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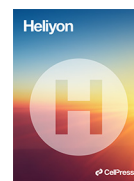
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Research article

Assessing the knowledge and practices of occupational safety and health in the artisanal and small-scale gold mining sector of Ghana: A case of obuasi



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ABSTRACT

It is noted that most developing countries such as Ghana are still grappling with health and safety policies and practices as governments and corporations have made insignificant efforts. This study utilized a questionnaire since it is suitable for both illiterate and literate respondents and allows for the gathering of massive quantities of data in a short space of time. The descriptive statistics, chi-square, likelihood ratio test regression, and correlation were used to assess the occupational safety and health knowledge and practices of employees in the artisanal small-scale gold mine in Obuasi. Although majority of the respondents had less than 5 years of job experience, however about 36% and 19% of the respondents had between 4-10 years and 11-15 years of experience respectively. However, the study further observed that an increase in health and safety practices such as safety training, committee, education, facilities, etc. will increase the level of knowledge of respondents on health and safety policies. The study further revealed that the more health and safety practices, the higher the primary responsibility of site managers to ensure that workers are practicing safety. However, the general working conditions of respondents did not meet acceptable standards as revealed by the observation checklist. The study, therefore, recommends that prime Stakeholders in the ASGM need to consider investing in future research on ASGM safety issues to acquire accurate database on ASGM operations safety.

1. Introduction

Globally, labor professionals feel that occupational safety and health (OSH) standards are preconditions for the continuation particularly in the production industries, the matter of a safe and healthy workplace has gained significance today (Swanson 2015). Generally, mining whether artisanal and small-scale gold mining (ASGM) or Large Scale Mining (LSM) offers Ghana both economic prospects and severe challenges, primarily in the field of OSH for workers (Amponsah-tawiah and Mensah 2016). Globally, it has been estimated that the ASGM sector alone produces roughly 20%–30% (Basu et al., 2015) of the world's gold output and significantly boosts gross domestic product (GDP) in some countries (Asamoah-Gyadu 2019; Barreto et al., 2018). The sector also employs

over 100 million people and largely supports global growth (Hilson et al. 2018; Levin 2004; Jennings 1999). In Ghana alone, the sector engages roughly one million people directly and indirectly (Amoah and Stemm 2018; Abdulai 2017; McQuilken and Hilson 2016).

Regardless, ASGM undertakings are known to impose major workplace injuries and/or accidents as well as environmental destructions (Abbasi 2018; Stemm et al. 2021). Largely, in more than 30 countries scattered, ASGM employees are noted to undertake most of their jobs under repulsive, unsafe, and low-paying circumstances (Bansah et al., 2018; Stephens 2016; Basu et al., 2015; Teschner 2012). As a result, this problem is not limited to Ghana; it affects most countries, primarily where gold is extracted, and the scale of the problem is most visible in ASGM, or “galamsey,” as locally known (Nakua et al., 2019). Though

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ASGM is unlawful in Ghana, it is very prevalent, contributing to almost 34% of the country's gold output (Bansah et al. 2016; McQuilken and Hilson 2016). It is documented that in 2013, ASGM contributed 34% of the total export of gold, and 35% in 2014 (McQuilken and Hilson 2016; MyjoyOnline 2015) constituting the aggregate production of the country's three largest foreign firms.

However, in countries of low- and middle-income status like Ghana, the high rate of accidents and injuries among miners in the ASGM has been attributed to a paucity of OSH policies, education, working infrastructure and equipment, law enforcement, training (Bansah et al., 2017; Wilson et al., 2015; Levin 2004). Findings from a survey by the International Labour Organisation (ILO) reveal that miners within the ASGM sector are more likely to encounter injuries as compared to those in the LSM (Jennings 1999). Consequently, miners particularly in ASGM die at a work rate 90-fold higher compared to LSM in industrialized countries (Cossa et al., 2021; Jennings 1999). Significantly, within the scope of mine undertakings, the application of engineering control has proven to be the most commended method for reducing safety concerns in mines, it is hardly utilized in resource-constrained environments, where the majority of illegal ASGM operate (Jennings 1999).

Pathetically, Personal Protective Equipment (PPE) (gloves, helmet, work boot, machine guarding shield, etc.) that is less common choices for reducing injuries/accidents are disregarded and essentially missing among ASGM miners (Stephens 2016; Debrah et al. 2014; Chimamise et al., 2013; Jennings 1999). In Ghana's Upper East Region, a study among 120 miners revealed that 5.8 % do use PPE, 70 % have never used it, while the rest claimed they do it "sometimes" (Paruchuri et al., 2010). Correspondingly, finding in the Central African Republic and Cameroon almost revealed the same (Schure and Ingram 2009). This raises the reservation of why the ASGM sector rejects even the simplest and most common technique for injury/accident avoidance. Studies undertaken at various locations in Ghana, revealed the majority of ASGM miners have never worn any form of PPE (Chimamise et al., 2013). Most ASGM undertakings are low-tech, labor-intensive tasks that need less investment (Baddianaah et al. 2022), are conducted with poor safety precautions, and expertise is regarded to be outmoded subjecting workers to injuries and other health concerns (Teschner 2012). It has been noted that manual equipment in comparison to automated equipment subject ASGM workers to occupational injuries/accidents, however, ASGM largely uses manual equipment in their undertakings (Nakua et al., 2019).

OSH encompasses the employee's physical well-being, emotional and mental about the performance of the employee's job and, therefore, is a critical topic of interest that significantly influences the accomplishment of the corporation's targets (Amponsah-tawiah and Dartey-Baah 2011). The mining industry must provide effective OSH services and largely enhance and preserve the social well-being, and mental and physical of workers. Except for a few global corporations that offer detailed OSH to workers, however, this is largely absent in the ASGM sector (Annan 2010).

A wealth of literature (e.g. Amponsah-tawiah and Mensah 2016; Yeboah 2008), have exposed particular concerns with the workforce's OSH practice in various aspects. However, little research has been conducted on OSH practice in the ASGM industry, particularly in the studied area. This study aims to find out about the health and safety knowledge and practices of workers at the ASGM, Obuasi.

The research questions for the study include;

- What is the frequency of occupational accidents in the Artisanal Small-scale Gold Mining?
- What are the implications of the health and safety policies of the Artisanal Small-scale Gold Mining?
- What is the level of knowledge on health and safety policy among Artisanal Small-scale gold Mining workers?
- What is the primary responsibility of workers toward the OSH policy of the Artisanal Small-scale Gold Mining?

- What are the working conditions of respondents in the Artisanal Small-scale Gold Mining?

The necessity of this research may be argued both theoretically and practically. Accident rates should, in theory, fluctuate depending on the type of job. Consequently, the mining sector particularly the ASGM has a reputation for being a risky one due to many disasters and accidents, as well as a high rate of crippling injuries in its early years. These findings have been related to the extraordinarily stressful working circumstances that miners face (Mensah et al., 2022; Annan 2010). Currently, the total number of workforces in ASGM largely remains unknown, consequently, several studies have always approximated on the total number of workforces in ASGM (e.g. (Hilson et al., 2017; Levin 2004; Jennings 1999)). Data and media reports reveal common hazardous operations of this environmental undertaking, particularly within the study area (see, e.g. (Ngenbe 2022; Daily Guide 2017, 2013)). Significantly, hazards including but not limited to pits cave-ins, death, injuries, etc. In addition, according to (Gakpe and Mahama 2014), injuries in the workplace reveal that every two working days in Ghana, a death or injury is recorded particularly in the mining sector due to industrial accidents or poor workplace safety circumstances, particularly in mining sectors with a large workforce, such as ASGM's in Obuasi. Studies, for instance by (Amponsah-tawiah and Mensah 2016; Yeboah 2008; Akosua Ganson 2014) have identified unique challenges in several aspects of OSH practice by the labor force. However, there has been relatively little research into OSH practices in the ASGM industries, particularly in the study area. At the back of this, this study aims to ascertain the health and safety knowledge and behaviors of workers at the ASGM in Obuasi in this context. The findings of this study will give managers and workers a firsthand understanding of their responsibilities in regard to the advancement of health and safety practices in the workplace, allowing ASGM to achieve a global standard of occupational health and safety management via strengthening, implementation, general upkeep, and continuous enhancement to push a robust OSH expectations of performance in consonant with international standards coupled with the firm's vision, mission, core values and codes of practice.

The study utilized (Geller 2010) proposal as a theoretical foundation, which states that health and safety in the workplace is based on three key elements: health and safety apparatus and devices, health and safety behaviors, and safety and health capacity building (Figure 1).

