

ASSESSMENT OF SAFETY PRACTICES AMONG MINERS IN KWARA STATE

By

Abdulrasaq, Q. O.,¹ Jaiyeola, J. O.,¹ Yakubu, S.,²

Department of Health Promotion and Environmental Health Education, Faculty of Education,
University of Ilorin¹

Department of Community Health, Adamawa State College of Health Science and Technology,
Michika²

abdulrasaq.qo@unilorin.edu.ng +2347034541382

Abstract

Mining is a critical economic activity with significant contributions to employment and development; however, it remains one of the most hazardous industrial sector globally. This study assessed the safety practices among miners in Kwara State, Nigeria. The specific objectives were to determine if (i) use of Personal Protective Equipment (PPE), (ii) co-worker safety practices, and (iii) safety signage and posters are employed as safety practices among miners in Kwara State. A descriptive survey design was adopted for the study. The population consisted of all registered miners across the thirteen active mining sites in Kwara State. A multistage sampling technique was used to select 381 respondents that served as the study participants, and a researcher-designed questionnaire served as the data collection instrument. The questionnaire was validated by experts, and reliability was established using the split-half method with a coefficient of 0.81. Data was analyzed using frequency counts, percentages, and chi-square statistical analysis at a 0.05 significance level. Findings revealed that: the use of Personal Protective Equipment is safety practice with cal. val. 675.440 > 16.92 @df of 9; practice of co-worker safety is safety practice with cal. val 387.797 > 16.92 @df 9; use of safety signage and posters is a safety practice with cal. val. 523.934 > 16.92 @df of 9. The study concluded that the use of PPE, co-worker safety, and safety signage are significant safety practice among miners. It was recommended that subsidized Personal Protective Equipment (PPE) and safety training programs for small-scale miners to reduce illegal and unsafe practices should be provided. Promote team-based safety programs where miners hold each other accountable, supported by incentives for safe behavior.

Keywords: Safety, Safety Practices, Miners, Personal Protective Equipments

Introduction

Nigeria is recognized as one of the countries that is blessed with rich solid minerals on the continent. It constitutes some of the major recognized deposits of diverse groups made up of valuable metals, stones and industrial minerals like coal, tin, gold, marble, limestone and others (Emetumah & Okoye, 2018). The core of these mineral deposits distributed across the country remains a major desirability for informal and conventional mining activities even though they are yet to be completely exploited on a large scale. Earth scientists have long noted the vast presence of over 40 to 50 different kinds of untouched sub-terrain assets hidden and un-prospected beneath Nigerian soil (Ali et al, 2018).

Mining is the extraction of minerals and supplementary geological resources of economic value from deposits of the earth. It is typically a destructive industry, as the effects of a solitary mining operation can have a severe effect on the environment, even though there are some protocols in place that are envisioned to minimize the damage (Pegasus, 2017). Mining activities involve scraping away earth and rocks surfaces to get to the deposits buried under or near the surface. In many cases, mountains are literally blasted apart to reach mineral sources within. This activity tends to leave permanent scars on the landscape, thus giving rise to adverse environmental issues (Dontalaa, et al., 2015).

A mine disaster is "A fatal mining disaster involving five or more casualties" (Ismail, *et al*, 2024). In the aspect of inadequacies or gaps in an organization's safety system, most accidents involve multifaceted dynamic interactions between individuals, task requirements, environmental occurrences, social and organizational variables (Nie, et al, 2019). Additionally, failing to learn all the lessons from an event leads to the incidence or recurrence of accidents. Weak safety culture was documented as a significant factor in most major mining accidents (Zhang, et al, 2019; Jiang, *et al*, 2020). Recently, Niger State recorded a mining disaster whereby fifty (50) miners were trapped in a collapsed mining pit in Galadima Kogo, in Shiroro Local Government Area of the State. This resulted in another collapse during the rescue mission whereby the process of rescue was delayed a bit before the rescue team could continue (Otuchikere, 2024). Some registered mines operate without following the state mining regulations, while most mining sites are run illegally without following any safety procedures.

