and their colleagues, ultimately reducing the incidence of work-related injuries and illnesses (*Amiri et al., 2024*).

An occupational health nurse in iron mines plays a critical role in safeguarding the health and well-being of miners. Nurses conduct regular health screenings and assessments to detect early signs of work-related illnesses and injuries, as respiratory conditions, musculoskeletal disorders, and heavy metal poisoning. These nurses provide immediate medical care and first aid for injuries sustained on the job, ensuring prompt treatment and minimizing the impact of accidents (*Naorem et al., 2023*). Additionally, nurses develop and implement health and safety programs, educate workers on best practices for maintaining health and preventing hazards, and promote wellness initiatives to enhance overall worker well-being. By collaborating with other health professionals and safety officers, occupational health nurses help create a safer and healthier work environment, ultimately contributing to the reduction of occupational hazards in the mining industry (*Angelakis et al., 2023*).

### Significance of the study

United States' mining industry employed 512,000 people in 2021. This was a decrease of more than 100,000 mining industry employees compared to 2019. 3.8% of all coal miners are women, while 96.2% are men. The average age of an employed iron miner is 44 years old. In 2021, women earned 95% of what men earned. Iron miners are 75% more likely to work at private companies in comparison to public companies (*Chadambuka et al., 2023*). Mining employment in Egypt has trebled from an average of 83,900 in 2002 to 264,700 in 2021. 88 percent of mining workers are permanent, and 96 percent are employed full-time. In 2022, Egypt had 26 iron mines and mining projects. As of 2021, Egypt produced about 560,000 metric tons of iron ore (*Amna, 2022*).

Every year more than 2 million workers die from occupational accidents or work-related diseases in the world. There are 270 million occupational accidents and 160 million cases of occupational diseases. Hazardous substances cause the deaths of an estimated 440,000 workers. Asbestos alone kills 100,000 workers worldwide each year. Pneumoconiosis (silicosis) is the most common occupational lung disease in Egypt where its prevalence rate ranges from 18.5% to 45.8% among workers exposed to free crystalline silica dust (*Musiba, 2022*).

Occupational health nurse plays an important role through encourage iron mines workers to use effective methods & protective equipment to protect from hazards as an eye-wash kit, chemically resistant gloves, warning signs, and many other cautious measures that should be carried while doing iron ore storage at a large scale. Covered conveyors should be used while carrying out various handling operations for iron ore storage like transport, feeding, and refining to minimize occupational hazards (*Alagarajan & Ahmad, 2022*).

### Aim of the study

This study aimed to assess the workers' awareness in iron mines regarding occupational hazards at Bahariya Oasis



through the following:

- 1-Assessing workers' knowledge about occupational hazards of iron mines.
- 2- Appraising workers' practices regarding occupational hazards of iron mines.

**Research questions:**

- 1-What is the workers' knowledge about occupational hazards of iron mines?
- 2-What are the workers' reported practices regarding the prevention of occupational hazards from iron mines?
- 3-Is there relation between worker's knowledge and practices?

**SUBJECTS AND METHODS**

**Research design:**

A descriptive research design was applied to achieve the aim of the study.

**Study Setting:**

This study was conducted in El -Gededa Iron Mine area at Bahariya Oasis.

**Sampling:** Purposive sample was used in this study.

**Sample size:** The total numbers of workers in the one-year beginning of November 2021 to the end of October 2022 are 240 workers so the target population of this study is 110 workers the sample size calculation was done based on the power analysis Herbert Equation.

$$n = \frac{p(1-p)}{(SE \div t) + [p(1-p) \div N]}$$

N = 240

t = 1.96

SE = 0.05

P = 0.50

0.50(1-0.50)

$$n = \frac{0.50(1-0.50)}{(0.05 \div 1.96) + [0.50(1-0.50) \div 240]}$$

**n = 110**

**Inclusion Criteria:**

- 1- Work in iron mines in Bahariya oasis,
- 2- Able to read and write,
- 3- Accept to participate in the study.

**Tools for data collection:**

Data was collected using the following one tool:

**Tool: A structured interviewing sheet:** was used in the study, it's developed by investigators after reviewing the national and international related literature and contains four parts:

**Part (I): Demographic characteristics of workers consisted of 9 items** as sex, age, marital status, number of family members.

**Part (II): Medical history:** It divided into 2 sub-items:

**A- Past medical history for workers consisted of 7 closed ended questions** as suffer from any chronic diseases, if the answer is yes, what is it, take some medications for a specific disease, if the answer is yes, what is it, suffer from respiratory diseases, if the answer is yes.