Routine servicing of OSH devices is required to guarantee their efficacy. Health and safety standards are developed by enabling and guaranteeing that the guideline is adequately conveyed to the workforce so that they may participate in the policy's execution. It also conducts a hazard assessment to detect potential risks associated with the usage of the health and safety committee. The sort of training required is determined by the dangers. A Worker's knowledge coupled with OSH understanding may be improved via skilling/training and re-skilling/re-training. Safety standards compliance, health and safety expertise, and a successful OSH committee are all intertwined to the degree that one has a significant inter-relation effect on the other. To create a solid safety culture in the firm, certain factors should be functional. Unavailability of these will precipitate accidents/injuries, and as such, fatal accidents, fractures, amputations, and other industrial disorders. While following these guidelines would result in a healthy and safe working conditions of a worker.

The findings of the study will provide a strong foundation for OSH policy development in Ghana's artisanal and small-scale mining industry.

2. Methods and materials

2.1. The study area

Generally, Obuasi is a mining town that can be found in the southern part of Ghana. Obuasi is roughly 39 miles (59.4km) south of Kumasi and 100 miles (160 km) from Accra, in hilly terrain. With coordinates of

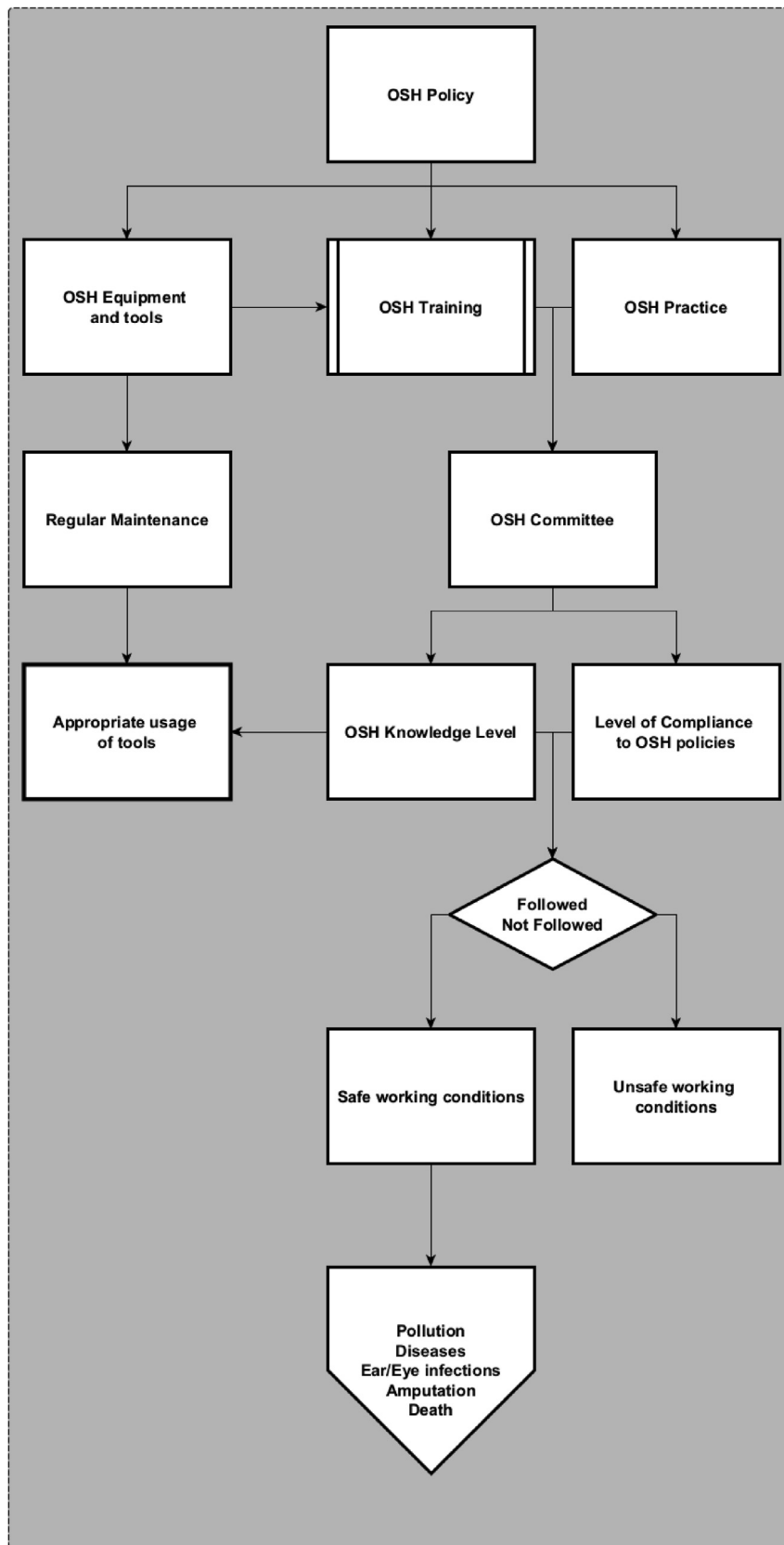


Figure 1. Conceptual framework on occupation safety and health practices modified from (Geller 2010).

6.2012°N, 1.6913°W (Figure 2), and a current population of 196, 698 people (GSS 2021). Obuasi is surrounded by mountains, and it sits quietly, but keenly, on the land that produces the top-tier. Affectionately called “the Golden City” because of its huge deposits of gold reserves, Obuasi experiences two rainy seasons with a semi-equatorial tropical savanna climate. Significantly, March to July happens to be the major rainy seasons, while in general, May and June remain the wettest months annually. Lighter rain usually happens from September to March. Obuasi general has an annual average rainfall of about 1,270mm with an average temperature of 26.5 °C (Taylor 2006).

Historically, the exploration of a major gold mine in 1897 and the construction of the railway from Sekondi in 1902 aided the development of Obuasi. While many got exhausted, Obuasi’s gold mine was still the biggest producer with regards to yields per ton of ore, globally, it remains one of the wealthiest gold mines. Globally, the Obuasi gold mine remained the 10th largest by the end of the 20th century. Despite its mining heritage, the town’s economy has expanded to include commerce and cocoa cultivation. Regardless, ASGM activities are prevalent and serve as a greater source of income for particularly, major rural settlers in Obuasi. Obuasi has one of the largest gold mining company which was formerly known as Ashanti Goldfields Corporation (AGC) however, currently AngloGold Ashanti (AGA) mines to a depth of 1,500m. From 2016 till the start of its reconstruction in early 2019, AGA was on “care and maintenance” while the Ghanaian government provided the appropriate permissions. In February 2019, the first phase explosion happened, and the first gold was poured in December of the same year (AGA 2020). The first part of the rehabilitation project was completed by the end of September 2020, and commercial production began on October 1, 2020. Construction and mining development for Phase 2 has begun, with a completion date of 2021. At the district level, AGA has a significant

impact on the local economy. For example, it offers the Obuasi Municipal Assembly (OMA) three principal revenue streams. Mineral royalties, property taxes, and voluntary contributions are examples. For the mining giant, property tax has been one of the most reliable sources of revenue. AGA pays the OMA a little more than 400,000 cedis (just under USD 100, 000) in property tax each year. Between 2007 and 2013, this amount accounted for an average of 70% of all property taxes collected by the OMA and 14% of total income earned (Natural Resource Governance Institute, 2014 cited in (TWM-Africa 2017). Also, AGA claimed to have funded a large sum of (23 million USD) in Obuasi and its nearby villages as part of its Corporate Social Responsibility (CSR) supported activities from 2007 to 2014 (TWM-Africa 2017).

2.2. Research design, data collection, and analysis

The study used the six (6) selected ASGM mining companies as a case study (see Table 1). These ASGM companies are community-based

Table 1. Some six selected Artisanal Small-scale gold mining firms operating in Obuasi.