Despite all the efforts to lessen the perils, mines remain the foremost hazardous workplace, due to the number of people who are unprotected to the threats inherent in this setting (Naeninip& Badri, 2023). Mining is a high-risk sector demanding effective control procedures to shield workers' health (International Labour Organisation, 2015; Bonsu, et al, 2017). Occupational Health and Safety (OHS) aim to prevent, manage, and control occupational hazards (International Labour Organisation, 2022). The pyramid of control measures, from the most to the least effective, includes elimination, substitution, engineering, administrative, and Personal Protective Equipment. Elimination and substitution are more feasible at the design and development stages and more challenging for existing operations (The National Institute for Occupational Safety and Health, 2015). Engineering control measures are premeditated to address hazards at the cause and are effective and less autonomous of human behaviour, despite the cost. Personal Protective Equipment is less effective, owing to dependence on human effort (Felix, et al, 2020).

A safety management system consists of comprehensive sets of policies, procedures and practices designed to ensure that barriers to unwanted incidents are in place, in use and are effective. An integrated safety management system focuses on both the traditional Occupational Health and Safety area and on management of engineering safety. The safety management system tends to integrate all aspects of safety into the ongoing activities of everyone involved in the operations from the operator to the chief executive officer. The responsibility for safety is both individual and collective (Daenen, et al, 2019). Understanding the safety practice in mining site is essential as it will help miners navigate through the possible dangers that are inherent in the site from the following cause and not limited to them only; blasting, slope failure, power/ electricity, parting collapse, fire, ore handling plant, explosion, strata / support failure, presence of gases, machineries, acid mine drainage, toxicity of gases, water contamination among others. Workplace risk factors are workplace situations that can cause accidents, e.g., incompetence,

inappropriate equipment, unsafe work practices, hazardous work environments, and noise levels that lead to accidents (Reason, 2016; Bonsu, *et al*, 2017).

The urge to maximize exploration costs to boost mine owners' profits is a common cause of mining accidents. However, despite thinking about profit, there is one thing that mine owners or operators ought to focus on as the main asset to the company (Ismail, *et al*, 2024). Mine owners ought to provide all safety resources such as proper Personal Protective Equipment (PPE), a safe working environment and organise safety programmes and training for their workers. Moreover, the workers should have awareness and commitment to assist the company by abiding by all the rules and regulations while performing the job. Therefore, mutual understanding and commitment from top management and workers are important to create a positive safety culture (Ismail, *et al*, 2024).

Worker participation in identification, assessment and control of workplace hazards is fundamental to reducing work-related injury and disease. Workers have the most direct interest in occupational health and safety of any party: it is their lives and limbs that are at risk when things go wrong. Moreover, workers often know more about the hazards associated with their workplace than anyone else, for the obvious reason that they must live with them, day by day (Singo, *et al*, 2023). The matter of consciousness manifests in safety when it is comprehended that being aware and adequately knowledgeable on the nature of recognized hazards and calculated risks does not guarantee that all measures and directives provided will be adhered to. However, Zhang, *et al*, (2020) affirmed that there is a positive relationship between safety investment and safety performance. This is because the more investment in safety management like safety posters and signages, the better the performance of the safety management system.

Safety training and competency courses reflect the commitment of mine owners or operators towards their workers. To create a positive safety culture, safety training is important to increase knowledge, worker productivity and developing competency among workers. The workers become aware of safety and will follow all the rules and regulations, or standard operating procedures as guided by their employer (Nikulin&Nikulina, 2017). Also, safety records are important because it is a compilation of all safety planning, safety programmes, safety activities, and safety reports which is useful for future reference. According to Dechy, (2012), effective safety documentation and record-keeping are essential for future reference. They streamline the audit process by ensuring that all safety-related activities are properly recorded and easily accessible.

