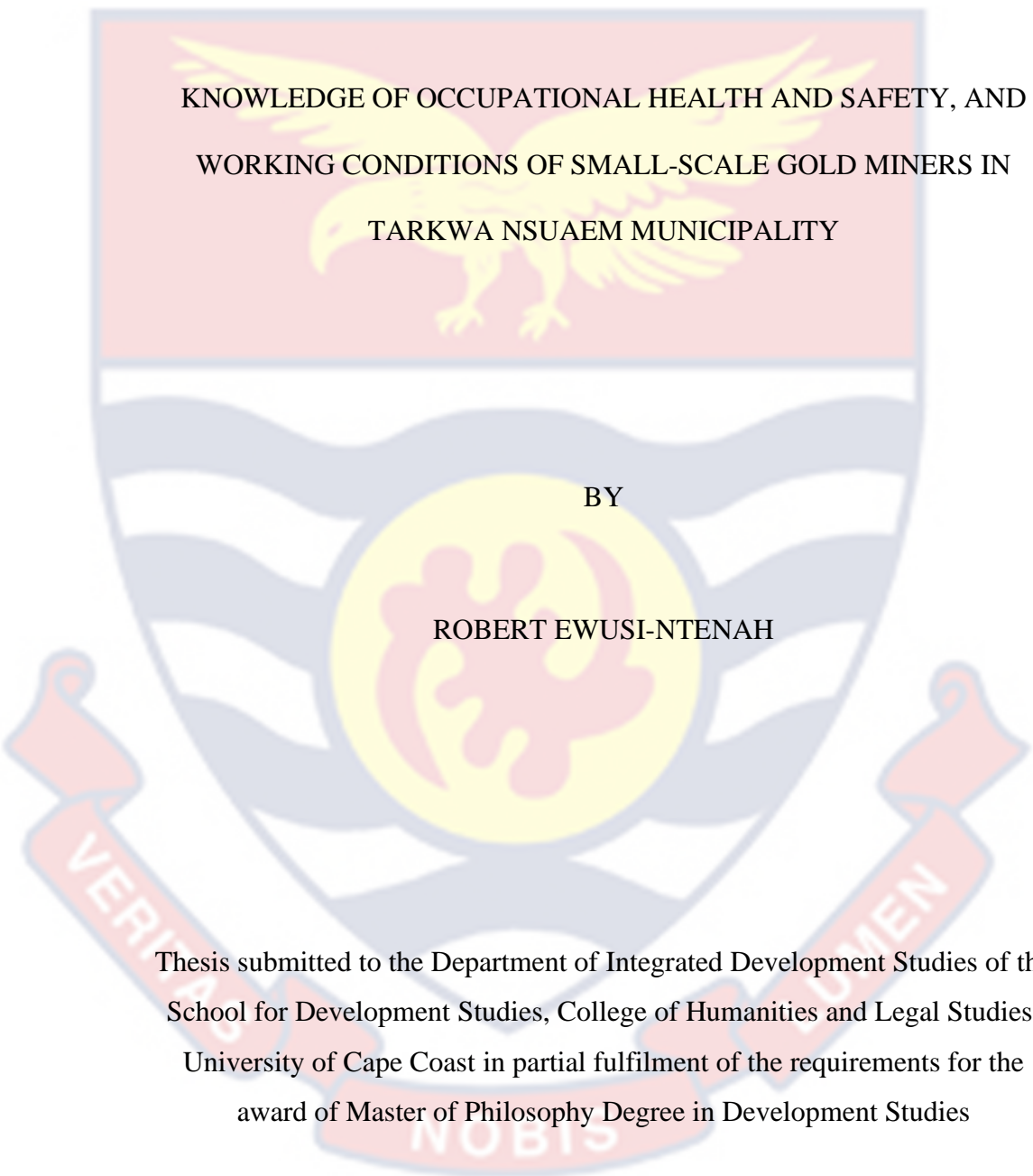


UNIVERSITY OF CAPE COAST



KNOWLEDGE OF OCCUPATIONAL HEALTH AND SAFETY, AND
WORKING CONDITIONS OF SMALL-SCALE GOLD MINERS IN
TARKWA NSUAEM MUNICIPALITY

BY

ROBERT EWUSI-NTENAH

Thesis submitted to the Department of Integrated Development Studies of the
School for Development Studies, College of Humanities and Legal Studies,
University of Cape Coast in partial fulfilment of the requirements for the
award of Master of Philosophy Degree in Development Studies

APRIL 2024

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:Date.....

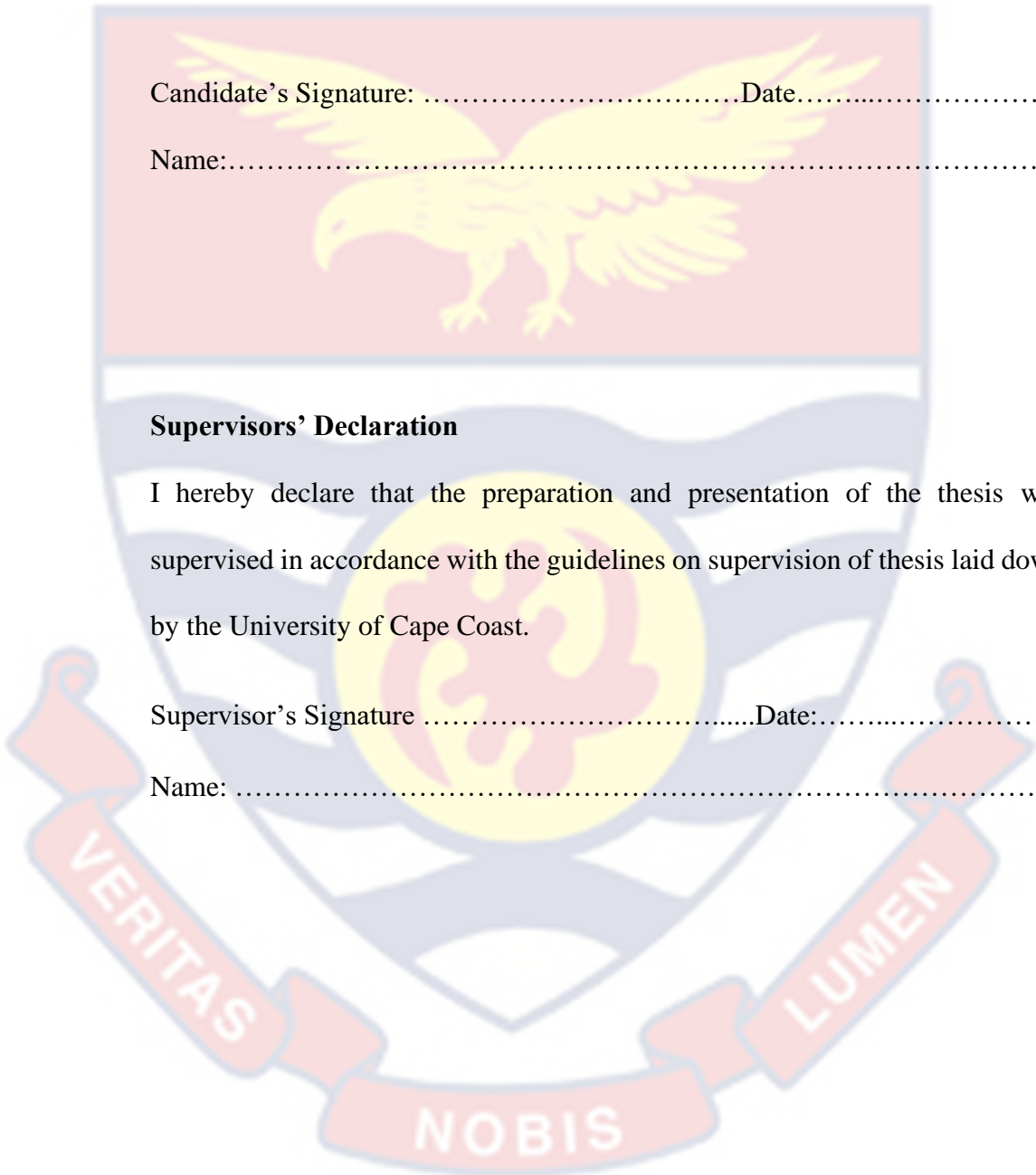
Name:.....

Supervisors' Declaration

I hereby declare that the preparation and presentation of the thesis was supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Supervisor's SignatureDate:.....

Name:



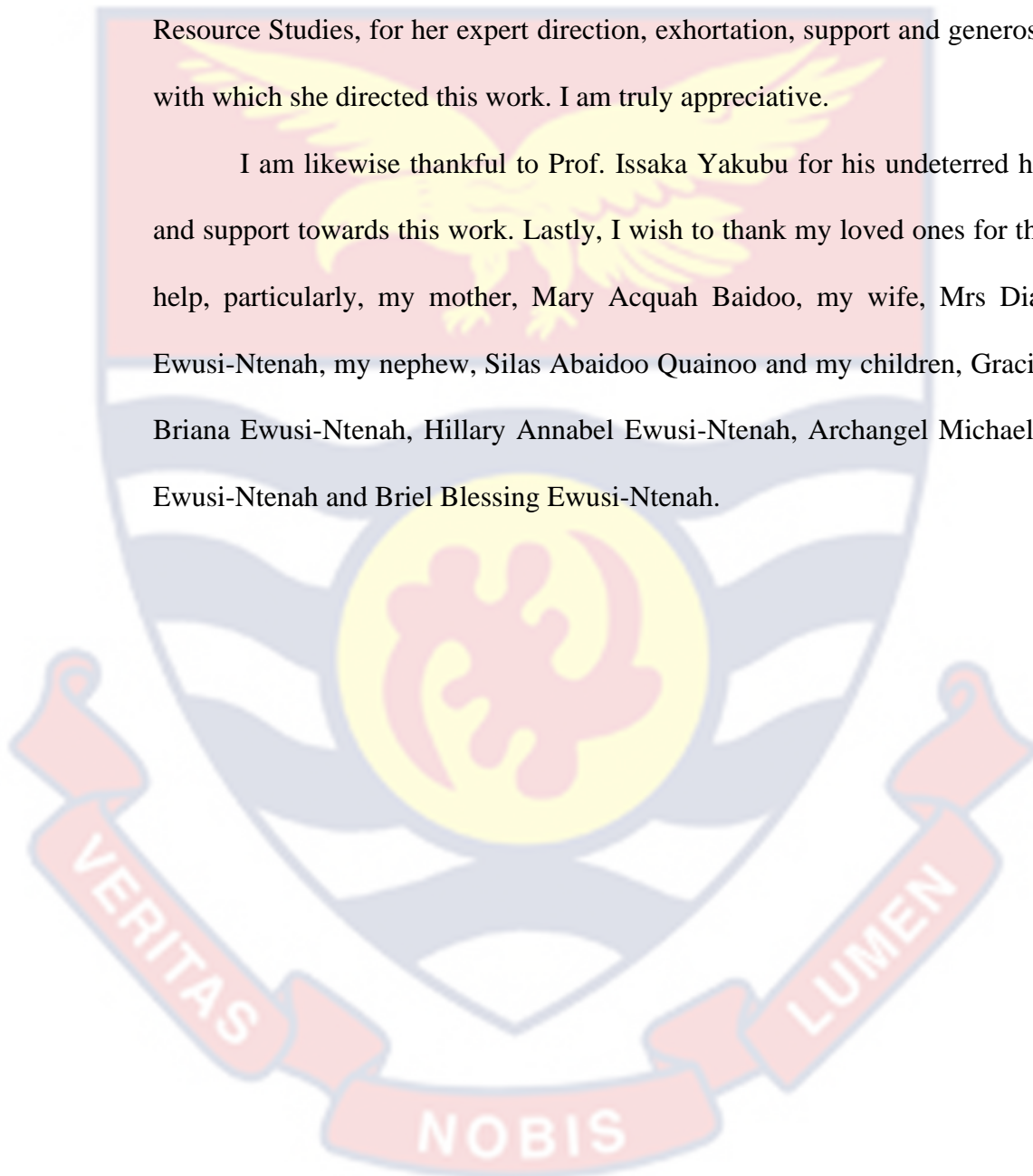
ABSTRACT

The main purpose of the study was to assess the knowledge of occupational health and safety, and working conditions of small-scale gold miners in Tarkwa Nsuaem Municipality. A quantitative research approach was used on a survey of 265 small-scale gold miners across Tarkwa through the usage of proportionate random sampling technique. Interview schedule was used to gather the data which were analysed using descriptive analytical techniques such as frequencies and percentages as well as chi-square statistics. The outcome of the study showed that majority of the miners expressed knowledge of occupational health and safety, while participation in basic occupational health and safety training enabled the miners to know about the occupational health and safety policy at the mining workplace. In terms of working conditions, most of the miners worked for more than eight hours per day, but were not paid for working overtime, while they were exposed to dust, rock falls, and harmful chemicals. The study also found that knowledge of occupational health and safety policies at the workplace was associated with the wearing of protective hand gloves and overall/overcoat for the body as well as ear protector while working. It was concluded that knowledge of occupational health and safety is relevant for promoting healthy and safe small-scale gold mining work. The study recommended further education for the small-scale gold miners to deepen their knowledge of occupational health and safety for the reduction of the occurrence of occupational hazards, diseases and injuries.

ACKNOWLEDGEMENTS

I am exceptionally thankful to the Almighty God for His grace and assistance in making this work a reality. I want to genuinely thank my supervisor, Prof. Angela D. Akorsu of the Department of Labour and Human Resource Studies, for her expert direction, exhortation, support and generosity with which she directed this work. I am truly appreciative.

I am likewise thankful to Prof. Issaka Yakubu for his undeterred help and support towards this work. Lastly, I wish to thank my loved ones for their help, particularly, my mother, Mary Acquah Baidoo, my wife, Mrs Diana Ewusi-Ntenah, my nephew, Silas Abaidoo Quainoo and my children, Graciela Briana Ewusi-Ntenah, Hillary Annabel Ewusi-Ntenah, Archangel Michaelina Ewusi-Ntenah and Briel Blessing Ewusi-Ntenah.



DEDICATION

I dedicate this work to the Ewusi-Ntenah family for their support.



TABLE OF CONTENTS

Content	Page
DECLARATION	ii
ABSTRACT	iii
ACKNOWLEDGEMENTS	iv
DEDICATION	v
TABLE OF CONTENTS	vi
LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF ABBREVIATIONS	xi
CHAPTER ONE: INTRODUCTION	
Background to the Study	2
Statement of the Problem	7
Objectives of the Study	9
Research Questions	9
Significance of the Study	10
Delimitation	10
Limitations	11
Organisation of the Study	11
Chapter Summary	12
CHAPTER TWO: REVIEW OF RELATED LITERATURE	
Introduction	13
Theoretical Perspective	13
Domino Theory of Accident	14
Health Belief Model	19

The Concept of Occupational Health and Safety	25
Occupational Health and Safety Legislation in Ghana	31
The Concept of Working Conditions	33
Overview of Small-Scale Gold Mining in Ghana	37
Gold Processing Steps	40
Review of Empirical Studies	44
Lessons Learnt from the Literature Reviews	51
Conceptual Framework for Knowledge of Occupational Health and Safety, and Working Conditions	53
Chapter Summary	55
CHAPTER THREE: METHODOLOGY	
Introduction	57
Research Design	57
Study Design	59
Study Area	60
Study Population and Sampling	63
Data Collection Method	65
Instruments Design	66
Pre-Testing	68
Ethical Consideration	68
Fieldwork	69
Data Management and Analysis	69
Chapter Summary	70
CHAPTER FOUR: RESULTS AND DISCUSSION	
Introduction	71

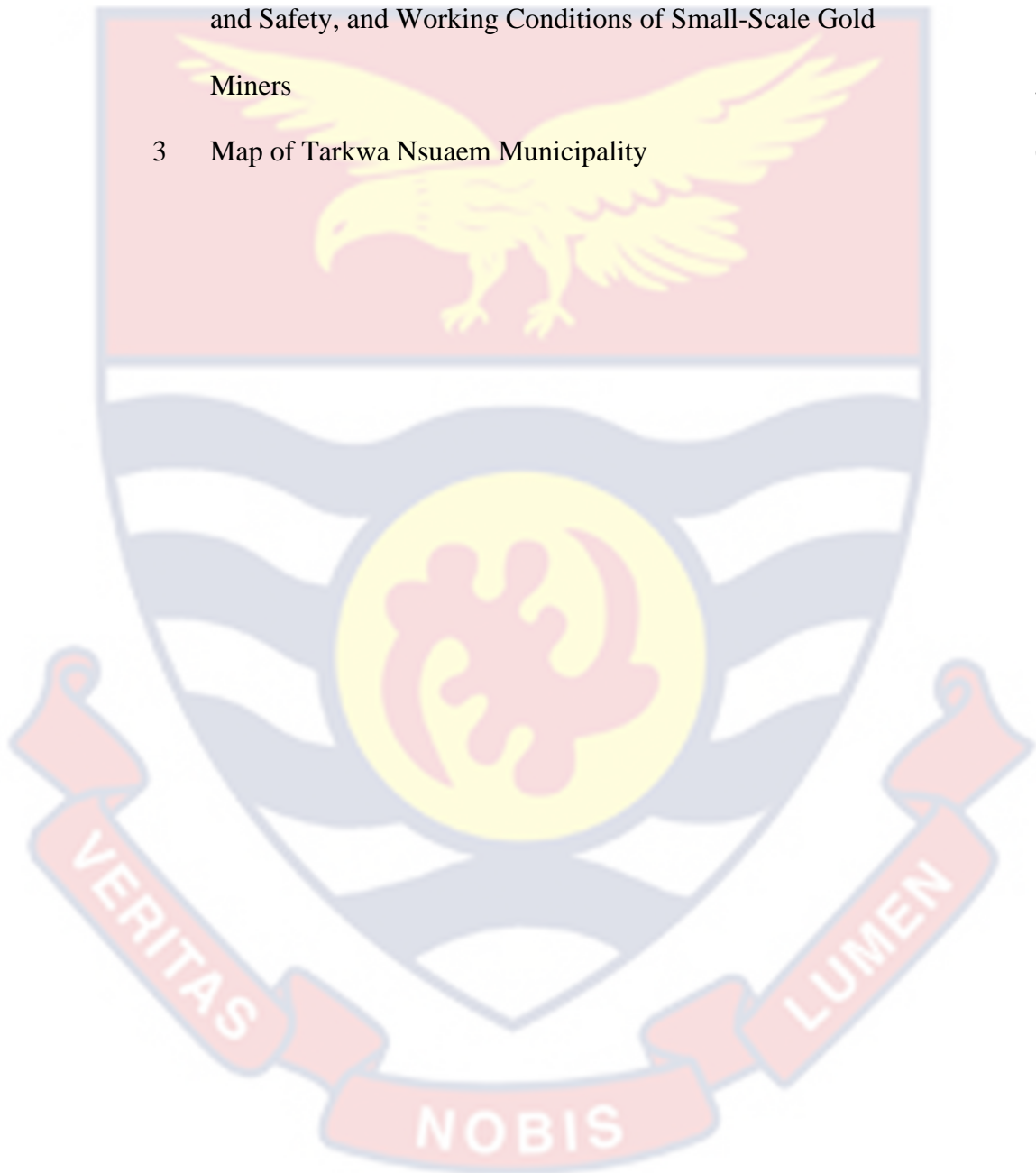
Demographic Information of Respondent	71
Miners' Knowledge of Occupational Health and Safety Issues	76
Appraisal of the Working Conditions of the Small-scale Gold Miners	82
Hazards and Exposures	88
Accidents and Injuries	90
Effects of Knowledge of Health and Safety on Working Conditions	92
CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	
Introduction	100
Summary	100
Conclusions	104
Recommendations	105
REFERENCES	107
APPENDIX A: Interview Schedule for Small-Scale Gold Miners in Tarkwa Nsuaem Municipality	139

LIST OF TABLES

Table	Page
1 Mining Companies used in the Study	65
2 Age of Respondents by Marital Status Cross-tabulation	72
3 Level of Education by Current Working Position of the Respondents Cross-Tabulation	74
4 Miners' Knowledge of Occupational Health and Safety Issues	78
5 Knowledge of OHS Policy at Workplace by Miners who have Undergone Basic OHS Training Cross-Tabulation	81
6 Current Position by Maximum Work Hours in a Day Cross- Tabulation	83
7 Level of Education by Receipt of Payment for Overtime Cross- Tabulation	85
8 Status of Company by Having Break Period for Lunch Cross- Tabulation	87
9 Noise-Induced Hearing Loss by Undergone Basic OHS Training Cross-Tabulation	94
10 Stumbling, Slipping and Falling by Knowledge on how to Perform a Job in a Safe Manner Cross-Tabulation	95
11 Knowledge of Occupation Health and Safety Policy at Workplace and Wearing of Hand Gloves, Overalls, and Ears Protector Cross-Tabulation	96

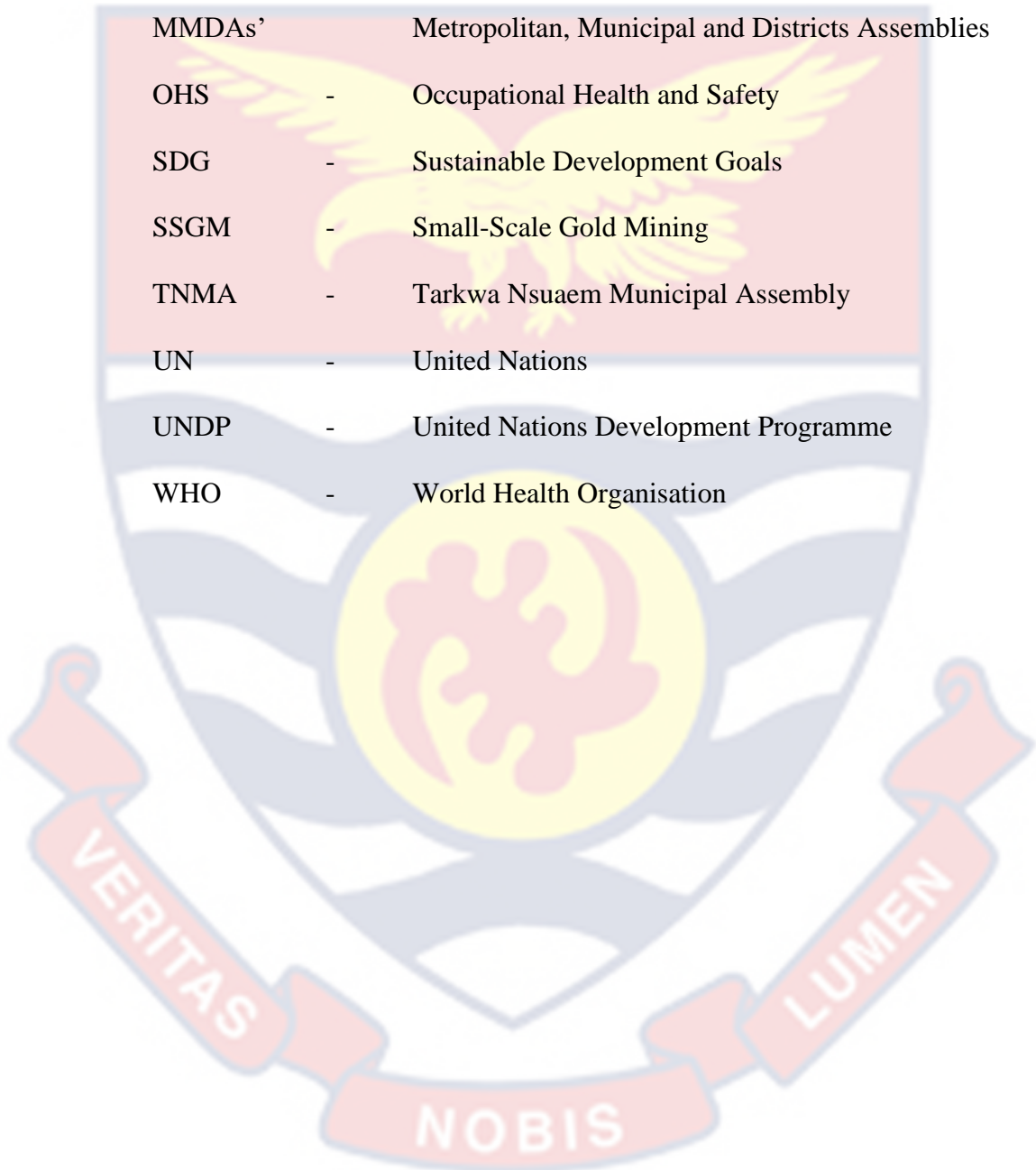
LIST OF FIGURES

Figure	Page
1 Heinrich's Domino Model of Accident Causation	15
2 Conceptual Framework for Knowledge of Occupational Health and Safety, and Working Conditions of Small-Scale Gold Miners	54
3 Map of Tarkwa Nsuaem Municipality	62



LIST OF ABBREVIATIONS

ASM	-	Artisanal Small-Scale Mining
GLSS5	-	Ghana Living Standards Survey Five
ILO	-	International Labour Organisation
MMDAs'		Metropolitan, Municipal and Districts Assemblies
OHS	-	Occupational Health and Safety
SDG	-	Sustainable Development Goals
SSGM	-	Small-Scale Gold Mining
TNMA	-	Tarkwa Nsuaem Municipal Assembly
UN	-	United Nations
UNDP	-	United Nations Development Programme
WHO	-	World Health Organisation



CHAPTER ONE

INTRODUCTION

The mining sector has earned a reputation for being a highly hazardous industry due to the high rate of incidence of accidents and fatality. There is thus the need for effective and efficient occupational health and safety management to critically safeguard employees and the industry (Amponsah-Tawiah & Mensah, 2016). According to the World Health Organisation, the injury rate in the mining sector is high, as compared to other industries, even though studies and novel practices continue to decrease the hazards associated with the sector (WHO, 2016). In Ghana, the small-scale gold mining sector is viewed to cause majority of the occupational injuries in the mining industry (Atakora & Stenberg, 2020).

It is estimated that about 15, 720 per 100, 000 occupational accidents and 1852 fatal accidents were recorded in the small-scale gold mining sector in 2014 (Atakora & Stenberg, 2020). Jonah and Abebe (2019) suggested that these accidents are as a result of several factors with inadequate knowledge of occupational health and safety of employees being identified as a key contributing factor. As Bansah, Dumakor-Dupey, Stenn and Galecki (2018) suggested, these require multifaceted knowledge of the difficulties of occupational health and safety as the first step in preventing work-related hazards. Yet, few studies have investigated the knowledge of employees' occupational health and safety, and working conditions of small-scale gold miners in Ghana. This explains the researcher's motivation for the current studies. The subsequent section presents the background to the study.

Background to the Study

Bhagawati (2015) opines that occupational health and safety (OHS) is a multidisciplinary idea that focuses on the advancement of health and safety of people occupied with work/business. Also, in 2015, a joint postoperative interview by the International Labour Organisation and the World Health Organisation Committee on Occupational Health and Safety stated that any strategy on occupational health and safety should focus on the advancement and support of the most significant level of physical, mental and social prosperity of labourers in all occupations. Gopang, Nebhwani, Khatri and Marri (2017) added that this requires the insurance of labourers in their work against factors that oppose their health together with situations that preserve labourers in an occupational climate adjusted towards their physiological and mental abilities.

The importance of occupational health and safety cannot be neglected. As Badri, Boudreau-Trudel and Souissi (2018) referred to, occupational health and safety outlines the assumption, appreciation, assessment and guidelines of dangers emanating from the workplace for guaranteeing the safety and prosperity of representatives, and considering the likely effect of any health risks on the adjoining networks and the general environmental elements. Relatedly, Salguero-Caparrós, Pardo-Ferreira, Martínez-Rojas and Rubio-Romero (2020) stated that healthy and fit labourers do not only benefit the establishment in which they work but the whole society. In this way, defending individuals' lives and ensuring a safe work environment would result in the proper functioning of nationals and also brings about improvement and accomplishment of business achievement (Zhang, Shi & Yang, 2020).

However, Zhang, Hu, Han and Zhang (2021) argued that occupational health and safety depends on the working conditions of the employees. Expanding this further, Ran and Sanders (2020) explained working conditions as the nature of the work environment and all current terms of employment contracts influencing work in that specific environment, including positions, working hours, actual viewpoints, legitimate rights and obligations. Bener (2017) maintained that the concept covers issues of association of work activities, preparation via skilled learning, abilities and employability, well-being, security and prosperity, and balance between serious and fun activities. Thus, working conditions reflect the nature of the relationship among workers, employers, and the physical workplace.

Small-scale gold mining workplaces are widely associated with poor working conditions and situations that cause injuries, labour inefficiency and low productivity (Laing & Moonsammy, 2021), which challenge occupational health and safety. As Nyanza, Bernier, Martin, Manyama, Hatfield and Dewey (2021) noted, small-scale gold mining is carried out by individuals, and or co-usable social unions that use manual strength-dominated methods or unsophisticated tools, which require low capital investment. Hilson, Van Bockstael, Sauerwein, Hilson and McQuilken (2021) added that small-scale gold mining includes activities at the lower end of the scale using basic hand tools, explosives and water pumps, washing plants and a gravity concentrator. Thus, there is the need to create a safe working environment for all stakeholders in the small-scale gold mining work (Abankwah, Aidoo, Etuah & Fialor, 2021).

