UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

ASSESSING THE WAYSIDE WELDERS' APPLICATION OF SAFETY MEASURES IN WELDING: A CASE STUDY OF JAMAN NORTH DISTRICT

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A Project Work in the Department of MECHANICAL AND AUTOMOTIVE TECHNOLOGY EDUCATION, Faculty of TECHNICAL EDUCATION, submitted to the School of Graduate Studies, University of Education Winneba, in partial fulfilment of the requirements for the award of Master of Technology Education (Mechanical) degree

OCTOBER, 2018

DECLARATION

STUDENT'S DECLARATION

I, **ERIC ESSEL**, declare that this project, with the exception of quotations and references contained in published works which have all been identified and dully acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

SIGNATURE: ……

DATE: ……

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of Thesis/ Dissertation / Project as laid down by the University of Education, Winneba.

NAME OF SUPERVISOR: **ENGR. MRS. MARTHA DANSO**

SIGNATURE: ……

DATE: ……

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DEDICATION

I dedicated this project work to my daughter, Nana Adwoa Arthur Essel and my father, William Christopher Essel who inspired me to reach this level of academic laurel.

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ACRONYMS AND ABBREVIATIONS

Db	-	Decibels
ENGR	-	Engineering
GSS	-	Ghana Statistical Service
GTAW	-	The Gas Tungsten Arc Welding
HAVS	-	Hand-Arm Vibration Syndrome
ILO	-	International Labour Organisation
ISCO	-	The International Standard Classification of Occupations
NIHL	-	Noise Induced Hearing Loss
OSHA	-	Occupational Safety And Health Administration
PPEs	-	Personal Protective Equipment
SMAW	-	Shielded Metal Arc Welding
SPSS	-	Statistical Package for Social Science
WHO	-	World Health Organization

ABSTRACT

Safety is a critical consideration for any welding project. Application of safety measures and practices among welders are important ways of preventing or reducing the levels of health hazards associated with the occupation. While adherence to these precautions is nearly applied in the industrial welding, for the non-industrial welding in which wayside welders are the focus, little information is known of them. The purpose of the study was to assess wayside welders‟ application of safety measures in welding. The research used the qualitative research design on 57 wayside welders in the Jaman North District sampled by the snowball non-probability method. A pretested structured interview guide was used to collect data which was entered and analysed using the Statistical Product and Service Solutions (SPSS, version 25) software. The results showed that all the respondents were males. A majority (94.7%) of welders were aware of safety measures with only 5.3% who were not aware. Again, safety measures adopted by wayside welders included the use of PPEs, good housekeeping and safe working procedures. Welders did not use the recommended PPES to protect themselves while working. They rather used ordinary sunglasses and did not protect their ears, eyes, nose and feet while working. The most adopted and applied safety measure by the welders were the use of PPES, good housekeeping and safe working procedures. It was concluded that welders‟ awareness of safety measures did not translate into their use to provide safety among welders. This calls for concern and need for more preventive measures within this occupational group to avoid injuries and illness through government and non-governmental interventions.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Welding has become one of the most important occupational groups, owing to rapid urbanization and industrialization, in many developing countries (Bhumika, Megha, Richa, Prachi & Enti, 2014 and Health and Executive, 2017). According to Adu (2011), welding in Ghana is extensively used in the manufacturing industry, construction industry and for maintenance and repairs. Welders are defined as workers who cut and join metal parts using flame or electric arc and other sources of heat (The International Standard Classification of Occupations, ISCO). The most commonly used welding processes in Ghana are the shielded metal arc welding (SMAW) in the electric arc welding group and oxyfuel gas welding. The gas tungsten arc welding (GTAW) process is also used by few industries. Majority of welders in the Ghanaian welding industry operate as micro, small scale and medium enterprises found in industrial places like Accra, Kumasi, Tema and Takoradi and also in the villages. Welding trade acquisition by the welders is mostly from apprenticeship training from experienced ones without attending any formal welding schools. Majority of the welders are school dropouts having terminated their secondary school education.