Statement of the Problem

Beyond immediate accidents, mining activities have long-term health consequences, including respiratory diseases such as chronic bronchitis, emphysema, and other obstructive pulmonary conditions (Mabila *et al*, 2018). Key barriers to hazard mitigation include ignorance, financial constraints, inadequate regulation, informal mining practices, and insufficient health and safety management. Additionally, inconsistent use of Personal Protective Equipment (PPE), poor adherence to co-worker safety practices, and disregard for safety signage, often due to accessibility issues, discomfort, or weak enforcement further exacerbate risks (Sapbamrer & Thammachai, 2020; Ismail *et al*, 2021). Systemic challenges such as non-compliance with regulations, lack of training, and underfunding also impede effective safety implementation

(Abubakar, 2015; Umeokafor, 2017). This study seeks to fill critical gaps by evaluating: the extent of PPE usage, co-worker safety practices, and safety signage adherence among miners. By identifying these challenges, this research aims to provide actionable recommendations to enhance safety protocols, reduce accidents, and safeguard miners' health in Kwara State's mining sector. Therefore, the need for this study, assessment of safety practices and barriers to compliance among miners in Kwara State.

Purpose of the Study

This study examined the assessment of safety practice among miners in Kwara State. The specific purpose of the study was to;

1. examine if use of Personal Protective Equipment is a safety practice among miners in Kwara State.
2. assess if practice of co-worker safety is a safety practice among miners in Kwara State.
3. determine if use of safety signage and posters is a safety practice among miners in Kwara State.

Research Questions

The following research questions were developed to guide the study;

1. is usage of Personal Protective Equipment a safety practice among miners in Kwara State.
2. is the co-worker safety practiced by miners in Kwara State.
3. is the use of safety signage and posters a safety practice among miners in Kwara State.

Research Hypotheses

1. The use of Personal Protective Equipment is not a significant safety practice among miners in Kwara State.
2. Practice of co-worker safety is not a significant safety practice among miners in Kwara State.
3. Use of safety signage and posters is not a significant safety practice among miners in Kwara State.

Methodology

Descriptive survey research design was adopted for this study. The population for this study comprised all miners in Kwara State, Nigeria with three thousand (3000) registered miners in total (Federal Ministry of Mines and Steel Development, Kwara State, 2024). Kwara State has fifty-seven registered mining sites, but only thirteen of the registered mining sites are in operation at the time of data collection at the Federal Ministry of Mines and Steel Development, Kwara State (2024). Therefore, the targeted population for this research were miners in the thirteen mining sites in Kwara State.

A total sample of three hundred and forty- six (346) respondents was selected for this study. This agrees with Krejcie and Morgan (1970) sample size determination which indicated

that, for a population of three thousand, five- hundred (3500), three hundred and forty- six (346) sample size is enough at 95% confidence level. With the addition of a 10% attrition rate of 35, the sample for the study were three hundred and eighty-one (381). Multi-stage sampling techniques consisting of purposive, proportionate and accidental sampling techniques were used for selecting the sample for the study.

Stage 1: Purposive sampling technique was used to select only six (6) mining sites out of all the thirteen operational registered mining sites by the researcher in Kwara State as a whole. The selected six mining sites were recommended at the point of data collection with reasons surrounding location, researcher safety and acceptance of research activities in the mining site.

Stage 2: Proportionate sampling technique was then used to select 32.2% of miners per mining site.

Sample Size= 381

Targeted Population= 1182

$$\% \text{ proportion} = \frac{\text{sample size}}{\text{sample population}} \times 100$$

$$\% = \frac{381}{1182} \times 100$$

$$\% = 0.322 \times 100$$

$$\text{proportion} = 32.2\%$$

Stage 3: Accidental sampling technique was used to select respondents from each mining site.

Table 1: Sample Size Determination

s/n	Name of Mining Site	Target Population	Selected Sample
1.	Kam Industries	17	6
2.	De Hong Construction	30	10
3.	Kursi Investment	1,060	341
4.	CGC Nigeria Limited	23	7
5.	W. Mining Global Service LTD	30	10
6.	Manhardi	22	7
	Total	1,182	381

Source: Federal Ministry of Mines and Steel Development, Kwara State (2024).