The thesis of this research is that occupational health and safety is influenced by workers' knowledge of occupational health and safety as

supported by working conditions specified in the contract. This argument is supported by the Domino theory of accident, which explains that accidents result from a chain of activities and that the prevention of accidents requires the control of unsafe conditions, which is at the centre of the chain (Heinrich et al., 1980). This is further supported by the Health Belief Model (Rosenstock, Strecher & Becker, 1988), which argues that the decision to comply with occupational health and safety measures depends on the knowledge of people's fear of getting a disease and their fear reduction abilities.

Nonaka (1994) expressed that knowledge is significant as a faultless conviction that works on an individual's capacity to make a successful move or settle on significant choices, while Griffin and Neal (2000) contended that safety knowledge about existing safety frameworks, systems, rules and guidelines in a working environment is an initial phase in getting away from business-related health problems. Manabe, Thuy, Manh, Hong, Phuong, Thanh et al. (2012) indicated that health knowledge creates essential role in minimising risky acts and engaging in protective and preventive ways. In circumstances where labourers know about occupational health and safety in their work, they get many advantages, for example, less expense, further developed organisation picture, less staff turnover and higher productivity (Koopmans, Bernaards, Hildebrandt, Schaufeli, Schaufeli & De Vet, 2011).

Accordingly, knowledge of occupational health and safety is relevant for increasing the degree of awareness of health and safety methods, rules and principles, self-health status, dangers associated with each work task, affective/normative stability, and fear of sickness and ability to reduce the fear (Patil, Salunkhe, Kakade, Katti & Mohite, 2016). Okafoagu, Oche, Awosan,

Abdulmumuni, Gana, Ango et al. (2017) argued that knowledge of workers on causes, risk factors and preventive measures for occupational injuries and accidents help labourers to safeguard themselves against any avoidable injuries and accidents in working environments. In the estimation of Zhang, Chen, Li, An and Wang (2020), knowledge of occupational health and safety has become a priority so labour experts believe that knowing occupational health and safety measures for occupational hazards prevention is a pre-requisite for the continuation of industrial production.

In view of this, the European Commission (2007) posited that strict occupational health and safety practices ought to be established by corporate institutions, particularly those in the mining areas to shorten the inescapable and high pace of event of business-related injuries and fatalities across the globe. The International Labour Organisation [ILO] (2005) assessed that consistently, around 270 million business-related accidents are recorded around the world, bringing about the demise of approximately 2 million individuals, while in 2015, the ILO reported that each year, about 264 million non-fatal accidents happen which lead to a work-related illness resulting in about three (3) days absence from work (ILO, 2015). Accordingly, as Patil et al (2016) stated, knowledge of occupational health hazards is needed by workers to reduce their exposure to different hazards associated with their place of work.

Studies revealed that knowledge of occupational health hazards among workers ensured conducive working conditions, which reduced worker exposure to preventable hazards in the mining sector (Amponsah-Tawiah & Mensah, 2016; Becker, Furu, Singo, Shoko & Elbel, 2021; Lu, 2012). Precisely, Leung and Lu (2016) found that while the small-scale gold miners in the

Philippines were exposed to all forms of occupational hazards, they were engaged in poor short-term employment contracts. Again, Beth (2018) reported that knowledge of safety requirements and authority disappointments were the key factors affecting compliance to health and safety measures by small-scale gold miners in Kenya. Poor health conditions included high fever in Zimbabwe (Matsa, Mazire, Musasa & Defe, 2020), while gold miners who worked under healthy conditions were less likely to encounter work-related health problems in Ghana (Aram, 2021).

As documented by Eyah, Kheni and Quartey (2019), Ghana recognises the relevance of occupational health and safety as well as conducive working environment. Thus some interventions, provisions and regulations were put in place as a way of ensuring that employees are protected from occupational injuries and diseases. The Labour Inspection Convention, 1947, the Hygiene Convention 1964, the Factories, Offices and Shops Act 1970 (Act 328); the Mining Regulations, 1970 (LI 665), the Working Environment Convention, 1977 (No. 148); the Workmen's Compensation Act, 1987 (PNDCL, 187); the 1992 Constitution of the Republic of Ghana; the Environmental Protection Agency Act 1994 (Act 490); the Ghana Health Service and Teaching Hospitals Act 1999 (Act 525); the Labour Act 2003 (Act 677); the National Pensions Act, 2008; and other ILO ratified conventions relating to Occupational Health and Safety (OHS) are all intended to ensure occupational health and safety; and are also for similar purposes.

The Workmen's Compensation Act, 1987 (PNDCL 187) expects managers to take responsibility for employees who suffer injury emerging out of and throughout their work and support them based on the assessed physical

loss. (Agyemang & Dickson, 2018). Relatedly, Liu, Nkrumah, Akoto, Gyabeng and Nkrumah (2020) stated that the National Pensions Act, 2008 (Act 766) was set up in acknowledgement of the requirement for changes to guarantee an annuity for all workers in the nation. Similarly, the Factories, Offices and Shops Act, 1970 (Act 328) was proclaimed in 1970 to reduce the risk of injury and defend the safety concerns of all workers in Ghana (Agyekum, Ghansah, Tetteh & Amudjie, 2020). Yet, as noted by Boadu, Sunindijo and Wang (2021), these provisions require reforms to meet international requirements and standards.

Tarkwa Nsuaem Municipality is in the Western Region of Ghana where limited scope gold mining practices have been done for quite a long time (Calys-Tagoe, Ovadje, Clarke, Basu & Robins 2015). The region is essential for the Birimian and Tarkwain topographical developments of which the Birimian rocks are financially viewed as the main arrangements because of their mineral holdings (Baah-Ennumh & Forson, 2017). Kumi-Boateng and Stern (2020) uncovered that there are three big mining organisations, namely: Goldfields Ghana Limited, AngloGold Ashanti and Ghana Manganese Company together with other limited scope gold mining organisations. As Osei, Ahenkorah, Ewusi and Fiadonu (2021) noticed, most individuals who are not engaged in the big mining firms are engaged in limited scope gold mining. Thus, the choice of Tarkwa for the study.

Statement of the Problem

It is well realised that mining is one of the most perilous sectors (Gyekye, 2003; ILO, 2010). As Elgstrand and Vingard (2013) noticed, casual mining presents much a greater number of risks than what might be found in an exceptionally coordinated and directed large scope mining. Clearly, limited

scope mining has been referred to as a high-hazard occupation worldwide and it has been generally ascribed to the idea of the work and absence of powerful occupational health and safety provisions (Wilson, Dann & Nickisch, 2015). Smith, Zeuwts, Lenoir, Hens, De Jong & Coutts (2016) recorded, this leads to various occupational health and safety risks for the people who are directly engaged in such a limited scale gold mining process.

As explained by the domino theory of accident, it could be that the chains of small-scale gold mining activities are done within unsafe conditions, which ignite hazards that undermine occupational health and safety (Heinrich et al., 1980). Relatedly, as the health belief model suggests, it might be that small-scale gold miners do not comply with occupational health and safety measures because they have low knowledge of occupational health and safety and thus could not fear being harmed (Rosenstock et al., 1988). The contribution by Calys-Tagoe et al. (2015) suggested that work-related well-being impedances, injuries and ailments cause extraordinary human anguish and draw in significant expenses, both for the people in question and the society at large. Thus, it is essential to investigate the level of knowledge that small-scale gold miners have about occupational health and safety, as well as the very working conditions within which they operate or function.

Although small-scale gold mining is carried out in other parts of Ghana, Annan, Addai and Tulashie (2015) indicated that small-scale gold mining activities at Tarkwa Nsuaem Municipality are highly associated with poor working conditions and situations that cause injuries, labour inefficiency and low productivity. Relatedly, several studies were undertaken on occupational health and safety conditions of small-scale gold miners (Amponsah-Tawiah &

Mensah, 2016; Becker et al., 2021; Leung & Lu, 2016; Lu, 2012, Beth, 2018), but knowledge of occupational health and safety on the part of the miners, was not considered. This is the essence of the study.

Objectives of the Study

The main objective of the study was to assess the knowledge of occupational health and safety, and working conditions of small-scale gold miners in Tarkwa Nsuaem Municipality. To achieve the main objective of the study, the associated specific objectives were to:

1. Examine the miners' knowledge of occupational health and safety issues;
2. Appraise the working conditions of the small-scale gold miners; and
3. Examine the effects of the small-scale gold miners' knowledge of health and safety on their working conditions;

Research Questions

To achieve the objectives of the study, the following questions were asked:

1. What do small-scale gold miners know about occupational health and safety?
2. What are the working conditions of the small-scale gold miners?
3. How does knowledge of occupational health and safety affect the working conditions of the miners?

Research Hypothesis

The following alternative hypothesis were stated:

1. H1: Small-scale gold miners have knowledge of occupational health and safety issues.
2. H2: Small-scale gold miners do not have poor working conditions.

3. H3: Knowledge of occupational health and safety affect the working conditions of the miners.

Significance of the Study

The findings of the study will help authorities in deciding on appropriate occupational health and safety policies to safeguard the health and safety of the informal sector small-scale gold miners. It will help create awareness in employees, employers and the public on the various accidents and diseases that occur among small-scale gold miners and to improve their understanding of health and safety issues. This will help in the prevention and control of occurrence of occupational accidents and diseases in the small-scale gold mining sector of Ghana. The study will also serve as an additional literature for those who will be conducting research in similar or related subject matter.

Delimitation

The study on the knowledge of occupational health and safety, and working conditions of small-scale gold miners could have been extended to many mining areas in Ghana. However, because of time and resource unavailability, the study was limited to only Tarkwa Nsuaem Municipality. The study content included the background features of the workers like their age; sex; educational level; marital status; position, etc. It also covered the knowledge of occupational health and safety issues; hazards, diseases and accidents at the various stages of the small-scale gold mining operations, the existing working conditions of the miners and ways to prevent and control occupational health and safety issues of small-scale gold miners. The theoretical framework of the study was based on Domino Theory of Accident and Health Belief Model.

Limitations

The study encountered time constraints and difficulty in data collection from the workers, especially those in unregistered companies. The workers felt the researcher was going to report them to authorities and they therefore, felt reluctant to help answer the questionnaires. It was also difficult to get the attention of the workers to assist in answering the questionnaire from the researcher because the workers were in a hurry to go and start or continue with their work. Despite these challenges, the necessary efforts were put in place to ensure adequate data collection. I personally, showed the workers, the introductory letter from the University, my student identity card as well as my organisation's identity card and also assured them that the information being gathered was for academic work and that, it was to bring about development in their field of operations. Again, we waited patiently for each sampled worker to finish with the activity he engaged in before the interview schedule was admitted.

Organisation of the Study

The research is organised into five chapters. Chapter 1 focuses on the background to the study, problem statement, purpose of the study, objectives, research hypothesis, significance of the study, delimitation and limitation. Chapter 2 reviews literature related to knowledge of occupational health and safety, and working conditions, and ends with a conceptual framework. Chapter 3 also discusses the methodology which includes study design, study area, population, sampling technique, data collection instruments and procedure, while chapter 4 focuses on the results and discussions of the study. Finally, Chapter 5 looks at the summary of the study and key findings coming from the

data analysis. Recommendations are also made based on the findings and conclusion of the study.

Chapter Summary

This chapter examined the background to the study, statement of the problem on occupational health and safety issues among small-scale gold miners as well as the objectives and their corresponding hypothesis. It further covered the significance of the study, delimitations and limitations to the study.



CHAPTER TWO

REVIEW OF RELATED LITERATURE

Introduction

Kralik, Visentin and Van Loon (2006) characterised writing survey extensively as a precise approach to gathering and orchestrating past exploration to accumulate examples that are essential for the review being referred to. Randolph (2009) contended that an all-round led writing survey makes a firm establishment for propelling information and facilitating a theoretical base of the study. This chapter reviews literature relating to the knowledge of occupational health and safety of small-scale gold miners. The review is organised under subheadings namely theoretical perspective, conceptual perspective, empirical review, lessons learnt and conceptual framework as well as the chapter summary.

Theoretical Perspective

Usher and Schunk (2018) argued that a theoretical perspective reveals a notion or an arrangement of thoughts proposed to clarify the linkages among concepts in research based on broad autonomous standards. Dong, Xiang and Dagotto (2019) added that those standards guide the study, and are identified with a thought used to represent a circumstance or legitimise a strategy. Lin, Wu and Mo (2020) explained that a theoretical perspective is relevant for providing a hypothetical structure of existing information. It helps to justify speculations and choice of research techniques. It also assists the researcher to know the limit points to the speculations used in a study. The Domino Theory and Health Belief Model are the two theories considered under the theoretical

perspective on the knowledge of occupational health and safety of small-scale gold miners.

Domino Theory of Accident

The domino theory is the principal logical way to deal with accident avoidance. In domino theory of accident, the pioneer, an occupational safety specialist, demonstrated how occupational accident happens and how to prevent it from happening. The author argues that an accident results from a series of interdependent events (Heinrich, 1941). Later, Heinrich, Peterson and Roos (1980) introduced a bunch of statements known as the adage of business safety, which was based on an assumption of accident causation. The basic idea is that the event of an injury perpetually results from a confounded succession of issues, the final remaining one which is simply, the observed accident.

According to DeCamp and Herskovitz (2015), the introduction of the domino theory was based on the observation that the sequence of the accident behaves like dominoes hitting each other down in succession. Singoro, Wakhungu and Obiri (2016) argued that the theory clarifies that at a point when one of the dominoes falls, it triggers the subsequent one, which in turn propels the next one. Be that as it may, Rahiman and Mahat (2018) contributed that eliminating a key factor like unsafe act/condition prevents the beginning of the chain of response or breaks the chain of the response. This implies that setting up safety guidelines and procedures, and encouraging labourers to follow them are the most basic requirements for guaranteeing work-related occupational health and safety.

According to Bird and Germain (1986), all incidents are straightforwardly identified with unsafe conditions and acts, like standing under

a suspended weights, silliness and removal of safety measures as well as exposing oneself to mechanical or physical dangers like unguarded gears and deficient light. Heinrich et al. (1980) set five metaphorical dominoes named with accident causes like ancestry and social climate; shortcoming of individual; unsafe act/condition; accident; and injury.

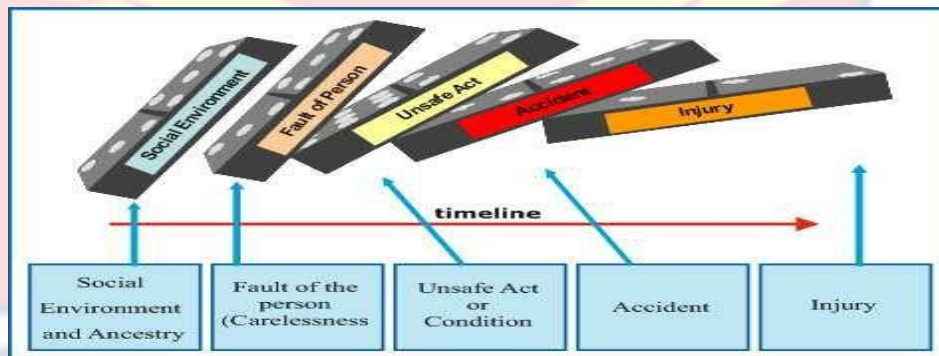


Figure 1: Heinrich's Domino Model of Accident Causation

Source: Adopted from Disaster Management Institute, Bhopal, Online Explanation of Domino theory.

Social environment and ancestry as the first domino in the sequence looks at the behaviour of workers. Lozada-Larsen and Laughery (1987) noted that under the social environment and ancestry, attributes like carelessness, eagerness, and bad cultural practices add to the fault of persons. Geller (2004) clarified that those unwanted character practices are likely to be passed along through inheritance and environment (nature and nurture). Thus, as noted by Lin and Liu (2016), the suitability of one's cultural and individual values to safety rules is fundamental in embracing occupational health and safety practices in an association.

The second factor looks at the fault of person which is the second domino in the sequence. Mahat, Ismail and Alwee (2015) clarified that innate or acquired character imperfections like terrible temper, rudeness,

obliviousness, and foolishness add to accident causation. Thus, right from environmental issues of an accident, the domino theory tries to apportion part of the blame of accidents causation to human behaviour (Mustapha, Aigbavboa & Thwala, 2015), and that much focus has been placed on a person's inborn attributes (Hyun-Jee, Young-Sul & Young-Guk, 2001).

Rowlinson (2004) added that such attributes can show up because of life conditions adding to dangerous acts or hazardous conditions. The contribution by Oakley (2005) suggested that the fault of the person prepares a viable medium for unsafe acts/conditions, which are risky demonstrations as well as hazardous conditions that are assumed to be the sign of the third domino at the focal point of events adding to an accident. As demonstrated by Jacinto (2016), ordinary or ecological defects in the worker's family or life cause these secondary personal faults, which are themselves contributors to unsafe acts, or the presence of unsafe conditions.

Unsafe act/condition as the third domino looks at Heinrich et al. (1980) direct cause of accident. Asanka and Ranasinghe (2015) felt that dangerous act and risky circumstances were the central elements in preventing occurrences, and the easiest causation component to fix, a procedure which was compared to lifting one of the dominoes, usually the middle one or unsafe act/condition, out of the line of the sequence. Saxena (2017) revealed that the theory assumes that unsafe acts/conditions are the main factors that cause accidents and that eliminating this domino requires less effort but is the most prudent alternative to prevent an accident.

Raymond (2018) added that the theory proposed four reasons namely inappropriate attitude, absence of knowledge/expertise, inadmissibility, and

improper industrial or physical environment being the reasons why individuals commit unsafe act. Demirkesen (2020) divided these classifications into direct and fundamental causes. The author argued that a worker who is engaged in an unsafe act might do so because the person in question is not persuaded that the fitting precautionary measure, is important and on the account of deficient management. Yeo, Yu and Kang (2020) added that the former is named an immediate reason, while the latter is named as the basic reason and that the mix of different causes make a precise chain of occasions prompting an accident.

Accident is the fourth domino. As indicated by Cooper (2007), the incidence of a preventable injury is the customary highest point of a movement of events or conditions which occur in a fixed and sequential manner. Aryeetey, Osei and Twerefou (2004) showed that events like falls of individuals or striking of individuals by flying things are typical accidents that cause injury. Miller (2017) concluded that accidents are unfortunate and undesirable occasions that occur and cause injury, and the occasions can be such as an individual tumbling from stature and striking an individual because of a breakdown of items.

Injury, as the fifth domino, results from accidents. As per Ngowi (2003), the obligation lies most importantly with the business owner to guarantee the safety of the labourers. Jorma (2004) argued that real safety conscious management ensures that labourers get involved, exercise their rights and get consistent support in finishing work to ensure that unsafe conditions are wiped out. Heinrich et al. (1980) solution for preventing any rebelliousness is severe monitoring, corrective practice, and discipline.

The domino theory is relevant for undertaking a study on knowledge of occupational health and safety and working conditions of small-scale gold

miners. As shown by Heinrich 1941, the domino theory is not quite similar to the other accident hypotheses, in the wording of comprehensibility with the goal of accident prevention because it is material and employable at all levels from workers to subject matter experts and bosses. Fu, Xie, Jia, Li, Chen and Ge (2020) added that recognising features of the theory that make it special to be utilised includes its simplicity, which depicts the means of causality, intelligently in basic words. Thus, it is not difficult to apply it and the researcher does not have to search for some complex interrelating reasons for individuals who are not experts in work of health and safety issues to understand (Jin, Li, Ye, Z, & Xiang, 2021).

In the estimation of He and Weng (2020), the domino theory helps in the easy solving of health and safety problems because it describes the causations linked to every individual who is included in a work environment. Wibowo, Sukaryawan and Hatmoko (2020) added that the blame-setting quality of the theory ensures that individuals who cause injury to others can be effectively perceived, dependent on the groupings of the theory. In this manner, a proper fault can be apportioned to the appropriate individual to repay for the injury caused (Famakin, Aigbavboa & Molusiwa, 2020).

A systematic review by Vishwakama, Arun, Nandan and Yadav (2020) revealed that the domino theory is good for studying the conditions under which people work, especially those who lose their privileges. Osei-Asibey, Ayarkwa, Acheampong, Adinyira and Amoah (2021) maintained that the theory serves as the best approach to ensure that health and safety work condition studies mirror the capacity of settling occurrence, while Li, Zhang and Peng (2021) expressed that the demonstrable behaviours of workers are reflected while the unsafe

working condition is removed. Ojeme and Raymond (2021) concluded that the theory proposed multiple approaches to health and safety, which is built on techniques such as close oversight, safety rules, worker schooling through preparation, banner and movies, as well as dangers distinguishing proof in the light of investigations of previous experiences, studies and inspections.

Be that as it may, the domino theory has been censured as a one-dimensional succession of accidents. Mushori, Rambo, Wafula and Matu (2021) critiqued that accidents are normally multi-factorial and are created through moderately extensive arrangements of changes and blunders, which prompted the guidelines for numerous causation. According to Iqbal, Alrajawy, Isaac and Ameen (2021), behind each accident, there lies many contributing factors, causes and sub-causes, which consolidate in random style, to cause accidents. Thus, in health and safety studies, there is the need to distinguish between causes, however many of these causes could be expected under the circumstances, instead of only one for each phase of the domino arrangement (He & Weng, 2020). Based on these weaknesses, Wibowo et al. (2020) supplemented their study with the Health Belief Model. Accordingly, the next section reviews the Health Belief Model.

Health Belief Model

Rosenstock et al. (1988) are known to have proposed the Health Belief Model, which explains the reason why people either engage or fail to take part in preventive health and safety measures like wearing protective garments, going to test for an illness, or keeping the workplace safe. As documented by Strecher and Rosenstock (1997), the basic thesis of the theory is that individuals fear getting severe ailments and that health-related practices reflect both an

individual's degree of fear of apparent health dangers and the expected fear reduction capability of complying with the medical prescriptions. Per Murphy (2005), the theory assumes that individuals consider whether the results of a behavioural change offset its practical and mental obstructions, while Mills, Kessler, Cooper and Sullivan (2007) explained that a safety act could only be taken if the net advantages of changing conduct lessen the risk are greater than the fear.

The Health Belief Model is used in this study to support the domino theory as a means of providing information to guide the promotion of healthy lifestyle and prevention of disease at the workplace. It is a theoretical model that can be used to guide health promotion and disease prevention programs. It is used to describe and forecast the changes individuals make in health behaviors. Abraham and Sheeran (2015) opined that the health belief model is attached to information sharing for enhancing an individual's awareness of and concern about severe health risks related to assured preventable ills, including diseases that could be relieved whenever known sufficiently early. Sulat, Prabandari, Sanusi, Hapsari and Santoso (2018) added that the theory attempts to explain that employers ought to make workers comprehend so that they could decrease workplace health risks and ensure workplace safety by taking certain proactive measures.

Green, Murphy and Gryboski (2020) also noted that the model serves as a premise to expand workers' knowledge of health challenges, improve the impression of worker risk, and urge activities to diminish/wipe out health risk, which in turn, emphasise the construction of self-appreciation adequacy to embrace the required changes. Abolfotouh, Ala'a, Mahfouz, Al-Assiri, Al-

Juhani and Alaskar (2015) also opined that the health belief model is built on four basic concepts such as perceived susceptibility, perceived severity, perceived benefits, and perceived barriers. However, Glanz, Lewis and Rimer (1990) indicated that the Health Belief Model consist of many concepts susceptibility, seriousness, benefits and barriers to behavior, cues to action, and lately, self-efficacy.

Emmanuel (2015) stated that in the health belief model, the idea of perceived susceptibility alludes to the degree to which people/workers feel they are vulnerable to risk in some conditions. It might be argued that if managers of small-scale gold mines know that their employees are defenceless against business-related health risks as a result of perilous working conditions and inordinate requests from work (Mohammadi, Ghajari, Valizade, Ghaderi, Yousefi, Taymoori et al., 2017), they will set up measures to diminish such health and safety risks. Guidry, Carlyle, LaRose, Perrin, Messner, and Ryan (2019) observed that once this is done, the workers would embrace greater work-related health and safety practices dependent on common knowledge.

Goodarzi, Heidarnia, Tavafian and Eslami (2019) hinted that perceived severity refers to the feelings about the seriousness of getting a disease (or of having the disease untreated). The feelings is subjective (differs from one person to the other) and it assesses the medical effects (e.g., loss of life, incapacity, and pain) as well as the likely social effects (e.g., the situational effects on work, family life, and social life) (Janz & Marshall, 1984). Castonguay, Filer and Pitts (2016) contributed that the argument from this tangent is that if businesses provide guidance and information about workers' health risks, the workers will change their mentalities and take part in practices

that further develop security at their workplace because they will experience the seriousness of the issue. For instance, Basu et al. (2015) opined that if the small-scale gold miners know that their inability to submit to health and safety practices would result into illnesses and loss of lives, they will change their mentality and become cautious.

Green et al. (2020) explained perceived benefits as the assessment that a “sufficiently-threatened” person makes on the positive outcome of performing a recommended health action. Thus, a person perceiving how susceptible he/she is to a situation and the serious nature of the situation or illness, will agree to take the recommended health behaviour only when he/she perceives the behavior to be advantageous by minimizing the threat (Glanz et al., 1990). According to Yakovleva and Vazquez-Brust (2018), this implied that if the gold miners understand that by observing health and safety precautions as suggested, would be advantageous to them by way of reducing perceived threat, they would probably take precautions to guarantee their safety against preventable accidents or diseases. Besides, Luquis and Kensinger (2019) argued that knowing that health and safety can be advanced via accident prevention would discourage workers from engaging in accident-prone acts at work.

Perceived barriers is explained by Jeihooni, Dindarloo and Harsini (2019) as the barriers/misfortunes that meddle with health behaviour change. Green et al. (2020) again explained perceived barriers as the assessment that a “sufficiently-threatened” person makes about the effects that impede the usage of the recommended behavior. Glanz et al. (1990) added that at this stage, the threatened person unconsciously conduct a cost and benefit analysis to compare the advantages of the recommended action as against the feelings that may be

costly, risky (e.g., side effects, iatrogenic outcomes), unfriendly (e.g., painful, difficult, upsetting), time-consuming, and so forth. The perception of a miner that the usage of PPEs' inconveniences him as their usage restricts physical movement as well as interferes with his work is a great barrier to the miner in taking a recommended health action (Kareem, Kareem, Owoeye-Lawal, Aro, Lawal, Ibekwe et al., 2022).

Cues to Action refers to the outside and inside factors or events that activate actions in a threatened person to perform a health behavior (Janz, Champion & Strecher, 2002; Mattson, 1999). The inside cues to action help in the growth of individuals' perceptions of their bodily health signs: signs that can be personally felt or perceived from relatives and friends. The outside cues comprises interpersonal communications with associates, relatives, and health officials about the marked disease and/or preventive actions, and media cues covers media crusade (Janz & Becker, 1984; Mattson, 1999). The small-scale gold miners upon hearing media reports on injuries and diseases that workers sustain at their workplaces and the need to take their health issues serious, will push the miners to take a recommended health action.

In addition to people being aware about the advantages of using personal protective equipment (PPE), the provision of constant reminder on the use of PPEs' improves its usage (Kareem et al., 2022). Self-efficacy is defined as the belief that one can effectively perform the recommended health behavior to yield the expected results (Bandura, Freeman & Lightsey, 1997). The higher the self-efficacy and perceived benefits of action, results in a greater readiness to partake in rampant preventive ways (Shahnazi, Ahmadi-Livani, Pahlavanzadeh, Rajabi, Hamrah & Charkazi, 2020; Barakat & Kasemy, 2020; Fathian-

Dastgerdi, Khoshgoftar & Jaleh, 2020). The belief of a miner about the effectiveness of PPEs' usage in minimising occupational injuries and maintenance of workers health becomes a strong faith in taking a recommended health action (Kareem et al., 2022).

As Yakubu, Garmaroudi, Sadeghi, Tol, Yekaninejad and Yidana (2019) explained, the theory implied that the notion of observing health and safety rules is a waste of work hours needs to be discouraged among the workers by making them well-informed and monitored. Thus, the health belief model is most appropriate for explaining the behavioural and work condition issues that surround the health and safety issues of small-scale gold miners.

The contribution by Luquis and Kensinger (2019) suggested that while the theory centres around the individual, it perceives and addresses the social setting where health practices occur. Saghafi-Asl, Aliasgharzadeh and Asghari-Jafarabadi (2020) explained that the theory maintains that having the fear of accidents is not enough to compel people to engage in preventive activities, but the knowledge and awareness of working conditions and their associated threats are also useful in ensuring occupational health and safety. Thus, Shahnazi et al. (2020) argued that employers ought to provide safe environment for their workers to escape preventable illnesses.

Gyapong, Garshong, Akazili, Aikins, Agyepong and Nyonator (2007) documented that small-scale gold miners in Ghana are vulnerable due to limited employment opportunities, and because of the demands of their employers, the workers become exposed to severe risks, thus the health belief model is suitable for studying their health and safety and working conditions. In contrast, Meyer and Maltin (2010) observed that in many workplaces where workers become

mindful that accidents can be decreased to the barest minimum, they are occupied with legitimate safety practices that radically diminish the occurrence of work-related accidents and promote occupational health and safety. Thus, the next section discusses the concept of occupational health and safety coupled with working conditions in the context of small-scale gold mining.