Site	Location	Start	Processing Method
Site 1	Adaase	2019	Open pit alluvial mining
Site 2	Amamerewa No 1	2017	Open pit mining
Site 3	Diawuoso	2011	Open pit mining
Site 4	Sanso	1989	Open pit mining
Site 5	Kobro	2007	Open pit mining
Site 6	Akatakyieso	2016	Open pit alluvial Mining

Source; Environmental Protection Agency- Obuasi Area Office, 2022

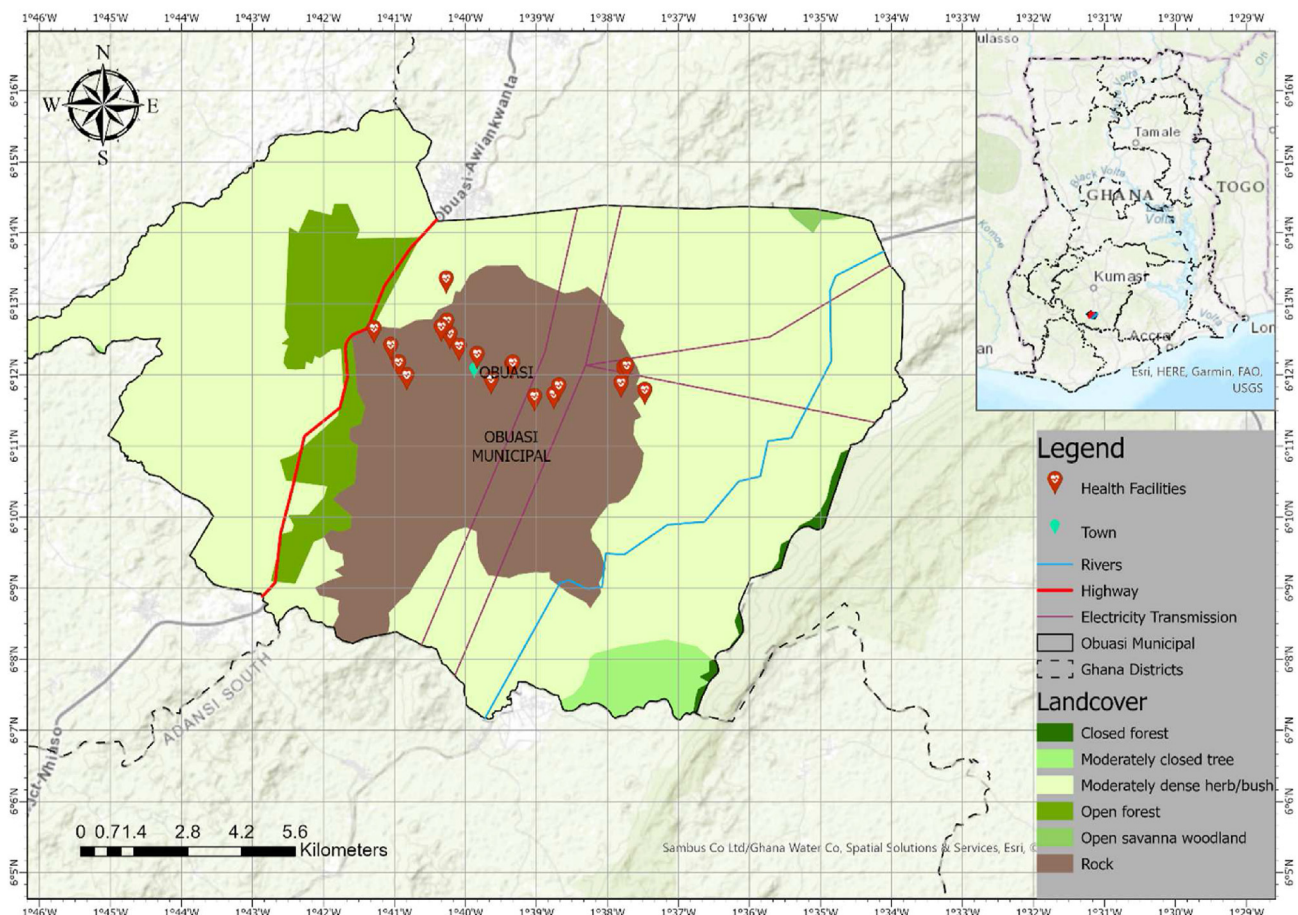


Figure 2. Study area Map.

mining companies. It was non-interventional since the researcher did not take part in the operations of the firms. Because the firms have so many diverse parts, the researcher employed a cross-sectional technique to collect the practices and perspectives of the firms. The open-pit mining method is used by all six ASGM firms (Table 1). In addition, as stated in Table 1, all the firms employ chemical (cyanide and mercury) heap leach processes. These techniques have far-reaching implications for human health and the environment.

The research was carried out in a five-stage process. The first step consisted of a literature study of pertinent papers, journals, and books on mining industry health and safety measures. The study's research instrument and questionnaire were the focus of the second stage. Pre-testing and adjustment of questionnaires based on responses from respondents, as well as the discovery of instrument problems and pilot test sampling processes, were all part of the third stage. The responders were given the main questionnaire at random. The data was coded in SPSS software for analysis in the fourth step. The outcomes of the data analysis and interpretation were generated at the fifth step. The survey technique was chosen as a sort of study design since it did not demand a large financial investment and allowed for the collection of data in a short period. This makes it easier to extrapolate from a sample to a whole population. According to (Leedy et al., 2010), the survey has a broader use since it allows data to be gathered on a big population in a short period.

The total population for the six selected sites was made up of 2,758 workers from ASGM in Obuasi who worked in various departments of the firm. For the study, a random sample approach was used to pick 252 respondents from all areas of the ASGM firms using the Sloven's formula (Equation 1).

$$\text{Sample Size} = \frac{N}{1 + (Ne)^2} \quad (1)$$

Where:

N = size of population, e = margin of error or tolerance of 6%

However, 51 senior employees and 200 junior employees who were chosen at random. The sample size of 251 was chosen to make study work easier, as including all employees would be unfeasible owing to the population's vastness. The 251 respondents chosen at random constituted around 10% of the total population. This contributed to a reduction in error and an improvement in accuracy. It was believed that replies from respondents in the same part would be similar, thus increasing the sample size from one category would not make a significant effect. The study used questionnaires as the tool for the data collection process. According to (Kheni and Braimah 2014), using a questionnaire as a research instrument for data collecting provides a distinct benefit over other data gathering approaches, particularly in quantitative investigations. This study utilized a questionnaire since it is suitable for both illiterate and literate respondents and allows for the gathering of massive quantities of data in a short space of time. It's also simpler to measure and statistically treat. Questionnaires, on the other hand, have the drawback of preventing human contact with respondents, and it is sometimes impossible to verify the correctness of replies. A blend of closed and open-ended questions created by the researcher was utilized for this investigation. English language was used in the administration of the questionnaires. However, where respondents were unable to understand, a trained enumerator was present to translate the questionnaire to Twi which is a widely used local dialect in the study area.

A pilot test was done employing the instrument at an ASGM company in the Amansie Central District of the Ashanti region to determine the instrument's reliability and validity. Challenges such as certain junior employees' failure to understand and reply to the issues correctly, some questions that were unclear to respondents, and so on were identified and remedied by re-framing the items to guarantee that they were replied to,

rendering the instrument more trustworthy. Before conducting the survey at the gold-mining sites, an ethical approval was granted by the Enforcement and Compliance Monitoring Department of EPA, Obuasi. Moreover, a brief presentation explaining the main and specific objectives of the study was done. The privacy and confidentiality of respondents were guaranteed (i.e. the consent of the respondents was sought as well as respondents were not obliged to provide information). Therefore, the respondents encompassed those who were willing to participate.

The SPSS 25 software was applied to analyze the data collected. The essential tendency coupled with several variables such as the use of standard deviations of the various variables were calculated using SPSS. The findings and comments were presented using such as bar chart. The data was displayed as frequency distribution, tables, pie charts, and bar charts.

2.3. Hypothesis testing and correlation analysis

The study utilized the Pearson's Chi-square (X^2) test and the likelihood ratio (LR) test for testing all hypotheses. These tests were employed due to their suitability in testing the independence of a variable from another. Moreover, correlation analysis was used to explore the strength of the association between safety practices and primary responsibilities of miners towards health and safety policies. A high correlation signifies a strong association between two or more variables (Franzese and Iuliano 2018). noted this analysis as the process of evaluating the strength of that association with the available statistical variables. The study used 99%, 95%, and 90% confidence intervals with their respective 1%, 5%, and 10% alpha (significance) levels in testing all hypotheses stipulated.

Table 2. Demographic characteristics of respondents.