According to the Department of Labour Wellington, New Zealand (2006) welding poses a range of both well-known and subtle hazards to health and safety. The workers get exposed to a range of dangers during the welding process. These are able to act quickly or may show up only in the long run. They can be rapidly deadly (electric shock or exposure to cadmium fumes) or have delayed effects (lung changes over time). Hazards that affect welders are grouped into physical, chemical,

mechanical and ergonomic. Physical hazards cause physical damage or injury and examples are exposure to noise, vibration, radiation (ionizing and laser) or excesses of heat, cold and physical trauma (Erdal and Berman, 2008). The hot oxyacetylene flame or the electric current produces excessively high temperature leading to burns and electric shocks. Laceration injuries and cuts from sharp or pointed metal panes, high velocity particles and occasional oxyacetylene gas tank explosions do happen (Erdal & Berman, 2008).

It is again stated that the welding machine produces sound as high as 120 decibels (dB) very dangerous to the hearing organ. Exposure to high levels of noise (>90dB) for an eight-hour period or more causes noise- induced hearing loss (NIHL) that results in damage to the sensory hair cells of the cochlear causing permanent deafness, fatigue and nervousness may also happen. It is further stated that the welding machines produce vibrations that may give rise to soft tissue injury and injury to the digital circulation of the hand and arm resulting in the condition called Hand-Arm Vibration Syndrome (HAVS) which has symptoms similar to that of Reynaud‟s Syndrome i.e. blanding of the fingers (Twinn, Roberts and Andrew, 1996: 24-5).

Chemical hazards also refer to the deleterious effects that the chemical components of welding materials welders are exposed to a daily basis. These are exposure to noxious metal fumes containing a cocktail of metals such as copper, cobalt, nickel, chromium, platinum, and their oxides leading to various respiratory dysfunctions and to the influenza-like condition called metal fever. Metal fume fever symptoms may occur after 4 to 12 hours, and include chills, thirst, fever, muscle ache, chest soreness, coughing, fatigue, wheezing, nausea and a metallic taste in the mouth (Welding Hazards AFSCME Factsheet, 2011).

Adelani, Adewale, Oladeji and Bello (2014), state welders have a high prevalence of musculoskeletal complaints namely back injuries, shoulder pain, tendinitis, reduced muscle strength, carpal tunnel syndrome, white finger, and knee joint diseases. Work postures (especially welding overhead, vibration, and heavy lifting) all able to contribute to such disorders. These problems can be prevented through proper lifting, not working in one position for periods of time, keeping the work at a comfortable height, using a foot rest when standing for long periods, locating tools and materials conveniently, and minimizing vibration.

According to World Health Organisation (WHO, 2014), there are about 250 million cases of work- related injuries per year worldwide and one of the jobs that contribute to these occupational injuries is non-industrial welding, especially in developing countries (Bhumika et al., 2014). 1.5 million workers suffer from occupational hazards in the United Kingdom. The fumes given off by welding processes is a varied mixture of airborne gases and very fine particles which if inhaled cause respiratory problems (Health and Safety Executive, 2017). India reported a 44% prevalence of respiratory morbidity among welders resulting from their exposure to welding fumes (Ganesh, Dharanipriya & Kar, 2013). A research work conducted in 2009 on awareness of occupational hazards and utilization of safety measures among welders in Kaduna Metropolis (north-west Nigeria), it was discovered that 85.3% of the subjects had experienced one or more work-related accidents and occupational hazards. The most common injuries sustained were cuts or injuries to the hands or fingers (38.0%), back or waist pain (1.0%), arc eye injuries due to foreign bodies in the eye (17.0%), burns (14.0%), hearing impairment (7.0%), fractures (4.0%) and amputation (1.0%). It was further noticed that there was sub-optimal utilization of

protective measures against these occupational hazards with only 34.2% of the welders using one or more types of protective devices (Sabitu, Iliyasu & Dauda, 2009).

Kumah, Cobbina and Duodu (2011) also in their study, "Radiation-related eye diseases among welders of Suame magazine in the Kumasi metropolis" concluded that the ocular symptoms and ailments prevalent among the welders were most likely due to radiations they are exposed to in their work environment.