The Concept of Occupational Health and Safety

Bhagawati (2015) defined the concept of occupational health and safety (OHS) as a multidisciplinary idea that focuses on the advancement of health, safety, and government assistance of employees. Similarly, Sinelnikov, Inouye, and Kerper (2015) viewed occupational health and safety as an idea that covers the psychological, passionate, and actual prosperity of the worker in relation to the exhibition of his/her work and thus marks a fundamental subject interest affecting the accomplishment of employers' objectives. In this respect, Gopang et al. (2017) presumed that the concept is both a science and art devoted to reaction, assessment and control of expected and unexpected factors emerging in working environments, which might cause ailment, impede health and prosperity of workers and may affect the entire business negatively.

Nikulin and Nikulina (2017) revealed that occupational health component manages all aspects of health in the work environment and has a solid spotlight on essential prevention of workplace hazards. As Badril et al. (2018) characterised, health is a condition of complete physical, mental and social prosperity and not just the shortfall of infection or infirmity. Salguero-Caparrós et al. (2020) argued that occupational health is a multidisciplinary field of healthcare, which is concerned about empowering workers to embrace their occupation in a way that makes them live a healthy life.

The World Health Organisation (2016) reported that occupational health is built on three unique goals that ought to be given equal attention. The report indicated that the goals include the upkeep and progression of workers' wellbeing and working ability; the improvement of work areas and attempt to become accommodating for security and wellbeing; and the improvement of work affiliations and working social orders towards a way which keeps up with wellbeing and wellbeing at work for propelling a positive social climate and smooth action that might redesign effectiveness of the workers. Thus, Fan, Zhu, Timming, Su, Huang and Lu (2020) opined that occupational health deals with behaviour issues, while occupational safety relates to putting in a healthy physical work environment.

Zhang, Shi and Yang (2020) defined occupational safety as the actual examination and assessment of the work environment conditions and hardware as a working system to identify the shortcomings that have the potential to cause an accident. In this manner, De Cieri and Lazarova (2020) discovered that restorative measures to curb unsafe circumstances should include consistent training and re-planning of tasks based on the level of risk involved. Fonseca and Carvalho (2019) thought that work-related well-being mirrors a functioning society in view of administrative structures, workforce procedure, norms for collaboration, planning courses of action and quality organisation of the business within a healthy working environment.

The World Health Organisation (1999) indicated that a healthy work environment is the one where both employers and employees unite to utilise a consistent improvement interaction to secure and advance the health, safety and prosperity of labourers in relation to support mechanisms. Amponsah-Tawiah

and Mensah (2016) stated that the mechanisms include health and safety issues in the actual workplace and a psychosocial workplace including the association of work and working environment culture. Similarly, Mohammadfam, Kamalinia, Momeni, Golmohammadi, Hamidi and Soltanian (2017) suggested that such mechanisms incorporate individual health assets in the working environment and methods of participating locally in work on the health of labourers, their families and different individuals locally.

Battaglia, Passetti and Frey (2015) observed that occupational health and safety is a multi disciplinary action to secure and advance the health of different workers as well as preventing and controlling sicknesses and accidents by eliminating elements and conditions unsafe to health and safety. Ricci, Chiesi, Bisio, Panari and Pelosi (2016) viewed healthy and safe workplace as an improved physical, mental and social setting that creates an enabling environment for employees and employers to keep up with their functions unhindered. Ilbahar, Karaşan, Cebi and Kahraman (2018) argued that healthy and safe workplace ensures that all players in the work support the health and safety improvement framework of the work. Ji, Pons and Pearse (2020) cited that this helps in promoting socially and monetarily useful lives that contribute significantly to managing potential accident events.

In dealing with occupational health and safety, Gul (2018) argued that it is vital to recognise hazards, identify risks and monitor accidents to reduce their occurrences. As suggested by Health and Safety Authority (2018), due to the hazardous nature of the small-scale gold mining sector, the players responsible for ensuring workplace health and safety ought to identify hazards in the workplaces, assess and write down the related risk of the identified hazards for

informed decision making. According to Bernardi (2019), these are issues that management bodies such as governments, employers, and trade unions cannot overlook in their tripartite conversations. Eyiah et al. (2019) added that insurance companies and other stakeholders would have to augment the efforts through public education on workplace hazards.

Hazard alludes to a risky peculiarity, substance, human activity or condition that could cause loss of life, injury/other prosperity impacts, property hurt, loss of jobs and organisations, social and monetary disturbances, or natural harm (UNDP, 2010). Yang and Ahn (2019) differentiated between safety hazards and health hazards. According to the authors, safety hazards have to do with the aspects of the work environment that can cause prompt and brutal damage or even the demise of workers, while health hazards are parts of the workplace situations that gradually but finally lead to the breakdown of workers' health. Pandit, Albert, Patil and Al-Bayati (2019) observed that both types of hazards need equal attention.

Hazardous conditions in the mining sector can be put into five classes. These are physical, biological, chemical, ergonomic, and psychological hazards (Donoghue, 2004). Amponsah-Tawiah, Jain, Leka, Hollis and Cox (2013) hinted that the physical hazards refer to an injury which is shocking and also substantially problematic and ranges from minor to deadly in the mining sector of Ghana. As Amponsah-Tawiah, Ntow and Mensah (2016) observed, normal reasons for the deadly injury comprise rock fall, fires, blasts, versatile gear mishaps, falls from tallness, capture and electric shock. Badril et al. (2018) suggested that the biological hazards are related to organic entities and that the

danger of tropical sicknesses like intestinal sickness and dengue fever are common in some distant mining areas.

Concerning chemical hazards, Batool (2015) revealed that silica for instance has been the most hazardous compound in mining, which is causing silicosis. Amponsah-Tawiah and Mensah (2016) demonstrated that chemical substances like mercury, coal dust, asbestos, nickel compounds, hydrofluoric corrosive, hydrogen sulphide gas, and xanthate reagent are hazardous such that their impact is deadly to humans. Silica, mercury, coal dust, asbestos, nickel compounds and hydrogen sulphide gas are natural materials whereas hydrofluoric corrosive and xanthate reagents are synthetic materials. Relatedly, Nikulin and Nikulina (2017) opined that ergonomic hazards refer to the posture and position of people in work situation or environment that has the potential to cause harm to the human musculoskeletal systems. Fonseca and Carvalho (2019) explained that ergonomic hazards occur even though the mine has been enormously motorised because some tasks do not require the utilisation of machines.

Donoghue (2004) proposed that psychosocial hazards refer to the features in the design or management of work that increase the risk of work-related stress and can result into psychological or physical harm, while Ivancevich (2015) revealed that the aim of boosting performance has expanded medication and liquor utilisation among excavators, which is becoming hard to deal with in the mining sector.

Yi, Albert, Chan, Wong, Del and Wong (2016) suggested that there should be an approach to ensuring a healthy and safer working environment for workers. Ilbahar et al. (2018) noticed that the use of a diagnostic approach to

health and safety should feature the kind of tasks, employees' disposition towards health and safety, monetary conditions, impact of associations and the employers' objectives.

According to Badril et al. (2018), the public authority would have to work towards achieving occupational health and safety by ensuring compliance with regulations on better health and safety work, hazard emergency treatment and clinical proximity based on dynamic interactions that expose the varying interests of the miners on health and safety issues. Precisely, the World Health Organisation (2008) reported that due to the higher exposure in informal sector workers such as small-scale gold miners, the government should prioritise their issues in the regulatory and mechanical arrangements for health and safety at work and that the miners need more knowledge on occupational health and safety for effective implementation.

Knowledge is characterised as a concrete conviction that works on an individual's capacity to make a successful move or settle on significant choices (Nonaka, 1994). Relatedly, workplace safety knowledge is characterised as the degree of awareness about existing safety frameworks, methods, rules, and principles at the workplace (Griffin & Neal, 2000). Safety knowledge has been distinguished among few factors like hazard discernment, melancholy, and stress to intercede the connection between safety practices and injuries (Freeman, Schwab & Pollard, 2003; Yin, Tserng & Tsai, 2008). Health knowledge implies realities, data and abilities gained through experience/instruction, which helps in comprehension of a subject identified with health and health care (Chin, Hahn & Meyerson, 2011).

It is evidenced by research that making workers proficient in well-being and security makes them mindful of the dangers of participating in an unsafe act to themselves, their families and the general public (Alfers, 2010; Gyapong et al, 2007; Mills et al, 2007). Thus, knowledge of health and safety affects workers and the organisation in many ways. Zhang and Fang (2013) stressed that employees' knowledge and execution of well-being information give persistent criticism, acknowledgement, improvement, and control of business-related dangers. Information on well-being and security emphatically influences hierarchical results, for example, less expense, further developed organisation picture, less staff turnover and higher usefulness (Patil et al., 2016).

Knowledge of occupational health hazards and awareness of workers would be able to reduce workers' exposure to different hazards located in their place of work (Koopman et al, 2011). As Okafoagu et al. (2017) observed, knowledge of workers on causes, risk factors and preventive measures for occupational injuries and accidents help the workers to protect themselves against any avoidable injuries and accidents in the workplace. However, as Zhang, Chen, Li, An and Wang (2020) revealed, the country's legislations determine the nature of responses that employers give to the occupational health and safety needs of their employees. The next section discusses occupational health and safety legislation in Ghana.

Occupational Health and Safety Legislation in Ghana

In Ghana, the Ministry of Employment and Labour Relations is responsible for the organisation of work-related health and safety of employees and this is done via the Department of Factories Inspectorate and the Labour Department (Monney, Bismark, Isaac & Kuffour, 2014). Kheni and Braimah

(2014) also observed that the country's constitution ensures that each person has protected and sound conditions coupled with the right to get the same compensation for the same work done. Similarly, Annan et al. (2015) indicated that portions of the international laws and provisions about advancing the privileges of workers have been domesticated into the national laws through a section of administrative instruments and institutional course of action.

The legislation of Ghana projected the establishment of work related well-being administrations. They incorporated the 1992 Constitution of Ghana; Environmental Protection Agency Act 490, 1994; the Factories, Offices and Shops Act 328, 1970; the Ghana Health Service and Teaching Hospitals Act 525, 1999, Hygiene Convention 1964, The Labour Act, 2003 Act (651); Labour Inspection Convention 1947; the Mining Regulations 1970 (LI 665), the National Pensions Act 766, 2008; Working Environment Convention, 1977 and other ratified conventions relating to Occupational Health and Safety (OHS). The Labour Act, 2003 (Act 651), was sanctioned to amalgamate the existing regulations concerning labour, businesses owners, worker's unions and industrial relations, which makes it obligatory for managers to ensure that each worker engaged in Ghana works under conducive, secured and safe environments (Labour Act, 2003 Act 651, Article 118:1).

Eyiah et al. (2019) also shared a view that the Labour Act 2003 provides regulations on health, safety and environment for the workers and business owners to ensure a healthy and safe environment. Osei-Asibey et al. (2021) explained this because the Act is not explicit on the best way to execute safety measures at the organisation's level and to whom to report accidents and work-related ailments. Asare and Badu (2021) added that the Act does not also

indicate who should be liable for guaranteeing that the enterprises in Ghana carry out safety actions.

Nevertheless, the Workers' Compensation Law 1987 (PNDCL 187) expects managers to take responsibility for employees who suffer injuries in the cause of doing their work (Agyemang & Dickson, 2018). Liu et al. (2020) stated that the National Pensions Act 2008, Act 766, was set up in acknowledgement of the requirement for changes to guarantee comprehensive annuity for all workers in the nation, and to register the interest of all Ghanaian workers, whether formal or informal. In the same vein, the Factories, Offices and Shops Act of 1970 (Act 328) was proclaimed in 1970 to diminish the risk of injury and defend the safety concern of all workers in Ghana (Alormene, 2021). Yet, as noted by Boadu et al. (2021), these provisions require reforms to meet international requirements and standards.

Annan et al. (2015) argued that there are challenges associated with occupational health and safety legislation and that even though informal workers dominate the labour market in Ghana, deficiencies exist concerning their needs being captured. The Factories, Offices and Shops Act of 1970 (Act 328) has for quite a long time been used to execute health and safety plans, but it is silent on the involvement of minor workers (Mustapha, Aigbavboa & Thwala, 2017). Thus, as Eyiah et al. (2019) noted, the legal Acts lack the need-base evaluations to guarantee reasonable working conditions.

The Concept of Working Conditions

Based on a systematic literature review, Ali, Ali and Adan (2013) characterised working circumstances as the idea of workspace and all current terms of business affecting work in that workplace, including position, working

hours, genuine perspectives, authentic privileges and commitments. Similarly, studying approaches to stable working conditions, Xia, Lin, Cui and Shan (2016) alluded to working conditions as the working environment and parts of the workers' agreements concerning business. Bener (2017) maintained that the concept covers issues of association of work activities, preparation via skilled learning, capacities and employability, prosperity, security and flourishing, and working time and harmony among genuine and fun exercises. Working conditions reflect the nature of relationships among workers, employers, and the physical workplace.

Wang, Shu, Tian, Liu, Li and Jing (2017) added that good working conditions embrace issues of working space, temperature, lighting, ventilation, humidity and government-aided offices as well as access to drinking water. The contribution by Wang et al. (2018) suggests that good working conditions reflect the nature of employment contracts, which in turn clarifies how the employers and employees have consented to cooperate. Islam, Ahmed and Ali (2019) observed that good working conditions generate interactions that translate into a social exchange, which is guided by intrinsic value and rewards.

However, as explained by Ran and Sanders (2020), working conditions are said to be poor when workers cannot undertake their daily obligations because the states of the working environments are excessively hazardous. For instance, Zhang, Chen, Li, An and Wang (2020) demonstrated that uncovered wiring, broken hardware, and risky materials/asbestos could represent poor working conditions for workers. Zhang, Hu, Han and Zhang (2021) also noted that poor working conditions incorporate deficient space use, inadequate work innovation, poor lighting, wasteful working environment processes, absence of

working environment adaptability and equilibrium, awkward working circumstances, and a poisonous organisational culture.

Moshrefzadeh (2021) argued that employees' usefulness and execution can diminish because of poor working conditions on the grounds that it unfavourably influences their confidence which leads to helpless inspiration and less work completion. Aram (2021) also stated that to overcome poor working conditions, the basic aim should be to spread opportunity of work, end mandatory work, nullify child work as well as end occupational inequality. Thus, working conditions require that labour is not seen as a commodity so that development is centred around development of humans for decent work.

Decent work is an idea that defines the reference point of traits of work, covering the four strategic objectives of International Labour Organization: rights of workers; employment; social protection; and social dialogue (ILO 1999). In 1999, the International Labour Organisation introduced the decent work agenda which later became an aspect of the UN agenda for sustainable development as the 8th Goal, and helping create the awareness that decent work promotes comprehensive and maintained economic development, and complete successful employment (ILO, 1999; General, 2015). According to Ghai (2002), the concept of decent work applies to all workers in both formal and informal sectors including the self-employed, home workers and uncontrolled wage workers.

The employment objective of decent work consist of issues that give insight on the quantity of labour needed and labour supplied in the economy and its focuses on the vital areas of the labour market situations that workers, potential workers and employers face (ILO, 2013). This strategic objective is

commonly measured with labour force participation rate (LFPR) which is seen as the number of people in the labour market used as a percentage of the working class population, employment-to-population ratios (EPR) which refers to the percentage of people employed in the working class population and unemployment rates (UR) which refers to the percentage of unemployed people in the labour market (ILO, 2013; Ghai, 2002).

The social dialogue objective entails all manner of negotiation, consultation and exchange of information between government representatives and that of employers and employees on matters which is of the same interest to them with the purpose of creating a common consent among the partners in the world of work (ILO, 2013). According to Ghai (2003), social dialogue helps to combat conflicts of interest on monetary and public policies in a supportive agenda and ensures fairness, increased productivity and cooperation for economic development. The social dialogue indicator is measured with collective bargaining, economic freedom of association and participation at the national level (ILO, 2013).

The social security as an objective of decent work covers the pressing needs for survival and provisions against contingencies like unemployment (Ghai, 2003). The Social Security Convention (1952) created nine categories of benefits namely old age, unemployment, medical care, maternity, invalidity, survivors, benefits in regards to sickness, occupational injury and family. The social security indicator is measured in two ways: assess to adequate social security in public expense on social security as a percentage of GDP, and adequate provisions for labourers in regard to the eventualities (Ghai, 2003). The Rights of working as an indicator of decent work looks at the issues of

forced labour, child labour under offensive situations, discrimination at work and freedom of association. it is a way of defending peoples' rights, promoting employment and securing work which brings about stability at all levels, the enterprise to society at large (ILO, 1999).

Even though the term working conditions is not referenced as such in the 2030 Agenda for Sustainable Development and the SDGs, many related angles are covered under different objectives and targets. SDG target 5.4 explicitly addresses the predicament of domestic work labourers, while SDG target 8.5 calls for equivalent compensation for work of equivalent worth and 8.8 calls for freedom from any harm concerning work. SDG target 10.4 looks to accomplish more prominent equity through proper pay approaches, and SDG target 16.6 is about the foundation of responsible organisations, which are vital for the improvement of working conditions. However, as Aram (2021) observed, wage setting is the main component of social discourse on working conditions of small-scale gold mining workers in Ghana.

Overview of Small-Scale Gold Mining in Ghana

Hilson (2002) defined small-scale gold mining as mining activity by an individual, an assembly of people and/or co-usable social orders that use manual strength-dominated methods, or utilise unsophisticated innovation and require low capital investment. Babut Sekyi, Rambaud, Potin-Gautier, Bannerman and Beinhoff (2003) noted that this incorporates activities at the lower end of the scale using mechanical penetrating and water siphoning, impacting, manual loading, plant with gravity concentrator and other comparative procedures. Rajae, Obiri, Green, Long, Cobbina, Nartey et al. (2015) concluded that small-scale mining is defined differently throughout the world but it is for the most

part characterised by a given ceiling and degree of complexity with which minerals are exploited.

In Ghana, the Small-scale Gold Mining Act, 1989, PNDCL 218 characterised small-scale gold mining as the mining of gold using any strategy, not including significant investment by individuals not more than nine in counts. Basu et al. (2015) added that small-scale gold mining licenses might be given to Ghanaians who are at least 18 years of age and that 1.2 hectares of land are allocated to people not more than four in number. Yet, McQuilken and Hilson (2016) suggested that in the allocation of land to the miners, a maximum of 2.0 hectares of land are awarded to a group of not less than nine people, 10 hectares are awarded to a cooperative society of 10 people or more and registered companies

Hilson, Hilson and Pardie (2007) pointed out that lawful employees work under a permit approved by the Ghana government on concessions registered in their names, and they are mostly organised and have extension services. Relatedly, Teschner (2012) argued that lawful miners secure concessions in regions where the gold reserves are rich, yet the areas are too small to justify investment in the infrastructure and equipment essential for large scale mining. Arthur, Agyemang-Duah, Gyasi, Yeboah and Otieku (2016) added that small-scale gold mining and processing systems are utilised on both hard rock and alluvial gold reserves, and the miners rely on excavators, traditional or manual techniques like shovels, pick-axe, containers, chisels and hammers due to their funds.

The contribution by Calys-Tagoe et al. (2015) suggested that in Ghana, small-scale gold is mined both underground and surface. Crawford and

Botchwey (2017) suggested that surface mining is the process whereby the mineral is gotten straightforwardly from the earth's surface and contact is kept up with the surface, throughout the process. Similarly, Clifford (2017) revealed that the functioning rule under this kind of mining is that the dirt and bedrock are eliminated to get the mineral from the surface. As Bansah et al. (2018) observed, small-scale surface gold mining is most appropriate for large, poor-quality metal stores under a slight layer, or alluvial stores found in sand and riverbeds.

In contrast, Abzalov and Abzalov (2016) noted that an underground mining is a means of retrieving and making full use of ore which are normally not available on the surface and so cannot be extracted with the use of open pit methods. Jonah and Abebe (2019) also demonstrated that the functioning guideline under this is that the bedrock is kept flawless, while channels are utilised to get to the mineral underneath. As Zolnikov (2020) indicated, small-scale underground gold mining is suitable for high-grade ore covered with thick overburdened soil and rock over the mineral. Thus, the mining strategies utilised by small-scale gold miners in Ghana depend on the kind of gold reserve being extracted and the area it is located.

Owusu-Nimo, Mantey, Nyarko, Appiah-Effah and Aubynn (2018) cited Anomabo, Chisel and sledge hammer, underground ghetto, dig and wash as well as changfa as some of the methods utilised by small-scale gold miners in Ghana. McQuilken and Hilson (2016) added that the procedure for shallow alluvial mining is prevalently called dig and wash, which includes unearthing a pit and burrowing, while the strategy for hard rock includes sinking an opening to capture the reefs. Arthur et al. (2016) alluded that where the reefs are endured,

etches and pounds are utilised to break the metal, yet where the metal is hard, explosives are utilised.

Rajae et al. (2015) stated that the small-scale gold miners in Ghana are grouped into chiselers/ drillers, loaders/load transporters, changfa/factory administrators, and others like the washers, panners, amalgamators and burner/purifier. Calys-Tagoe et al. (2015) observed that the underground small-scale gold miners have different categories of workers like the underground administrator, underground chief, security architect official/bosses who do not work directly in the process yet assume fundamental roles As Jonah and Abebe (2019) explained, the more manual the function of the group of workers, the higher the likelihood of occurrence of accidents and vice versa.

Zolnikov (2020) revealed that primarily, the drivers of small-scale gold mining accidents include rock falls, sinking, and absence of ventilation, while Adu-Baffour, Daum and Birner (2021) cited other factors such as abuse of explosives, absence of information, lack of training, and out of date and poorly maintained equipment. Barenblitt, Payton, Lagomasino, Fatoyinbo, Asare, Aidoo et al. (2021) additionally expressed that the ultimate explanations behind the risks comprise the absence of assets, absence of or non-use of security guidelines, absence of mindfulness and preparation as well as ignorance among workers. From the above discourse, small-scale gold mining may be defined as the mining of gold by individuals or a group of individuals with low capital who use unsophisticated tools, therefore producing limited gold.

Gold Processing Steps

The gold mining process in small-scale gold mining is categorised into six (6) steps namely: extraction, processing, concentration, amalgamation,

burning and refining (World Health Organisation, 2016). In all the work process, the miners, people who leave around and those who work close to the small-scale mining sites are exposed to different environmental and occupational health dangers. It must also be noted that through this process, there are safety measures to be taken under each of the above stated step. In situations where the miners comply with the necessary safety regulations, accidents and death are reduced to the barest minimum if not eliminated. For the purposes of this work, the gold processing steps in hard rock deposits would be considered.

Extraction which is the first stage of the small-scale gold mining process is where miners obtain hard rock-deposits. The extraction of the hard rock is done by tunneling, after the sediments or overburdened is cleared (United Nations Environment Programme, 2015). The miners undertake the extraction by using hammers, chisels, axes, metal bars, mattock etc. to break the rocks containing the ore. Sometimes, the miners drill or blast with the use of explosives like dynamite. The explosives expose workers to dangerous levels of dust, noise, vibration and asphyxiation (WHO, 2016) and the unsuitable use of explosives may result in death because of acute traumatic injury (Harari & Harari Freire, 2013).

The extracted rocks are collected into sacks and transported to processing site. In the process of carrying the loads over a long distance, the miners suffer/experience shoulder disorders. According to Donoghue (2004), the miners suffer as a result of the load they lift and carry. They also suffer long-lasting injury and weakness from the carriage of loads over a long distance.

Processing, which is the second stage of the gold processing steps deals with extricating the gold from other minerals and is dependent upon the type of deposit (WHO, 2016). For hard rocks deposits, the extracted ores are first crushed into smaller particles with simple tools like hammers. The crushed particles are further grinded into smaller particles, and finally to fine powder with the use of milling machine (WHO, 2016). During drilling, crushing and milling of the ore to extract the gold, silica dust is freed into the atmosphere. The dust particles contain silica which is toxic to the immune system as well as lung issues. The silica dust causes progressive scarring and increased exposure to infectious agents like tuberculosis (Gottesfeld, Andrew, & Dalhoff, 2015).

According to NIOSH (2002), failure to use the appropriate protective equipment in situations where silica dust is continuously emitted into the air results in silicosis and lung cancer, chronic renal and diseases as well as rheumatoid arthritis. Again, the noise generated by the stated processes create hearing impairment, hypertension, ischemic heart disease and stress. (Basner, Babisch, Davis, Brink, Clark, Janssen et al. 2014).

The concentration stage follows the processing stage. It refers to the means of making more visible, the amount of gold present in the ore or sediment by carefully removing lighter particles and is known as gravity concentration (WHO, 2016). According to WHO (2016), sluices, vibrating tables, centrifuges etc. are some of the examples of methods used to concentrate the gold. Sluicing is where the ore is washed with water down in succession in a sluice box positioned in an angled platform. In washing the sediments down the sluice, gold particles sink and are trapped by a carpet material that covers the bottom of the sluice. With panning, water is used to separate heavy gold particles within

a medium sized pan. In this process, sediment believed to contain gold is put in a wide curved pan along with water and the miners move the pan in series of motion purposed to remove lighter sediments. In the process, gold is kept under the bottom of the pan.

Amalgamation is where mercury is added to a concentrate to produce a mercury-gold alloy known as amalgam (Abbey, Nartey, Al-Hassan & Amankwah, 2014). The two main procedures used in small-scale gold mining are the whole ore amalgamation and concentrate amalgamation (WHO, 2016). With the whole ore amalgamation, primary mercury is added little by little prior comminution and concentration and in the process, large amount of mercury is used (Sousa, Veiga, Klein, Telmer, Gunson & Bernaudat, 2010; United Nations Environment Programme, 2015). However, for concentrate amalgamation, the mercury is added to only the little quantity of the concentrate obtained through the concentration process and less mercury is usually used. (United Nations Environment Programme, 2015).

In the amalgamation process, miners add mercury to the black sand (concentrate) in the pan, roll and rub it through the sand until it gets in contact with the gold grains and stick them together to form a gold mercury amalgam paste. The amalgam paste is then transferred onto a cotton handkerchief and squeezed until it becomes compact. The miners use their bare hands in the process and this practice exposes them to mercury which causes gingivostomatitis, photophobia, tremors and neuropsychiatric symptoms such as fatigue, insomnia, anorexia, shyness, withdrawal, depression, nervousness, irritability and memory problems (World Health Organisation, 2003).

The burning stage is where the amalgam is heated on a charcoal fire to vaporise the mercury and separate the gold (WHO, 2016). The gold formed at this stage is called sponge gold. In the process, mercury is evaporated into the air, and are inhaled directly by the miners and people living in the environment into their bodies. The inhalation of the mercury affect lungs, causes airway irritation, chemical pneumonitis, and pulmonary oedema, with consequent chest tightness and respiratory distress (Watters, & Rayman, 2014). It can also lead to respiratory failure and death (Landrigan & Etzel, 2013).

Refining is the last stage and here, the sponge gold is mixed with borax and further subjected to heat to remove the remaining mercury and other impurities (WHO, 2016). The molten gold is then poured into a mould The mould contain palm oil used for the cooling purpose and preventing the gold from getting stuck in the mould. The workers at this stage are also exposed to mercury and other chemicals like nitric acid and caustic. The next section presents some empirical studies on the knowledge of occupational health and safety and working conditions among small-scale gold miners.

Review of Empirical Studies

Miller (1983) opined that an empirical literature review is normally called an efficient overview report, which analysis past empirical studies to identify research gaps and respond to specific research questions. Similarly, Neuman (2014) showed that empirical review enables the current study to maintain a strategic distance from duplications, whereas Nakano and Muniz (2018) revealed that an empirical review is done in such a way that different readers see unequivocally what was done and what was found in a specific study and to see if the study is repeated, or the discoveries will be the same.

This study reviewed literature related to knowledge of occupational health and safety, and working conditions of small-scale gold miners. The empirical studies were selected based on the application of domino theory and/or the health belief model, while the reviews were presented in chronological order with respect to years of publication. To start with, women's participation in small-scale mining and their occupational safety and health conditions in the Philippines was conducted on secondary data by Lu (2012). The underpinning theories were the domino theory and the health belief model. Public data were taken from offices like the Mines and Geosciences Bureau, and the Department of Labour and Employment. Civil society data and those from non-governmental associations were likewise dissected utilising chi-square statistics in a cross-sectional design.

The study found that women expressed knowledge of facing many health-related issues such as homework obligations, exposure to either cyanide or mercury utilised in separating gold dust from manganese and different minerals. The researchers also reported that women suffered from respiratory and basic sicknesses from poisonous compound exposures and that women worked longer hours and had no friendly safety net. Yet, the study failed to consider the knowledge of occupational health and safety of the miners.

Nevertheless, Amponsah-Tawiah and Mensah (2016) examined the relationship and impact of occupational health and safety on employees organisational commitment in Ghana mining industry. The domino theory and health belief model informed the argument of the paper. The study adopted a quantitative approach and investigated work-related health and safety, and the various elements of authoritative responsibility by using a cross-sectional

review configuration. The respondents were both males and females who were chosen based on simple random sampling and the sample size was 370 small scale miners. Correlation analysis and multiple regression were utilised to determine the relationship and effect between the factors.