A researcher-developed questionnaire was used for data collection. The questionnaire was titled “Assessment of Safety Practice among Miners in Kwara State”. The questionnaire was validated by three experts in the department of Geology and Mineral Sciences, Health Promotion and Environmental Health Education, University of Ilorin and the Federal Ministry of Mineral and Resources Development, Kwara State. Their comments and suggestions were used to improve the contents of the questionnaire before administration to the respondents. To determine

the reliability of the instrument, the researchers adopted a split-half method of reliability. Twenty copies of the questionnaire were administered in a quarry site in Asa Local Government Area, Kwara State. The instrument was numbered, scored and were correlated using Cronbach Alpha and the scale demonstrated good internal consistency, a result of 0.81 was obtained which was judged to be consistent.

The data collection process was carried out over a period of 11 weeks. The instrument was administered with the help of three (3) trained research assistants. They were taught how to interpret the developed questionnaire and how to assist miners in answering the questionnaire in their native language. Ethical principles guiding the use of human participants in research was upheld throughout the conduct of the research. Participation in the study was made voluntary and informed consent was obtained from each participant.

The data obtained was sorted, coded and subjected to appropriate statistical analysis. Descriptive statistics of frequency and percentages were used to answer the research questions raised for the study. Inferential statistics of Chi-Square were used to analyze the stated null hypotheses at 0.05 level of significance, using Statistical Package for Social Science (SPSS) version 26.0. The results of the analysis were then tabulated and presented. Seventeen (17) questionnaires were not usable for the data analysis because some of them were not completed while others contain multiple answers for a single item, which reduced the sample size to three hundred and sixty-four (364) that's 95.54% of the total sample selected.

Answering Research Question

Research Question One: Will the usage of Personal Protective Equipment be a safety practice among miners in Kwara State.

Table 2: Percentage Analysis of Usage of PPE as a Safety Practice

S/N	ITEM	SA	A	Positive	D	SD	Negative
1.	Personal Protective Equipment helps to shield the body against accidents.	205 (56.3%)	152 (41.8%)	357	5 (1.4%)	2 (0.5%)	7
2.	Personal Protective Equipment helps to reduce the effect of occupational hazards in mining	175 (48.1%)	184 (50.5%)	359	4 (1.1%)	1 (0.3%)	5
3.	Personal Protective Equipment helps in the reduction of risk to injury and illness in the mining	198 (54.4%)	160 (44.0%)	358	4 (1.1%)	2 (0.5%)	6
4.	Non-fits and inadequate Personal Protective Equipment cause more risk of injury and accidents in mining.	157 (43.1%)	199 (54.7%)	356	6 (1.6%)	2 (0.5%)	8
Average				357.5			6.5

Table 2 shows the result of Percentage Analysis for usage of Personal Protective Equipment as a safety practice among miners in Kwara State. It was revealed that the majority of miners have a perception of the usage of Personal Protective Equipment as a safety practice with the average positive response of 357.5. This means that the usage of Personal Protective Equipment is a safety practice among miners in Kwara State.

Research Question Two: Will practice of co-worker safety be a safety practice among miners in Kwara State.

Table 3: Percentage Analysis of Practice of Co-worker Safety as a Safety Practice among Miners

S/N	ITEM	SA	A	Positive	D	SD	Negative
1.	Usage of safety practices is a form of co-worker safety practices in mining.	171 (47.0%)	187 (51.4%)	358	5 (1.4%)	1 (0.3%)	6
2.	Practice of co-worker safety improves the safety culture in the mining site.	161 (44.2%)	190 (52.2%)	351	6 (1.6%)	7 (1.9%)	13
3.	Practice of co-worker safety helps in the reduction of risks of injury and illness in the mining site.	171 (47.0%)	187 (51.4%)	358	5 (1.4%)	1 (0.3%)	6
4.	Non-compliance with co-worker safety affects the work-rate, work-output in mining and increases the record of mining accidents.	217 (59.6%)	137 (37.6%)	354	8 (2.2%)	2 (0.6%)	10
Average				355.25			8.75

Table 3 revealed the Percentage Analysis of practice of co-worker safety as a safety practice among miners in Kwara State. The table revealed that the practice of co-worker safety is a safety practice among miners with an average positive response of 355.25, while the average negative response is 8.75. This implies that the majority perceived the practice of co-worker safety as safety practice among miners in Kwara State.