1.2 Statement of the Problem

Safety is a critical consideration for any welding project. Application of safety measures and practices among welders are important ways of preventing or reducing the levels of health hazards associated with the occupation. While adherence to these precautions is nearly applied in the industrial welding, for the non-industrial welding in which wayside welders are the focus, little information is known of them.

In the Jaman North District, wayside welders are usually located around mechanic workshops, motor spare-parts markets along major highways and feeder roads where they establish privately owned small-scale workshops. This group has no organised occupational health service and their application to safety measures is unknown.

It is therefore in the light of this that the researcher wishes to assess wayside welders" application of safety measures in welding in the Jaman North District, so as to make recommendations on ways of ameliorating the effects of the dangers of welding.

1.3 Purpose of the Study

The purpose of the study was to assess wayside welders‟ application of safety measures in welding.

1.4 Objectives of the Study

i. Determine level of awareness on application of safety measures in welding among wayside welders in the Jaman North District.
ii. Establish types of safety devices/ personal protective equipment (PPE) used by the wayside welders in applying safety measures in welding.
iii. Assess the types of safety measures adopted by wayside welders.

1.5 Research Questions

i. What are the safety measures awareness level among wayside welders to avoid occupational hazards or injuries?
ii. What are the available safety devices/ personal protective equipment (PPE) for the application of safety measures in welding by the wayside welders?
iii. What are the types of safety measures adopted and applied by the wayside welders?

1.6 Significance of the Study

The research is to assess the wayside welders‟ perception on the application of safety measures in welding in the Jaman North District. The study would help to unravel some of the problems associated with the application of safety measures in welding by the wayside welders. Again, the study would create more awareness on welding hazards and the need to apply safety measures in welding for the wayside welders.

Also, the study would increase education or training on the application of safety measures in welding by the wayside welders. Lastly, the study would serve as a reference document for future researchers.

1.7 Limitation of the Study

A number of experiences were encountered during interactions with the respondents. One main observation made was that, some of the respondents in the research were not willing to be interviewed. They explained that they had granted similar interviews to previous researchers who promised to reward them with money and or gifts but failed to do so after gathering the information they needed.

Secondly, some apprentices were very uncomfortable with and intimidated by the presence of their masters when responding to questions especially regarding the availability of PPE. In such circumstance, the questions were explained to the extent possible, that respondents answered them objectively. To achieve this, the researcher had to ask some of the questions in respondents" local dialect.

Also, some welders were not at work at the time of the interview which reduced the number of welders used in the study to a relatively smaller sample size.

Again, the issue of welders who were not willing to provide any information at all to the research when visited was also a form of hindrance to the study.

Finally, for places where the master was the only one there, the researcher had to wait for several hours before a respondent could be available to be interviewed. Some of the respondents were also reluctant to grant the interview because they did not see any improvement in their conditions of work after granting audience to similar researches. However, all the above did not affect the outcome of the study.

1.8 Delimitation of the Study

The study was conducted for only towns or communities that have welders in them. The towns or communities are Sampa (district capital), Kabile, Jamera, Suma Ahenkro, Koti, Morle, Asiri, Goka, Asuorkor-Akoata, Duadaso 1&2, and Kokoa.

1.9 Organization of the Study

The study is organised in five chapters. Chapter one is about introduction to the study. It consists of the background to the study, statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, limitation of the study, delimitation of the study and organisation of the study. Chapter two focuses on literature review. It mainly reviews what other authors, researchers and writers have said about the chosen topic. Chapter three is about research methodology. It comprises of study area, research design, data sources, population, sample and sampling procedure, instruments for data collection, reliability and validity of instruments, data collection procedure and method data analysis. Chapter four is also about analysis and discussion of results. Chapter five deals with the summary of findings, conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This section of the study reviews literature related to the subject under study. The study"s literature review is based on the following thematic headings of the research questions: safety measures awareness level among wayside welders to avoid occupational hazards or injuries, the available safety devices / personal protective equipment (PPE) for the application of safety measures in welding by wayside welders and types of safety measures adopted and applied by wayside welders.