The researchers found a positive significant association between work-related health and safety, and affective, normative, and continued commitment to health and safety measures. This means there was a significant effect of work-related health and safety on affective, normative, and continued commitment to health and safety measures. It was concluded that employees do not simply become focused on the organisation but rather on the anticipation that management should initially ponder on their health and safety needs by establishing great and sound measures. However, the knowledge of occupational health and safety of the miners as well as the examination of the working conditions of the respondents were omitted.

To narrow such research gaps, Leung and Lu (2016) used a cross-sectional survey to examine the ecological well-being dangers at work and cyanide exposure of small-scale gold miners occupied with gold mining in the Philippines. Domino theory and health belief model were used to develop the thesis of the paper. A quantitative approach was used and the methods comprised organised surveys, directed meetings, work measure perception instruments, actual well-being evaluation by clinical specialists, and lab assessment of blood samples including cyanide determination of 34 native small-scale gold miners from Benguet, Philippines. Data were analysed with the use of Pearson Chi-square test and Spearman's correlation analysis technique.

The results showed that the small-scale gold miners worked for a mean of 10.3 years, had a mean age of 36 years, with mean lifetime mining work long stretches of 18,564. All were associated with short-term contracts (100%) while an extensive number were exposed to blending cyanide with metal (44%). A significant number (35%) were harmed during the mining activities, and a disturbing number (35%) had raised blood cyanide levels. The most predominant risk was exposure to chemical substances, especially to cyanide and nitric corrosive, which were generally taken care of with exposed hands, while the common health issues reported were sprains (25%), lower back pain (23%), contusions (3%), chest pains (23%), cuts (12%); fractures (11%) and swelling of joint (3%). The paper concluded that the small-scale gold miners were exposed to work-related and natural perils at work.

Armah, Boamah, Quansah, Obiri and Luginaah (2016) investigated the differences in the mean scores of the climate, health, safety and economic working conditions among male and female gold miners in Ghana. The study was supported by the domino theory and health belief model. A quantitative approach was adopted and a stratified random sampling technique was used in a cross-sectional study of 482 males and 106 females artisanal and small-scale gold miners, while the data were gathered with the help of interview schedules. Subsequently, utilising four counterfactual disintegration strategies, the disparity in working conditions was disaggregated as per group contrasts in the sizes of the determinants and group contrasts in the effects of the determinants.

By and large, the review observed a critical contrast in the mean upsides of the surveyed coefficients, which addressed a huge qualification in the environment, well-being, security, and financial working circumstances

between the male and female distinctive and limited-scope gold miners. The specialists revealed that the difference in working circumstances between the male and female diggers may be credited to separation, yet it could in a like manner come from the effect of inconspicuous elements. The researchers also reported that sex-explicit contracts exist for the artisanal and small-scale gold miners such that age and long periods of work were notable for men, while training and number of years lived locally were more significant for females.

Beth (2018) assessed the occupational safety compliance in small-scale gold miners in Central Sakwa Ward, Siaya County of Kenya. The health belief model supported the study and a mixed-method approach was adopted. A simple random sample of 97 members was done at small-scale gold mines in the examination region. The quantitative data were collected with the use of questionnaires while key informant interviewees were similarly reached for qualitative data. The quantitative data were analysed with bivariate regression analyses, while the qualitative data were analysed using manual thematic method.

The study reported that back/chest injuries and cuts comprised the most often cited kinds of injuries representing (34.7%) and (26.3%) of announced injuries individually, with shafts breakdown (33.7%) being the fundamental occupational health issue experienced at the mines. The researcher found that the main basic reasons for back/chest injuries were lifting weighty loads and off-kilter sitting position (34.7%) and that the revealed injuries were conveyed across all body parts; hands (41.1%), back/chest wounds (34.7%), leg/knee/feet (12.6%), arm (7.4%) and head (4.2%). Ultimately, the investigation uncovered that apparent expense of compliance, knowledge of safety requirements and

authority disappointments were the key variables affecting safety compliance. It was concluded that small-scale mining area in Kenya is defaced with risky practices which have contributed enormously to accidents and injuries. This study also did not consider the knowledge of occupational health and safety.

In a related study, Matsa et al. (2020) inspected the health and safety issues influencing artisanal and small-scale gold miners in Penhalonga, Ward 21, Mutasa District in Zimbabwe. The study was developed based on ideas from domino theory and health belief model. A mixed-method approach was adopted, which consisted of a blend of polls, interviews, centre-gathering conversations and direct field perceptions. A simple random sample of 88 respondents were studied using self-administered questionnaires coupled with secondary data while the qualitative data were obtained through focus group discussion. The qualitative data were analysed using content analysis, while the quantitative data were analysed using descriptive statistics.

The results from the exploration uncovered that the artisanal and small-scale gold miners experienced sicknesses like high fever and physical weakness coupled with sexual harassment. It was reported that odd notions and fantasies were among the reasons for the incidents and that few measures were put in place to address health and safety issues, incorporate mindfulness crusades, danger identification and hazard appraisal. The study suggested that knowledge of health and safety issues relate inversely with incidence of occupational hazards and thus it was concluded that training and awareness creation on the utilisation of individual defensive gear help to prevent occupational hazards.

Aram (2021) assessed the impact of subsector divisions, compositional traits, relevant factors and working conditions on gold miners' probability of

encountering work-related health challenges in Ghana. Domino theory and health belief models were used to establish the thesis of the paper. Quantitative research approach was used, while a cross-sectional survey of 504 gold miners were fitted to a settled binary logistic strategic model. Relatedly, systematic random sampling techniques were used to sample the respondents, while the data were obtained using questionnaires. Data were analysed using chi-square statistics. The study found that gold miners who were in artisanal small-scale non-mining, large scale mining and non-mining were less likely to encounter occupational-related health problems when contrasted with their partners in artisanal small-scale gold mining.

The researchers further reported that the components of female gold miners, married gold miners, and older gold miners, were bound to encounter occupational health problems when contrasted with their counterparts male gold miners, unmarried gold miners and younger gold miners, respectively. At the context-oriented level, miners who run shifts, and those who lived near mine destinations were found to encounter occupational health problems compared to the miners who did not run a shift and those who did not leave proximate to the mining sites. With working conditions, it was reported that gold miners who worked under healthy conditions were less likely to encounter work-related health problems. The study concluded that gold miners are presented with various well-being hazard situations across the subsectors and the divisions of the mining process. Yet, a qualitative approach was used, which did not allow for generalization of the results.

However, the fundamental goal of the study by Becker, Furu, Singo, Shoko, Elbel, Bose-O'Reilly et al. (2021) was to recognise the determinants of

health in artisanal small-scale gold mining and of the miners' health needs. The researchers based their thesis on domino theory and health belief model. Mixed-method approach (qualitative and quantitative) was used and it included group interviews, focused group discussions, observations and casual discussions.

There were 85 organised and 84 semi-organised interviews. The quantitative data was analysed with the use of chi-square cross tabulation and the qualitative data was analysed thematically.

Six principal subjects were identified around which miners' health needs were identified, which included everyday environments, nourishment and cleanliness, safe workplace and mining measures, monetary help, health care administrations, formalisation and schooling. The study also reported that mediations target expanding instruction, knowledge and familiarity with miners were identified with better working conditions. However, appraisal of the working conditions of the small-scale gold miners and assessment of the effects of health and safety knowledge on working conditions of the miners were omitted. Thus, this study intended to narrow those identified gaps in literature which are the absence of knowledge of occupational health and safety, and examination of working conditions of the miners.

Lessons Learnt from the Literature Reviews

Theoretical lessons were that domino theory explains that occupational accidents result from a chain of activities and that the prevention of accident requires the control of unsafe conditions, which is at the centre of the chain of activities. The health belief model explains that the decision to comply with occupational health and safety measures depends on people's fear of getting a disease and their fear reduction abilities. Also, knowledge of occupational

health and safety was understood to be the degree of awareness about existing health and safety frameworks, methods, rules, and principles at a particular workplace, while the working conditions was said to be the nature of working environment and the current terms of contract influencing work in a particular work environment.

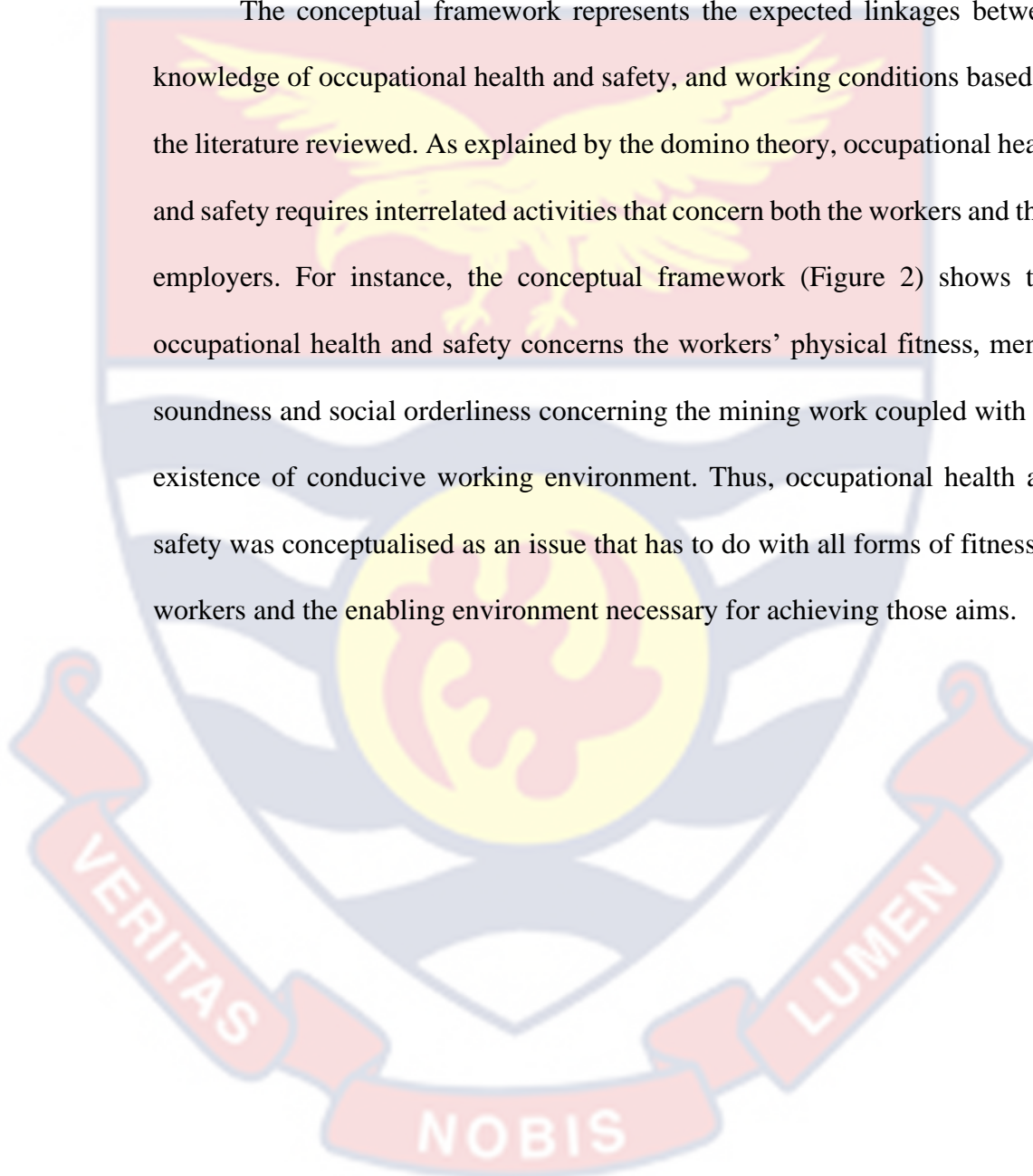
Methodological lessons were that the majority of the studies reviewed used quantitative method, while a few of them used mixed-method approach and none of them used qualitative approach solely. Questionnaires were mostly used in the studies to capture quantitative data, while focus group discussion guides were the dominant qualitative data collection instrument. Knowledge of occupational health and safety was measured with awareness about dangers associated with each work task, self-assessed health and safety status, affective stability, normative stability, and continued commitment to health and safety measures. Working conditions was measured with indicators such as working hours, training on occupational hazards, exposure to injury-prone tasks, experience of work-related illness, and shift running system.

The working conditions indicators also include healthcare needs like nourishment and cleanliness, safe workplace and mining measures, monetary help, healthcare administrations, formalisation and schooling. Also, the analytical lessons showed that chi-square, regression, descriptive statistics, correlation analysis and multiple regressions were used to analyse the quantitative data, while content thematic analyses were triangulated into the mixed-method approaches. The identified gaps are the absence of knowledge of occupational health and safety and the examination of working conditions. These lessons guided the methods chosen in this study and also informed the

conceptual framework of the study. The next section describes the conceptual framework.

Conceptual Framework for Knowledge of Occupational Health and Safety, and Working Conditions

The conceptual framework represents the expected linkages between knowledge of occupational health and safety, and working conditions based on the literature reviewed. As explained by the domino theory, occupational health and safety requires interrelated activities that concern both the workers and their employers. For instance, the conceptual framework (Figure 2) shows that occupational health and safety concerns the workers' physical fitness, mental soundness and social orderliness concerning the mining work coupled with the existence of conducive working environment. Thus, occupational health and safety was conceptualised as an issue that has to do with all forms of fitness of workers and the enabling environment necessary for achieving those aims.



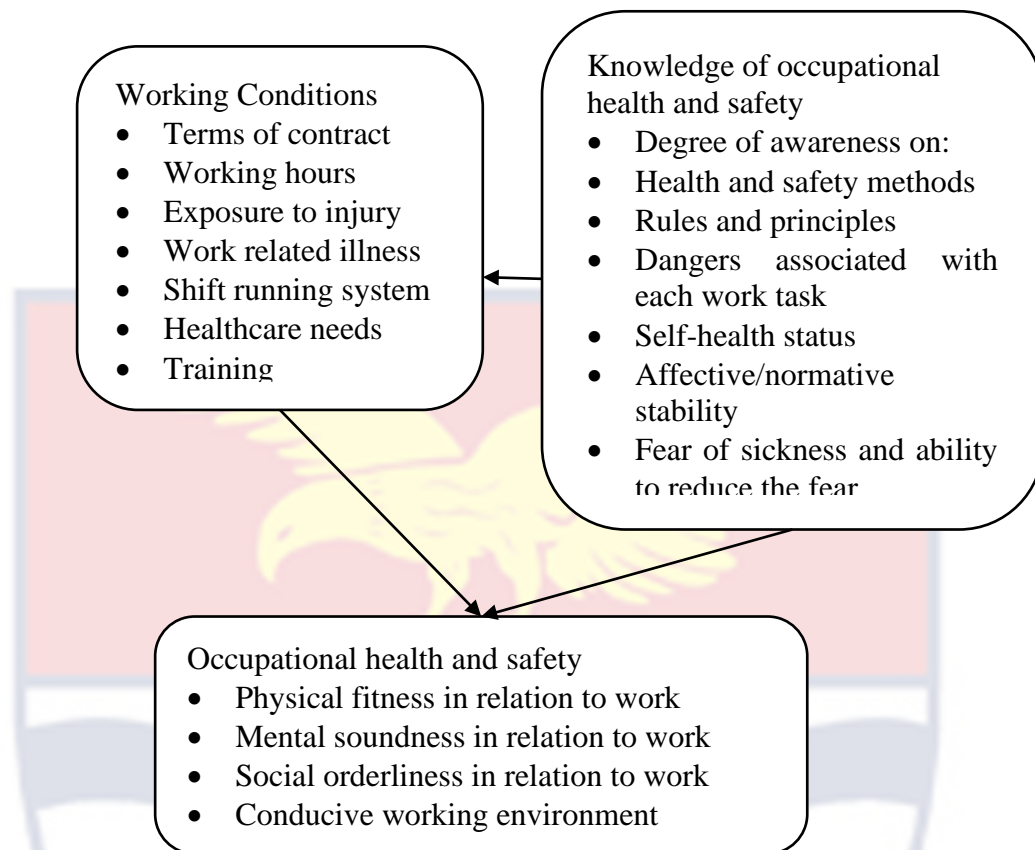


Figure 2: Conceptual Framework for Knowledge of Occupational Health and Safety, and Working Conditions of Small-Scale Gold Miners

Source: Author's Construct (2021)

However, as can be inferred from the health belief model, for the workers to ensure that their employers put measures in place for promoting occupational health and safety, the employees ought to have knowledge of occupational health and safety. As highlighted in the conceptual framework (Figure 2), knowledge of occupational health and safety relates to the degree of awareness of health and safety methods, rules and principles, self-health status, dangers associated with each work task, affective/normative stability, and fear of sickness and ability to reduce the fear. As a result, knowledge of occupational health and safety was conceptualised as the awareness of the small-scale miners

on the health and safety issues coupled with their ability to comply with the health and safety measures.

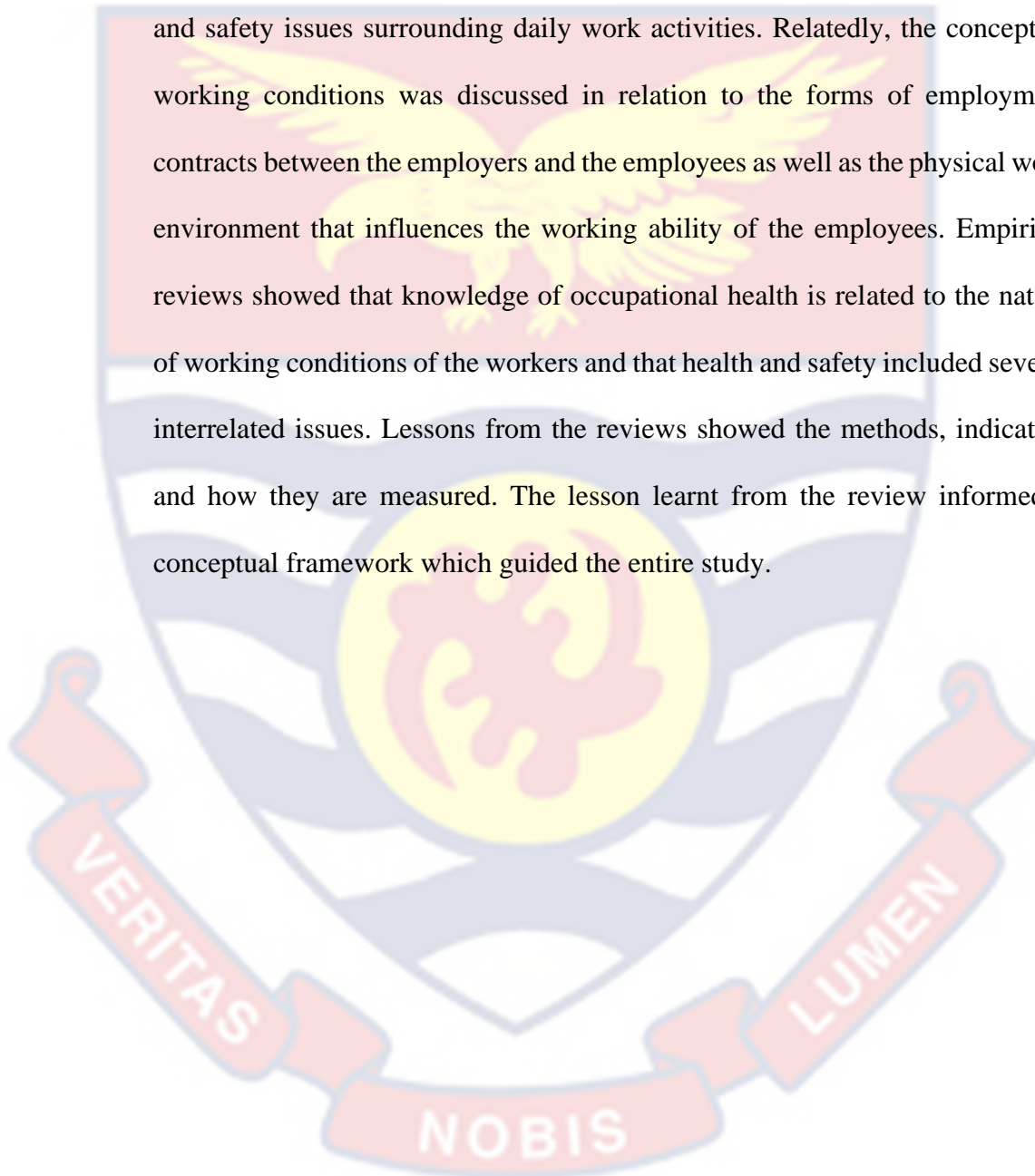
Based on ideas from the domino theory of accidents and health belief model, knowledge of occupational health and safety may influence the occupational health and safety among the small-scale gold miners. From Figure 2, the working conditions cover issues of terms of employment contract, working hours, exposure/non-exposure to injury, work-related illness, shift running, healthcare needs assessment, and on-the-job training. Thus, the main argument is that small-scale gold miners who have higher knowledge of occupational health and safety are more likely to be engaged based on better working conditions than their counterparts who have little or no knowledge of occupational health and safety. Similarly, the knowledge of occupational health and safety would in turn affect the occupational health and safety for the associations to be sustained. The next section presents the summary of the chapter.

Chapter Summary

This chapter presented the literature review related to knowledge of occupational health and safety and working conditions of small-scale gold miners. Concerning the theoretical review, the domino theory of accident was first reviewed followed by a presentation on the health belief model. The domino theory of accident was adopted to explain the causes of occupational hazards and how they can be prevented through adherence to occupational health and safety measures. The health belief model was employed to explain how the knowledge of occupational health and safety together with the fear of

getting severe illness and the ability to reduce the fear, influence the working conditions of the small-scale gold miners.

The concept of knowledge of occupational health and safety was discussed with respect to the awareness level of workers in relation to the health and safety issues surrounding daily work activities. Relatedly, the concept of working conditions was discussed in relation to the forms of employment contracts between the employers and the employees as well as the physical work environment that influences the working ability of the employees. Empirical reviews showed that knowledge of occupational health is related to the nature of working conditions of the workers and that health and safety included several interrelated issues. Lessons from the reviews showed the methods, indicators and how they are measured. The lesson learnt from the review informed a conceptual framework which guided the entire study.



CHAPTER THREE

METHODOLOGY

Introduction

Kothari (2004) opined that a research methodology is the deliberate hypothetical presentation of the techniques applied to a field of study. This includes methods and procedures used to address the objectives of the research. Kumar (2018) concluded that methodology establishes the logical pathway to discovering replies to the examination issue of a review. This chapter discusses the research design, study population, sample and sampling procedure, sample size, sources of data, data collection methods and instruments and data analysis as well as the ethical issues.

Research Design

Orodho (2003) referred to a research design as a blueprint for generating answers to research problems and it can be seen as the preparation of situations for collecting and analysing data in a way that aims to join the importance with the research purpose. Bhattacharjee (2012) noticed that the plan is based on the approach and that there are three main approaches to research: quantitative, qualitative and mixed methods.

Patel (2015) stated that the qualitative approach follows the relativists' ontological position, whereby the truth is made separately and differs from person to person, which results into the presence of different real factors. Creswell and Garrett (2008) revealed that the quantitative approach is fortified by the positivist philosophy, which requires objectiveness by inspecting the association among variables. Scotland (2012) proposed that the ontology of this approach is realism, which means that objects exist independent of the knower

and that there exists only one true reality which is understandable, identifiable and measurable.

As Comte (2015) noted, the epistemology of this approach is objectivism, which suggests that the researcher and subjects are independent of each other and the conscience of the researcher is unimportant once the meaning lies within the subject. Anderson, Sweeney, Williams, Camm and Cochran (2018) suggested that the use of the quantitative approach is important because larger samples can be used for broader studies involving more subjects and enabling more generalisation, but lacks details of social issues. Johnson and Onwuegbuzie (2004) noted that the mixed method approach is underpinned by the pragmatist perspective based on information claims that emerge out of the results of research activities, circumstances and additional outcomes of request as opposed to precursor conditions.

This study employed quantitative approach because of large samples and is considered to be the representative of the population, and that results are accepted as constituting a general and adequately widespread idea of the entire population (Martin & Bridgmon, 2012). The objectives of the study were to examine the miners' knowledge of occupational health and safety issues and to appraise the working conditions of the small-scale gold miners as well as to assess the effects of the small-scale gold miners' knowledge of health and safety on their working conditions informed the choice of the quantitative research design. Specifically, a quantitative cross-sectional study design was adopted and the next section presents the study design.

Study Design

Setia (2016) revealed that a cross-sectional design is used to determine the frequency of a particular attribute, such as knowledge of occupational health and safety issues and other work condition-related events in a defined population at a particular point in time. Therefore, a cross-sectional survey was suitable for considering the knowledge of occupational health and safety and working conditions of small-scale gold miners in Tarkwa Nsuaem Municipality. As Al-Hanawi (2020) applied, the design includes checking out information from a populace such as the miners who are chosen dependent on specific factors of interest. Cross-sectional investigations are frequently utilised in social science research, which is observational, and implied that it cannot be utilised for causal-effect studies (Lu, Wang, Lin & Li, 2020).

Guo, Luo, Lam, Cross, Plummer and Zhang (2018) proposed that the cross-sectional study design requires that researchers record the data that is available in a populace, yet they do not have to control any factor and thus, it is utilised to portray qualities that exist in their natural setting. In this respect, Cabello, Sorrel, Fernández-Pinto, Extremera and Fernández-Berrocal (2016) concluded that this strategy is often used to make inductions about potential connections or to accumulate fundamental information to help further research and experimentation. Hence, as Das (2015) noted, in contrast to longitudinal examinations, which check out a group of individuals over a drawn-out period, cross-sectional study designs are utilised to portray what is going on right now in relation to miners' knowledge of occupational health and safety working conditions. Again, several types of analysis (frequency, comparative, chi-square test, correlation, multiple regression etc) can be performed on the data that

collected over the short period of time depending on the research questions, the nature of variables.

Study Area

The study area (selected communities) is Tarkwa Nsuaem Municipality covers towns such as Efuanta, Railway Station, Akon, Nkanponase, Akyempem, Ahwetieso, Wassa Agona and Bonsaso. Tarkwa Nsuaem Municipality is one of the 22 administrative Metropolitan, Municipal and Districts Assemblies (MMDAs) in the Western Region of Ghana which came into existence through the Legislative Instrument (L.I) 1886 in 2008. It is situated between Latitude 4°05' and Longitude 0°55'. It shares borders with Prestea Huni-Valley towards the north, the south by Ahanta West, the west by Nzema East and the east by Mpohor Wassa East. Tarkwa Nsuaem Municipality exists in the South-Western Equatorial climatic zone. The temperature of the study area ranges between 26°C in August and 30°C in March. Relative humidity is by and large high all through the year between (70% – 80%) in the dry season and (75% - 78%) in the raining season.

Tarkwa Nsuaem Municipality experiences one of the greatest rainfall patterns in Ghana with a mean yearly rainfall of 187.83cm and has double rainfall patterns beginning from March to September as the primary rainfall season. Between November and February, North-East trade winds blow over the area and produces dry condition. The Municipality has a complete land space of 978.26 sq. km which is sub-partitioned into six (6) local administrative areas like Urban/Area Councils. The urban/area councils are Tarkwa urban council, Nsuaem zonal council, Nsuta zonal council, Simpa zonal council, Dompim zonal council and Benso zonal council. It has about 438 communities.

The Municipality is purposely situated to trade with districts it shares borders with, for ease of transporting goods and services within the four districts. This brings about high economic activities which result in per-capita income growth. The municipality is estimated to have a population of 90,477 which involves 48.43% females and 51.57% males (Population & Housing Census, 2010). The Municipality is part of the Birimian and Tarkwain geological formations. The Birimian rocks are economically seen as the most important formations because of their mineral deposits. The Municipality is exposed to the main gold strap of Ghana which springs from Axim in the South-West to Konongo in the North-East (Katsoulakos, & Katsoulacos, 2007). These geological formations are the reasons behind the presence of high mineral deposits in the Municipality. Because of the mineral deposits, numerous gold and manganese mining firms are situated in the Municipality (Ghana Statistical Service, 2014).

Tarkwa which is the capital of the Municipality hosts three large-scale mining companies (Gold Fields Ghana Ltd, AngloGold Ashanti (Iduaprim), and Ghana Manganese Company) and several small-scale gold mining outlets that give employment to an appreciable percentage of the population in the Municipality. Mining of minerals (gold) is done on large scale as well as limited scale and it is the super modern action nearby (Aubynn, 2009). The small-scale mining activities happen in all six (6) administrative areas. In Tarkwa Urban Council alone, it occurs in places like Efuanta, Railway Station, Akon, Kwabadu, Nkanponase, Akyempem, Ahwetieso, Wassa Agona and Bonsaso etc.