**B- Current health status for workers consisted of 14 items** as suffer from a dry and persistent cough, suffer from tightness or pain in the chest, suffer from crackling and dry sounds in lungs when you inhale, suffer from spitting up, suffer from digestive tract disorders, suffer from constant nausea.

**Part (III): Knowledge of workers about occupational hazards of irons mines consisted of 3 sub items as:**

**A- Worker's knowledge about risks of iron mines included 6 closed ended questions as:** meaning of mine, types of risks resulting from iron mines, most important physical risks resulting from iron mines.

**B- Worker's knowledge about impact of working environment in mines on mine workers included 11 closed ended questions as:** impact of risks resulting from iron mines on mental health, most important mechanical risks resulting from iron mines, impact of working environment risks from iron mines.

**C- Worker's knowledge about ways to prevent the risks of working in mines included 5 closed ended questions as:** care about occupational health and safety, ways to prevent physical risks resulting from iron mines, ways to prevent chemical risks resulting from iron mines.

**Scoring system:**

Each statement was assigned score according to worker's knowledge were: complete correct was scored 2 grades, incomplete correct was scored 1 grade and incorrect or don't know was scored 0. Total scores were 44 grades from 22 questions. The total scores each item summed up and then converted into percent score as the following:

-Good knowledge ( $\geq 75\%$ ) =  $\geq 33$  grades, was considered high score.

-Average knowledge ( $50 - < 75\%$ ) =  $22 - < 33$  grades, was considered moderate score.

-Poor knowledge ( $< 50\%$ ) =  $< 22$  grades, was considered poor.

**Part (IV): Workers' reported practices about prevention of occupational hazards from irons mine consisted of 4 sub items as:**

**A- Workers' reported practices about personal protective equipment included 5 closed ended questions as:** wears hard hats when working, wear protective clothing when working.

**B- Workers' reported practices about special practices to prevent physical hazards included 8 closed ended questions as:** machines are used to reduce vibrations when working, communication systems are used when working, underground monitoring devices are used when working, mining radios and telephones are used when working.

**C- Workers' reported practices about hand washing practices included 8 closed ended questions as:** place the soap on the palms of the hands, and distribute it over both hands, rub the hands well by scrubbing the palms, rub the back of the left hand with the palm of the right hand, interlacing the fingers, and vice versa for the back of the right hand, pickling the fingers, while rubbing the palms.



**D- Workers' reported practices about environmental measures in mines included 11 closed ended questions as:** develop better legislation and regulations, carefully sort toxic mining waste, build from reusable waste, closes and reclaims closed mine sites, improves the efficiency of manufacturing processes.

#### **Scoring system:**

Each statement was assigned score according to workers' response were "Done", "Not Done", and were scored 1, and 0. (done 1, not done 0), respectively. Total scores were 32 grades for 32 questions. The scores of items summed up and then converted into percentage score as the following:

-( $> 60$ ) was considered satisfactory =  $> 19$  grades.

-( $\leq 60$ ) was considered unsatisfactory =  $\leq 19$  grades.

#### **Operational Item:**

It was included preparatory phase, content validity and reliability, pilot study and field work.

#### **Preparatory phase:**

Prepare the study tools based on related literature review and develop the study tool and test its content validity and reliability.

#### **Pilot study:**

A pilot study conducted on 10 % of the workers equal 11 workers under study to assess the feasibility, practicability, clarity and objectivity of the tool. Based on the results, no modification was done. Workers in the pilot study were included in the main study sample because no modifications were done.

#### **Content validity:**

The revision of the tool for clarity, relevance, comprehensiveness, understanding and applicability was done by a panel of five experts all of them from Faculty of Nursing from Community Health Nursing Department to measure the content validity of the tools and the necessary modification was done accordingly.

#### **Tool Reliability:**

Reliability was tested statistically using the appropriate statistical tests to assure that the tool is reliable before data collection. Answers from the repeated testing were compared Test- re- test reliability was 0.82 for knowledge, and Cronbach's Alpha reliability was 0.890 for reported practice.

#### **Ethical Considerations:**

The research approval was obtained from the Scientific Research Ethical Committee in the Faculty of Nursing, Helwan University before starting the study, The investigators was clarified the objective and aim of the study to workers included in the study, The investigators assured anonymity and confidentiality of subjects' data. Workers' formal consent that they are allowed to choose to participate or not in the study and that they have the right to withdraw from the study at any time.