2.1 Safety Measures Awareness Level among Wayside Welders to Avoid Occupational Hazards or Injuries

According to Okuga, Mayega and Bazeyo (2012) in Kenya, awareness of occupational accidents and hazards is the first step in promoting workplace safety. Bhumika et al. (2014) assert that occupational hazards contribute to 2.3% of Disability Adjusted Life Year, DALY, lost among middle income countries. Adding that employment of safety measures and practices among welders are potential ways of Preventing or reducing the levels of health hazards associated with the occupation. According to the International Labour Organization (2013);

> Welders are a potential group often suffering bodily injuries. Welders have been identified as a high risk group according to ranking of occupations based on cost related injuries. Traumatic eye injury is one of the most significant occupational health and safety concern for the welding workers. Injuries mostly occur during a normal operation of welding machine and not as a consequence of any mechanical failure.

Sabitu, Iliyasu and Dauda (2009), studied the awareness of occupational hazards and utilization of safety measures among welders in Kaduna Metropolis (north-west Nigeria) and discovers that 85.3% of the subjects had experienced one or more work-related accidents and occupational hazards. The most common injuries sustained were cuts or injuries to the hands or fingers (38.0%), back or waist pain (1.0%), arc eye injuries due to foreign bodies in the eye (17.0%), burns (14.0%), hearing impairment (7.0%), fractures (4.0%) and amputation (1.0%). The study also observes that there was sub-optimal utilization of protective measures against these occupational hazards with only (34.2%) of the welders using one or more types of protective devices. However, regular use of safety equipment, shorter working hours and increasing experience were all protective of occupational accidents (Sabitu et al., 2009).

As regards the awareness level of safety measures among wayside welders, Kumar, Dharanipriya and Kar (2013), has it that about 58.9% of welders were aware of importance of wearing goggles. One-third (n=75, 35.8%) were aware of importance of wearing face mask or shield. Only few of the studied welders were aware of importance of gloves (n=44, 21.0%) and boots (n=26, 12.44%) as protective devices. Though none of the welders were aware of the protective effect of apron, ear plugs, and air filter. The majority of them used at least one protective measure in the preceding week (n=200, 95.7%). This revelation is alarming to say the least.

Z‟gambo (2015) states that although the majority (98%) of the welders were aware of at least one type of welding hazard, or personal protective equipment (PPE), about 2% were not aware of any hazards or any personal protective measures adding that none of the welders used all the recommended PPE at any time during their work. A high prevalence of self-reported eye (88%), nasal (78%), metal fume fever (68%) and

respiratory (64%) related symptoms was found in addition to burns (87%) and cuts (79%) on hands/arms. Adelani, Adewale, Oladeji & Bello (2014) retorts in affirmation that;

> Welders have a high prevalence of musculoskeletal complaints namely back injuries, shoulder pain, tendinitis, reduced muscle strength, carpal tunnel syndrome, white finger, and knee joint diseases. Work postures (especially welding overhead, vibration, and heavy lifting) all able to contribute to such disorders.

In addition, Balchin and Castner (1993), outlines some of the hazards a welder may encounter and safety precautionary measures are as follows:

i. Eye injuries and burns
ii. Explosive Risks
iii. Fume Risks
iv. Fire Risks
v. Electric shock

All the above stipulates that welders are aware of the fact these problems can be prevented through a number of safety measures which include; not working in one position for periods of time, keeping the work at a comfortable height, using a foot rest when standing for long periods, locating tools and materials conveniently, and minimizing vibration. Also welders are aware that precautions must be taken to avoid eye injuries and burns to exposed body parts which may occur as the result of spattering of incandescent metal particles and from flying slag particles; during welding and cutting operations. Buonanno et al (2011) adds, if the eyes are exposed to the light of the arc, even for quit short periods, arc eye may develop. Therefore, helmets or hand-held shields with appropriate filter lenses and cover plates must be used by welders and nearby personnel when viewing the arc. Burns are almost