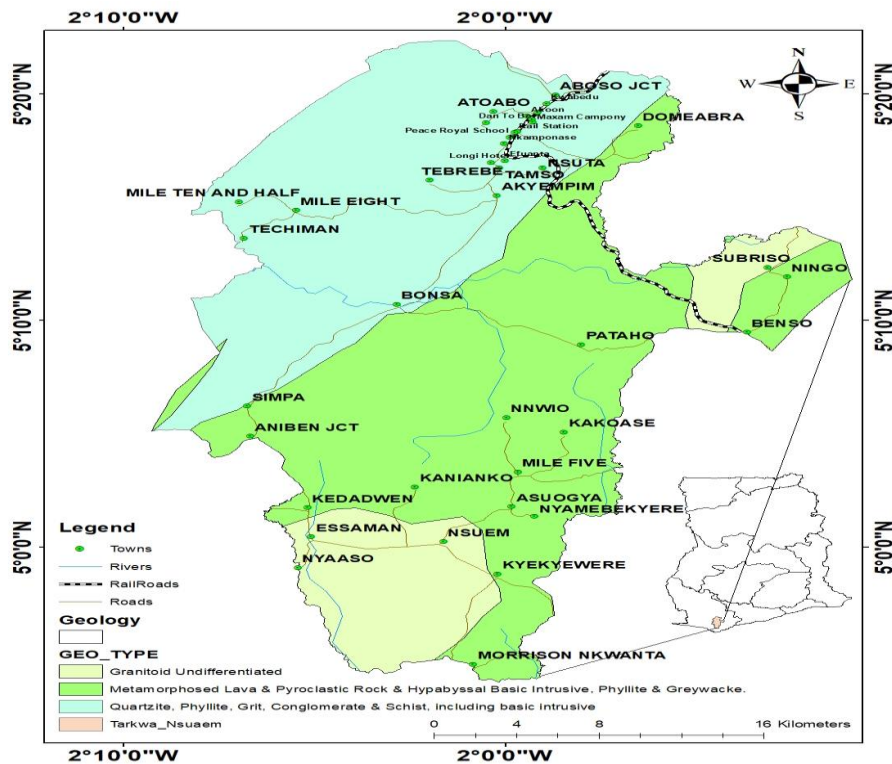


Figure 3: Map of Tarkwa Nsuaem Municipality

Source: Adopted from Geomatic Engineering Department, UMaT (2023)

The six companies used in the study were 3-registered companies namely Tarsk Mining Company, Dakete Mining Company and Johnson Mining Company. Tarsk Mining Company is located at Akon a suburb in Tarkwa with a workforce of 300 people. Dakete and Johnson Mining Companies are also located at Efuanta another suburb in Tarkwa with a workforce of 200 people and 150 people respectively. The unregistered companies were Company D, located behind Peace Royal School, Tarkwa Railway Station with a workforce of 80 people. Company E, located at Kwabadu, opposite Dan-To-Be-Hardware Shop with 70 people and Company (F), located at Nkanponase Community with a workforce of 50 people.

Study Population and Sampling

The population or the universal set for any study refers to the finite or infinite set of objects, elements, people or items that possesses structures that are of importance to the scholar (Kothari, 2004). Plano, Clark and Creswell (2015) posit that a population is a group of individuals or organisations who have the same characteristic. The population for the study consisted of 850 staff from three registered small-scale gold mining companies' (Tarsk Mining, Dakete Mining and Johnson Mining) and three unregistered small-scale gold mining companies (Company D, Company E and Company F). I used the above-listed companies because they undertake the same activities or procedures in doing the same work and were readily accessible for the study.

Koul (2009) viewed sampling as a procedure of choosing a relatively small number of respondents in the study population, from whom responses are derived for a better understanding of the entire population. Similarly, Plano et al. (2015) referred to a sample as a sub-group of the population that partakes in a study and offers data for the study. Sharma (2017) also hinted that the choice of a sampling technique is based on the nature of the target population and how it is distributed across the study area. For the purpose of this study, stratified random sampling technique was used. As Etikan and Bala (2017) explained, stratified sampling is the type of sampling technique whereby every individual in the target population is given an equal opportunity to be selected by sampling randomly from subgroups called strata.

Sarantakos (2005) clarified that stratified sampling is a probability sampling technique used in situations where the target population is divided into a number of strata, and the sample is drawn from each stratum. Accordingly, in

this study, I treated the individual companies as strata from whom the miners were randomly sampled. As validated by Jing, Tian and Huang (2015), the stratified sampling technique was used as a means to reduce the level of heterogeneity in the study population and to also achieve greater accuracy in estimating the sample. The miners were classified based on their specialisation and the type of company in which they work.

To initiate the actual sampling procedure, the sample size was determined. According to Roscou (1975), the rule of thumb for sample size determination in behavioural research states that a sample size of more than 30 and less than 500 is good enough for most studies. However, Friedman, Furberg, DeMets, Reboussin and Granger (2015) critiqued that such an approach makes it difficult to establish the representativeness of the sample size used in the study. Malone, Nicholl and Coyne (2016) suggested that to overcome such weakness, a statistical method ought to be used in determining the sample size. Thus, I used the statistical sample size computation table proposed by Krejcie and Morgan (1970) to select the sample size of the study.

From Krejcie and Morgan's (1970) statistical sample size determination table, the sample size for the population of 850 small-scale gold miners is 265 (Table 1). The determined sample size was then proportionally distributed across the various mining groups to determine the sample size for each of the groups. Simple random sampling was then used to pick the final sample. This was done by numbering pieces of paper up to the number of respondents in strata and a field assistant was asked to pick a number at random and the identification attached to each number picked was recorded until the sample size for each stratum was gotten.

Table 1: Mining Companies used in the Study

Company	Population (P)	Sample size (s)
Tarsk Mining Company	300	93
Dakete Mining Company	200	62
Johnson Mining Company	150	47
Company D	80	25
Company E	70	22
Company F	50	16
Total	850	265

Source: Field Survey: March-April, (2020)

The sample size of 265 was grouped into 94 workers under the extraction stage (drillers & loaders), 75 workers under the processing stage (crushers), 51 workers under the concentration stage (washers and panners), 39 workers under the amalgamation stage (amalgamators) and, 6 workers under the burning and refining stage (burners/refiners). These numbers were chosen based on the number of people who undertake a particular job and it was done to ensure that the sample used, was a full representation of the entire workforce. The population was made up of only males because of the nature of work (underground mining).

Data Collection Method

Data was needed to address the specified objectives of the study, which were to examine gold miners' knowledge of occupational health and safety issues and to appraise the working conditions of the small-scale gold miners as well as to assess the effects of the small-scale gold miners' knowledge of health and safety on their working conditions. Flick (2017) viewed data collection as

a methodical procedure of exploring express information to offer responses to appropriate requests and surveys, which revolve around finding all the results that are considered applicable to a particular theme. In this way, Flick (2018) contended that the essential for data collection is to get quality evidence that looks to address all of the exploration questions that have been posted.

Some of the issues for which data were needed included the respondents' knowledge of health and safety practices, training on workplace safety, and awareness of the health implication of workplace health hazards. Relatedly, data was needed on the working conditions of the respondents such as working hours, the existence of break periods and first aid as well as observation of holidays and leave periods. Information was also requested on hazards and risks, accidents associated with various stages of small-scale mining operations. Finally, the data was collected on ways to prevent and control occupational health and safety issues of small-scale gold miners and how knowledge affects the occupational health and safety situation of workers and the organisation. Thus, in this work, data was collected about all three objectives. The data was obtained with the use of interview schedule.

Instruments Design

The instrument used in gathering the primary data for the study was an interview schedule. According to Creswell & Garrett (2008) an interview schedule is a research instrument that consist of set of questions (close-ended questions, and or open-ended questions) with answers for the purpose of gathering data from respondents. The interview schedule used in this study contained both closed-ended and open-ended questions because it helps to gather data on known and unknown issues and the information provided by the

respondents can easily be converted into quantitative data by coding. The instrument was designed into five sections.

Section one contained the demographic characteristics, which was designed with eight (8) items, while section two was about the knowledge of the respondents on occupational health and safety and this contained thirteen (13) items. The issues within section two were meant to measure the first objective of the study, which is to examine the miners' knowledge of occupational health and safety issues. Section three measured the second objective of the study, which is to appraise the working conditions of small-scale gold mining operations. Section three was further divided into three sub-parts (3a, 3b and 3c).

Part 3a had ten (10) items that sought to look at the existing health and safety conditions of small-scale gold miners, part 3b had fourteen (14) items which sought to consider the hazards and exposure, diseases and accidents/injuries that occur at the various stages of the small-scale gold mining operations and part 3c with three (3) items which sought to look at ways to prevent and control occupational health and safety issues respectively. Section 4 had five (5) items which measured the third objective which is examining how knowledge of health and safety situations affects the working conditions of the miners.

The instruments were self-administered to the workers of the various small-scale gold mining companies used in this study with the help of two assistants, who helped the respondents in answering the questions as they read and explained the items and their corresponding responses to them. The answers the respondents provided were indicated on the interview schedule. It was done

in this way because majority of the respondents were in a hurry to go and work while most of them too could hardly read, which meant that when the workers are left alone, they will not answer the instrument. All the information gathered were organised for processing and analysis.

Pre-Testing

Before the main fieldwork, the interview schedule was pre-tested on ten people from the Tarkwa Nsuaem Municipality. Ten interview schedules were administered to some ten selected individuals who are into the small-scale gold mining business to determine the suitability or otherwise of the instruments to fulfil the objectives of the study. This was to test the instrument for validity. The selected respondents were used because they were engaged in similar small-scale mining activities. They assisted in uncovering and addressing the irregularities and unclearness in the surveys. After the pre-test, the questions were revised by adding new questions and erasing old ones that were not required.

Ethical Consideration

In order not to abuse the cultural, social and emotional rights of respondents, the consent of the respondents were sought before administering the questions and their privacies were respected. Measures were also taken to ensure that information gathered was protected from getting into the hands of third parties. Respondents were assured that participation was voluntary and that they had the right to withdraw from the study at any time if they so wished. Respondents were not required to write their names on the interview schedule in order to ensure the confidentiality and anonymity of subjects. Finally, a cover

letter which explained the objectives of the study accompanied the interview schedule..

Fieldwork

The fieldwork was organised between March 26, 2020, and April 28, 2020. The researcher engaged the services of two research assistants to aid him in the data collection. The research assistants were taken through the research instruments to understand the questions and to interpret them well for the data collection exercise. The researcher sought permission from the owners of the firms and showed them his (researcher) letter of introduction from the University. The owners of the firm then introduced the researcher and his team to the workers. The researcher and his team explained the purpose of the study to the workers and sought their consent before administering the interview schedule.

Data Management and Analysis

The quantitative data obtained from the interview schedule were edited, coded, and inputted into SPSS version 23 for cleansing and onward usage to address the objectives of the study. Thus, the specific objectives coupled with the Conceptual Framework (Figure 2) served as guidelines for managing and analysing the data. A quantitative approach was used to address the objectives of the study. The first objective was about miners' knowledge of occupational health and safety issues in the Tarkwa Nsuaem Municipality, while the second objective focused on appraisal of the working conditions of the small-scale gold miners, and the last objective assessed the effects of the small-scale gold miners' knowledge of health and safety on their working conditions. Concerning all three objectives, descriptive analytical methods such as frequencies and

percentages as well as chi-square statistics were used to derive meaningful information from the data, while the results were presented in tables and figures. One limitation in using chi-square for large samples is that, all relationships tend to be significant when they are basically not so but because large samples are used (Kothari, 2004).

Chapter Summary

Based on the specified objectives of the study, a quantitative approach was adopted, which conformed to the positivists' idea that the truth is one and can be obtained by following systematic procedures. A survey of 265 small-scale gold miners across the study area of Tarkwa Nsuaem Municipality were randomly sampled and data was collected from them with the use of an interview schedule, whereby the researcher read the questions and wrote the responses that were given. Descriptive analytical techniques such as frequencies and percentages coupled with chi-square statistics were used to analyse the data, while the results were presented in tables and figures. The next chapter presents the results and discussion of the analysis.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter discussed the results of the study in line with its specific objectives. The chapter is divided into four sections. Section one looked at the demographic information of respondents, while section two focused on the examination of the miners' knowledge of occupational health and safety issues. Relatedly, section three appraised the working conditions of the small-scale gold miners, while the final section assessed the effects of the small-scale gold miners' knowledge of health and safety on their working conditions. A proportionate random sample of 265 miners at a (100%) response rate was used in the study.

Demographic Information of Respondent

This sub-section examined the demographic information of the respondents which includes sex, age, marital status, level of education and position. Focusing on the sex of the respondents, all 265 respondents were males representing (100%). The issue of males totally dominating their female counterparts could be assigned to the socio-cultural views that mining is a male vocation as explained by Zalk (2013) that the male prevalence in the mining industry is that, it required extended periods which the female partners could not offer because they needed to attend to specific social obligations like kids bearing and supporting.

In order to provide detailed information on the demographic characteristics of the respondents, the marital status and the age data were cross-tabulated.

Table 2: Age of Respondents by Marital Status Cross-tabulation

		Marital Status				
		Single	Married	Divorced	Total	
Age in years	20 or below	Count	3	0	0	3
		% within Marital Status	2.9%	0.0%	0.0%	1.1%
	21-30	Count	67	27	0	94
		% within Marital Status	65.7%	16.9%	0.0%	35.5%
	31-40	Count	32	85	3	120
		% within Marital Status	31.4%	53.1%	100.0%	45.3%
	41-50	Count	0	33	0	33
		% within Marital Status	0.0%	20.6%	0.0%	12.5%
	51-60	Count	0	12	0	12
		% within Marital Status	0.0%	7.5%	0.0%	4.5%
	Above 60	Count	0	3	0	3
		% within Marital Status	0.0%	1.9%	0.0%	1.1%
Total		Count	102	160	3	265
		% within				
	Total		38.5%	60.4%	1.1%	100.0%

Source: Fieldwork, March – April, (2020)

Out of the 265 respondents, 45.3 percent were in the range of 31-40 years, while 1.1 percent each were either above 60 years of age or 20 years of age or below. Exactly 35.5 percent of the respondents were between the ages of 21-30 years, while 12.5 percent were in the age range of 41-50 years. Thus majority (81.9%) of the respondents were at most 40 years (Table 2). This indicated that majority of the workforce in the small-scale gold mining companies were youth. Santos, Oliveira, Gallottini, Caliento and Sarmento (2018) explained that most mining companies preferred young and middle-aged workers to elderly ones because younger miners are more energetic, prompt, curious, enthusiastic and innovative than the elderly people.

In relation to marital status, the majority (60.4%) of the respondents were married, while 38.5 percent were still single and only 1.1 percent of the respondents were found to have divorced their partners (Table 2). The details revealed that none of the respondents who were 20 years of age or below were ever married/divorced, while the majority (65.7%) of the respondents who were single were within the age range of 21-30. Again, all the respondents who were divorced as well as the majority (53.1%) of the miners who were married were within the age range of 31- 40 years.

Axinn and Thornton (2000) clarified that after 1960, marriage rates and conjugal maturity started to fall, while at first, marriage and non-conjugal issues all rose. Ayaaba, Yuan and Ni (2017) saw that decreases in marriage rates resulted from ladies' expanded status and autonomy and that the absence of marriage for blacks is due to limited business opportunities for individuals of colour as the economy moved away from farming to mining and non-manual works.

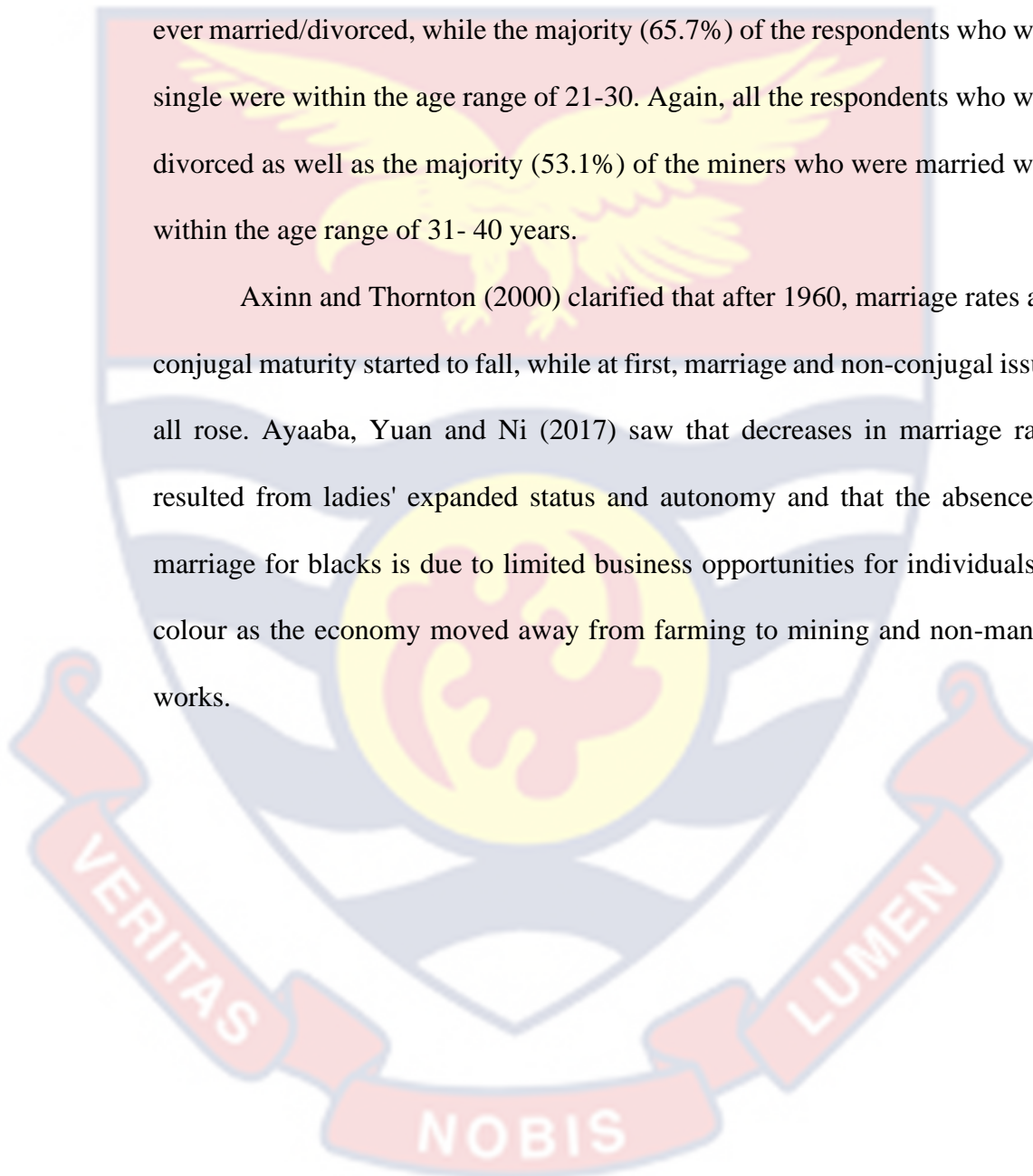


Table 3: Level of Education by Current Working Position of the Respondents Cross-tabulation

			Educational Level				
			JSS/ JHS /				
			No schooling	Primary	Form 4	Secondary	Total
Current Position	Loader	Count	0	6	19	12	37
		% within Educational Level	0.0%	20.0%	12.2%	15.8%	14.0%
	Driller	Count	0	6	39	12	57
		% within Educational Level	0.0%	20.0%	25.0%	15.8%	21.5%
	Crusher	Count	0	12	42	12	66
		% within Educational Level	0.0%	40.0%	26.9%	15.8%	24.9%
	Refiner or Burner	Count	0	0	7	12	19
		% within Educational Level	0.0%	0.0%	4.5%	15.8%	7.2%
	Amalgamator	Count	0	6	18	15	39
		% within Educational Level	0.0%	20.0%	11.5%	19.7%	14.7%
	Sluicer or Panner or Doller or Sump Boys	Count	3	0	31	13	47
		% within Educational Level	100.0%	0.0%	19.9%	17.1%	17.7%
Total		Count	3	30	156	76	265
		% within Total	1.1%	11.3%	58.9%	28.7%	100.0%

Source: Fieldwork, March – April, (2020)

The majority (97.7%) of the workers had formal education. The majority (58.9%) of the respondents had up to Junior High School/ Junior Secondary School/Form Four level/stage education (Table 3). This goes to describe the category of people in the informal sector and in this case the small-scale gold mining sector. This is in line with what was claimed by Osei-Boateng and Ampratwum (2011) that the growing rate of informal work in Ghana can be explained by the low educational level attainment of workers within the sector.

In relation to the position of the workers, 14.0 percent were loaders /drillers, while 21.5 percent were drillers. Similarly, 24.9 percent of the respondents were crushers, while 7.2 percent were washers/panners. Again, 14.7 percent of the miners were amalgamators and 17.7 percent were sluicers/dollers/sump boys (Table 3). All the respondents who never had formal education were engaged as sluicers/dollers/sump boys, while none of the respondents who had up to just primary level education was neither engaged as refiners/burners nor as sluicers/dollers/sump boys. The highest number (40.0%) of the respondents who had primary level of education as well as the greatest number (26.9%) of the respondents who had School/Form Four level/stage education were engaged as crushers. Also, the highest number (19.7%) of those who had secondary level education were engaged as amalgamators.

All the mining companies used in the study were engaged in underground mining. The majority (78.5%) of the respondents were working in registered small-scale mining companies, while the rest (21.5%) of the respondents were working in unregistered small-scale mining companies. The Ghana Small-scale Gold Mining Act, (1989), PNDCL (218) characterised small-scale gold mining as the mining of gold by using underground or any

other strategy and that small-scale gold mining companies could be registered in the name of Ghanaians who are at least 18 years. McQuilken and Hilson (2016) revealed that registration is vital to ensure that the operations conform to the laws.

Miners' Knowledge of Occupational Health and Safety Issues

The first specific objective of this research was to examine the miners' knowledge of occupational health and safety issues. As highlighted in the conceptual framework (Figure 2), knowledge of occupational health and safety relates to the degree of awareness of health and safety methods, rules and principles, self-health status, dangers associated with each work task, affective/normative stability, and fear of sickness and ability to reduce the fear. In evaluating this objective, workers were asked a series of questions which they responded to as presented in Table 4. All 265 miners said that they knew their rights and responsibilities in relation to workplace health and safety.

The majority (98.9%) of the respondents said that they knew how to perform their jobs in a safe manner while all the respondents again said they have the knowledge to assist in responding to any health and safety concerns at their workplace. Relatedly, all 265 respondents said that they knew the necessary precautions to take in performing their jobs and added that they undertake the appropriate health and safety practices. Again, all the respondents indicated that they were very much aware that failure to undertake health and safety practices would result in injuries, diseases and even, death.

Additionally, the larger part (86.4%) of the respondents said that each worker is given the necessary health and safety training at the work environment while starting new work, changing a job, or using new techniques/machines.

Okafoagu et al. (2017) indicated that this information is significant as it helps individuals to make a compelling move or settle on significant choices on their own. This is clarified by Zhang, Chen, Li, An and Wang (2020) that information about existing well-being frameworks, methodology, rules, and principles in the work environment is an initial phase in getting away from business related wellbeing gambles.

Voukelatou, Gabrielli, Miliou, Cresci, Sharma, Tesconi et al. (2021) indicated that this information on wellbeing is a significant value for the lives of people and this could be seen as a guide for group advancement. In circumstances where labourers know about work-related wellbeing and security in their work, they enjoy many advantages, for example, less expense, further developed organisations image, less staff turnover and higher usefulness (Koopman et al, 2011). Subsequently, information on work-related well-being and security is relevant for increasing the level of mindfulness on wellbeing and wellbeing techniques, rules and standards, self-wellbeing status, perils related with each work task, full of feeling/standardising dependability and apprehension about disorder and capacity to diminish the dread (Becker et al., 2021).

Table 4: Miners' Knowledge of Occupational Health and Safety Issues

Variable	Option	No. of	
		Respondents	Percentage
	Yes	265	100%
I know my rights and responsibilities in relation to workplace health and safety	No	0	0%
	Not sure	0	0%
	Yes	262	98.9%
I know how to perform my job in a safe Manner	No	3	1.1%
	Not sure	0	0%
	Yes	265	100%
I have the knowledge to assist in responding to any health and safety concerns at my workplace	No	0	0%
	Not sure	0	0%
	Yes	265	100%
I know the necessary precautions that I should take while doing my job	No	0	0%
	Not sure	0	0%
	Yes	265	100%
I know the health and safety practices related to my work	No	0	0%
	Not sure	0	0%
	Yes	265	100%
I undertake the appropriate health and safety Practices	No	0	0%
	Not sure	0	0%
	Yes	265	100%
I know that failure to undertake health and safety practices would result in injuries, diseases and even death	Yes	265	100%
	No	0	0%
	Not sure	0	0%

Table 4 continued

Every employee is given the necessary workplace health and safety when starting a job, changes a job or using new techniques/machines	Yes	229	86.4%
	No	36	13.6%
	Not sure	0	0%
There is a regular communication between employees and management about health and safety issues	Yes	235	88.7
	No	30	11.3%
	Not sure	0	0%
Employers are responsible for the health and safety of Employees	Yes	157	59.2
	No	108	40.8%
	Not sure	0	0%
Employees are responsible for their own health and safety	Yes	157	59.2
	No	108	40.8%
	Not sure	0	0%
I undergo basic OHS training	Yes	172	64.90
	No	90	34.0
	Not sure	3	1.1
We have OHS policy at the workplace	Yes	208	78.5%
	No	57	21.5%
	Not sure	0	0%

Source: Fieldwork, March – April, (2020)

Table 4 further demonstrates that the majority (88.6%) of the respondents said that there was consistent communication between workers and management about health and safety issues. Again, majority (59.0%) of the miners claimed that employers are responsible for the health and safety of employees. Even though employers were supposed to provide them with the necessary personal protective equipment (PPE), they hardly provide for them and even in situations where employers provide them with health and safety items, the cost of the items are deducted from their wages.

From the results gathered, it is evident that the workers had knowledge on occupational health and safety issues and they tried on their own to ensure they were safe and healthy. This is in line with Ivancevich (2015) that the accomplishment of wellbeing and security programs lay fundamentally on how representatives and bosses work together with security rules. The practice whereby employers provide health and safety equipment for workers and deduct it from their wages is against the provision of Section 118(1) of part XV of Labour Act (2003) Act 651 which expresses that it is the obligation of each business to guarantee that each labourer engaged by the business in question works under agreeable, safe and wellbeing conditions.

Finally, the respondents' knowledge of occupational health and safety policy at the workplace was cross-tabulated by participation in basic occupational health and safety training. Out of the 265 respondents, majority (61.1%) said that they have undergone basic occupational health and safety training (Table 5). This has implications for knowledge of occupational health and safety policy at the workplace because as the domino theory explains, knowledge of occupational health and safety policy at the workplace is

consequent of a subsequence of occasions including basic occupational health and safety training that are so interdependent (DeCamp & Herskovitz, 2015).

Table 5: Knowledge of OHS Policy at Workplace by Miners who have Undergone Basic OHS Training Cross-Tabulation

			Undergo basic OHS training			Total
			Yes	No	Not Sure	
Know OHS policy at the workplace	Yes	Count	138	67	0	205
		% within I undergo basic OHS training	85.2%	67.0%	0.0%	77.4%
	No	Count	24	33	3	60
		% within I undergo basic OHS training	14.8%	33.0%	100.0%	22.6%
	Total	Count	162	100	3	265
		% within Total	61.2%	37.7%	1.1%	100.0%

Source: Fieldwork, March – April, (2020)

The majority (77.4%) of the respondents said that they knew about the occupational health and safety policy at the workplace. The details show that majority (85.2%) of the respondents who have undergone basic occupational health and safety training as well as majority (67.0%) of the respondents who knew that they did not undergo any basic occupational health and safety training, knew about the occupational health and safety policy at the mining workplace. However, all the respondents were not sure whether they have undergone any basic occupational health and safety training or did not know about any occupational health and safety policy at the mining workplace (Table 5).

Furthermore, the chi-square statistics ($\chi^2 = 22.042$, P-value = 0.000) revealed that participation in basic occupational health and safety training had a significant association with knowledge of occupational health and safety

policy at the mining workplace. The implication is that the miners who had undergone basic occupational health and safety training were more likely to have knowledge about the occupational health and safety policy at the mining workplace, than the miners who did not undergo basic occupational health and safety training.

Per the health belief model, basic occupational health and safety training is attached to individuals' awareness of, and concern about, severe health risks related to assured preventable ills, including diseases that could be relieved whenever known sufficiently early (Abraham & Sheeran, 2015). Sulat et al. (2018) shared a view that the health belief model attempts to explain that as employers train workers to comprehend health issues, it could decrease workplace health risks and ensure workplace safety by taking certain proactive measures, and serve as a premise to expand workers' knowledge on health challenges. Green et al. (2020) added that this, in turn, improves the challenges of worker risk, and propels activities to diminish/wipe out health risks which will result in the creation of self-appreciation to embrace the required changes.