#### **Field work:**

- An official letter issued from the dean of Faculty of Nursing Helwan University, and workers, El -Gededa Iron Mine area at Bahariya Oasis, including the aim of the study to obtain permission after establishing a trustful relationship, each subject interviewed individually by the investigators to explain the study purpose.
- Data collected within 6 months from first of October 2023 until end of March 2024 one day per week (Tuesday) at the previously mentioned setting over period from (9am- 2pm), till the needed sample completed, interview of workers, informed consent obtained from workers after the investigators introduce himself for each worker, then explain the purpose of the study to assess knowledge, and reported practices of workers about prevention of occupational hazards from irons mine. Study collected through structure face to face interview and the entire tool filled by the investigators.
- The investigators utilize one tool, was need 20 -30 minutes and meeting the workers one day per week (Tuesday) from

9am - 2pm.

- The investigators taken about 18 workers per month, total number of workers = 110 workers.

**Administrative Item:**

Approval to carry out this study was obtained from Dean of Faculty of Nursing, Helwan University and official permission was obtained from the iron mines manager.

**IV- Statistical Item**

The collected data from the studied sample was revised, coded and entered using personal computer (PC). Computerized data entry and statistically analyzed using SPSS program (Statistical Package for Social Science) version 24. Data were presented using descriptive statistics in the form of frequencies and relative percentages. Chi square test (X<sup>2</sup>) was used to calculate difference between qualitative variables through this equation:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

**Where:**

Σ= sum      O= observed value      E= expected      P=.0001

**Degrees of Significance of the results were:**

- Non-Significant (NS) if p > 0.05.
- Significant (S) if p < 0.05.
- High Significant (HS) if p < 0.01.

**Result:**

**Table (1):** Frequency Distribution of the Studied Workers according to their Demographic Characteristics (n=110).

| Demographic Characteristics     | No. | %                       |
|---------------------------------|-----|-------------------------|
| <b>Sex</b>                      |     |                         |
| Male                            | 80  | 72.7                    |
| Female                          | 30  | 27.3                    |
| <b>Age (Years)</b>              |     |                         |
| 25<35                           | 24  | 21.8                    |
| 35<45                           | 35  | 31.8                    |
| 45<55                           | 30  | 27.3                    |
| ≥ 55                            | 21  | 19.1                    |
| <b>Mean ± SD</b>                |     | <b>43.4 ± 2.7 years</b> |
| <b>Marital status</b>           |     |                         |
| Single                          | 25  | 22.7                    |
| Married                         | 70  | 63.6                    |
| Divorced                        | 5   | 4.5                     |
| Widowed                         | 10  | 9.2                     |
| <b>Number of family members</b> |     |                         |
| ≤ 4 people                      | 35  | 31.8                    |
| ≥ 5 people                      | 50  | 45.5                    |
| ≥ 6 people                      | 25  | 22.7                    |
| <b>Mean ± SD</b>                |     | <b>5.4 ± 1.1 People</b> |
| <b>Educational level</b>        |     |                         |
| Not read and not write          | 5   | 4.5                     |
| Read and write                  | 12  | 10.9                    |
| Basic education                 | 31  | 28.2                    |
| Secondary education             | 52  | 47.3                    |
| University education or more    | 10  | 9.2                     |
| <b>Monthly income</b>           |     |                         |



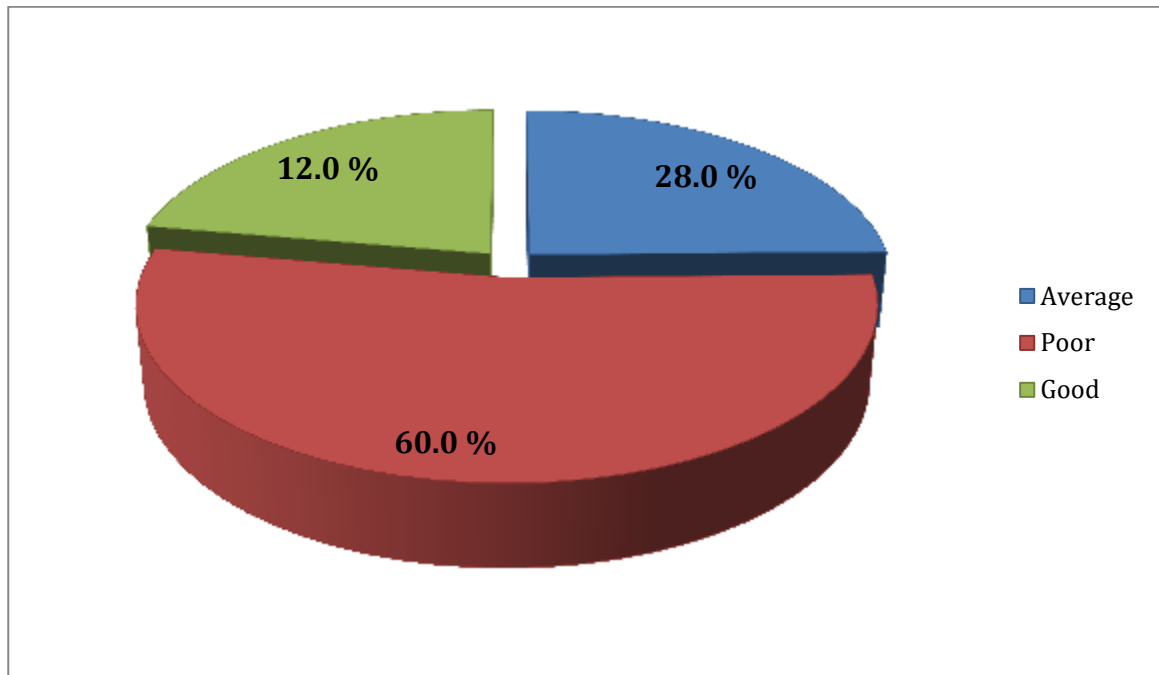
|   |    |      |
|---|----|------|
| Sufficient and saved                        | 27 | 24.5 |
| Sufficient for basic needs                  | 65 | 59.1 |
| Not satisfy basic needs                     | 18 | 16.4 |
| <b>Years of experience working in mines</b> |    |      |
| < 1 year                                    | 10 | 9.2  |
| 1 - < 5 years                               | 60 | 54.6 |
| 5 - < 10 years                              | 20 | 18.1 |
| ≥ 10 years                                  | 20 | 18.1 |
| <b>Shift work in mines</b>                  |    |      |
| 6:12 hours                                  | 30 | 27.2 |
| 12:6 hours                                  | 50 | 45.6 |
| 6:6 hours                                   | 30 | 27.2 |