Research Question Three: Will use safety signage and posters be a safety practice among miners in Kwara State.

Table 4: Percentage Analysis of Use of Safety Signage and Posters be a Safety Practice

S/N	ITEM	SA	A	Positive	D	SD	Negative
1.	Signages and posters help to create awareness about dangers in the mining site.	151 (41.5%)	202 (55.5%)	353	9 (2.5%)	2 (0.6%)	11
2.	Signages and posters help in the reduction of risks of injury and illness in the mining site.	209 (57.7%)	147 (40.4%)	356	5 (1.4%)	3 (0.8%)	8
3.	Lack of signage and posters will put the organization in danger of lawsuit in case of accidents to miners or visitors.	180 (49.5%)	171 (47.0%)	351	12 (3.3%)	1 (0.3%)	13
4.	Signages and posters help in the navigation and movements of people in mining sites.	187 (51.4%)	171 (47.0%)	358	5 (1.4%)	1 (0.3%)	6
Average				353.5			9.5

Table 4 revealed the Percentage Analysis of the use of safety signage and posters as a safety practice among miners in Kwara State. It was shown that most of the respondents perceived the use of safety signage and posters as a safety practice among miners with the average positive response of 353.5, while the average negative response is 9.5. This implies that the majority perceived the use of safety signage and posters as a safety practice among miners in Kwara State.

HYPOTHESES TESTING

Hypothesis One: Use of Personal Protective Equipment is not a significant safety practice among miners in Kwara State.

Table 5: Chi-Square Analysis of Personal Protective Equipment as Safety Practice

Variable		N	df	Cal. χ^2 value	Crit. χ^2 value	P value	Remark
Personal Equipment Practice	Protective as Safety	364	9	675.440	16.92	0.000	H0 ₁ Rejected

Table 5 revealed the chi-square analysis of Personal Protective Equipment as Safety Practice. It was shown that the calculated χ^2 value of 675.440 was greater than the table value of

16.92 at 0.05 alpha level. This implies that the hypothesis was rejected, therefore, use of Personal Protective Equipment will be a significant safety practice among miners in Kwara State.

Hypothesis Two: Practice of co-worker safety is not a significant safety practice among miners in Kwara State.

Table 6: Chi-Square Analysis of Practice of Co-Worker Safety as Safety Practice

Variable	N	df	Cal. χ^2 value	Crit. χ^2 value	P value	Remark
Practice of Co-Worker Safety as Safety Practice	364	9	387.797	16.92	0.000	H0 ₂ Rejected

Table 6 shows the result of Chi-square analysis of Practice of Co-Worker Safety as Safety Practice. It was revealed that the calculated χ^2 value 387.797 was greater than the table value of 16.92 at 0.05 significant level. This means that the hypothesis was rejected, therefore, Practice of co-worker safety will be a significant safety practice among miners in Kwara State.

Hypothesis Three: Use of safety signage and posters is not a significant safety practice among miners in Kwara State.

Table 7: Chi-Square Analysis of Use of Safety Signage and Posters as a Safety Practice

Variable	N	df	Cal. χ^2 value	Crit. χ^2 value	P value	Remark
Use of Safety Signage and Posters as a Safety Practice.	364	9	523.934	16.92	0.000	H0 ₃ Rejected

0.05

Table 7 revealed the Chi-square analysis of Use of Safety Signage and Posters as a Safety Practice. It was shown by the table that the calculated χ^2 value of 523.934 was greater than the table value of 16.92 at 0.05 level of significance. Therefore, the hypothesis was rejected, which implies that use of safety signage and posters will be a significant safety practice among miners in Kwara State.