Appraisal of the Working Conditions of the Small-scale Gold Miners

In respect of the second objective, I appraised the health and safety working conditions of small-scale gold miners. In doing this, issues like the maximum hours worked, breaking for lunch, off days, as well as health and safety facilities availability were considered. The empirical review and the conceptual framework (Figure 2) informed the selected issues. As explained by the domino theory of accident (Heinrich, 1941), the chains of activities of the small-scale gold miners are done within unsafe conditions, which ignites hazards that undermine occupational health and safety. The health belief model

maintains that even though poor working conditions cause injuries, labour inefficiency and low productivity, people have varying opinions about what constitutes poor/good working conditions (Calys-Tagoe et al., 2015)

Accordingly, as the labour standards require that the normal working hours should be at most eight hours per day, the respondents were asked to state the maximum hours that they work in the small-scale gold mining activities.

Table 6: Current Position by Maximum Work Hours in a Day Cross-Tabulation

			Maximum work hours in a day			
			Less than 8 hours	8 hours	More than 8 hours	Total
Current Position	Loader	Count	0	6	31	37
		% within Position	0.0%	16.2%	83.8%	14.0%
	Driller	Count	15	9	33	57
		% within Position	26.3%	15.8%	57.9%	21.5%
	Crusher	Count	3	24	39	66
		% within Position	4.5%	36.4%	59.1%	24.9%
	Refiner or Burner	Count	0	4	15	19
		% within Position	0.0%	21.1%	78.9%	7.2%
	Amalgamator	Count	9	0	30	39
		% within Position	23.1%	0.0%	76.9%	14.7%
	Sluicer/ Panner/ Doller/	Count	3	10	34	47
		% within Position	6.4%	21.3%	72.3%	17.7%
Total		Count	30	53	182	265
		% within Total	11.3%	20.0%	68.7%	100.0%

Source: Fieldwork, March – April, (2020)

The data from the responses were further cross-tabulated by the work category of the miners (Table 6). The result of the analysis showed that the majority (68.7%) of the miners worked for more than eight hours per day. The

chi-square statistics showed that the respondents' work category related significantly with the maximum number of hours that they worked per day ($\chi^2 = 47.410$, P-value = 0.000). The test of the effect size indicated that the association was moderate (Contingency Coefficient = 0.390, P-value = 0.000).

The loaders were most likely to work for more than eight hours per day, followed by the refiners/burners, amalgamators, sluicers/panners/dollars, crushers, and drillers respectively. This goes against the ILO and Labour Act 2003, Acts 651 provisions for a maximum of eight hours of work. Badril et al. (2018) hinted that working hours relate to the five classes of hazards in working conditions namely physical, biological, chemical, ergonomic, and psychological hazards because people who work for long hours are prone to such risks. Yet, Kumi-Boateng and Stemn (2020) noted that due to high levels of unemployment, people subject themselves to working beyond the stipulated eight hours per day.

As part of the appraisal of the working conditions, the miners were also asked whether they were paid for working overtime or not and the responses were cross tabulated with the level of education of the respondents (Table 6). It was shown that the majority (67.5%) of the miners were not paid for working overtime. The results of the chi-square analysis showed that there was a weak (Contingency Coefficient = 0.175, P-value = 0.037) statistically significant association between the respondents' level of education and receipt of payment for overtime work ($\chi^2 = 8.486$, P-value = 0.037).

Table 7: Level of Education by Receipt of Payment for Overtime Cross-Tabulation

Level of Education	No schooling	Count % within Paid for Overtime	Paid for	Overtime	Total
			Yes	No	
			0	3	3
			0.0%	1.7%	1.1%
	Primary	Count % within Paid for Overtime	15	15	30
			17.4%	8.4%	11.3%
	JSS/ JHS / Form 4	Count % within Paid for Overtime	53	103	156
			61.6%	57.5%	58.9%
	Secondary	Count % within Paid for Overtime	18	58	76
			20.9%	32.4%	28.7%
Total		Count % within Total	86	179	265
			32.5%	67.5%	100.0%

Source: Fieldwork, March – April, (2020)

Specifically, all the respondents who never had any form of formal education were not paid for working overtime (Table 7). However, the majority (61.6%) of the respondents who were paid for working overtime as well as a greater number (57.5%) of those who were not paid for working overtime were miners who had up to JSS/JHS/Form 4 level education. Thus, miners who had at least a primary level education were more likely to be paid for overtime work than miners who did not have any form of formal education. Comparing this situation to what was reported by Lu (2012) that majority of the small-scale gold miners in the Philippine worked more than the stipulated eight hours without

pay for the extra hours of work is accurate. However, that study did not establish the relationship between payment for overtime work and level of education.

Relatedly, out of the 265 respondents who provided information about having break period to have lunch or not, the results showed that the majority (91.7%) of them were not given break period to have lunch (Table 8). The cross-tabulation of the data on having break period to have lunch or not by the status of the company in terms of being registered or not showed that all the respondents who worked in unregistered mining companies never had a break period to have lunch, while all the respondents who had break period to have lunch were working in registered small-scale gold mining companies. The chi-square statistics also revealed that there was a weak (Cramer's $V = 0.158$, $P\text{-value} = 0.010$) significant association between the company being registered and the workers being given break period to have lunch ($\chi^2 = 6.575$, $P\text{-value} = 0.010$).

The implication is that the respondents who worked in registered small-scale gold mining companies were more likely to be given a break period to have lunch than those who worked in unregistered companies. Similar outcomes were documented by Beth (2018) that small-scale miners in Kenya were less likely to be given an official break time to have lunch due to the unregulated nature of their work. However, the researcher failed to show the relationship between working in registered/unregistered small-scale gold mining companies and having a break period to have lunch, while this study revealed that registered small-scale gold mining companies were more likely to give their workers break period to have lunch than unregistered small-scale gold mining companies in the study area (Table 8).

Table 8: Status of Company by Having Break Period for Lunch Cross-Tabulation

			Break for lunch		Total
			Yes	No	
Status of Company	Non-registered	Count	0	57	57
		% within having break period for lunch	0.0%	23.5%	21.5%
	Registered	Count	22	186	208
		% within having break period for lunch	100.0%	76.5%	78.5%
Total		Count	22	243	265
		% within Total	8.3%	91.7%	100.0%

Source: Fieldwork, March – April, (2020)

The next working conditions issues were about having off days and observing holidays without going to work. The cross-tabulation showed that majority (87.5%) of the respondents had off days from work, but majority (83.0%) of them did not observe public holidays. The chi-square statistics also showed that there was a significant weak (Cramer's V = 0.171, P-value = 0.005) association between the observation of public holidays and off days ($\chi^2 = 7.710$, P-value = 0.005). Specifically, all the respondents who observed public holidays also had off days from work. Yet, majority (85.0%) of the respondents who did not observe public holidays were people who had off days.

Disaggregation of the data showed that out of the 220 respondents who worked on public holidays, only 17.7 percent were paid the double wage salary set in the labour standards, while majority (82.3%) of them were paid their usual salary even when they worked on public holidays. As Routh and Borghi (2016) suggested, small-scale gold mining dominates the informal economy. Ram, Edwards, Jones and Villares-Varela (2017) also observed that the informal

economy has been extended to include paid work in unprotected occupations such that businesses recruit workers without a legal working agreement and thus pay them what the business deems fit under the prevailing condition. Lips (2020) added that these miners in the informal economy are dealt with like contractual workers and are mostly paid in cash that was not predetermined.

Relatedly, out of the 265 respondents who were asked whether they had access to first aid box and fire extinguisher, majority (73.6%) did not have access to first aid at work and almost 93 percent (92.8%) did not have access to fire extinguisher at work. The majority (76.8%) of the miners who did not have access to first aid, did not also have access to fire extinguisher, while majority (68.4%) of the workers who had access to first aid, also had access to fire extinguishers. Furthermore, there was a statistically moderate (Cramer's $V = 0.265$, $P\text{-value} = 0.000$) significant association between having access to first aid and having access to fire extinguisher ($\chi^2 = 18.580$, $P\text{-value} = 0.000$). Thus, the miners who had access to first aid were more likely to also have access to fire extinguisher and vice versa.

Hazards and Exposures

The respondents were asked to state the types of hazards that they were exposed to at each stage of the mining work. It came out that concerning dust, majority (96.6%) of the 88 people who worked at the extraction stage as well as a greater number (95.8%) of the 72 respondents who worked at the processing stage were exposed to dust, while none of the four respondents who worked at the burning stage was exposed to dust. At the concentration stage, (55.3%) of the 47 people, and (76.9%) of the 39 people who worked at the amalgamation stage as well as (80%) of the 12 people who worked at the refining stage were

not exposed to dust. The respondents who worked at the extraction and processing stage were more likely to be exposed to dust compared to their counterparts who worked at higher stages of the mining work ($\chi^2 = 136.390$, P-value = 0.000).

The results concerning exposure to chemicals, majority (92.3%) of the 39 people who worked at the amalgamation stage as well as all the four respondents who worked at the burning stage, and all the 15 people who worked at the refining stage claimed that they were exposed to chemicals. The majority (54.5%) of the 88 people who worked at the extraction stage as well as a greater number (70.8%) of the 72 respondents who worked at the processing stage and majority (61.7%) of the 47 people who worked at the concentration stage were not exposed to chemicals. The respondents who worked at the amalgamation, burning and refining stages of the small-scale mining were more likely to be exposed to chemicals compared to their counterparts who worked at lower stages of the mining work ($\chi^2 = 62.699$, P-value = 0.000).

Rockfalls was dominant (92.3%) among the 88 people who worked at the extraction stage. The respondents who worked at the extraction stage of the small-scale mining were more likely to be exposed to rock falls compared to their counterparts who worked at the higher stages of the mining work ($\chi^2 = 146.543$, P-value = 0.000).

Diseases

The respondents were also asked to state the diseases that they were exposed to and the data from the respondents were cross-tabulated by the stage at which the miners worked. It was shown that majority (52.3%) of the people who worked at the extraction and more (91.7%) of the people who worked at

the processing stage suffered from noise-induced hearing loss. The chi-square statistics showed that noise-induced hearing loss associated significantly with working at the extraction and processing stages of the small-scale mining work ($\chi^2 = 88.985$, P-value = 0.000).

Skin disease was common among a greater number (65.9%) of people who worked at the extraction stage and among more (54.2%) of the people who worked at the processing stage as well as among the majority (69.2%) of the people who worked at the amalgamation stage. The majority of the miners who worked at the other stages of the small-scale mining were not prone to skin diseases. The chi-square statistics showed that there was a significant association between the stage at which the miners worked and their likelihood of being infected with skin diseases ($\chi^2 = 20.986$, P-value = 0.001).

Similarly, the majority (92.3%) of the people who worked at the amalgamation stage suffered as well as all the people who worked at the burning stage claimed that they had intestinal infections, while majority of the people who worked at the other stages of the small-scale gold mining work did not complain about intestinal infections. The chi-square statistics showed that these observations were significant ($\chi^2 = 136.924$, P-value = 0.000). Similarly, majority of the respondents who worked at the processing/crushing/milling stage had traumatic injuries, while the majority of the miners who worked at the other stages of the small-scale gold mining did not have traumatic injuries, and this observation was also statistically significant ($\chi^2 = 75.847$, P-value = 0.000).

Accidents and Injuries

Concerning accidents and injuries, the majority (93.2%) of the people who worked at the extraction stage as well as a greater number (91.7%) of the

72 respondents who worked at the processing stage as well as all the respondents who worked at the burning stage had contusion. Furthermore, the chi-square statistics showed that these observations were significant ($\chi^2 = 179.069$, P-value = 0.000). Similarly, majority (93.2%) of the people who worked at the extraction stage as well as a greater number (79.2%) of the respondents who worked at the processing stage had lacerations. This observation was also significant ($\chi^2 = 162.188$, P-value = 0.000).

The majority (79.5%) of the people who worked at the extraction stage never experienced stumbling/slipping/falling. The chi-square statistics revealed that there was a significant association between the stage of working and the experience of stumbling/slipping/falling ($\chi^2 = 100.271$, P-value = 0.000). Again, most of the respondents who worked at the other stages apart from the refining stage complained about spinal cord injuries. There was a proof that the workers who worked at all the other stages of the small-scale gold mining were more likely to experience spinal cord injuries compared to those who worked at the refining stage ($\chi^2 = 37.080$, P-value = 0.000).

The majority (52.3%) of the people who worked at the extraction stage never had puncher wounds. There was statistical evidence that the workers who worked at all the other stages of the small-scale gold mining were less likely to have puncher wounds compared to those who worked at the extraction stage ($\chi^2 = 64.970$, P-value = 0.000).

As the domino theory argues, these hazards and exposures, diseases as well as injuries and accidents are consequences of the subsequence of occasions that are so interdependent (Heinrich, 1941). The proponents of the theory Heinrich et al. (1980), explained that the basic idea is that the event of these

hazards and exposures, diseases as well as injuries and accidents perpetually result from a confounded succession of issues, the final remaining one of which is simply the observed accident. The simplest explanation has been that all these hazards and exposures, diseases as well as injuries and accidents are directly identified with unsafe conditions and acts at the workplace.

Singoro et al. (2016) clarified that at a point when one of the dominoes falls, it triggers the subsequent one, which in turn propels the next one. Be that as it may, Rahiman and Mahat (2018) contributed that eliminating the key factor like unsafe act/condition prevents the beginning of the chain of response or breaks the chain of the response. This implies that setting up security guidelines and approaches and propelling labourers to know and stick to them are the most basic components in guaranteeing occupational-related health and safety. Thus, the next section assessed the effects of the small-scale gold miners' knowledge of health and safety on their working conditions.

Effects of Knowledge of Health and Safety on Working Conditions

In the final section, I examined the effects of the small-scale gold miners' knowledge of health and safety on their working conditions. Workplace health and safety knowledge is characterised by the degree of awareness about existing safety frameworks, methods, rules, and principles at the workplace (Griffin & Neal, 2000). As explained by Green et al. (2020), Health Belief Model serves as a premise to expand workers' knowledge of health challenges, improve the impression of worker risk, and halt activities to diminish/wipe out health risk, which in turn emphasise the construction of self-appreciation adequate to embrace the required changes. Thus, as can be inferred from the

Conceptual Framework (Figure 2), employees ought to have knowledge of occupational health and safety at the workplace for a healthy and safe work.

To address this objective, all the 265 respondents were asked to either strongly agree, agree, remain unsure, disagree, or strongly disagree with the statements that knowledge of occupational health and safety improves company image, as well as that knowledge of occupational health and safety provides control and improvement of work-related hazards.

The data from the responses were cross-tabulated and chi-square tests were carried out. The results showed that the majority (92.1%) of the 265 respondents strongly agreed that knowledge of health and safety provides control and improvement of work-related hazards. Similarly, the majority (81.9%) of the 265 respondents strongly agreed that knowledge of health and safety improves the company image.

Furthermore, it was revealed that the majority (90.3%) of the respondents who strongly agreed that knowledge of health and safety improves company image, also strongly agreed that knowledge of health and safety provides control and improvement of work-related hazards. All the respondents who agreed that knowledge of occupational health and safety improves company image, strongly agreed that knowledge of health and safety provides control and improvement of work-related hazards.

Similarly, the majority (75.1%) of the 265 respondents strongly agreed that knowledge of health and safety results in low turnover and higher productivity. Relatedly, a greater proportion (87.5%) of the respondents strongly agreed that knowledge of health and safety helps labourers to safeguard themselves against any avoidable injuries and mishaps in the work environment.

Precisely, both the majority (74.1%) of the respondents strongly agreed as well as a greater proportion (81.8%) of those who agreed that knowledge of health and safety helps labourers to safeguard themselves against any avoidable wounds and mishaps in the work environment, strongly agreed that knowledge of health and safety results in low turnover and higher productivity.

Moreover, majority (81.9%) of the 265 respondents strongly agreed that knowledge of health and safety would be able to reduce workers' exposure to different hazards located in their various stages of work. Similarly, a greater proportion of the respondents strongly agreed that knowledge of health and safety provides control and reduction of work-related hazards. Specifically, the majority (80.3%) of the respondents strongly agreed that knowledge of health and safety provides control and reduction of work-related hazards. The majority of the respondents expressed knowledge about the effects of knowledge of health and safety issues on the work and the safety of workers.

Table 9: Noise-Induced Hearing Loss by Undergone Basic OHS Training Cross-Tabulation

		Undergo basic OHS training				
		Yes	No	Not Sure	Total	
Noise-induced hearing loss	No	Count	83	42	0	125
		% within undergo basic OHS training	51.2%	42.0%	0.0%	47.2%
	Yes	Count	79	58	3	140
		% within undergo basic OHS training	48.8%	58.0%	100.0%	52.8%
Total		Count	162	100	3	265
		% within undergo basic OHS training	100.0%	100.0%	100.0%	100.0%

Source: Fieldwork, March – April, (2020)

As part of assessing the effects of the respondents' knowledge of occupational health and safety on their working conditions, the data on noise-

induced hearing loss were cross-tabulated with miners having undergone/not undergone basic occupational health and safety training (Table 9). The results showed that the majority (51.2%) of the small-scale gold miners who had undergone basic occupational health and safety training did not experience noise-induced hearing loss. Yet, all the respondents who were not sure whether they had undergone basic occupational health and safety training or not as well as majority (58.0%) of those who did not undergo basic occupational health and safety training, experienced noise-induced hearing loss. Thus, undergoing basic occupational health and safety training is significantly associated with non-experience of noise-induced hearing loss ($\chi^2 = 5.852$, P-value = 0.049).

Table 10: Stumbling, Slipping and Falling by Knowledge on how to Perform a Job in a safe manner Cross-tabulation

		Knowledge of how to perform job in a safe manner			
		Yes	No	Total	
Stumbling, Slipping and falling	No	Count	153	0	153
		% within Knowledge of how to perform job in a safe manner	58.4%	0.0%	57.7%
	Yes	Count	109	3	112
		% within Knowledge of how to perform job in a safe manner	41.6%	100.0%	42.3%
Total		Count	262	3	265
		% within Knowledge of how to perform job in a safe manner	98.9%	1.1%	100.0%

Source: Fieldwork, March – April, (2020)

Table 10 also demonstrates that almost 99 percent (98.9%) of the respondents claimed that they had knowledge of how to perform their mining job in a safe manner, and that majority (57.7%) of them ever stumbled, slipped

or fell. The majority (58.4%) of the respondents who claimed that they had knowledge of how to perform their mining job in a safe manner had never stumbled, slipped or fell. The chi-square statistics showed that there was a significant association between knowledge of how to perform their mining job in a safe manner and nonexperience of stumbling, slipping and falling ($\chi^2 = 4.145$, P-value = 0.042). Thus, miners who had knowledge of how to perform their mining job in a safe manner were less likely to stumble.

Table 11: Knowledge of Occupation Health and Safety Policy at Workplace and Wearing of Hand Gloves, Overalls, and Ears Protector Cross-Tabulation

		Know. of OHS policy at the workplace		Total
		Yes (%)	No (%)	
Protective hand gloves	Yes	189(93.6%)	51(85.0%)	240(91.6%)
	No	13(6.4%)	9(15.0%)	22(8.4%)
Total		202(77.1)	60(22.9)	262(100%)
Overall /Overcoat for the body	Yes	164(80.0%)	39(65.0%)	203(76.6%)
	No	41(20.0%)	21(35.0%)	62(23.4%)
Total		205(77.4)	60(22.6)	265(100.0%)
Ears Protector	Yes	170(82.9%)	42(70.0%)	212(80.0%)
	No	35(17.1%)	18(30.0%)	53(20.0%)
Total		205(77.4%)	60(22.6)	265(100%)

Source: Fieldwork, March – April, (2020)

The data on the miners' knowledge of occupational health and safety policies at the workplace were cross-tabulated with the wearing of hand gloves, overalls, and ear protectors. Concerning wearing of protective hand gloves, only

262 responded and almost 92 percent (91.6%) of them claimed that they put on protective hand gloves while working. Also, majority of the miners stated that they knew of the occupational health and safety policies at the workplace. The cross-tabulation showed that majority (93.6%) of the respondents who knew of the occupational health and safety policies at the workplace as well as a higher number (85.0%) of those who did not know the occupational health and safety policies at the workplace put on the protective hand gloves while working (Table 11).

The chi-square statistics showed that there was a statistically significant association between knowledge of occupational health and safety policies at the workplace and wearing of protective hand gloves while working ($\chi^2 = 4.411$, P-value = 0.036). Thus, miners who knew of the occupational health and safety policies at the workplace were more likely to put on protective hand gloves while working than their counterpart miners who did not know about the occupational health and safety policies at the workplace.

Concerning wearing of protective overall/overcoat for the body, all the 265 miners responded and the majority (76.6%) of them claimed that they put on protective overall/overcoat for the body while working. The majority (77.4%) of them also stated that they knew of the occupational health and safety policies at the workplace. The cross-tabulation showed that majority (80.0%) of the respondents who knew of the occupational health and safety policies at the workplace as well as more (65.0%) of the miners who did not know the occupational health and safety policies at the workplace put on the protective overall/overcoat for the body while working (Table 11).

The chi-square statistics showed that there was a statistically significant association between knowledge of occupational health and safety policies at the workplace and wearing of protective overall/overcoat for the body, while working ($\chi^2 = 5.827$, P-value = 0.016). Thus, miners who knew of the occupational health and safety policies at the workplace were more likely to put on the protective overall/overcoat for the body while working than their counterpart miners who did not know about the occupational health and safety policies at the workplace.

Finally, in terms of wearing of ear protector while working, all the 265 miners responded and the majority (80.0%) of them claimed that they put on ear protector while working. The majority (77.4%) of them also specified that they knew of the occupational health and safety policies at the workplace. The cross-tabulation showed that majority (82.9%) of the respondents who knew of the occupational health and safety policies at the workplace as well as more (70.0%) of the miners who did not know the occupational health and safety policies at the workplace put on the ear protector while working (Table 11).

The chi-square statistics showed that there was a statistically significant association between knowledge of occupational health and safety policies at the workplace and wearing of ear protector while working ($\chi^2 = 4.848$, P-value = 0.028). Thus, miners who knew of the occupational health and safety policies at the workplace were more likely to put on the ear protector while working than their counterpart miners who did not know about the occupational health and safety policies at the workplace.

The main findings from objective three were that knowledge of occupational health and safety policies at the workplace was relevant for

reducing avoidable injuries, disease and accidents in the workplace as well as helping the workers to put on hand gloves, overall, and ear protectors while working. Similar findings were reported by Amponsah-Tawiah and Mensah (2016) that knowledge of occupational health hazards among workers ensured conducive working conditions, which reduced worker exposure to preventable hazards in the mining sector. Precisely, Leung and Lu (2016) found that while the majority of the small-scale gold miners in the Philippines were exposed to all forms of occupational hazards, such exposures were significantly reduced by knowledge of occupational health and safety policies at the workplace.

The findings are consistent with that of Beth (2018) who reported that knowledge of safety requirements was the key factor affecting compliance with health and safety measures by small-scale gold miners in Kenya, which was further supported by the outcome of the study by Aram (2021) that gold miners who worked under healthy conditions were less likely to encounter work-related health problems in Ghana. The findings support the argument of the conceptual framework (Figure 2), which maintains that small-scale gold miners who have higher knowledge of occupational health and safety are more likely to be engaged based on better working conditions than their counterparts who have little or no knowledge of occupational health and safety.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter summarises the study and presents the findings. The initial section of the chapter recaps the main idea of the study and presents the key findings. Conclusions and recommendations were then drawn from the vital discoveries of the study. In the last section, constraints and ideas for additional investigations are advanced to direct arrangements for improving occupational health and safety within the small-scale gold mining sector.

Summary

The main purpose of the study was to assess the knowledge of occupational health and safety, and working conditions of small-scale gold miners in Tarkwa Nsuaem Municipality. The study examined the miners' knowledge of occupational health and safety issues in Tarkwa Nsuaem Municipality and appraised the working conditions of the small-scale gold miners in Tarkwa Nsuaem Municipality. Lastly, the study examined the effects of the small-scale gold miners' knowledge of health and safety on their working conditions.

A quantitative research approach, which was conducted with the use of a survey of 265 small-scale gold miners across the study area was adopted. Proportionate probability sampling method was used to engage the small-scale miners across six small-scale gold mining companies in Tarkwa Nsuaem Municipality. Interview schedule was used to gather the data, whereby the researcher read the questions and wrote the responses that were given. Descriptive analytical techniques such as frequencies and percentages as well

as chi-square statistics were used to derive meaningful information from the data, while the results were presented in tables and figures.

The first objective of the study focused on the examination of the miners' knowledge of occupational health and safety issues in the study area.

The major findings were as follows:

1. Even though 86.4 percent of the respondents said that every employee was given the necessary workplace health and safety training to start/change a job or use new techniques/machines, only 61.1 percent said that they have actually undergone basic occupational health and safety training.
2. About 89 percent (88.6%) of the respondents stated that they had regular communication with management about health and safety issues at work, but just 59.0 percent of them knew that employers are responsible for the health and safety of the employees.
3. Though only 77.4 percent of the respondents said that they knew about the occupational health and safety policy at the workplace, almost 99 percent (98.9%) of them stated that they knew how to perform their jobs in a safe manner.
4. Participation in basic occupational health and safety training associated directly with knowledge of occupational health and safety policy at the mining workplace ($\chi^2 = 22.042$, P-value = 0.000).

The key findings that emerged from the second objective which appraised the working conditions of the small-scale gold miners in the Tarkwa Nsueam Municipal Assembly were that:

1. The majority (68.7%) of the miners worked for more than eight hours per day and that the loaders mostly worked for more than eight hours per day,

followed by refiners/burners, amalgamators, sluicers/panners/dollars, crushers, and drillers respectively ($\chi^2 = 47.410$, P-value = 0.000).

2. The greater number (67.5%) of the miners were not paid for working overtime, and that receipt of payment for working overtime related significantly with the respondents' level of education ($\chi^2 = 8.486$, P-value = 0.037).
3. Most (91.7%) of the small-scale miners were not given break period to have lunch, and the respondents who worked in registered small-scale gold mining companies were given a break period to have lunch than those who worked in unregistered companies ($\chi^2 = 6.575$, P-value = 0.010).
4. Almost 93 percent (92.8%) of the respondents did not have access to fire extinguisher at work and the majority (73.6%) of them did not have access to first aid at work, while there was a statistically significant association between access to fire extinguisher at work and access to first aid ($\chi^2 = 18.580$, P-value = 0.000).
5. The respondents who worked at the extraction and processing stage were more exposed to dust as compared to their counterparts who worked at higher stages of the mining work ($\chi^2 = 136.390$, P-value = 0.000), while only workers at the extraction stage were more exposed to rock falls compared to their counterparts ($\chi^2 = 146.543$, P-value = 0.000).
6. The respondents who worked at the amalgamation, burning and refining stages of the small-scale gold mining were exposed to chemicals compared to their counterparts who worked at lower stages of the mining work ($\chi^2 = 62.699$, P-value = 0.000).

The final objective of the study examined the effects of the small-scale gold miners' knowledge of health and safety on their working conditions. The key findings were as follows:

1. Although more than 92 percent (92.1%) of the miners strongly agreed that knowledge of health and safety provides control to reduce work-related hazards, a relatively lower proportion (87.5%) of them strongly agreed that knowledge of health and safety assists labourers in safeguarding themselves against any avoidable injuries and mishaps in the working environment.
2. Almost 82 percent (81.9%) of them strongly agreed that knowledge of health and safety improves a company's image, but only 75.1 percent of them strongly agreed that knowledge of health and safety results in low turnover and higher productivity.
3. Knowledge from the basic occupational health and safety training was significantly associated with non-experience of noise-induced hearing loss ($\chi^2 = 5.852$, P-value = 0.049).
4. There was a statistically significant association between knowledge of how to perform the mining job in a safe manner and non-experience of stumbling/slipping/falling ($\chi^2 = 4.145$, P-value = 0.042).
5. The chi-square statistics showed that knowledge of occupational health and safety policies at the workplace associated significantly with wearing of protective hand gloves while working ($\chi^2 = 4.411$, P-value = 0.036), overall/overcoat for the body while working ($\chi^2 = 5.827$, P-value = 0.016) as well as ear protector while working ($\chi^2 = 4.848$, P-value = 0.028).

Conclusions

The following conclusions were made. For objective one, it was concluded that:

- i. The small scale gold miners expressed high occupational health and safety knowledge and most of them knew how to perform their jobs in a safe manner, while participation in basic occupational health and safety training associated with occupational health and safety knowledge.

For objective two, it was concluded that:

- i. Most of the small scale gold miners worked without break and were engaged in unpaid overtime.
- ii. Workers at the extraction and processing stage were more exposed to dusts, and exposure to chemicals was common among workers at the amalgamation, burning and refining stages, while only the extractors were exposed to rock falls.

For objective three, it was concluded that:

- i. Workers with high OHS knowledge were less likely to be engaged in noisy tasks, and were less likely to experience stumbling/slipping/falling, while they were more likely to wear protective hand gloves, overall/overcoat and ear protector while working.