**Table (1): Shows that,** the mean age of studied workers were  $43.4 \pm 2.7$  years. Also, 47.3 % of the studied worker's educational level were secondary education and 63.6 % of the studied worker's marital status were married. Moreover, 72.7 % of studied worker's sex was male. Additionally, 59.1 % of the studied worker's monthly income was sufficient for basic needs.

**Table (2):** Frequency Distribution of Studied Worker's Past and Current Medical History (n=110).

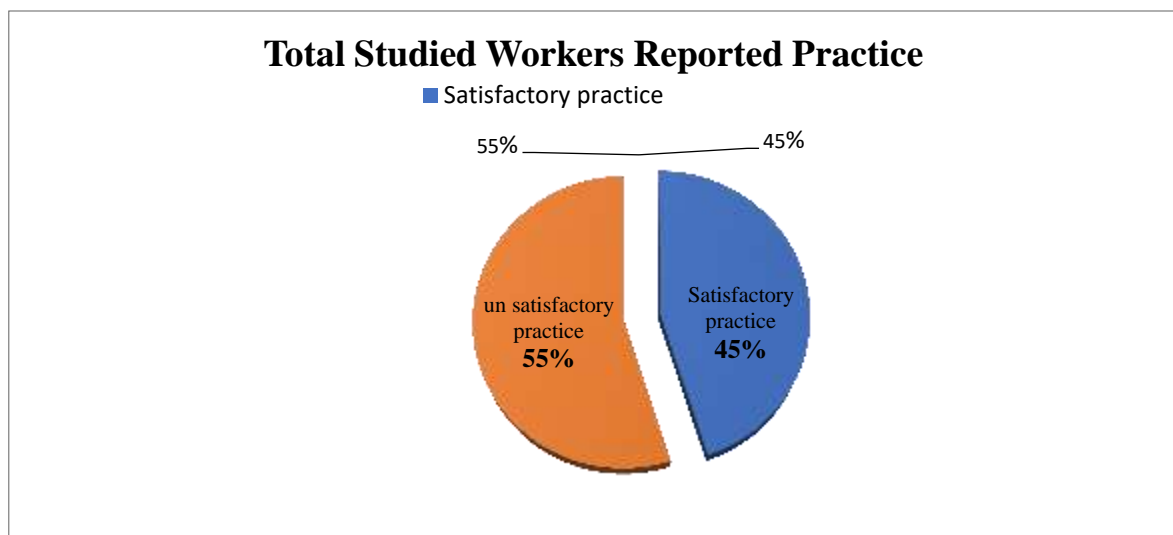
| Item  | No. | %     |
|---|-----|-------|
| <b>Part History:</b>                                      |     |       |
| <b>Do you suffer from any chronic diseases?</b>           |     |       |
| Yes   | 90  | 81.8  |
| No  | 20  | 18.2  |
| <b>- If the answer is yes, what is it (No=90)</b>         |     |       |
| Diabetes  | 55  | 61.1  |
| Heart disease   | 20  | 22.2  |
| Asthma  | 15  | 16.7  |
| <b>Do you suffer from respiratory diseases?</b>           |     |       |
| Yes   | 80  | 72.7  |
| No  | 30  | 27.2  |
| <b>- If the answer is yes, what is it:</b>                |     |       |
| Allergies   | 65  | 81.25 |
| Bronchitis  | 15  | 18.75 |
| <b>Current History</b>                                    |     |       |
| <b>*Respiratory system:</b>                               |     |       |
| <b>Do you suffer from a dry and persistent cough?</b>     |     |       |
| Yes   | 70  | 63.6  |
| Sometimes   | 20  | 18.2  |
| No  | 20  | 18.2  |
| <b>Do you suffer from tightness or pain in the chest?</b> |     |       |
| Yes   | 60  | 54.5  |
| Sometimes   | 30  | 27.3  |
| No  | 20  | 18.2  |
| <b>Others systems:</b>                                    |     |       |
| <b>Do you suffer from skin ulcers?</b>                    |     |       |
| Yes   | 60  | 54.5  |
| Sometimes   | 30  | 27.3  |
| No  | 20  | 18.2  |