Discussion of Findings

As revealed by the result of hypothesis one, the use of Personal Protective Equipment is a significant safety practice among miners in Kwara State. The null hypothesis was rejected based on the chi-square result ($\chi^2 = 675.440$, $p < 0.05$), indicating that the use of PPE is indeed a significant safety practice among miners in Kwara State. This finding aligns with the best international practices and the literature that underscores PPE as one of the most essential frontline measures in occupational safety. Okoffo, Mensah, and Fosu-Mensah (2016) reported that the consistent use of PPE significantly reduces occupational injury rates and fosters a sense of protection and job satisfaction among workers. Similarly, Sawada et al. (2017) emphasized PPE's importance in protecting against chemical, physical, and mechanical hazards in high-risk sectors like mining. However, the study's findings diverge from those of Ismail et al. (2021), who identified non-use of PPE as a major unsafe behavior in underground mines. They linked

this non-compliance to discomfort, lack of training, and poor enforcement of safety protocols. These points are reinforced by Sapbamrer and Thammachai (2020), who argued that mere availability of PPE is insufficient without corresponding worker education and management support. Therefore, while PPE is recognized as a key safety tool, its effectiveness hinges on consistent enforcement, proper training, and addressing comfort-related concerns. This is especially relevant in informal mining setups in Kwara State where enforcement is often lax.

Hypothesis two revealed that practice of co-worker safety is a significant safety practice among miners in Kwara State. The null hypothesis was rejected ($\chi^2 = 387.797$, $p < 0.05$), confirming that co-worker safety is a significant safety practice among miners. This outcome reflects literature's consensus on the influence of peer behavior in shaping safety culture. Felix, Isaac, and Degraft-Arthur (2020) emphasized that a supportive co-worker environment encourages proactive safety behavior and positive reinforcement of safety norms. According to Årstad and Aven (2017), co-worker involvement fosters a communal approach to hazard recognition and mitigation, promoting a collective sense of responsibility. Moreover, Zivkovic and Ivanova (2016) observed that safety programs incorporating co-worker training and peer-led interventions tend to be more sustainable and effective in the long term. This finding is consistent with the theory of social learning, where individuals model the behaviors of those around them. On the other hand, Pater (2015) warned that if the dominant workplace culture undervalues safety, co-worker influence may instead perpetuate negative practices. In mining settings with informal labor or inadequate oversight as seen in parts of Kwara this could be a critical concern. Therefore, training programs must not only promote safety knowledge but also instill shared values and mutual accountability.

As revealed by hypothesis three, use of safety signage and posters is a significant safety practice among miners in Kwara State. This hypothesis was also rejected ($\chi^2 = 523.934$, $p < 0.05$), suggesting that safety signage and posters are a significant aspect of safety practices among miners in Kwara State. This result is supported by literature emphasizing the role of visual communication in hazard recognition and avoidance. Mrugalska et al. (2016) noted that signage effectively reduces human error by serving as constant reminders of best practices, especially in high-risk zones. Similarly, Lages (2012) identified visual cues such as danger signs and machine labels as instrumental in enforcing safety compliance in mining environments. Contrastingly, Virchow (2015) and Papic & Kovacevic (2016) argued that signage alone is insufficient in mitigating risks unless combined with training and enforcement. They observed that when signs are poorly placed, faded, or ignored due to familiarity, their effectiveness is drastically reduced. In the context of Kwara State, this implies that while signage is important, its value lies in continuous maintenance, strategic placement, and regular reinforcement through training and peer communication. Furthermore, posters should be multilingual and pictorial to cater to workers with limited literacy.