Recommendations

Grounded on the main outcomes and deductions from the study, the following recommendations were put forward:

1. The miners may have to encourage their employers to organise more of such basic occupational health and safety training. The leadership of small-scale gold mine workers may ensure that this goal is achieved by ensuring that regular basic occupational health and safety training is organised.
2. Workers in the small-scale gold mining are encouraged to take up formal education (for example, certificate programme for artisanal small-scale gold miners which is organised by University of Mines and Technology). The workers in the small-scale gold mining could achieve this by entering into an agreement with their employers to provide scholarship opportunities for the employees after five years of service.
3. The workers in the small-scale gold mining business ought to ensure that their employers provide the protective gears that are needed at each stage of the mining work. The workers in the small-scale gold mining could realise this by seeing to it that the provision of protective gears that are needed at each stage of the mining work is made part of their terms of engagement or working conditions.
4. The miners are admonished to abreast themselves with knowledge on occupational health and safety. The miners might realise this by sharing information on occupational health and safety with one another.
5. Policy makers like (the Minerals Commission of Ghana and the Environmental Protection Agency) are being encouraged to visit the small-scale gold mining workplaces (registered and unregistered) to monitor their

operations and help formulate policies that will help the informal sector small-scale gold miners; to get a congenial atmosphere or environment for safe work and and high productive output.

6. The employers are being encouraged to ensure that they create a safe and conducive working environment for the miners by way of providing the miners with the necessary safety apparels needed for their work and to ensure that the miners use the apparels appropriately.



REFERENCES

- Abankwah, V., Aidoo, R., Etuah, S., & Fialor, S. C. (2021). Predicting livelihood dimensions of agrarian households in small-scale mining communities of Ghana using structural equation modeling. *Journal of Agricultural Economics, Extension and Rural Development, Vol. 9(1), 001-031.*
- Abbey, C. E., Nartey, R. S., Al-Hassan, S., & Amankwah, R. K. (2014). Direct smelting of gold concentrates, a safer alternative to mercury amalgamation in small-scale gold mining operations. *American International Journal of Research in Science, Technology, Engineering and Mathematics, 7, 74-179*
- Abolfotouh, M. A., Ala'a, A. B., Mahfouz, A. A., Al-Assiri, M. H., Al-Juhani, A. F., & Alaskar, A. S. (2015). Using the health belief model to predict breast self-examination among Saudi women. *BMC Public Health, 15(1), 1-12.*
- Abraham, C., & Sheeran, P. (2015). The health belief model. Predicting health behaviour: *Research and Practice with Social Cognition models, 2, 30-55.*
- Abzalov, M., & Abzalov, M. (2016). Exploratory data analysis. *Applied Mining Geology, 207-219.*
- Adu-Baffour, F., Daum, T., & Birner, R. (2021). Governance challenges of small-scale gold mining in Ghana: Insights from a process net-map study. *Land Use Policy, 102, 105271.*

- Alfers, L. (2010). Occupational health and safety for informal workers in Ghana. A case study of market and street traders in Accra. School of Developmental Studies, University of KwaZulu-Natal, Durban
- Agyemang, C. B., & Dickson, E. (2018). A health gap in Ghana's workmen's compensation act 1987 (PNDC 187): Embracing the starring role of psychologists. *African Journal for the Psychological Studies of Social Issues*, 21(3), 145-158.
- Al-Hanawi, M. K., Angawi, K., Alshareef, N., Qattan, A., Helmy, H. Z., Abudawood, Y., & Alsharqi, O. (2020). Knowledge, attitude and practice toward COVID-19 among the public in the Kingdom of Saudi Arabia: a cross-sectional study. *Frontiers in Public Health*, 8, 217.
- Ali, A. Y. S., Ali, A. A., & Adan, A. A. (2013). Working conditions and employees' productivity in manufacturing companies in Sub-Saharan African context: Case of Somalia. *Educational Research International*, 2(2), 67-78.
- Agyekum, K., Ghansah, F. A., Tetteh, P. A., & Amudjie, J. (2020). The role of project managers (PMs) in construction health and safety implementation in Ghana. *Journal of Engineering, Design and Technology*, 19(1), 245-262.
- Alormene, G. A. (2021). The role of project managers in construction health and safety implementation in Ghana (Doctoral dissertation). Kwame Nkrumah University of Science and Technology, Kumasi.
- Amponsah-Tawiah, K., & Mensah, J. (2016). Occupational health and safety and organizational commitment: Evidence from the Ghanaian mining industry. *Safety and Health at Work*, 7(3), 225-230.

- Amponsah-Tawiah, K., Jain, A., Leka, S., Hollis, D., & Cox, T. (2013). Examining psychosocial and physical hazards in the Ghanaian mining industry and their implications for employees' safety experience. *Journal of Safety Research*, 45, 75-84.
- Amponsah-Tawiah, K., Ntow, M. A. O., & Mensah, J. (2016). Occupational health and safety management and turnover intention in the Ghanaian mining sector. *Safety and Health at Work*, 7(1), 12-17.
- Anderson, D. R., Sweeney, D. J., Williams, T. A., Camm, J. D., & Cochran, J. J. (2018). An introduction to management science: quantitative approach. *Cengage Learning*.
- Annan, J. S., Addai, E. K., & Tulashie, S. K. (2015). A call for action to improve occupational health and safety in Ghana and a critical look at the existing legal requirement and legislation. *Safety and Health at Work*, 6(2), 146-150.
- Aram, S. A. (2021). Managing occupational health among gold miners in Ghana: Modelling the likelihood of experiencing occupational related health problems. *Plos One*, 16(7), e0254449.
- Armah, F. A., Boamah, S. A., Quansah, R., Obiri, S., & Luginaah, I. (2016). Working conditions of male and female artisanal and small-scale gold miners in Ghana: Examining existing disparities. *The Extractive Industries and Society*, 3(2), 464-474.
- Arthur, F., Agyemang-Duah, W., Gyasi, R. M., Yeboah, J. Y., & Otieku, E. (2016). Nexus between artisanal and small-scale gold mining and livelihood in Prestea mining region, Ghana. *Geography Journal*, 2016.

Aryeetey, E., Osei, B., & Twerefou, D. (2004). Globalization, employment and livelihoods in the mining sector of Ghana. *Accra: ESSER Occasional Paper.*

Asanka, W. A., & Ranasinghe, M. (2015). Study on the impact of accidents on construction projects. In *6th International Conference on Structural Engineering and Construction Management* (pp. 58-67).

Asare, J. D., & Badu, E. (2021). An assessment of occupational health and safety requirements on the Ayanfuri resettlement project in Ghana (Doctoral Dissertation). *Kwame Nkrumah University of Science and Technology, Kumasi.*

Atakora, M., & Stenberg, B. (2020). Assessment of workers' knowledge and views of occupational health hazards of gold mining in Obuasi Municipality, Ghana. *International Journal of Occupational Safety and Health, 10*(1), 38-52.

Aubynn, A. (2009). Sustainable solution or a marriage of inconvenience? The coexistence of large-scale mining and artisanal and small-scale mining on the Abooso Goldfields concession in Western Ghana. *Resources Policy, 34*(1-2), 64-70.

Axinn, W. G., & Thornton, A. (2000). The transformation in the meaning of marriage. *The Ties that Bind: Perspectives on Marriage and Cohabitation, 147-165.*

Ayaaba, E., Li, Y., Yuan, J., & Ni, C. (2017). Occupational respiratory diseases of miners from two gold mines in Ghana. *International Journal of Environmental Research and Public Health, 14*(3), 337.

Baah-Ennumh, T. Y., & Forson, J. A. (2017). The impact of artisanal small-scale mining on sustainable livelihoods: a case study of mining communities in the Tarkwa-Nsuaem municipality of Ghana. *World Journal of Entrepreneurship, Management and Sustainable Development*, 13(3), 204-222.

Babut, M., Sekyi, R., Rambaud, A., Potin-Gautier, M., Tellier, S., Bannerman, W., & Beinhoff, C. (2003). Improving the environmental management of small-scale gold mining in Ghana: a case study of Dumasi. *Journal of Cleaner Production*, 11(2), 215-221.

Badri, A., Boudreau-Trudel, B., & Souissi, A. S. (2018). Occupational health and safety in the industry 4.0 era: A cause for major concern? *Safety Science*, 109, 403-411.

Bandura, A., Freeman, W. H., & Lightsey, R. (1999). Self-efficacy: The exercise of control.

Bansah, K. J., Dumakor-Dupey, N. K., Stemn, E., & Galecki, G. (2018). Mutualism, commensalism or parasitism? Perspectives on tailings trade between large-scale and artisanal and small-scale gold mining in Ghana. *Resources Policy*, 57, 246-254.

Barakat, A. M., & Kasemy, Z. A. (2020). Preventive health behaviours during coronavirus disease 2019 pandemic based on health belief model among Egyptians. *Middle East Current Psychiatry*, 27(1), 1-9.

Barenblitt, A., Payton, A., Lagomasino, D., Fatoyinbo, L., Asare, K., Aidoo, K., & Wood, D. (2021). The large footprint of small-scale artisanal gold mining in Ghana. *Science of the Total Environment*, 781, 146644.

Basner, M., Babisch, W., Davis, A., Brink, M., Clark, C., Janssen, S., & Stansfeld, S. (2014). Auditory and non-auditory effects of noise on health. *The lancet*, 383(9925), 1325-1332.

Basu, N., Clarke, E., Green, A., Calys-Tagoe, B., Chan, L., Dzodzomenyo, M., ... & Wilson, M. L. (2015). Integrated assessment of artisanal and small-scale gold mining in Ghana—Part 1: Human health review. *International Journal of Environmental Research and Public Health*, 12(5), 5143-5176.

Batool, K. A. (2015). Occupational Health Hazards in Mining in Pakistan: An Overview. *European Academic Research*, 3(5), 5306-19.

Battaglia, M., Passetti, E., & Frey, M. (2015). Occupational health and safety management in municipal waste companies: A note on the Italian sector. *Safety Science*, 72, 55-65.

Bhagawati, B. (2015). Basics of occupational safety and health. *IOSR Journal of Environmental Science, Toxicology and Food Technology*, 9(8), 91-94.

Becker, J., Furu, P., Singo, J., Shoko, D., Elbel, J., Bose-O'Reilly, S., & Steckling-Muschack, N. (2021). Determinants of health and health needs assessment of artisanal and small-scale gold miners in Kadoma, Zimbabwe: A mixed method approach. *Environmental Research*, 197, 111081.

Becker, M. H. (1974). The health belief model and personal health behavior. *Health Education Monographs*, 2, 324-473.

- Bener, A. (2017). Health status and working condition of migrant workers: Major public health problems. *International Journal of Preventive Medicine*, 8.
- Bernardi, A. (2019). Using the capability approach and organizational climate to study occupational health and safety. *Insights into Regional Development*, 1(2), 138-154.
- Beth, A. A. (2018). *Assessment Of Occupational Safety Compliance In Small-Scale Gold Mines In Siaya County, Kenya* (Doctoral dissertation, University of Nairobi).
- Bhattacharjee, A. (2012). Social science research: Principles, methods, and practices. *University of South Florida*.
- Bird Jr, F. E., & Germain, G. L. (1986). Practical loss control leadership. *Loganville, Ga.*
- Boadu, E. F., Sunindijo, R. Y., & Wang, C. C. (2021). Health and safety consideration in the procurement of public construction projects in Ghana. *Buildings*, 11(3), 128.
- Cabello, R., Sorrel, M. A., Fernández-Pinto, I., Extremera, N., & Fernández-Berrocal, P. (2016). Age and gender differences in ability emotional intelligence in adults: A cross-sectional study. *Developmental Psychology*, 52(9), 1486.
- Calys-Tagoe, B. N., Ovadje, L., Clarke, E., Basu, N., & Robins, T. (2015). Injury profiles associated with artisanal and small-scale gold mining in Tarkwa, Ghana. *International Journal of Environmental Research and Public Health*, 12(7), 7922-7937.

- Carpenter, C. J. (2010). A meta-analysis of the effectiveness of health belief model variables in predicting behavior. *Health communication, 25*(8), 661-669.
- Castonguay, J., Filer, C. R., & Pitts, M. J. (2016). Seeking help for depression: applying the health belief model to illness narratives. *Southern Communication Journal, 81*(5), 289-303.
- Chilisa, B., & Kawulich, B. (2012). Selecting a research approach: Paradigm, methodology and methods. *Doing Social Research: A Global Context, 5*(1), 51-61.
- Chin, L., Hahn, W. C., Getz, G., & Meyerson, M. (2011). Making sense of cancer genomic data. *Genes & Development, 25*(6), 534-555.
- Clifford, M. J. (2017). Assessing releases of mercury from small-scale gold mining sites in Ghana. *The Extractive Industries and Society, 4*(3), 497-505.
- Comte, A. (2015). A general view of positivism. *Routledge*.
- Cooper, D. (2007). Behavioral Safety Approaches: Which are the most effective. *White Paper, BSMS, Brighton, August*.
- Crawford, G., & Botchwey, G. (2017). Conflict, collusion and corruption in small-scale gold mining: Chinese miners and the state in Ghana. *Commonwealth & Comparative Politics, 55*(4), 444-470.
- Creswell, J. W., & Garrett, A. L. (2008). The “movement” of mixed methods research and the role of educators. *South African Journal of Education, 28*(3), 321-333.
- Das, J., Kwan, A., Daniels, B., Satyanarayana, S., Subbaraman, R., Bergkvist, S., & Pai, M. (2015). Use of standardised patients to assess quality of

tuberculosis care: a pilot, cross-sectional study. *The Lancet Infectious Diseases*, 15(11), 1305-1313.

De Cieri, H., & Lazarova, M. (2020). "Your health and safety is of utmost importance to us": A review of research on the occupational health and safety of international employees. *Human Resource Management Review*, 100790.

DeCamp, W., & Herskovitz, K. (2015). The theories of accident causation. In *Security Supervision and Management* (pp. 71-78). Butterworth-Heinemann.

Demirkesen, S. (2020). Investigating linear models of accident causation: A review study in the construction safety context. *Sigma: Journal of Engineering & Natural Sciences/Mühendislik ve Fen Bilimleri Dergisi*, 38(4).

Dong, S., Xiang, H., & Dagotto, E. (2019). Magnetoelectricity in multiferroics: a theoretical perspective. *National Science Review*, 6(4), 629-641.

Donoghue, A. M. (2004). Occupational health hazards in mining: an overview. *Occupational Medicine*, 54(5), 283-289.

Elgstrand, K., & Vingård, E. (2013). *Occupational safety and health in mining*. Arbets-och miljömedicin, Göteborgs universitet.

Emmanuel, A. (2015). A literature review of the factors that influence breastfeeding: An application of the health belief model.

Environment Protection Agency 1994, Act 490, Ghana.

Etikan, I., & Bala, K. (2017). Sampling and sampling methods. *Biometrics & Biostatistics International Journal*, 5(6), 00149.

European Commission (2007). The social situation in the European Union 2005–06, *Office for Official Publications of the European Communities, Luxembourg.*

Eyiah, A. K., Kheni, N. A., & Quartey, P. D. (2019). An assessment of occupational health and safety regulations in Ghana: A study of the construction industry. *Journal of Building Construction and Planning Research*, 7(2), 11-31.

Factories, Offices and Shops Act, 1970 (Act 328). Ghana Publishing Company Limited, Accra.

Famakin, I. O., Aigbavboa, C., & Molusiwa, R. (2020). Exploring challenges to implementing health and safety regulations in a developing economy. *International Journal of Construction Management*, 1-35.

Fan, D., Zhu, C. J., Timming, A. R., Su, Y., Huang, X., & Lu, Y. (2020). Using the past to map out the future of occupational health and safety research: where do we go from here?. *The International Journal of Human Resource Management*, 31(1), 90-127.

Fathian-Dastgerdi, Z., Tavakoli, B., & Jaleh, M. (2021). Factors associated with preventive behaviors of COVID-19 among adolescents: Applying the health belief model. *Research in Social and Administrative Pharmacy*, 17(10), 1786-1790.

Flick, U. (Ed.). (2017). *The Sage handbook of qualitative data collection*. Sage.

Flick, U. (2018). *An introduction to qualitative research*. Sage.

Fonseca, L., & Carvalho, F. (2019). The reporting of SDGs by quality, environmental, and occupational health and safety-certified organizations. *Sustainability*, 11(20), 5797.

- Freeman, S. A., Schwab, C. V., & Pollard, T. (2003). Assessment of Iowa farmers' perceptions about auger safety. *Journal of Agricultural Safety and Health*, 9(1), 61.
- Friedman, L. M., Furberg, C. D., DeMets, D. L., Reboussin, D. M., & Granger, C. B. (2015). Sample size. In *Fundamentals of Clinical Trials* (pp. 165-200). Springer, Cham.
- Fu, G., Xie, X., Jia, Q., Li, Z., Chen, P., & Ge, Y. (2020). The development history of accident causation models in the past 100 years: 24Model, a more modern accident causation model. *Process Safety and Environmental Protection*, 134, 47-82.
- Geller, S. E., Rosenberg, D., Cox, S. M., Brown, M. L., Sikumonson, L., Driscoll, C. A., & Kilpatrick, S. J. (2004). The continuum of maternal morbidity and mortality: factors associated with severity. *American Journal of Obstetrics and Gynecology*, 191(3), 939-944.
- General, A. (2015). United Nations transforming our world: the 2030 agenda for sustainable development. *Division for Sustainable Development Goals: New York, NY, USA*.
- Ghai, D. (2002). Education and decent work: Concepts, models and indicators. *Models and Indicators*.
- Ghai, D. (2003). Decent work: Concept and indicators. *Int'l Lab. Rev.*, 142, 113.
- Ghana Health Service. (1999). Ghana health service and teaching hospitals Act 525. *Government Printer, Assembly Press, Accra*.
- Ghana Statistical Service. (2014). 2010 Population & housing census: District analytical report. Tarkwa Nsuaem Municipality.

- Glanz, K., Lewis, F. M. & Rimer B. K. (1990.). Health behavior and health education: Theory, research, and practice. (eds.) *San Francisco: Jossey-Bass.*
- Goodarzi, A., Heidarnia, A., Tavafian, S. S., & Eslami, M. (2019). Predicting oral health behaviours among Iranian students by using the health belief model. *Journal of Education and Health Promotion, 8.*
- Gopang, M. A., Nebhwani, M., Khatri, A., & Marri, H. B. (2017). An assessment of occupational health and safety measures and performance of SMEs: An empirical investigation. *Safety Science, 93*, 127-133.
- Gottesfeld, P., Andrew, D., & Dalhoff, J. (2015). Silica exposures in artisanal small-scale gold mining in Tanzania and implications for tuberculosis prevention. *Journal of Occupational and Environmental Hygiene, 12(9)*, 647-653.
- Green, E. C., Murphy, E. M., & Gryboski, K. (2020). The health belief model. *The Wiley Encyclopedia of Health Psychology*, 211-214.
- Griffin, M. A., & Neal, A. (2000). Perceptions of safety at work: a framework for linking safety climate to safety performance, knowledge, and motivation. *Journal of Occupational Health Psychology, 5(3)*, 347.
- Guidry, J. P., Carlyle, K. E., LaRose, J. G., Perrin, P., Messner, M., & Ryan, M. (2019). Using the health belief model to analyze Instagram posts about Zika for public health communications. *Emerging Infectious Diseases, 25(1)*, 179.
- Gul, M. (2018). A review of occupational health and safety risk assessment approaches based on multi-criteria decision-making methods and their

fuzzy versions. *Human and Ecological Risk Assessment: An International Journal*, 24(7), 1723-1760.

Guo, Y. F., Luo, Y. H., Lam, L., Cross, W., Plummer, V., & Zhang, J. P. (2018). Burnout and its association with resilience in nurses: A cross-sectional study. *Journal of Clinical Nursing*, 27(1-2), 441-449.

Gyapong, J., Garshong, B., Akazili, J., Aikins, M., Agyepong, I., & Nyonator, F. (2007). Critical analysis of Ghana's health system with a focus on equity challenges and the national health insurance. *SHIELD Workpackage*, 1, 27.

Gyekye, S. A. (2003). Causal attributions of Ghanaian industrial workers for accident occurrence: Miners and non-miners perspective. *Journal of Safety Research*, 34(5), 533-538.

Harari R & Harari Freire F (2013). Safety and health in mining in Ecuador. In: K Elgstrand & E Vingård, editors. occupational safety and health in mining. Anthology on the situation in 16 mining countries. *Gothenburg: Occupational and Environmental Medicine at Sahlgrenska Academy, University of Gothenburg: 171-178.*

He, Z., & Weng, W. (2020). A dynamic and simulation-based method for quantitative risk assessment of the domino accident in chemical industry. *Process Safety and Environmental Protection*, 144, 79-92.

Health and Safety Authority Annual Report (2018). Occupational safety and health programmes. Retrieved from <https://www.hsa>.

Heinrich, H. W. (1941). Industrial accident prevention. A scientific approach. *Industrial Accident Prevention. A Scientific Approach.*, (Second Edition).

Heinrich, H. W., Petersen, D., & Roos, N. (1980). Industrial accident prevention: A safety management approach (5th Edition). *New York, NY: McGraw-Hill.*

Hilson, G. (2002). The environmental impact of small-scale gold mining in Ghana: identifying problems and possible solutions. *Geographical Journal, 168*(1), 57-72.

Hilson, G., Hilson, C. J., & Pardie, S. (2007). Improving awareness of mercury pollution in small-scale gold mining communities: challenges and ways forward in rural Ghana. *Environmental Research, 103*(2), 275-287.

Hilson, G., Van Bockstael, S., Sauerwein, T., Hilson, A., & McQuilken, J. (2021). Artisanal and small-scale mining, and COVID-19 in sub-Saharan Africa: A preliminary analysis. *World Development, 139*, 105315.

Hochbaum, G. M. (1958). Public participation in medical screening programs: A socio-psychological study (No. 572). *US Department of Health, Education, and Welfare, Public Health Service, Bureau of State Services, Division of Special Health Services, Tuberculosis Program.*

Hyun-Jee, P., Young-Sul, P., & Young-Guk, K. (2001). Safety factors in mega event. In *Proceedings of the Safety Management and Science Conference* (pp. 161-168). *Korea Safety Management and Science.*

Ilbahar, E., Karaşan, A., Cebi, S., & Kahraman, C. (2018). A novel approach to risk assessment for occupational health and safety using Pythagorean fuzzy fuzzy AHP & fuzzy inference system. *Safety Science, 103*, 124-136.

ILO (1999). Report of the Director-General: Decent Work. In *87th Session, International Labour Conference, Geneva*.

ILO (2005). Decent work – Safe work: a global report on work related accidents and ill health. *Geneva: ILO*

ILO (2008). ILO declaration on social justice for a fair globalization. Rep., *ILO, Geneva*

ILO (2010). Work related diseases in developing countries. Retrieved from <http://www.oil.org/pubic/English/standard>.

ILO (2013). Women and men in the informal economy: A statistical picture (2nd ed.). *Geneva: ILO*

ILO (2015). Encyclopedia of occupational health and safety. Retrieved from <http://www.oil.org/public/English/standard>

Iqbal, M. I., Alrajawy, I., Isaac, O., & Ameen, A. (2021). Study the impact of safety awareness program (SAP) as moderating variable for reduction of accidents in oil and gas industry—A proposed framework. *International Journal of Management and Human Science (IJMHS)*, 5(1), 10-20.

Islam, T., Ahmed, I., & Ali, G. (2019). Effects of ethical leadership on bullying and voice behaviour among nurses: mediating role of organizational identification, poor working condition and workload. *Leadership in Health Services*, 32(1), 2-17.

Ivancevich, J. M. (2015). Personal management in Africa. *New York Press*.

Ivankova, N., & Wingo, N. (2018). Applying mixed methods in action research: Methodological potentials and advantages. *American Behavioral Scientist*, 62(7), 978-997.

Jacinto, C. (2016). Accident investigation and analysis-a roadmap for organisational learning.

Janz, N. K., & Becker, M. H. (1984). The health belief model: A decade later. *Health Education Quarterly*, *11*(1), 1-47.

Janz, N.K., Champion, V.L. and Strecher, V.J. (2002). The Health belief model. In Glanz, K., Rimer, B, K. and Lewis, F.M (Eds). Health behaviour and health education: Theory. research and practice. *San Francisco: Jossey Bass* (pp. 45 - 66)

Jeihooni, A. K., Dindarloo, S. F., & Harsini, P. A. (2019). Effectiveness of health belief model on oral cancer prevention in smoker men. *Journal of Cancer Education*, *34*(5), 920-927.

Ji, Z., Pons, D. J., & Pearse, J. (2020). Integrating occupational health and safety into plant simulation. *Safety Science*, *130*, 104898.

Jin, C., Li, B., Ye, Z., & Xiang, P. (2021). Identifying the non-traditional safety risk paths of employees from Chinese international construction companies in Africa. *International Journal of Environmental Research and Public Health*, *18*(4), 1990.

Jing, L., Tian, K., & Huang, J. Z. (2015). Stratified feature sampling method for ensemble clustering of high dimensional data. *Pattern Recognition*, *48*(11), 3688-3702.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, *33*(7), 14-26.

Jonah, O. T., & Abebe, T. (2019). Tensions and controversies regarding child labour in small-scale gold mining in Ghana. *African Geographical Review*, 38(4), 361-373.

Jorma, S. (2004). A healthy and safe workplace. *African Newsletter on Occupational Health and Safety*, 16, 7-8.

Kareem, A. J., Kareem, A. O., Owoeye-Lawal, O. T., Aro, A. J., Lawal, O. A., Ibekwe, O. C., ... & Ejiyooye, T. (2022). The use of safety practices to reduce occupational injury among solid mineral miners in Southwest, Nigeria: an examination of the health belief model. *International Journal of Community Medicine and Public Health*, 9(3), 1492.

Katsoulakos, T., & Katsoulacos, Y. (2007). Integrating corporate responsibility principles and stakeholder approaches into mainstream strategy: a stakeholder-oriented and integrative strategic management framework. *Corporate Governance: The International Journal of Business in Society*.

Keshani, P., Hossein Kaveh, M., Faghih, S., & Salehi, M. (2019). Improving diet quality among adolescents, using health belief model in a collaborative learning context: A randomised field trial study. *Health Education Research*, 34(3), 279-288.

Kheni, N. A., & Braimah, C. (2014). Institutional and regulatory frameworks for health and safety administration: a study of the construction industry of Ghana. *International Refereed Journal of Engineering and Sciences*, 3(2), 24-34.

Koopmans, L., Bernaards, C. M., Hildebrandt, V. H., Schaufeli, W. B., de Vet Henrica, C. W., & Van Der Beek, A. J. (2011). Conceptual frameworks

of individual work performance: A systematic review. *Journal of Occupational and Environmental Medicine*, 53(8), 856-866.

Kothari, C. R. (2004). Research methodology: Methods and techniques. *New Age International*.

Koul, L. (2009). Methodology of educational research (4th ed.), New Delhi. *Vikas Publishing House Pvt Ltd*. P. 206

Kralik, D., Visentin, K., & Van Loon, A. (2006). Transition: a literature review. *Journal of Advanced Nursing*, 55(3), 320-329.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607-610.

Kumar, R. (2018). Research methodology: A step-by-step guide for beginners. *Sage*.

Kumi-Boateng, B., & Stemm, E. (2020). Spatial analysis of artisanal and small-scale mining in the Tarkwa-Nsuaem municipality of Ghana. *Ghana Mining Journal*, 20(1), 66-74.

Labour Act of Ghana. (2003). Act 651, Accra: *GPC Printing Division*.

Laing, T., & Moonsammy, S. (2021). Evaluating the impact of small-scale mining on the achievement of the sustainable development goals in Guyana. *Environmental Science & Policy*, 116, 147-159.

Landrigan P. J & Etzel R. A (2013). Textbook of children's environmental health. oxford: *Oxford University Press*.

Legislative Instrument 1886 (2008). Accra: *GPC Printing Division*.

Leung, A. M. R., & Lu, J. L. D. (2016). Environmental health and safety hazards of indigenous small-scale gold mining using cyanidation in the Philippines. *Environmental Health Insights*, 10, EHI-S38459.

Lips, H. M. (2020). Sex and gender: An introduction. *Waveland Press*.

Li, Q., Zhang, Z., & Peng, F. (2021). Causality-network-based critical hazard identification for railway accident prevention: complex network-based model development and comparison. *Entropy*, 23(7), 864.

Lin, F. S., & Liu, H. F. (2016). Applying domino theory to early childhood burn education visual message communicability research. *設計研究*, (12), 73-80.

Lin, X., Wu, W., & Mo, Y. (2020). A theoretical perspective of the agostic effect in early transition metal compounds. *Coordination Chemistry Reviews*, 419, 213401.

Liu, S., Nkrumah, E. N. K., Akoto, L. S., Gyabeng, E., & Nkrumah, E. (2020). The state of occupational health and safety management frameworks (OHSMF) and occupational injuries and accidents in the Ghanaian oil and gas industry: assessing the mediating role of safety knowledge. *BioMed Research International*, 2020.

Lozada-Larsen, S. R., & Laughery Sr, K. R. (1987, September). Do identical circumstances precede minor and major injuries? In *Proceedings of the Human Factors Society Annual Meeting* (Vol. 31, No. 2, pp. 200-204). Sage CA: Los Angeles, CA: SAGE Publications.

Lu, J. L. (2012). Occupational health and safety in small scale mining: Focus on women workers in the Philippines. *Journal of International Women's Studies*, 13(3), 103-113.