**Table (2): Demonstrates that,** 81.8 % of studied worker suffer from any chronic diseases, 61.1% of them suffer from diabetes. Moreover, 72.7 % of studied worker suffer from respiratory diseases, 81.25 % of them suffer from allergies. While, 68.2 % of studied worker have injured because of work in iron mines, 53.3 % of them had wounds.



**Figure (1):** Percentage Distribution of the Studied Worker's Knowledge regarding Occupational Hazards of Iron Mines (n= 110).

**Figure (1): Shows that,** 60 % of the studied worker had poor knowledge regarding occupational hazards of iron mines. Also, 28 % of the studied worker had average knowledge regarding occupational hazards of iron mines. While, 12 % of the studied worker had good knowledge regarding occupational hazards of iron mines.



**Figure (2):** Percentage Distribution of the Studied Worker's Total Reported Practice Regarding the Prevention of Occupational Hazards from Irons Mines (n=110).

**Figure (2): Shows that,** 45 % of the studied worker had a satisfactory level in total reported practice regarding the prevention of occupational hazards from iron mines. While 55 % of them had unsatisfactory total reported practice regarding the prevention of occupational hazards from iron mines.



**Table (3):** Relation between Studied Worker’s Demographic Characteristics and their Total Knowledge (n=110).

| Demographic characteristics                 | Total Knowledge |      |              |      |           |       | X <sup>2</sup> | P – value |
|---|-----------------|------|--------------|------|-----------|-------|----------------|-----------|
|   | Poor (66)       |      | Average (31) |      | Good (13) |       |                |           |
|   | No.             | %    | No.          | %    | No.       | %     |                |           |
| <b>Sex</b>                                  |                 |      |              |      |           |       |                |           |
| Male  | 50              | 75.8 | 20           | 64.5 | 10        | 76.9  | 10.210         | .000**    |
| Female                                      | 16              | 24.2 | 11           | 35.5 | 3         | 23.1  |                |           |
| <b>Age (year)</b>                           |                 |      |              |      |           |       |                |           |
| 25<35                                       | 15              | 22.7 | 5            | 16.1 | 4         | 30.8  | 11.391         | .000*     |
| 35<45                                       | 25              | 37.9 | 5            | 16.1 | 5         | 38.4  |                |           |
| 45<55                                       | 20              | 30.3 | 6            | 9.1  | 4         | 30.8  |                |           |
| ≥ 55  | 6               | 9.1  | 15           | 48.4 | 0         | 0.00  |                |           |
| <b>Marital status</b>                       |                 |      |              |      |           |       |                |           |
| Single                                      | 20              | 30.3 | 5            | 16.1 | 0         | 0.00  | 15.558         | .001**    |
| Married                                     | 40              | 60.6 | 20           | 64.5 | 10        | 76.9  |                |           |
| Divorced                                    | 3               | 4.5  | 2            | 6.5  | 0         | 0.00  |                |           |
| Widower                                     | 3               | 4.5  | 4            | 12.9 | 3         | 23.1  |                |           |
| <b>Number of family members</b>             |                 |      |              |      |           |       |                |           |
| ≤4 people                                   | 25              | 37.9 | 5            | 16.1 | 5         | 38.5  | 16.274         | .000**    |
| ≥5 people                                   | 40              | 60.6 | 10           | 32.3 | 0         | 0.00  |                |           |
| ≥6 people                                   | 1               | 1.5  | 16           | 51.6 | 8         | 61.5  |                |           |
| <b>Educational Level</b>                    |                 |      |              |      |           |       |                |           |
| Not read or write                           | 3               | 4.5  | 2            | 6.5  | 0         | 0.00  | 17.239         | .000**    |
| Read or write                               | 7               | 10.6 | 3            | 9.6  | 2         | 15.4  |                |           |
| Basic education                             | 30              | 45.5 | 1            | 3.2  | 0         | 0.00  |                |           |
| Secondary education                         | 20              | 30.3 | 21           | 67.7 | 11        | 84.6  |                |           |
| University education                        | 6               | 9.0  | 4            | 12.9 | 0         | 0.0   |                |           |
| <b>Monthly income</b>                       |                 |      |              |      |           |       |                |           |
| Sufficient and saved                        | 20              | 30.3 | 7            | 22.6 | 0         | 0.00  | 16.274         | .000**    |
| Sufficient for basic needs                  | 40              | 60.6 | 20           | 64.5 | 5         | 38.5  |                |           |
| Not satisfy basic needs                     | 6               | 9.0  | 4            | 12.9 | 8         | 61.5  |                |           |
| <b>Years of experience working in mines</b> |                 |      |              |      |           |       |                |           |
| < 1 year                                    | 5               | 7.6  | 5            | 16.1 | 0         | 0.00  | 18.199         | .000**    |
| 1 - < 5 years                               | 60              | 90.9 | 0            | 0.0  | 0         | 0.00  |                |           |
| 5 - < 10 years                              | 1               | 1.5  | 19           | 61.3 | 0         | 0.00  |                |           |
| ≥ 10 years                                  | 0               | 0.0  | 7            | 22.6 | 13        | 100.0 |                |           |
| <b>Shift work in mines</b>                  |                 |      |              |      |           |       |                |           |
| 6:12 hours                                  | 30              | 45.5 | 0            | 0.0  | 0         | 0.00  | 16.365         | .001**    |
| 12:6 hours                                  | 30              | 45.5 | 10           | 32.3 | 10        | 76.9  |                |           |
| 6:6 hours                                   | 6               | 9.0  | 21           | 67.7 | 3         | 23.1  |                |           |
| <b>Place of residence</b>                   |                 |      |              |      |           |       |                |           |
| Rural                                       | 30              | 45.5 | 8            | 25.8 | 0         | 0.00  | 10.210         | .000**    |
| Urban                                       | 36              | 54.5 | 23           | 74.2 | 13        | 100.0 |                |           |