invariably caused through lack of care, or through failure to wear protective clothing. Operators should make sure that their clothing is free from oil or grease, and that their workplace is tidy and not encumbered by any inflammable material which may be ignited by sparks or spatter. They should also avoid working with sleeves rolled up and hands and forearms unprotected by suitable gloves or sleeves. In overhead welding, a protective cape is a useful addition to equipment. Kumah et al (2011) in their study stated that the commonest radiation-related ocular eye diseases among welders at the Suame magazine in Kumasi were obstruction of vision due to an abnormal tissue of the eye(pterygium), (56.6%), photoconjuctivitis (22.6%) and cataract (5.1%) where as in the control group the commonest conditions were pterygium (6.2%), pinguecula (2.2%) and cataract (1.1%). There was a small number of retinopathies associated with radiation (4.0%). Most (60.0%) of the welders used electricity (arc welding) and the remaining (40.0%) used carbide (oxy-acetylene flame). Explosive Risks; explosions can occur when acetylene gas is present in the air in any proportion between 2 and 82%. Acetylene is also liable to explode when under excessive pressure, even in the absence of air. The first essential requirements are, therefore, adequate and proper ventilation, and the examination of the installation to ensure that it is free from leaks.

Fume Risks; good ventilation must be provided for oxyfuel gas welding. The heat produced by prolonged contact of the acetylene flame with a large mass of metal leads to formation of oxides of nitrogen, and in confined spaces special ventilation or breathing equipment is necessary. The fumes given off when welding and cutting parts which have been galvanised, lead-coated or otherwise treated may be injurious to the operator and special precautions must be taken. The powder cutting process used to cut stainless steel and non-ferrous metals also requires special precautions.

The ultraviolent light from the arc, may form ozone from the air or phosgene from solvents. Shielding gases are released into the atmosphere, and may build up where ventilation is restricted, or even in open topped tanks, as they are generally heavier than air. In the above operations the operator should guard against the possibility of inhaling toxic fumes, for example, by wearing a suitable respirator. Fire Risks; the risk of any welding or cutting operation starting a fire is considerable. However, there is one risk special to oxyfuel gas welding, and particularly to gas cutting. If the oxygen content is increased, burning intensity and speed is increased, normally non-flammable materials may burn, and oil or grease may catch fire spontaneously.

Oxygen may be released into the air by leaks in the equipment, by supplies being left on, or by excessive purging. In the normal operation of the flame cutting process about 30% of the oxygen supplied is released unconsumed to the atmosphere: oxyfuel gas cutting should never be undertaken in a confined space without proper ventilation arrangements. Sparks and spatter from arc welding are always liable to ignite any flammable material in the vicinity. Care should therefore be taken to make sure that the workplace and the surrounding area are clear of anything which may catch fire. Electric shock; under normal industrial conditions a supply of no more than 120V has been used to obtain an adequate measure of safety against electric shock. Any exposed metal part of a portable control device operates above 50volts must be grounded. Welders are liable to come into contact with live conduction in the welding circuit in the course of their work. As the risk of shock from 80V is normally low, welders may come to regard this safe and become careless. When work is carried out in hot or damp surroundings, the risk of a fatal shock may be significantly increased (Balchin & Castner, 1993).

Adu (2011) in his study, „research survey of current welding practices in selected metal welding industries/ engineering firms in Ghana", reported the following hazards welders went through: a total of 172 (86.00%) encountered burns while 28 (14.00%) did not. A total of 155 (77.50%) encountered electric shock while 45 (22.50%) did not. A total of 120 (60.00%) had eye related problems or diseases while 80 (40.00%) responded not having any eye problems or diseases. A total of 40 (20.00%) responded they have ever encountered explosion of cylinders/flashback while 160 (80.00%) said they had never encountered explosion of cylinders/flashback. A total of 121 (60.50%) responded they had experienced respiratory diseases or headache which they believed was as a result of the fumes from the welding they did while 79 (39.50%) responded they did not experience respiratory diseases or headache. A total of 101 (50.50%) of the respondents said they had skin diseases while an almost equal proportion 99 (49.50%) responded they did not have skin diseases. A total of 39 (19.50%) said they ever experienced fire outbreak while 161 (80.50%) said they had never experienced fire outbreak.