Variables	Frequency	Percentage
Age		
18–25	32	12.7
26–35	105	41.8
36–45	72	28.7
46–55	21	8.4
56 & Above	21	8.4
Gender		
Male	54	21.5
Female	197	78.5
Education		
No Education	106	42.2
Primary School	58	23.1
Junior High School	42	16.7
Senior High School	23	9.2
Diploma	19	7.6
University	2	0.8
Post graduate	1	0.4
Work Experience		
Less than 5	93	37.1
6 to 10	91	36.2
11 to 15	47	18.7
16 to 20	13	5.2
21 & Above	7	2.8
Department		
Crushing & washing	100	39.8
Excavation & blasting operation	65	25.9
Removal of ore from pit	86	34.3

3. Results

3.1. Socio-demographic features

The demographic features of respondents at the selected mining sites are presented in Table 2. Majority of the respondents (41%) were between the ages of 26–35 years (Table 2). This implies that most of the respondents were found to be of a productive age. Approximately, about 79% of the respondents were males (Table 2). This may be associated with the energy-intensive nature of ASGM where female miners may not be appropriate for the job and reveal the gender disparity present in the mining industry. Moreover, majority of the respondents (42%) were found to be illiterates. However, about 23%, 17%, 9%, 8%, 0.8% and 0.4% had a primary school, Junior high school, Senior High School, Diploma, university and postgraduate education respectively. This signifies that most of the respondents have little or no education. For working experience, most of the respondents (37%) had less than 5 years of experience. However, about 36% and 19% of the respondents had between 4–10 years and 11–15 years of experience respectively. In terms of the department of work, about 40% of the respondents representing the majority were found in the Crushing and washing department (Table 2).

3.2. Causes and frequency of accidents in the study area

The study evaluated the major causes of accidents in ASGM at the selected mining sites (Figure 3). Approximately 80 respondents representing 32% indicated that negligence is the major cause of accident in their workplaces. However, incompetence and poor facilities were also noted to be some of the major causes of accident (see Figure 3).

The influence of socio-demographic features on the occurrence of accident at the selected mining sites was evaluated. Therefore, the Chi-square and likelihood ratio test was used to test the hypothesis;

H_0 = Socio-demographic features do not influence the occurrence of an accident

H_1 = Socio-demographic features influence the occurrence of an accident

Concerning age, most of the respondents (34%) who were between the ages of 26–35 years noted the occurrence of an accident in their job. This was followed by those between the ages of 36–45 years (see Table 3). This suggests that both the young and old in the ASGM are vulnerable to accidents. As a result, the association between age and the occurrence of accident was not statistically significant ($X^2 = 5.540$, $df = 5$, $p = 0.354$; $LR = 4.276$, $df = 5$, $p = 0.510$). For gender, most of the respondents (69%) who claimed “Yes, they recorded accidents” were males (Table 3). This shows that most of the male miners were vulnerable to accidents compared to their female counterparts. This may be attributed to the dangerous and more difficult roles assigned to the male miners. The relationship between gender and the occurrence of accident was statistically significant at 1% significance level ($X^2 = 12.722$, $df = 1$, $p = 0.000$; $LR = 11.309$, $df = 1$, $p = 0.001$). In terms of education, most of the respondents (39%) who had no education reported that they had accidents (Table 3). This is followed by 17% of the respondents who were primary school leavers (Table 3). This shows that most of the respondents who had little or no education were more vulnerable to accidents. The link between education and the occurrence of accident was statistically significant at 5% significance level ($X^2 = 14.109$, $df = 6$, $p = 0.028$; $LR = 14.285$, $df = 6$, $p = 0.027$).

For work experience, approximately 32% of the respondents who have less than 5 years of work experience recorded most accidents (Table 4.2). This is followed by those who have 6–10 and 11–15 years respectively. This shows an inverse relationship between work experience and the occurrence of an accident. Thus, as a miner grows in experience, the miner becomes less susceptible to accidents. Therefore, the association between work experience and the occurrence of accident was statistically significant at 5% significance level ($X^2 = 12.223$, $df = 5$, $p = 0.032$; $LR = 11.119$, $df = 5$, $p = 0.049$). Finally, on the department of work, most of the respondents (35%) in the crushing and washing department were found to record more accidents (Table 4.2). This was followed by the removal of ore from pit and excavation and blasting operation (Table 4.2). The relationship between the department of work and the occurrence of accidents was statistically significant at 1% significance level ($X^2 = 14.235$, $df = 2$, $p = 0.001$; $LR = 12.897$, $df = 2$, $p = 0.002$). We, therefore, reject the null hypothesis and accept the alternative hypothesis that socio-demographic features have an influence on the occurrence of accidents.

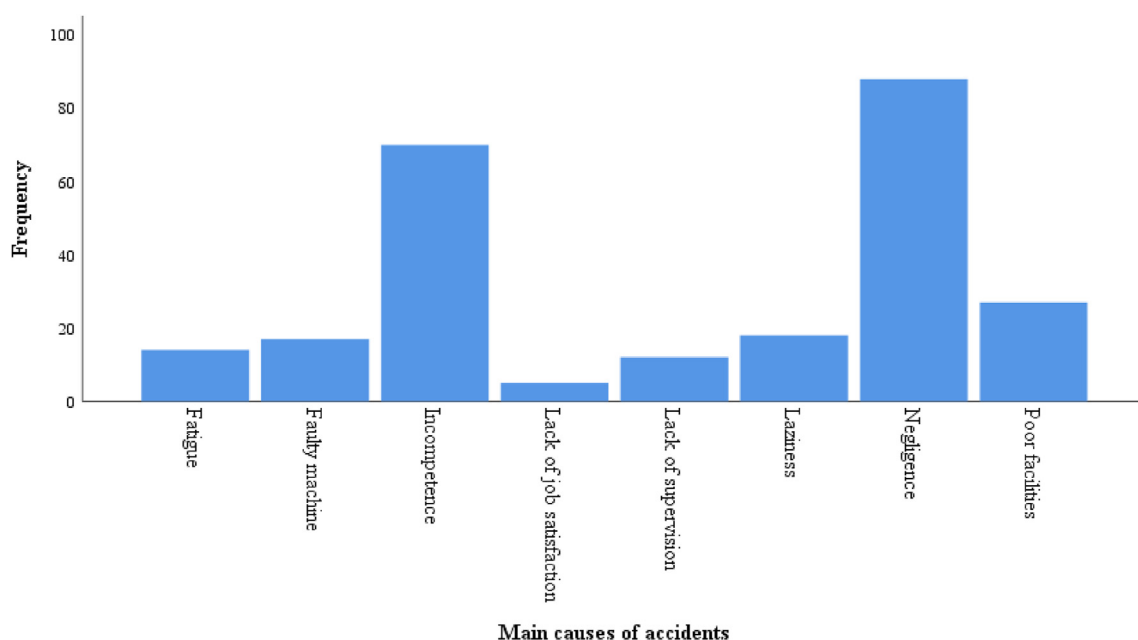


Figure 3. Main causes of accidents in the studied area.

Table 3. The influence of socio-demographic features on the occurrence of an accident.

Variable	Occurrence of accident			Test	Value	df	P value
	No	Yes	Total				
Age				Pearson Chi-Square (X^2)	5.540	5	0.354
18–25	4	28	32	Likelihood Ratio (LR)	4.276	5	0.510
26–35	19	86	105				
36–45	13	59	72				
46–55	3	18	21				
56 & Above	4	17	21				
Total	43	208	251				
Gender							
Female	18	36	54	Pearson Chi-Square (X^2)	12.722	1	0.000
Male	25	172	197	Likelihood Ratio (LR)	11.254	1	0.001
Total	43	208	251				
Education							
No Education	9	97	106	Pearson Chi-Square (X^2)	14.109	6	0.028
Primary School	14	44	58	Likelihood Ratio (LR)	14.285	6	0.027
Junior High School	12	30	42				
Senior High School	5	18	23				
Diploma	2	17	19				
Degree	1	1	2				
Post graduate	0	1	1				
Total	43	208	251				
Work Experience							
Less than 5	12	81	93	Pearson Chi-Square (X^2)	12.223	5	0.032
6 to 10	22	68	90	Likelihood Ratio (LR)	11.119	5	0.049
7 to 10	1	0	1				
11 to 15	4	43	47				
16 to 20	3	10	13				
21 & Above	1	6	7				
Total	43	208	251				
Department of Work							
Crushing & Washing	12	88	100	Pearson Chi-Square (X^2)	14.235	2	0.001
Excavation & blasting operation	21	44	65	Likelihood Ratio (LR)	12.897	2	0.002
Removal of ore from pit	10	76	86				
Total							

For the most affected body parts, over 80 respondents (see Figure 4) at the selected mining sites indicated the upper limb as the most affected part of their body. This was followed by the lower limb and chest respectively (Figure 4). This may be attributed to the low usage of PPEs in ASGM and the poor medium for reporting the occurrence of accidents. This is confirmed by the respondents in Figure 5 where over 80 respondents noted that they do not report their accidents to management despite less than 60 respondents reporting to co-workers. As a result, most of the miners are exposed to different degrees of accidents in the course of their operation.