\*\*Highly statistically significant <0.001

**Table (3): Shows that,** there were highly statistically significant relation between studied worker’s total knowledge and all items of demographic characteristics, where (P = < .0001).

**Table (4):** Relation between Studied Worker’s Demographic Characteristics and their Total Reported Practices (n=110).

| Demographic characteristics                 | Total Reported Practices |      |                   |       | X <sup>2</sup> | P – value |
|---|--------------------------|------|-------------------|-------|----------------|-----------|
|   | Unsatisfactory (60)      |      | Satisfactory (50) |       |                |           |
|   | No.                      | %    | No.               | %     |                |           |
| <b>Sex</b>                                  |                          |      |                   |       |                |           |
| Male  | 30                       | 50.0 | 50                | 100.0 | 11.021         | .000**    |
| Female                                      | 30                       | 50.0 | 0                 | 0.00  |                |           |
| <b>Age (year)</b>                           |                          |      |                   |       |                |           |
| 25<35                                       | 20                       | 33.3 | 4                 | 8.0   | 13.225         | .000*     |
| 35<45                                       | 30                       | 50.0 | 5                 | 10.0  |                |           |
| 45<55                                       | 10                       | 16.7 | 20                | 40.0  |                |           |
| ≥ 55  | 0                        | 0.00 | 21                | 42.0  |                |           |
| <b>Marital status</b>                       |                          |      |                   |       |                |           |
| Single                                      | 20                       | 33.3 | 5                 | 10.0  | 19.225         | .001**    |
| Married                                     | 30                       | 50.0 | 40                | 80.0  |                |           |
| Divorced                                    | 5                        | 8.4  | 0                 | 0.00  |                |           |
| Widower                                     | 5                        | 8.3  | 5                 | 10.0  |                |           |
| <b>Number of family members</b>             |                          |      |                   |       |                |           |
| ≤4 people                                   | 30                       | 50.0 | 5                 | 10.0  | 18.225         | .001**    |
| ≥5 people                                   | 30                       | 50.0 | 20                | 40.0  |                |           |
| ≥6 people                                   | 0                        | 0.00 | 25                | 50.0  |                |           |
| <b>Educational Level</b>                    |                          |      |                   |       |                |           |
| Not read or write                           | 5                        | 8.3  | 0                 | 0.00  | 17.102         | .000**    |
| Read or write                               | 10                       | 16.7 | 2                 | 4.0   |                |           |
| Basic education                             | 25                       | 41.7 | 6                 | 12.0  |                |           |
| Secondary education                         | 20                       | 33.3 | 32                | 64.0  |                |           |
| University education                        | 0                        | 0.0  | 10                | 20.0  |                |           |
| <b>Monthly income</b>                       |                          |      |                   |       |                |           |
| Sufficient and saved                        | 20                       | 33.3 | 7                 | 14.0  | 20.214         | .000**    |
| Sufficient for basic needs                  | 40                       | 66.7 | 25                | 50.0  |                |           |
| Not satisfy basic needs                     | 0                        | 0.00 | 18                | 36.0  |                |           |
| <b>Years of experience working in mines</b> |                          |      |                   |       |                |           |
| < 1 year                                    | 10                       | 16.7 | 0                 | 0.00  | 19.220         | .000**    |
| 1 - < 5 years                               | 50                       | 83.3 | 10                | 20.0  |                |           |
| 5 - < 10 years                              | 0                        | 0.00 | 20                | 40.0  |                |           |
| ≥ 10 years                                  | 0                        | 0.00 | 20                | 40.0  |                |           |
| <b>Shift work in mines</b>                  |                          |      |                   |       |                |           |
| 6:12 hours                                  | 30                       | 50.0 | 0                 | 0.00  | 17.553         | .001**    |
| 12:6 hours                                  | 0                        | 0.00 | 50                | 100.0 |                |           |
| 6:6 hours                                   | 30                       | 50.0 | 0                 | 0.00  |                |           |
| <b>Place of residence</b>                   |                          |      |                   |       |                |           |
| Rural                                       | 30                       | 50.0 | 50                | 100.0 | 11.021         | .000**    |
| Urban                                       | 30                       | 50.0 | 0                 | 0.00  |                |           |