- Lu, W., Wang, H., Lin, Y., & Li, L. (2020). Psychological status of medical workforce during the COVID-19 pandemic: A cross-sectional study. *Psychiatry Research*, 288, 112936.
- Luquis, R. R., & Kensinger, W. S. (2019). Applying the health belief model to assess prevention services among young adults. *International Journal of Health Promotion and Education*, 57(1), 37-47.
- Mahat, N. A. A., Ismail, F., & Alwee, S. N. A. S. (2015). Propelling site safety through accident causation models. In *InCIEC 2014* (pp. 321-331). Springer, Singapore.
- Malone, H. E., Nicholl, H., & Coyne, I. (2016). Fundamentals of estimating sample size. *Nurse Researcher*, 23(5).
- Manabe, T., Hanh, T. T., Lam, D. M., Van, D. T. H., Thuy, P. T. P., Thi Thanh Huyen, D., ... & Kudo, K. (2012). Knowledge, attitudes, practices and emotional reactions among residents of avian influenza (H5N1) hit communities in Vietnam.
- Martin, W. E., & Bridgmon, K. D. (2012). Quantitative and statistical research methods: From hypothesis to results. *John Wiley & Sons*.
- Mattson, M. (1999). Toward a reconceptualization of communication cues to action in the health belief model: HIV test counseling. *Communications Monographs*, 66(3), 240-265.
- Matsa, M. M., Mazire, F., Musasa, T., & Defe, R. (2020). Health and safety issues within artisanal and small-scale gold mining: a case for Penhalonga, Ward 21 Mutasa District, Zimbabwe. *African Geographical Review*, 1-15.

- McQuilken, J., & Hilson, G. (2016). Artisanal and small-scale gold mining in Ghana: Evidence to inform an action dialogue'.
- Meyer, J. P., & Maltin, E. R. (2010). Employee commitment and well-being: A critical review, theoretical framework and research agenda. *Journal of Vocational Behavior, 77*(2), 323-337.
- Miller, J. D. (1983). Scientific literacy: A conceptual and empirical review. *Daedalus, 29*-48.
- Miller, R. H. (2017). Safety: Incident prevention in our industry and beyond. *Safety*.
- Miller, R. M., Chan, C. D., & Farmer, L. B. (2018). Interpretative phenomenological analysis: A contemporary qualitative approach. *Counselor Education and Supervision, 57*(4), 240-254.
- Mills, P. R., Kessler, R. C., Cooper, J., & Sullivan, S. (2007). Impact of a health promotion program on employee health risks and work productivity. *American Journal of Health Promotion, 22*(1), 45-53.
- Mohammadfam, I., Kamalinia, M., Momeni, M., Golmohammadi, R., Hamidi, Y., & Soltanian, A. (2017). Evaluation of the quality of occupational health and safety management systems based on key performance indicators in certified organizations. *Safety and Health at Work, 8*(2), 156-161.
- Mohammadi, S., Ghajari, H., Valizade, R., Ghaderi, N., Yousefi, F., Taymoori, P., & Nouri, B. (2017). Predictors of smoking among the secondary high school boy students based on the health belief model. *International Journal of Preventive Medicine, 8*.

- Monney, I., Bismark, D. A., Isaac, O. M., & Kuffour, R. A. (2014). Occupational health and safety practices among vehicle repair artisans in an urban area in Ghana. *Journal of Environmental and Occupational Health, 3*(3), 147-153.
- Murphy, E. M. (2005). Promoting healthy behavior. Washington, DC: *Population Reference Bureau.*
- Moshrefzadeh, A. (2021). Condition monitoring and intelligent diagnosis of rolling element bearings under constant/variable load and speed conditions. *Mechanical Systems and Signal Processing, 149*, 107153.
- Mushori, J., Rambo, C. M., Wafula, C. M., & Matu, J. (2021). Evaluating contractors' safety record and its influence on performance of road infrastructural projects. *World Journal of Engineering and Technology, 9*(2), 203-228.
- Mustapha, Z., Aigbavboa, C., & Thwala, W. (2017, July). Examination of occupational health and safety practices in Ghana. In *International Conference on Applied Human Factors and Ergonomics* (pp. 403-409). Springer, Cham.
- Mustapha, Z., Aigbavboa, C., & Thwala, D. T. (2015). Conceptualized integrated health and safety compliance model for the Ghanaian construction industry. *Int. J. Adv. Technol. Eng. Stud, 4*, 33-48.
- Nakano, D., & Muniz Jr, J. (2018). Writing the literature review for empirical papers. *Production, 28*.
- Neuman, W. L., & Robson, K. (2014). Basics of social research. Toronto: *Pearson Canada.*

- Ngowi, A. V. F. (2003). Occupational exposure to pesticides in flower farms in northern Tanzania. *African Newsletter on Occupational Health and Safety*, 13 (1), 16-18.
- Nikulin, A., & Nikulina, A. Y. (2017). Assessment of occupational health and safety effectiveness at a mining company. *Ecology, Environment and Conservation*, 23(1), 351-355.
- Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, 5(1), 14-37.
- Nyanza, E. C., Bernier, F. P., Martin, J. W., Manyama, M., Hatfield, J., & Dewey, D. (2021). Effects of prenatal exposure and co-exposure to metallic or metalloids on early infant neurodevelopmental outcomes in areas with small-scale gold mining activities in Northern Tanzania. *Environment International*, 149, 106104.
- NIOSH (2002). Health effects of occupational exposure to respirable crystalline silica. *Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2002-129*
- Oakley, J. S. (2005, June). Using accident theories to prevent accidents. In *ASSE Professional Development Conference and Exposition*. OnePetro.
- Ojeme, J. A., & Raymond, E. (2021). Occupational safety and health practices required by electrical/electronics technology graduates in North Central Nigeria. *ATBU Journal of Science Technology and Education*, 9 (2), 235-245

- Okafoagu, N. C., Oche, M., Awosan, K. J., Abdulmulumuni, H. B., Gana, G. J., Ango, J. T., & Raji, I. (2017). Determinants of knowledge and safety practices of occupational hazards of textile dye workers in Sokoto, Nigeria: a descriptive analytic study. *Journal of Public Health in Africa*, 8(1).
- Orodho, A. J. (2003). Essentials of educational and social science research methods. *Nairobi: Masola Publishers*, 54, 71-82.
- Osei-Asibey, D., Ayarkwa, J., Acheampong, A., Adinyira, E., & Amoah, P. (2021). Framework for improving construction health and safety on Ghanaian construction sites. *Journal of Building Construction and Planning Research*, 9(2), 115-137.
- Osei-Boateng, C., & Ampratwum, E. (2011). The informal sector in Ghana. *Accra: Friedrich-Ebert-Stiftung, Ghana Office*.
- Osei, B. K., Ahenkorah, I., Ewusi, A., & Fiadonu, E. B. (2021). Assessment of flood prone zones in the Tarkwa mining area of Ghana using a GIS-based approach. *Environmental Challenges*, 3, 100028.
- Owusu-Nimo, F., Mantey, J., Nyarko, K. B., Appiah-Effah, E., & Aubynn, A. (2018). Spatial distribution patterns of illegal artisanal small scale gold mining (Galamsey) operations in Ghana: A focus on the Western Region. *Heliyon*, 4(2), e00534.
- Pandit, B., Albert, A., Patil, Y., & Al-Bayati, A. J. (2019). Impact of safety climate on hazard recognition and safety risk perception. *Safety Science*, 113, 44-53.
- Patel, L. (2015). Decolonizing educational research: From ownership to answerability. *Routledge*.

- Patil, S. D., Salunkhe, A. H., Kakade, N. R., Katti, A. V., & Mohite, V. R. (2016). A Study to assess knowledge on occupational health hazards among the workers of jaggery factory with special emphasis to prepare health educational material in selected jaggery factories at kolhapur, India. *International Journal of Innovative Research and Development*, 5(6), 124-132.
- Plano Clark, V. L., & Creswell, J. W. (2015). Understanding research: A consumer's guide.
- Rahiman, M. A., & Mahat, N. A. A. (2018). The influence of domino theories in preventing construction accidents.
- Rajaei, M., Obiri, S., Green, A., Long, R., Cobbina, S. J., Nartey, V., ... & Basu, N. (2015). Integrated assessment of artisanal and small-scale gold mining in Ghana—Part 2: Natural sciences review. *International Journal of Environmental Research and Public Health*, 12(8), 8971-9011.
- Ram, M., Edwards, P., Jones, T., & Villares-Varela, M. (2017). From the informal economy to the meaning of informality: Developing theory on firms and their workers. *International Journal of Sociology and Social Policy*.
- Ran, F. X., & Sanders, J. (2020). Instruction quality or working condition? The effects of part-time faculty on student academic outcomes in community college introductory courses. *AERA Open*, 6(1), 2332858420901495.
- Randolph, J. (2009). A guide to writing the dissertation literature review. *Practical Assessment, Research, and Evaluation*, 14(1), 13.

Raymond, R. (2018). The role of occupational health and safety management system in reducing workplace hazards a case of selected manufacturing industries in Dar es Salaam (Doctoral dissertation, University of Dar es Salaam).

Ricci, F., Chiesi, A., Bisio, C., Panari, C., & Pelosi, A. (2016). Effectiveness of occupational health and safety training: A systematic review with meta-analysis. *Journal of Workplace Learning*.

Roscoe, J. T. (1975). *Fundamental research statistics for the behavioural sciences* by John T. Roscoe.

Rosenstock, I. M. (2005). Why people use health services. *The Milbank Quarterly*, 83(4).

Rosenstock, I. M. (1974). Historical origins of the health belief model. *Health Education Monographs*, 2(4), 328-335.

Rosenstock, I. M., Strecher, V. J., & Becker, M. H. (1988). Social learning theory and the health belief model. *Health Education Quarterly*, 15(2), 175-183.

Routh, S., & Borghi, V. (Eds.). (2016). Workers and the global informal economy: Interdisciplinary perspectives. *Routledge*.

Rowlinson, S. (2004). The need for accident reporting systems: legal versus company needs (pp. 405-410). *Taylor & Francis, Inc.* New York, NY.

Saghafi-Asl, M., Aliasgharzadeh, S., & Asghari-Jafarabadi, M. (2020). Factors influencing weight management behaviour among college students: An application of the health belief model. *PloS one*, 15(2), e0228058.

- Salguero-Caparrós, F., Pardo-Ferreira, M. C., Martínez-Rojas, M., & Rubio-Romero, J. C. (2020). Management of legal compliance in occupational health and safety. A literature review. *Safety Science*, *121*, 111-118.
- Santos, R. F. D., Oliveira, R. L. D., Gallottini, M., Caliento, R., & Sarmento, D. J. D. S. (2018). Prevalence of and factors associated with actinic cheilitis in extractive mining workers. *Brazilian Dental Journal*, *29*, 214-221.
- Sarantakos, S. (2005). Social research. *Palgrave Macmillan*.
- Saxena, N. (2017). Analysis of Road Traffic Accident using Causation Theory with Traffic Safety Model and Measures. *International Journal For Research In Applied Science & Engineering Technology (Ijrasnet)*, *5*, 1263-1269.
- Scotland, J. (2012). Exploring the philosophical underpinnings of research: Relating ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms. *English Language Teaching*, *5*(9), 9-16.
- Setia, M. S. (2016). Methodology series module 3: Cross-sectional studies. *Indian Journal of Dermatology*, *61*(3), 261.
- Shahnazi, H., Ahmadi-Livani, M., Pahlavanzadeh, B., Rajabi, A., Hamrah, M. S., & Charkazi, A. (2020). Assessing preventive health behaviors from COVID-19: a cross sectional study with health belief model in Golestan Province, Northern of Iran. *Infectious diseases of poverty*, *9*(06), 91-99.
- Sharma, G. (2017). Pros and cons of different sampling techniques. *International Journal of Applied Research*, *3*(7), 749-752.

- Sinelnikov, S., Inouye, J., & Kerper, S. (2015). Using leading indicators to measure occupational health and safety performance. *Safety Science*, 72, 240-248.
- Singoro, B. W., Wakhungu, J., & Obiri, J. (2016). Causes and trends of public transport motorcycle accidents in Bungoma County, Kenya.
- Small-Scale Gold Mining Law, 1989 (LI 665). Ghana Publishing Company Limited, Accra.
- Smith, M. R., Zeuwts, L., Lenoir, M., Hens, N., De Jong, L. M., & Coutts, A. J. (2016). Mental fatigue impairs soccer-specific decision-making skill. *Journal of Sports Sciences*, 34(14), 1297-1304.
- Sousa, R. N., Veiga, M. M., Klein, B., Telmer, K., Gunson, A. J., & Bernaudat, L. (2010). Strategies for reducing the environmental impact of reprocessing mercury-contaminated tailings in the artisanal and small-scale gold mining sector: insights from Tapajos River Basin, Brazil. *Journal of Cleaner Production*, 18(16-17), 1757-1766.
- Strecher, V. J., & Rosenstock, I. M. (1997). The health belief model. *Cambridge Handbook of Psychology, Health and Medicine*, 113, 117.
- Sulat, J. S., Prabandari, Y. S., Sanusi, R., Hapsari, E. D., & Santoso, B. (2018). The validity of health belief model variables in predicting behavioral change: A scoping review. *Health Education*, 118(6), 499-512.
- Teschner, B. A. (2012). Small-scale mining in Ghana: The government and the galamsey. *Resources Policy*, 37(3), 308-314.
- Usher, E. L., & Schunk, D. H. (2018). Social cognitive theoretical perspective of self-regulation.

United Nations Development Programme. (2010). Human development report 2010. *Palgrave Macmillan*.

United Nations Environment Programme (2015). Developing a national action plan to reduce, and where feasible, eliminate mercury use in artisanal and small scale gold mining: working draft. *Geneva: United Nations Environment Programme*.

Vishwakama, N., Arun, P. A., Nandan, A., & Yadav, B. P. (2020). Scenario evaluation of domino effects in process industries: A review. *Advances in Industrial Safety*, 85-99.

Voukelatou, V., Gabrielli, L., Miliou, I., Cresci, S., Sharma, R., Tesconi, M., & Pappalardo, L. (2021). Measuring objective and subjective well-being: dimensions and data sources. *International Journal of Data Science and Analytics*, 11, 279-309.

Wang, X., Shu, G., Tian, H., Liu, P., Li, X., & Jing, D. (2017). Engine working condition effects on the dynamic response of organic rankine cycle as exhaust waste heat recovery system. *Applied Thermal Engineering*, 123, 670-681.

Wang, X., Song, C., Yang, C., & Xie, Y. (2018). Process working condition recognition based on the fusion of morphological and pixel set features of froth for froth flotation. *Minerals Engineering*, 128, 17-26.

Watters, M., & Rayman, J. (2014). Agency for toxic substances and disease registry's don't mess with mercury initiative. *Journal of Environmental Health*, 76(10), 34.

Wibowo, T., Sukaryawan, I. M., & Hatmoko, J. U. D. (2020, September). Identifying Causal Factors of Accidents Related to Working at Height:

A Case Study of a Construction Company. In *Proceedings of the International Conference on Engineering and Information Technology for Sustainable Industry* (pp. 1-7).

Wilson, A. G., Dann, C., & Nickisch, H. (2015). Thoughts on massively scalable Gaussian processes. *arXiv preprint arXiv:1511.01870*.

Wilson, M. L., Renne, E., Roncoli, C., Agyei-Baffour, P., & Yamoah Tenkorang, E. (2015). Integrated assessment of artisanal and small-scale gold mining in Ghana Part 3: Social sciences and economics. *International Journal of Environmental Research and Public Health*, 12(7), 8133-8156.

Workmen's Compensation Act, 1987. PNDCL 187. Ghana Publishing Company Limited, Accra.

World Health Organisation. (1999). WHO monographs on selected medicinal plants (Vol. 2). *World Health Organisation*.

World Health Organisation (2003). Elemental mercury and inorganic mercury compounds: human health aspects. Concise International Chemical Assessment Document 50. *Geneva: World Health Organisation*.

World Health Organisation. (2008). World health statistics 2008. *Geneva: World Health Organisation*.

World Health Organisation. (2016). World health statistics 2016: Monitoring health for the SDGs sustainable development goals. *Geneva: World Health Organisation*.

World Health Organisation (2016). Environmental and occupational health hazards associated with artisan and small-scale gold mining. *Geneva: World Health Organisation*.

- Xia, S., Lin, R., Cui, X., & Shan, J. (2016). The application of orthogonal test method in the parameters optimization of PEMFC under steady working condition. *International Journal of Hydrogen Energy*, 41(26), 11380-11390.
- Yakovleva, N., & Vazquez-Brust, D. A. (2018). Multinational mining enterprises and artisanal small-scale miners: From confrontation to cooperation. *Journal of World Business*, 53(1), 52-62.
- Yakubu, I., Garmaroudi, G., Sadeghi, R., Tol, A., Yekaninejad, M. S., & Yidana, A. (2019). Assessing the impact of an educational intervention program on sexual abstinence based on the health belief model amongst adolescent girls in Northern Ghana, a cluster randomised control trial. *Reproductive Health*, 16(1), 1-12.
- Yang, K., & Ahn, C. R. (2019). Inferring workplace safety hazards from the spatial patterns of workers' wearable data. *Advanced Engineering Informatics*, 41, 100924.
- Yeo, C. J., Yu, J. H., & Kang, Y. (2020). Quantifying the effectiveness of technologies for accident prevention. *Journal of Management in Engineering*, 36(5), 04020054.
- Yi W, Albert P.C, Chan P.C, Wong F.K.W, Del P & Wong D.P, (2016). Effectiveness of a newly designed construction uniform for heat strain attenuation in a hot and humid environment. *Applied Ergonomics*. doi:10.1016/j.apergo.2016.04.011
- Yin, S. Y., Tserng, H. P., & Tsai, M. D. (2008). A model of integrating the cycle of construction knowledge flows: lessons learned in Taiwan. *Automation in Construction*, 17(5), 536-549.

Zalk, D. M. (2013). Participatory occupational hygiene: A path to practical solutions. *Asian-Pacific Newsletter*.

Zhang, J., Hu, Y., Han, C., & Zhang, H. (2021). Stress response and contact behaviour of PEMFC during the assembly and working condition. *International Journal of Hydrogen Energy*.

Zhang, M., & Fang, D. (2013). A continuous behaviour-based safety strategy for persistent safety improvement in construction industry. *Automation in Construction*, 34, 101-107.

Zhang, M., Shi, R., & Yang, Z. (2020). A critical review of vision-based occupational health and safety monitoring of construction site workers. *Safety Science*, 126, 104658.

Zhang, Z., Chen, H., Li, S., An, Z., & Wang, J. (2020). A novel geodesic flow kernel based domain adaptation approach for intelligent fault diagnosis under varying working condition. *Neurocomputing*, 376, 54-64.

Zolnikov, T. R. (2020). Effects of the government's ban in Ghana on women in artisanal and small-scale gold mining. *Resources Policy*, 65, 101561.

APPENDIX A

Interview Schedule for Small-Scale Gold Miners in Tarkwa Nsuaem Municipality

My name is Robert Ewusi-Ntenah, an MPhil Student from the School of Development Studies, University of Cape Coast, Ghana. I am conducting a study on occupational health and safety among small-scale miners in Tarkwa Mining Area. You are invited to participate in this research by providing your candid views concerning this study. Your contributions will help in the completion of this study. Participation in this study is voluntary and your confidentiality will be reserved as the information you give will be used strictly for academic purposes.

Part 1: Demographic Information (tick as appropriate)

1. Sex: Male Female
2. What is your age?
 - i) 20 years or below
 - ii) 21-30 years
 - iii) 31-40 years
 - iv) 41-50 years
 - v) 51-60 years
 - vi) Above 60 years
3. What is your Marital status?
 - i) Single
 - ii) Married
 - iii) Divorced
 - iv) Separated
4. What is your level of education?
 - i) No schooling
 - ii) Primary
 - iii) JHS
 - iv) Secondary
 - v) Tertiary
5. What is the name of your mining company?
6. Is the company registered?
 - i. Yes
 - ii. No

7. What is your current position? (tick as appropriate)
- i. Loader [....] Driller [....] Crusher [....] Supervisor [....]
 - ii. Others, please specify.....
8. What type of mining do you undertake?
- Surface [....] Underground. [....] Both [....]

Part 2: Knowledge of Occupational Health and Safety Issues

9. This section tries to gather information on occupational health and safety issues. For each item in the box, please use the (√) symbol to indicate the appropriate response.

	Yes	No	Not Sure
a) I know my rights and responsibilities in relation to workplace health and safety			
b) I know how to perform my job in a safe manner.			
c) I have the knowledge to assist in responding to any health and safety concerns at my workplace			
d) I know the necessary precautions that I should take while doing my job			
e) I know the health and safety practices related to my work			
f) I undertake the appropriate health and safety practices			
g) I know that failure to undertake health and safety practices would result in injuries, diseases and even death			
h) Every employee is given the necessary workplace health and safety when starting a job, changes a job or using new techniques/machines			
i) There is a regular communication between employees and management about health and safety issues			
j) Employers are responsible for the health and safety of employees			
k) Employees are responsible for their own health and safety.			
l) I undergo basic OHS training			
m) We have OHS policy at the workplace			

Part 3: Existing health and safety working conditions of Small-scale gold miners.

Please use (√) to indicate the appropriate response.

10. How many hours do you work in a day?

- a) Maximum less than 8 hours [] b) Maximum 8 hours []
c) Maximum more than 8 hours []

11. If you work more than 8 hours, are you paid overtime?

- a) Yes [] b) No []

12. Do you have break period for lunch?

- a) Yes [] b) No []

13. If yes, how many minutes do you use?

- a) Below 15 minutes [] b) 15-30 minutes [] c) 31-45 minutes []
d) 46-1hour []

14. Where do you take lunch?

- a) Canteen [] b) Open space [] c) Any sp [] d) None []

15. Do you have off-days

- a) Yes [] b) No []

16. If yes, how many days in a week

- a) 1day [] b) 2days [] c) 3days []

17. Do you observe public holidays?

- a) Yes [] b) No []

18. If no, are you paid double the wage you take on that day?

- a) Yes [] b) No []

19. Use (√) to indicate the health and safety facilities available in your workplace.

- a) First aid box [] b) Fire Extinguisher [] c) Dust extractor []

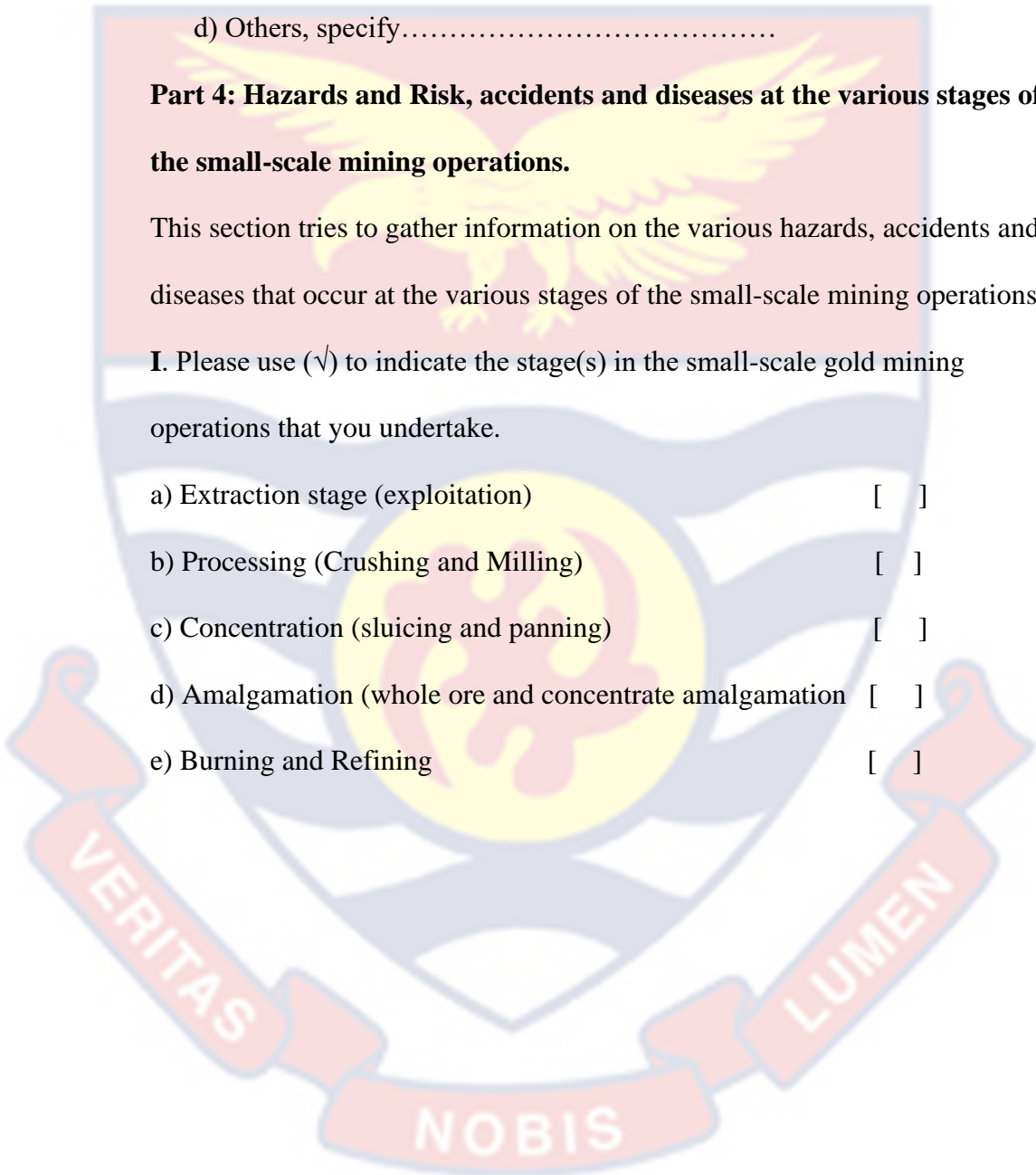
d) Others, specify.....

Part 4: Hazards and Risk, accidents and diseases at the various stages of the small-scale mining operations.

This section tries to gather information on the various hazards, accidents and diseases that occur at the various stages of the small-scale mining operations.

I. Please use (√) to indicate the stage(s) in the small-scale gold mining operations that you undertake.

- a) Extraction stage (exploitation) []
- b) Processing (Crushing and Milling) []
- c) Concentration (sluicing and panning) []
- d) Amalgamation (whole ore and concentrate amalgamation) []
- e) Burning and Refining []



II. Please use (✓) to indicate the hazards and exposures, diseases, and accidents/Injuries that you encounter under the stage(s) in the small-scale mining operations.

No	Hazards and exposures	Diseases	Accidents/Injuries
	Dust []	Lung diseases []	Fractures []
	Noise and Vibration []	Tuberculosis []	Contusions []
	Poor air quality []	Silicosis []	Lacerations []
	Lack of ventilation []	Hypertension []	Neurogenic shock []
	Obsolete/inappropriate equipment []	Mental impairments: psychological effects []	Stumbling, Slipping and falling []
	Heat/humidity and lack of oxygen []	Asphyxiation []	Spinal cord injuries []
	Rock falls []	Dengue fever []	Shoulder disorders []
	Lack of exits []	Noise-induced hearing loss []	Abrasions []
	Flooding []	Intestinal infections []	Dislocations []
	Unstable underground structures []	Musculoskeletal disorders and diseases (arthritis) []	Upper and lower limbs, eye, head, eyes & ears []
	Poor visibility and light []	Cardiovascular diseases []	Puncture Wounds []
	Poorly built tunnels []	Cholera/typhoid []	Amputations []
	Poor sanitation []	Traumatic injury []	
	Improper use of /Exposure to chemicals []	Skin diseases []	
		Nervous system damages []	

Part 5: Ways to prevent and control occupational health and safety issues of small-scale gold miners.

Please use (√) to indicate how to prevent and control the occupational health and safety issues of small-scale gold miners.

No.	Prevention and control measures	Yes	No
a)	Engineering controls – which require a physical change to the workplace		
b)	Administrative controls – which require the worker or the employer to do something.		
c)	Use of personal protective equipment like		
d)	i. Safety helmet for head	[.....]	[.....]
	ii. Overall /Overcoat for the body	[.....]	[.....]
	iii. Protective gloves hand	[.....]	[.....]
	iv. Safety boots for legs	[.....]	[.....]
	v. Hearing protection or (earplugs) for ears	[.....]	[.....]
	vi. Dust mask for nose	[.....]	[.....]
	vii. Safety glasses/ Goggles for eyes	[.....]	[.....]

Part 6: Effects of Knowledge of Occupational Health and Safety on Working Conditions/Safety

Please tick the appropriate option

No	Statement	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
a) 1	Knowledge of health and safety provides control and improvement of work-related hazards					
b)2	Knowledge of health and safety results in improved company image					
c)3	Knowledge of health and safety results in less turnover and higher productivity					
d)4	Knowledge of health and safety helps workers to protect themselves against any avoidable injuries and accidents in the workplace					
e)5	Knowledge of health and safety would be able to reduce workers' exposure to different hazards located in their various stages of work					

I thank you very much for your support