3.3. PPE usage and OSH compliance

An assessment of the usage of PPEs in the daily operations of miners in the ASGM shows that about 62% of the respondents representing the majority do not use PPEs (Table 4). The rest of the respondents who use PPEs indicated boots as the most used PPE. This is followed by ear plugs and helmets respectively. The link between the use of PPEs and the type of PPEs was significant at 1% significance level ($X^2 = 238.539$, $df = 6$, $p = 0.000$; $LR = 304.234$, $df = 2$, $p = 0.003$).

As a result, most of the respondents (67) noted that they do not use PPEs and further indicated that PPEs are less important (Table 4). This was followed by about 35 respondents who do not use PPEs indicating that PPEs are not important (Table 4). This may be attributed to the price of PPEs affecting their usage. For instance, the high price of PPEs may

deter some miners from patronizing them. However, the association between PPEs usage and the importance of PPEs usage was not statistically significant ($X^2 = 5.177$, $df = 3$, $p = 0.159$; $LR = 5.211$, $df = 3$, $p = 0.157$).

3.4. Level of knowledge of OSH policies and health and safety practices among ASGM workers

Table 5 shows the level of knowledge of OSH policies and health and safety practices among respondents in the ASGM. The results show that respondents' knowledge of OSH policies education is positively related to the health and safety policies in ASGM. This shows that most of the respondents do not have in-depth knowledge about the health and safety practices in ASGM. Thus, an increase in the ASGM policies will lead to a 20% increase in the level of knowledge of respondents. This is statistically significant at a 1% significance level ($p = 0.000$) (Table 5). Moreover, there was a positive relationship between the knowledge of respondents on OSH policies and the presence of health and safety committee at 1% significance level ($p = 0.000$). This reveals that despite not having in-depth knowledge about the health and safety practices in ASGM, they acknowledged the presence of health and safety committee. Therefore, a rise in the presence of health and safety committee will result in about a 37% increase in the level of knowledge of respondents on health and safety practices. Also, there is a positive correlation between the responsibility of health and safety committee and the level of

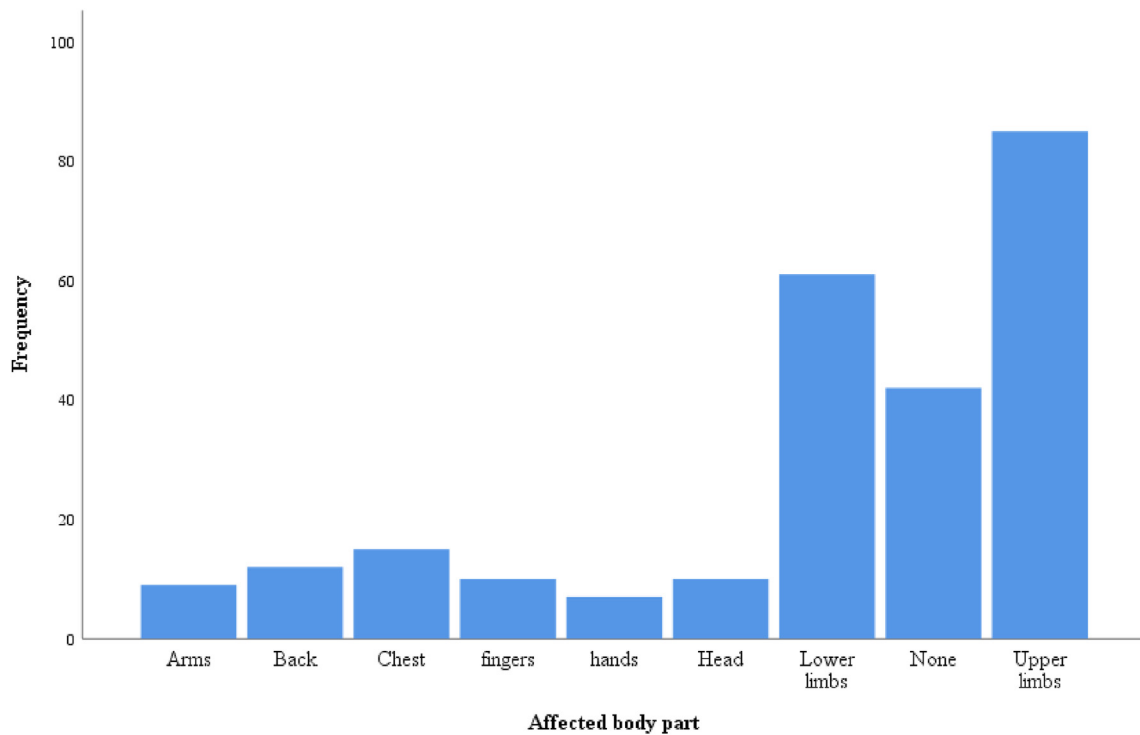


Figure 4. Most affected part of the body.

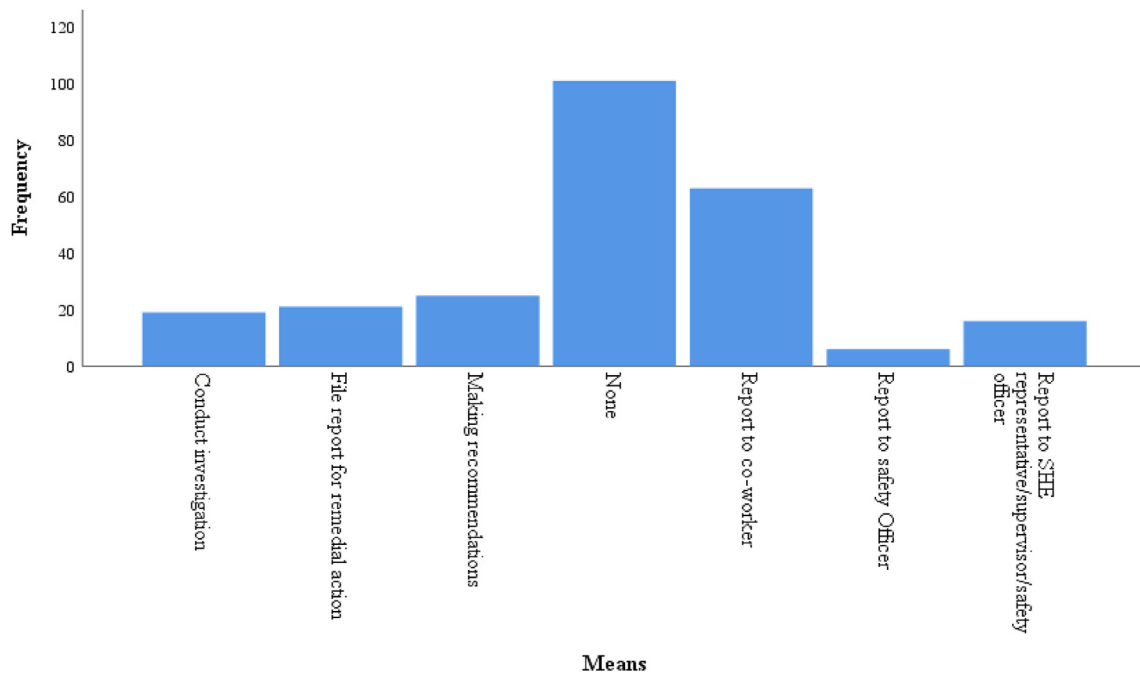


Figure 5. Means of reporting the occurrence of accidents.

knowledge of respondents on health and safety practices. This shows that an increase in the responsibility of health and safety committee will trigger a 9% increase in the level of knowledge of respondents on health and safety practices (Table 5). However, this was not statistically significant. Again, there was a positive association between the frequency of health and safety precaution training and the level of knowledge of respondents on health and safety practices. This depicts that an increase in health and safety training will lead to about a 4.5% increase in the level of knowledge of respondents on health and safety practices. This was

statistically significant at a 5% significance level (see Table 5). Furthermore, Table 5 shows negative associations between the inadequacy of safety education and facilities and the level of knowledge of respondents on health and safety practices. Thus, a rise in the inadequacy of health and safety education and facilities will lead to a 3% and 0.9% respectively reduction in the level of knowledge of respondents on health and safety practices. However, this was not statistically significant. Finally, the results reveal a positive relationship between acting on the reports of health and safety and the individual role played to ensure that health and

Table 4. The most used Personal Protective Equipment vs. the use of Personal Protective Equipment in the Artisanal Small-scale gold mining.

Variable	Occurrence of accident			Test	Value	df	P value
	No	Yes	Total				
Type of PPE				Pearson Chi-Square (X^2)	238.539	6	0.000
	155	3	158	Likelihood Ratio (LR)	304.234	6	0.000
Boots	0	42	42				
Ear plug	0	13	13				
Goggles	0	11	11				
Hand gloves	0	10	10				
Helmet	0	11	11				
Overall coat	0	6	6				
Total	155	96	251				
Importance of PPE							
Important	29	11	40	Pearson Chi-Square (X^2)	5.177	3	0.159
Less important	67	36	103	Likelihood Ratio (LR)	5.211	3	0.157
Not Important	35	32	67				
Very important	24	17	41				
Total	155	96	251				

Table 5. Level of knowledge on Occupational Safety and Health policies and health and safety practices among respondents in the Artisanal Small-scale gold mining.