\*\*Highly statistically significant <0.001

**Table (4): Shows that,** there were highly statistically significant relation between studied worker’s total reported practices and all items of demographic characteristics, where ( $P = < .0001$ ).

**Table (5):** Correlation between Studied Worker’s Total Knowledge, and Total Reported Practices (n= 110).

| Knowledge and reported practices | Changes of scores of total knowledge and total reported practices |       |                          |       |
|----------------------------------|---|-------|--------------------------|-------|
|                                  | Total Knowledge   |       | Total reported practices |       |
| Total knowledge                  | -----   | ----- | 0.166                    | 0.094 |
| Total reported practices         | 0.822   | 0.000 | -----                    | ----- |

**Table (5):** Illustrates that, there was strong positive correlation between total knowledge and total reported practices.

**Discussion:**

Iron mining plays a crucial role in the global economy by providing the primary raw material for steel production, which is essential for construction, transportation, and various industries. The extraction of iron ore involves surface (open-pit) or underground mining methods, depending on the ore deposit's depth and location. Once mined, the ore undergoes crushing, screening, and beneficiation processes to increase iron content and reduce impurities (*Yan et al., 2023*). Occupational hazards in iron mining are significant and multifaceted, posing serious risks to workers' health and safety. One of the primary hazards is exposure to respirable dust, which contains silica and other harmful particles that can lead to respiratory diseases such as silicosis and chronic obstructive pulmonary disease (COPD). Prolonged exposure to high noise levels from machinery and blasting operations can result in hearing loss and other auditory issues (*MacPhail et al., 2023*).

Concerning the place of residence of studied workers, the current study result revealed that, more two third of studied workers was live in urban area. This result in the same line with **Qiu et al., (2023)** who carried out a study conducted in Pakistan about " Construction and application of a knowledge graph for iron deposits using text mining analytics and a deep learning algorithm ", they found that 72.5 % of studied sample had live in urban area. From the investigators point of view, urban areas typically offer a wide range of amenities and services as healthcare facilities, educational institutions, shopping centers, entertainment venues, and cultural attractions.

Concerning the marital status of studied workers, the current study result revealed that, less two third of studied workers were married. This result in the same line with **Lin et al., (2023)** who carried out a study conducted in Karachi about " Treatment of high turbidity mine drainage with iron-based hybrid flocculants: Synthesis process and mechanism, and its interfacial flocculation mechanism ", they found that 62.4 % of studied sample had married. From the investigators point of view, many workers seek companionship and emotional support as their age. Marriage can provide a stable and enduring relationship that fulfills these needs.