Conclusion

Based on the findings of this study, it was concluded that:

1. the use of Personal Protective Equipment is a safety practice among miners in Kwara State. Personal Protective Equipment helps in the reduction of risk to injury and illness in the mining while non-fits and inadequate Personal Protective Equipment cause more risk to injury and accidents in mining.
2. practice of co-worker safety is a safety practice among miners in Kwara State. Practice of co-worker safety helps in the reduction of risks of injury and illness in the mining site and

non-compliance with co-worker safety affects the work-rate, work-output in mining and increases the record of mining accidents.

3. use of safety signage and posters is a safety practice among miners in Kwara State. Signages and posters help in the reduction of risks of injury and illness in the mining site. Lack of signage and posters will put the organization in danger of lawsuit in case of accidents to miners or visitors.

Recommendations

Based on the conclusion of this study, the following recommendations were made:

1. subsidized Personal Protective Equipment (PPE) and safety training programs for small-scale miners to reduce illegal and unsafe practices should be provided.
2. promote team-based safety programs where miners hold each other accountable, supported by incentives for safe behavior.
3. allocate funds for safety signage and engineering control to minimize hazards like dust and chemical exposure.

Reference

- Abubakar, U. (2015). An Overview of the Occupational Safety and Health Systems of Nigeria, UK, USA, Australia, and China: Nigeria Being the Reference Case Study. *American Journal of Educational Research*. 3(11), 1350-1358.
- Ali, A. F., Abdullahi A. S., & Zangina, A. S. (2018). Environmental Issues and the Prospects of Mining in Nigeria. *Dutse Journal of Pure and Applied Sciences (DUJOPAS)*. Vol. 4 No. 2 December 2018 ISSN (Online): 2635-3490.
- Årstad, I., & Aven, T. (2017). Managing major accident risk: concerns about complacency and complexity in practice. *Safety Science*. 91, 114-121.
- Bonsu, J., Van Dyk, W., Franz IDIs, J., Petersen, F., & Isafiade, A. (2017). A systemic study of mining accident causality: An analysis of 91 mining accidents from a platinum mine in South Africa. *Journal of the Southern African Institute of Mining and Metallurgy*. 117(1): 59–66.
- Daenen, K., Andries, A., Mekahli, D., Van Schepdael, A., Jouret, F., & Bammens, B. (2019). Oxidative stress in chronic kidney disease. *pediatric nephrology*34 (6), 975e991.
- Dechy, N. (2012). “Results and lessons learned from the Estrada’s accident investigation working group”. *Journal of Safety Science. Special issues on ‘Industrial Events Investigation* 50, 1380-1391.
- Dontalaa, S. P. Reddyb, T. B., & Vaddec, R. (2015). Environmental Aspects and Impacts its Mitigation Measures of Corporate Coal Mining. Global Challenges, Policy Framework & Sustainable Development for Mining Mineral and Fossil Energy Resources (GCPF2015). *Procedia Earth and Planetary Science* (11) 2 – 7.
- Emetumah, F., & Okoye, A. (2018). Role of Government in Ensuring Safety Consciousness During Mineral Mining Activities in Nigeria. *European Scientific Journal*. 14, (20):1857- 7431.
- Federal Ministry of Mines and Steel Development, Kwara State, (2024). Numbers of Registered mining sites in Kwara State and their yearly return reports on numbers of workers.