	Coefficients	Standard Error	t Stat	P-value
Con	1.235	0.093	13.151	0.000**
Artisanal Small-scale gold mining Policies education	0.201	0.010	-19.972	0.000**
Presence of health and safety committee	0.377	0.031	11.920	0.000**
Responsibility of health and safety Committee	0.009	0.032	0.311	0.755
Frequency of health and safety precaution training	0.002	0.004	0.638	0.052*
Inadequacy of health and safety education	-0.030	0.052	-0.587	0.558
inadequacy of safety facilities	-0.009	0.013	-0.721	0.471
Acting on the reports of health and safety	0.007	0.005	1.200	0.231
Individual role played to ensure that health and safety policy is maintained	0.001	0.004	-0.276	0.782

Model summary: $F = 203.0242$, $df = 12$, $p = 0.00$, $R^2 = 0.91$, **. significant at the 0.01 level, *. significant at the 0.05 level.

safety policy is maintained and the level of knowledge of respondents on health and safety practices although this was not statistically significant (Table 5). This implies that an increase in acting on the reports of health and safety and the individual roles played to ensure that health and safety policy is maintained will result in a 0.07% and 0.01% increase in the level of knowledge of respondents on health and safety practices.

3.5. Correlation between health and safety practices and primary responsibilities of workers towards OSH policies in ASGM

The correlation analysis of the safety practices and primary responsibilities of miners toward health and safety policies are presented in Table 6. All the mean response values (see Table 6) reveal the Site manager as the overall person responsible for all the safety practices in ASGM. There was a positive relationship between health and safety practices and the primary responsibility that people are properly supervised for safety. This was statistically significant at 1% level. This implies that the more health and safety practices, the higher the primary responsibility of the site manager to ensure that people are properly supervised for safety. Similarly, the association between health and safety practices and the primary responsibility that people are properly trained

for safety was positive at 5% significance level. As a result, the more health and safety practices, the higher the primary responsibility of the site manager to ensure that people are properly trained for safety. Also, there existed positive correlations between the health and safety practices and primary responsibility that machinery and equipment are inspected, primary responsibility that people are using the correct safety appliance properly, and primary responsibility that everyone knows what to do in an emergency at 5% significance level respectively. This denotes that as health and safety practices increase, the primary responsibility of the site manager is that machinery and equipment are inspected, that people are using the correct safety appliance properly and that everyone knows what to do in an emergency.

However, the correlation results reveal a negative association between health and safety practices and the primary responsibility that everyone is aware of the hazards in the workplace. This was statistically significant at 1% level. This implies that the higher health and safety practices the lower the primary responsibility that everyone is aware of the hazards in the workplace. This is because as miners are properly supervised and trained for safety, the awareness of existing hazards in the workplace will be automatically known. This will reduce the primary responsibility of the site manager in ensuring that everyone is aware of the hazards in the ASGM site. Similarly, the correlation between the health and safety practices and the primary responsibility that working areas are kept clean, clear, and tidy. This shows that as the health and safety practices increase, the primary responsibility of the site manager to ensure that working areas are kept clean, clear, and tidy lessens. This may be attributed to the individual's contribution toward compliance with health and safety policies. Therefore, it does not become the sole responsibility of the site manager but all the workers.

Finally, the correlation between health and safety practices and the primary responsibility that action is taken following accidents and near misses was positive at 1% and 5% significance level respectively (see Table 6). This implies that the more health and safety practices, the higher the primary responsibility of the site manager to ensure that action is taken following accidents and near misses. This will give site managers no option but to act on reported accidents and near-miss cases. Currently, most reported cases are left redundant and victims are left to cater for themselves without compensation from the site manager/owners. There is currently no laid down procedure or guidelines for reporting incidents of accidents in ASGM.

3.6. Evaluation of observation checklist

The results for the observation checklist of respondents at the selected mining sites are presented in Tables 7, 8, 9, 10, and 11. Table 7 reveals that

Table 6. Correlation analysis of the safety practices and primary responsibilities of miners towards health and safety policies.

	Mean	Std. D	1	2	3	4	5	6	7	8	9	10	11	12	13
Primary responsibility that People are properly supervised for safety	2.81	1.25	1												
Primary responsibility that people work and behave safely	2.77	1.19	0.170**	1											
Primary responsibility that people are properly trained for safety	2.74	1.24	0.121*	0.050	1										
Primary responsibility that people are obeying company health and safety rules and regulations	2.77	1.22	.011	-0.071	0.017	1									
Primary responsibility that everyone is aware of the hazards in the workplace	2.78	1.23	-0.079	-0.014	-0.024	-0.164**	1								
Primary responsibility that machinery is properly guarded	2.78	1.25	0.006	-0.067	0.069	-0.020	-0.003	1							
Primary responsibility that machinery and equipment are inspected	2.75	1.21	0.091	-0.004	0.009	0.026	-0.035	0.123*	1						
Primary responsibility that people are using the correct safety appliances properly	2.73	1.25	0.110*	-0.031	0.032	-0.080	-0.022	0.002	-0.078	1					
Primary responsibility that people are not unnecessarily exposed to hazardous substances	2.53	1.18	0.012	0.046	0.067	-0.002	0.079	-0.012	0.034	-0.068	1				
Primary responsibility that people are using the correct personal protective equipment	2.63	1.21	-0.040	0.038	-0.041	0.054	0.067	0.011	0.000	0.004	-0.049	1			
Primary responsibility that the working area is kept clean, clear and tidy	2.50	1.24	-0.051	0.029	0.080	0.017	-0.157**	0.067	0.092	-0.002	-0.119*	0.014	1		
Primary responsibility that everyone knows what to do in an emergency	2.71	1.21	0.125*	0.012	0.046	0.132*	-0.051	-0.011	0.001	0.035	-0.088	-0.015	-0.028	1	
Primary responsibility that action is taken following accidents and near misses	2.52	1.19	-0.051	0.028	0.024	0.060	-0.052	-0.005	0.109*	-0.015	0.002	-0.064	0.158**	0.006	1

** Correlation is significant at the 0.01 level.

* Correlation is significant at the 0.05 level.

Table 7. Observation checklist on health.

Parameter	Mean	S.D
Sanitation	1.693	0.462
Eating and drinking facilities	1.653	0.477
First-Aid	1.681	0.467
Emergency Response	1.761	0.427

[1] = Acceptable [2] = Not acceptable.

sanitation, eating and drinking facilities, first-aid, and emergency response did not meet acceptable standards with a mean response between 1.65-1.76. ASGM is noted for poor working conditions such as the non-existence of first aid, poor sanitation, eating and drinking facilities among others. Moreover,

all safety-related measures did not meet acceptable standards as revealed in [Table 8](#). For instance, safety devices, facilities, zones, precautions, standards, and training produced a mean response between 1.67-1.71. This implies that there are no safety emergency preparedness procedures in the study area. Similarly, [Table 9](#) shows the exposure of respondents to unacceptable levels of heat, noise, and dust with a mean response between 1.64-1.74. [Table 9](#) further reveals the use of firefighting equipment that is not acceptable. This produced a mean response of 1.66. However, the attitude of respondents was fairly acceptable with a mean response of 1.45. This may be attributed to the rudimentary means of working in the ASGM. In terms of hazard identification, [Table 10](#) shows that hazards such as falling object, fire and explosives, vibrations, and dust are easy to identify. This produced a mean response between 1.50-1.68. However, chemical hazards (1.46) and disease (1.45) were not easy to identify ([Table 10](#)).

Table 8. Observation checklist on safety.

Parameter	Mean	S.D
Safety Device	1.705	0.457
Safety Facilities	1.673	0.469
Safety Zones	1.673	0.469
Safety Precautions	1.709	0.455
Safety Standards	1.700	0.459
Safety Training	1.657	0.476

[1] = Acceptable [2] = Not acceptable.

Table 9. Observation checklist on prevention and control.

Parameter	Mean	S.D
Heat level	1.653	0.477
Noise Level	1.741	0.439
Dust level	1.641	0.481
Worker's attitude	1.454	0.499
Fire fighting	1.665	0.473

[1] = Acceptable [2] = Not acceptable.

Table 10. Observation checklist on the identification of hazards.