Concerning suffers from any chronic diseases that majority of studied workers were suffers from chronic diseases and less two third of them suffer from diabetes. This result in the same line with **Miklowitz et al., (2024)** who carried out a study conducted in Brazil about " Family Conflict, Perceived Criticism, and Aggression in Symptomatic Offspring of Parents with Mood Disorders", they found that, 84.1 % of studied sample had suffers from chronic diseases and 60 % of them suffer from diabetes. From the investigator point of view, mining work schedules can make it challenging for workers to maintain a healthy diet. The availability of nutritious food options may be limited, especially in remote mining locations, leading to a reliance on processed and convenience foods that are high in sugars and unhealthy fats. Poor dietary habits are a significant risk factor for diabetes and other chronic conditions.

**The following paragraphs, answered research question Q1: What is the workers’ knowledge about occupational hazards of iron mines?**

Concerning studied workers’ total knowledge, the current study revealed that, less two third of them had poor knowledge, more than quarter had average knowledge and more than tenth of them had good knowledge, this result agrees with **Tang et al., (2023)** who conducted a study in Argentina about “Disaster-causing mechanism and risk area classification method for composite disasters of gas explosion and coal spontaneous combustion in deep coal mining with narrow coal pillars”, they found that,13.0 % of the studied sample had good total knowledge. Also, 61.0 % had poor

knowledge and 26.0 % of them had average knowledge. From the investigators point of view, comprehensive training programs may not be consistently implemented, leading to gaps in workers' knowledge about various aspects of iron mining operations. Iron mining involves complex processes and specialized knowledge. Workers may not fully understand all the technical aspects, leading to inaccuracies when discussing or answering questions about mining operations.

Regarding studied workers' total knowledge, the current study revealed that, less two third of them had poor knowledge, more than quarter had average knowledge and more than tenth of them had good knowledge, this result disagrees with **Podgórska & Józwiak, (2024)** who conducted a study in Malaysia about "Heavy metals contamination of post-mining mounds of former iron-ore mining activity", they found that, 60.0 % of the studied sample had good total knowledge. Also, 35.0 % had poor knowledge and 5.0 % of them had average knowledge. From the investigators point of view, working in iron mines often provides opportunities for workers to gain specialized skills and training, which can enhance their career prospects in the mining industry and related sectors and workers have university education.

**The following paragraphs, answered research question number Q2: What are the workers' reported practices regarding the prevention of occupational hazards from irons mines?**

Regarding to relation between studied worker's demographic characteristics and their total knowledge, the current study revealed a highly statistically significant between studied workers' age, educational levels occupation and their total knowledge scores. This result agrees with the study done by **Zheng, & Pan, (2024)** who conducted a study in Jinbao about "Study on Target Reliability of Mine Rock Slopes by Grey Fixed Weight Clustering and Analogy Method Case Study of the Jinbao Iron Mine", they found that, a statistically significant relation between studied samples' age, level of education and occupation, and their total knowledge scores. From the investigators point of view, high work pressure and tight deadlines can lead workers to cut corners or skip important safety and procedural steps to meet production targets. Poor communication within the organization can lead to misunderstandings or lack of awareness about proper practices. Workers may not receive clear and consistent information on what is expected.

Concerning to relation between studied worker's demographic characteristics and their total reported practices, the current study revealed a highly statistically significant between studied workers' age, educational levels occupation and their total knowledge scores. This result agrees with the study done by **Wu et al., (2024)** who conducted a study in Yudong River Basin about "Source reduction and end treatment of acid mine drainage in closed coal mines of the Yudong River Basin", they found that, a statistically significant relation between studied samples' age, level of education and occupation, and their total reported practices scores. From the investigators point of view, Workers who have not experienced accidents or witnessed their consequences may become complacent and underestimate the risks associated with their tasks, leading to lax practices. Develop and deliver regular training sessions that emphasize the importance of best practices and safety protocols. Include practical demonstrations and hands-on training.

## Conclusion

**Based on the results of the present study and research question the following conclusion includes:**

Less two third of the studied workers had poor total knowledge about occupational hazards of iron mines, and more than quarter of them had average total knowledge about occupational hazards of iron mines. While, more than half of them had unsatisfactory total reported practices regarding prevention of occupational hazards from irons mines. There a relation between workers' knowledge, and reported practices towards occupational hazards from irons mines. There is statistically significant relation between workers' demographic data and their knowledge, and reported practices regarding prevention of occupational hazards from irons mines.

## Recommendations

**In the light of the result of this study, the following recommendations were suggested:**

1. Provide health education program for workers about prevention of occupational hazards from irons mines.
2. Design booklets about occupational hazards and prevention of occupational hazards from irons mines used which include all information for workers.
3. Design posters and put in iron mines that would help workers to improve' knowledge, and practice of prevention of occupational hazards from irons mines regarding workers.

4. Encourage workers to make group discussion regarding occupational hazards to exchange knowledge, and practice about prevention of occupational hazards from iron mines used under observation from occupational health nurse.

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