- Felix, K. O., Isaac, K., & Degraft-Arthur, D. (2020). Enhancing Workplace Safety Culture in the Mining Industry in Ghana. *Ghana Journal of Development Studies*, 17(2).
- ILO, (2022). “Work hazards kill millions, cost billions,”.
- International Labour Organisation, (2015). Mining: Hazardous Work. Geneva: *International Labour Office*. 2015.
- Ismail, S. N., Ramli, A., & Aziz, H. A. (2021). Research trends in mining accidents study: a systematic literature review. *Safety Science* 143:105438.
- Ismail, S. N., Ramli, A., Aziz, H. A., Saud, A., & Tejamaya, M. (2024). Safety culture and safety education in mining industry: Issues and challenges. *Research Article* 10. (1): 063-072
- Jiang, W., Fu, G., Liang, C., & Han, W. (2020). Study on quantitative measurement results of safety culture. *Safety Science*. 128, 104751.
- Krejcie, R. V., & Morgan, D. W. (1970). Determining Sample Size for Research Activities. *Educational and Psychological Measurement*.
- Lages, J. (2012). Mining safety signs. An overview of the most important mining warning signs. *Minas de Wanda Pirquitas, Argentina*.
- Mabila, S. L., Almberg, K. S., Friedman, L., & Cohen, R. (2018). High exposure mining occupations are associated with obstructive lung disease, National Health Interview Survey (NHIS), 2006-2015. *American Journal of Industrial Medicine*, 61 (9), 715e724.
- Mrugalska, B., Nazir, S., Tytyk, E., & Overgard, K. I. (2016). Human error and response to alarms in process safety. *Journal of the Facultad de Minas, Universidad Nacional de Colombia-Medellin Campus*. 83(197), 81-86.
- Naeinip, S. A., & Badri, A. (2023). Identification and categorization of hazards in the mining industry: A systematic review of the literature. *International Review of Applied Sciences and Engineering*. 15: 1, 1–19.
- Nie, X. X., Bai, C., & Zhang, J. (2019). “Simulation Research on the Effectiveness of a Multiagent Mine Safety Supervision System and Its Verification, *Mathematical Problems in Engineering*. 1-18.
- Nikulin, A., & Nikulina, A. Y. (2017). Assessment of occupational health and safety effectiveness at a mining company. *Ecology, Environment and Conservation*. 23, 351–355.
- Okoffo, E. D., Mensah, M., & Fosu-Mensah, B. Y. (2016). Personal Protective Equipment usage among Ghanaian miners. *Journal of Occupational Safety*, 18(2), 132–139.
- Otuchikere, C. (2024). Buried beyond recovery: Sad story of Niger collapsed mine victims. Punch Nigeria limited. Punchng.com
- Papic, L., & Kovacevic, A. (2016). Safety Communication in Mining Industries. *Journal of Mining Technology*, 23(1), 14–24.
- Pater, R. (2015). Toward global-class safety. *Journal of Professional Safety*. 60(1), 18.

- Pegasus, (2017). Effects of mining on the environment and wildlife.
- Reason, J. (2016). *Managing the Risks of Organisational Accidents*; Routledge: London, UK.
- Sapbamrer, R., & Thammachai, A. (2020). Factors affecting the use of Personal Protective Equipment and pesticide safety practices: a systematic review. *Environment Research*, 185:109444.
- Sawada, S. I., Kuklane, K., Wakatsuki, K., & Morikawa, H. (2017). New development of research on Personal Protective Equipment (PPE) for occupational safety and health. *Industrial Health*, 55: 471-472.
- Singo, J., Isunju, J. B., Moyo, D., Steckling-Muschack, N., Bose O'Reilly, S., & Mamuse, A. (2023). Hazards and Control Measures among Artisanal and Small-Scale Gold Miners in Zimbabwe. *Annals of Global Health*. 88(1): 21, 1–18.
- The National Institute for Occupational Safety and Health (NIOSH), (2015):Hierarchy of Controls. *NIOSH*.
- Umeokafor, N. (2017). Barriers to Construction Health and Safety Self - Regulation: A Scoping Case of Nigeria. *Civil Engineering Dimension*. 19(1), 44 - 53.
- Virchow, R. (2015). Causes of coal mine accidents in the world and Turkey.
- Zhang, J., Fu, J., Hao, H., Fu, G., Nie, F., & Zhang, W. (2020). Root causes of coal mine accidents: characteristics of safety culture deficiencies based on accident statistics. *Process Safety Environment*, 136:78-91.
- Zhang, J., Zhang, W., & Xu, P. (2019). Applicability of accident analysis methods to Chinese construction accidents. *Journal of Safety Research* 68, 187–196
- Zivkovic, S., & Ivanova, T. (2016). Organizational culture as one of the main factors for successful safety management. *Serbian Journal of Management*. 11(1), 69-80.