Parameter	Mean	S.D
Falling objects	1.683	0.494
Fire and explosives	1.509	0.501
Vibration	1.554	0.498
Chemicals	1.458	0.499
Noise	1.472	0.500
Dust	1.504	0.493
Diseases	1.450	0.499

[1] = Easy [2] = Not easy.

Table 11. Observation checklist on Personal Protective Equipment.

Parameter	Mean	S.D
Head Protection	1.717	0.451
Eye/Face Protection	1.546	0.499
Hearing Protection	1.586	0.494
Respiratory Protection	1.598	0.491
Hand Protection	1.546	0.499
Body Protection	1.546	0.499
Ergonomics	1.510	0.501

[1] = Adequate [2] = Not adequate.

For PPEs, all protections on the body parts such as the head, eye/face, ears, nose, hand as well as protection against ergonomic hazards were not adequate. This produced a mean response between 1.51–1.72 (Table 11). This may be attributed to the low usage of PPEs in ASGM.

4. Discussion

4.1. Demographic features of respondents

The results of the study reveal majority of the respondents are of the productive age (i.e. the ages between 26–35years) and are males. This is in line with the findings of (Danso, 2015) cited in (Bentil 2018) that the mean age of mining employees in the Ghanaian mining industries lies between the ages of 20–30 years (Mensah et al., 2022). noted that ASGM is mostly youth-dominated. The tedious nature of ASGM requires intense

energy to run. Most people who engage in ASGM are usually strong and energetic and are in their productive years (Hilson and Mcquilken 2014; Steckling et al., 2017). noted the significance of ASGM in emergent economies, especially in developing countries where good sustainable jobs are inadequate, the youth end up finding themselves in the ASGM. As a result, ASGM employs more males compared to females. This may be due to the energy requirement of ASGM. There the ASGM has a large gender disparity. Where females remain temporary workers for less-energetic tasks such as washing, loading, and carrying ore (Bansah et al. 2016).

Moreover, the results revealed that almost half of the respondents were uneducated at the selected mining sites. This agrees with the findings of (Mensah et al., 2022) where about 36% of the respondents had no education. People who mostly engage in ASGM are those who do not go to school or school dropouts. According to (DELVE 2020), ASGM is often spearheaded by people with low output and capital investment. ASGM in general requires less special skills and most of the people involved are those from primitive areas (Arthur et al., 2016).

However, this contradicts the findings of (Arthur-Holmes et al., 2022) that most graduates from the university joined ASGM as a result of ASGM serving as primary livelihood, lack of employment, opportunity to start business and income diversification. Comparing the ASGM to industrial large-scale mining (ILM) (Appah et al., 2021), found that ASGM in Ghana encompasses more usually indigenous people. Industrial large-scale miners are found to be more educated (Appah et al., 2021). It is common knowledge that will employ highly skilled, qualified employees and technocrats to ensure efficiency and maximize output.

Although majority of the respondents had less than 5 years of job experience, however about 36% and 19% of the respondents had between 4–10 years and 11–15 years of experience respectively. This implies that most of the respondents had quality experience to provide valid information for the study. Majority of the respondents were found in the crushing and washing department. This may result from the assignment of less energetic roles to the females and newly recruited miners who are inexperienced.

4.2. Causes and frequency of accidents in the ASGM

The study identified negligence as the main cause of accidents at the selected mining sites. However, incompetence and poor facilities were also noted to be some of the major causes of accidents. This is consistent with the findings of (Betts 2008) that most accidents are caused by different types of negligence, such as negligent use of machinery or tools, failure to wear protective clothes, taking risks, disregard for surrounding colleagues, lack of focus, or failure to employ safety devices. In trying to establish the predisposing factors of occupational injuries and accidents among a section of small-scale miners in the Democratic Republic of Congo, the study of (Elenge et al. 2013) revealed a shocking statistic of 51.1% (wrong used/serviced mine equipment/tools), 32.9% (heavy manual work), and finally 15.5% (trips and falls). The findings of (Marriott 2008) from two South Africa; Kwa Zulu small-scale mine sites revealed improper use of mining equipment, the collapse of mine structure/tunnel, lack of safety facilities, gas/dust explosion coupled with objects such as rockfall from above being the leading factors responsible for a high rate of accidents and injuries among South Africa Miners. Accidents occur when extraneous irregularities, breakdowns, or poorly functioning interplay within and between system parts are not properly controlled by the control system, that is, when safety-related restrictions on the progress, layout, and functioning of the system are not treated effectively or enforced.

Concerning the influence of the socio-demographic features on the occurrence of accidents, age was found not to have an influence on the occurrence of accidents as both the young and the old were vulnerable to accidents. However, the findings of (Mensah et al., 2022) revealed that age had an inverse relationship with the uptake of OSH practices. Thus, an increase in age reduced the uptake of OSH practices among miners.

This was noted to be a result of the older miners who found it difficult to assimilate the modern OSH uptakes whereas the younger ones remained smart and energetic with robust assimilative capacity. This may result in the vulnerability of the older respondents to the occurrence of an accident.

Gender was found to influence the occurrence of accidents. Male miners were found to be vulnerable to the occurrence of accidents. This is parallel to the findings of (Mensah et al., 2022) that males tend to possess more control over the job and will not put much consideration into health and safety practices. As a result, the chances of a male involving in an accident are very high.

Moreover, most of the respondents who had little or no education were more vulnerable to accidents. This may be attributed to the negligence of the illiterates in failing to follow instructions due to the inability to read. Also, incompetence on the side of newly recruited miners may be a cause. This agrees with the findings of (Mensah et al., 2022) that an increase in the level of education will lead to an increase in the OSH uptake among respondents.

The study reveals that respondents with less work experience were more vulnerable to accidents and vice versa. This shows an inverse relationship between the level of work experience and the occurrence of accidents. Miners with more job experience might have gathered safety measures to avoid accidents as they continue to work in the ASGM. As a result, they become less susceptible to accidents compared to the newly recruited people who have less experience on the job.

Respondents in the crushing and washing departments recorded more accidents. This was followed by the removal of ore from pit and excavation and blasting operation. This may be attributed to the newly recruited miners who are incompetent and assigned to roles such as crushing and washing departments. Miners in the ASGM are known for the use of rudimentary tools in their operational activities. These rudimentary tools used especially in crushing are dangerous and likely to cause more accidents, especially with the slightest negligence and incompetence. Also, incompetent miners and females who are assigned to the washing department sometimes end up drowning. The removal of ore from pit was the next highest department recording accidents. This may be due to the collapse of mine pits on miners mostly occurring in ASGM, especially in Ghana.

For the most affected body parts, the upper limb was identified as the most affected part of their body. This was followed by the lower limb and chest respectively. This is in line with the findings of (Salman et al. 2015) that among ASGM in Latin America particularly in San Simon mining Province in Bolivia injuries to the back, neck, and fractures with upper limb were noted as the severely affected body parts among miners. A study by the (Human Right Watch, 2011) reveals that the continuous use of sledgehammers for striking rocks exposes miners to chest, back, and arms pains and in an extreme event, death. Furthermore, trend analysis in the Upper East region of Ghana on records on injuries observed the Lower limbs (feet & legs) as the commonest injuries (Long et al. 2015). Also, the evaluation of injuries within mining areas in Tarkwa, a renowned and predominant mining town in Ghana revealed a major injury to be cut (56.9%) before lower limbs, that is feet (knee and legs) (Calys-tagoe et al., 2015).

The Labour Act of 2003 (Act 651) guides both firms and laborers regarding tasks and obligations particularly, in the handling of OSH coupled with the environment in Ghana. Regardless, the Labour Act of 2003 (Act 651) failed to point out specifics, therefore some aspects of the Act remain tainted/unclear. For example, ailments/diseases gotten as a result of work are not well interpreted, therefore, leaving works in a very confusing position. Also, Act 651 fails to clarify an exact regulatory body in charge of compliance-monitoring and enforcement of OSH standards (Gyekye 2007). Comparing this findings to the ILM (Appah et al., 2021), noted that most of these mining regulations are more focused on ILM neglecting the ASGM. This as noted by (Appah et al., 2021) may be largely due to the more organized and formal nature of ILM companies and their

resources and capacity to adhere and implement to safety policies and standards.

However, over 80 respondents noted that they do not report their accidents to management. Ivancevich (2015) found that the seeming apathy in accident reporting is due partly to the low emphasis given to OSH by most African firms. This is due to officials' readiness to overlook poor health and safety standards sake of commercial or political interests. Bentil (2018) also observed that significantly, ignorance is likely to be the cause of African nations' disregard for OSH practices and investment.

4.3. PPE usage and OSH compliance

The majority of the respondents at the selected mining sites do not use PPEs because they are less important. However, the rest of the respondents who use PPEs indicated boots as the most used PPE. Studies undertaken at various locations in Ghana, revealed the majority of ASGM miners have never worn any form of PPE (Chimamise et al., 2013). PPEs such as gloves, helmets, work boots, machine guarding shields, etc. are less common choices for reducing injuries/accidents are disregarded and essentially missing among ASGM miners (Stephens 2016; Chimamise et al., 2013; Jennings 1999; Debrah et al. 2014). In Ghana's Upper East Region, a study among 120 miners revealed that 5.8% do use PPE, 70% have never used it, while the rest claimed they do it "sometimes" (Paruchuri et al., 2010). This is consistent with the findings of this study. Finding in the Central African Republic and Cameroon almost revealed the same (Schure and Ingram 2009). This raises the reservation of why the ASGM sector rejects even the simplest and most common technique for injury/accident avoidance.

Appah et al. (2021) found that, due to the well organised and structured management system of LIM who have their set safety targets and goals in tandem with international and national standards. The ILM often strive to maintain better environment, safety and health of their workers. However, the ASGM is characterized by a non-functioning management system where most workers are at their own management though some have structured system but do not care about safety and health conditions of their workers. This was confirmed by the findings of (Veiga and Omatayo, 2020; Morante-Carballo et al., 2022) that as a reason of the booming nature of the ASGM, majority of workers do not care about their safety and health conditions. Moreover (Armah et al., 2016; Pejtersen and Kristensen 2009), found that the ability of mining workers to self-protect and observe work-related health issues is mostly dependent on where they work. For instance, the ASGM sector in Ghana, lacks professionals who have adequate technical expertise to implement adequate safety protocols and design proper mining techniques. This has resulted in series of safety, health and environmental mishap.

4.4. The influence of health and safety practices on the level of knowledge on OSH policies in ASGM

The study shows that most of the respondents do not have in-depth knowledge about the health and safety practices in ASGM. However, the study further observed that an increase in health and safety practices such as safety training, committee, education, facilities, etc. will increase the level of knowledge of respondents on health and safety policies. This falls in line with the findings of (Levin 2004; Bansah et al., 2017; Wilson et al., 2015) where in countries of low- and middle-income status like Ghana, the high rate of accidents and injuries among miners in the ASGM has been attributed to a paucity of OSH policies, education, working infrastructure and equipment, law enforcement, training. It is noted that Ghana just like major African countries is grappling in the area of OSH practices as governments and corporations have made insignificant efforts. More essentially, in the case of Ghana, there is little or no comprehensive OSH policy. This has led to the enactment of several fragmented OSH laws. For instance The labor Act, 2003 and the Factories Offices and Shops Act, 1970 etc. Significantly, developing countries can benefit from using local expertise in training, designing, and executing safety policies.

4.5. Health and safety practices and primary responsibilities of workers toward OSH policies in ASGM

The study observed that the more health and safety practices, the higher the primary responsibility of site managers to ensure that workers are properly supervised, and trained for safety, machinery and equipment are inspected, using the correct safety appliance amongst others. This is in line with the findings of (Pratt and Bennett 2009), that there is a responsibility of firms to interact with employee representatives to make provisions for encouraging health and safety practices. Also, the findings of the study agree with that of (Lockyer et al. 2008) that to ensure successful health and safety, the adoption of positive safety policy objectives inside an organization must be followed by a clear allocation of responsibilities within the management structure. This backs up (Ivancevich 2015) assertion that the performance of health and safety policy is mostly determined by how well employees and managers follow safety policies. Corporation's safety policy is a document that often outlines the structures, procedures, and processes that make up a safe working environment. Significantly, safety policy is to outline that solely, safety and health are key duties of management; to state that it incumbent upon management to do anything as reasonable and practicable to eliminate injuries in the manufacturing, styling, building, and establishment of all facility, machinery, and equipment; and to state that every employee makes it a duty to act prudently and do all they can to avoid injuries. According to (Pratt and Bennett 2009), all companies are obligated to create and publish written statements of general policy for employee health and safety, as well as the arrangements for carrying out the policy. There will also be provisions for policies to be changed and conveyed to employees regularly. A written policy statement should incorporate some specific topics, such as a written statement of the overall policy surrounding employee health and safety (Torrington and Hall 2010). The policy statement should specifically include the organization in terms of the policy's implementation systems. It should list all statutory duty bearers, including directors and managers. The general policy statement, as well as any revisions to it, must be made known to all employees, for example, through communication, the distribution of a paper, and the display of posters throughout the workplace. The policy document should clarify the employees' responsibilities and include training courses, briefing meetings, and a thorough induction method for new employees.

4.6. Assessment of acceptable working conditions of respondents through checklist observation

The results showed that the observation checklist on health issues such as sanitation, first aid, emergency response, eating and drinking facilities did not meet acceptable limits. Also, safety-related measures such as safety facilities, devices, zones, precautions, standards, and training did not meet acceptable standards in the ASGM. Moreover, safety prevention and control measures such as heat, noise, and dust were at unacceptable levels in the studied area. Firefighting equipment was observed to be below acceptable standards. Furthermore, hazards such as falling objects, fire, explosions, vibrations, and dust were easy to identify. However, chemical hazards and diseases were not easy to identify. All protections on the body parts such as the head, eye/face, ears, nose, hand as well as protection against ergonomic hazards were not adequate. Occupational safety implies the natural exploration and analysis of work environment circumstances, equipment, and working practices to establish the vulnerabilities and prospects for causing accidents, and also the development of mitigation actions to correct the condition, such as worker reskilling and training, task revamping to reduce unsafe conditions, and routine monitoring (Milkovich and Boudreau 2011). However, the general working conditions of respondents did not meet acceptable standards as revealed by the observation checklist. This may be the cause of the increase in the occurrence of accidents in ASGM. Largely, developed countries have a superior occupational and health system, and the

distinction is mostly because of more health and safety policies, increased medical and first-aid infrastructures in these countries, coupled with proactive employee involvement in decisions bothering safety and health. Generally, OSH Act provisions span General Safety Regulations, 1986, Environmental Regulations for Workplaces, 1987, General Machinery Regulations, 1988, Diving Regulations, 2009, Noise-Induced Hearing Loss Regulations, 2003, Construction Regulation, 2003, Driven Machinery Regulations, 1988, Pressure Equipment Regulations, 2004 and Certificate of Competency Regulations (1990) are just a few of the OSH Act's provisions. Sadly, all these health and safety standards are not met in the ASGM operational activities in Ghana.

5. Conclusion

The study assessed the occupational health and safety knowledge and practices in ASGM in Ghana. The results show that socio-demographic features were found to have an influence on the occurrence of accidents. Majority of the respondents do not use PPEs and fail to report accidents. However, the study further observed that an increase in health and safety practices such as safety training, committee, education, facilities, etc. will increase the level of knowledge of respondents on health and safety policies. However, the general working conditions of respondents did not meet acceptable standards as revealed by the observation checklist. The study, therefore, recommends a written policy statement that incorporates some specific topics, such as a written statement of the overall policy surrounding employee health and safety. Mining firm's safety policy document must outline the structures, procedures, and processes that make up a safe working environment. Also, the policy document should clarify the employees' responsibilities and include training courses, briefing meetings, and a thorough induction method for new employees. Prime Stakeholders in the ASGM need to consider investing in future research on ASGM safety issues to acquire an accurate database on ASGM operations safety. Finally, a more inclusive and comprehensive formalization of the ASGM must be considered as a top priority. This will help to regulate and enable smooth implementation of safety and health regulations as well as support proper monitoring of ASGM activities. Also, incentives to reward ASGM operators who adhere to safety and health regulations in the ASGM of Ghana. Due to time constraints the study could not assess inequalities prevail in the ASGM. Therefore, further studies can consider focusing on investigating subsector-based inequalities in safety, health and environmental conditions of ASGM in Ghana. Again, the assessment of incentives and management commitments that promote the performance of ASGM operators in adhering to safety, health and environmental conditions will be interesting for further studies.

Declarations

Author contribution statement

Ebenezer Kwadwo Siabi: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

Peter Donkor: Performed the experiments; Contributed to reagents, materials, analysis tools or data; Wrote the paper.

Samuel Kofi Mensah; Sarah Elikplim Siabi: Analyzed and interpreted the data.

Richmond Kotei Dzane: Conceived and designed the experiments; Performed the experiments.

Napoleon Kurantin; Kwasi Frimpong; Eddie van Etten: Contributed to reagents, materials, analysis tools or data.

Christopher Vuu: Performed the experiments.

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