Appiah (2014) also in his research "workplace safety and accidents among artisans at Kokompe - Accra, Ghana", reported that, the common injuries and accident welders experience in the course of their job included cuts and burns on various parts of their bodies as a result of the handling of hot metals during welding. However, other welders, experienced eye injuries due to exposure to naked fire. A 35year old apprentice welder narrated an injury he sustained, about three months before the interview, while working on a car. According to him:

> I was working on a car when I realized that the fire from the welding machine was poor. I, therefore, decided to increase the oxygen outflow by pouring water on the carbonated stones. All that I saw was that my cloth had been lit with fire and burning my hand. It took the timely intervention of my master and others to save me. You can now see my arms with the healed scars (35year old apprentice welder).

The welders interviewed indicated that, they were aware their work exposes them to physical hazards such as welding sparks, inhaling welding arc and fumes, handling of hot metals and extreme weather conditions among others (Appiah, 2014).

Another observation made by the researcher concerning safety and working conditions among the artisans was that, welding, spraying, vehicle repairing and other related activities were all carried out at the same place and at the same time. This resulted in multiple exposures to different hazards including excessive noise apparently beyond the recommended maximum noise levels of 85 dB (A) for an eight–hour working day (ILO/WHO, 2013). The high level of noise was a concern raised by most of the artisans interviewed. They complained that it was a major problem but there was nothing they could do about it since noising-making is one of their occupational hazards (Appiah, 2014).

2.2 The Available Safety Devices/Personal Protective Equipment (PPE) For Safety Measures Application by Wayside Welders

Having examined the general level of awareness of safety measures of welders, it is now important to also establish the available safety devices or personal protective equipment for safety measures application in order to avoid accident. This is necessitated by the point that apart from it being one of the objectives of this study. According to Canada‟s National Occupational Health and Safety Resource;

> "PPE is an equipment worn by a worker to minimize exposure to specific occupational hazards. Examples of PPE are respirators, gloves, aprons, fall protection, and full body suits, as well as head, eye, and foot protection", (OSH, 2005; 2006).

Tagurum, Gwomson, Yakubu, Igbita, Chingle and Chirdan (2018) in their study on awareness of occupational hazards and utilization of PPE among welders in Jos Metropolis, Nigeria found out that majority of respondents 289 (98.0%) had googles, gloves 272 (92.2%) and facemasks 223 (75.6%) as PPE. About 148 (50.2%) admitted having earplugs. Almost all the respondents reported using PPE in the workplace with goggles (98%) being the most commonly used followed by gloves 65.4%, boots 58% and overalls 36.3%.

Z'gambo (2015), also reported that Eye cup type welding goggles (worn out with broken filter lens), Welding helmet (missing filter lens), Gauntlet leather gloves, Ear muffs, welding goggles, face mask (mask missing filter), Welding helmet and shield (worn out and missing filter lenses) and sunglasses and a disposable face mask were the PPE used by the welders.

Budhathoki, Singh, Sagtani, Niraula and Pokharel (2014) in their research on awareness of occupational hazards and use of safety measures among welders: a cross-sectional study from eastern Nepal recorded that while welding goggles/eye shields (86.7%) were the most commonly reported PPE for use, the most commonly worn PPE was study footwear (40.7%). Sunglasses were considered protective and were used as a personal protective device by 74.3% of the 260 welders who reported being aware about welding goggles/eye shields as PPE. None of the welders used welding masks, while cotton mask was used by 45% of the 300 welders who reported being aware of welding masks.

Sabitu et al. (2008) in their study on awareness on occupational hazards and use of safety measures among welders in northern Nigeria reported the more frequently used protective device against hazards by the welders were eye goggles (60.9%), hand gloves (50.3%) and boots (34.5%).

Kumar et al. (2013) in their research on awareness of occupational injuries and utilization of safety measures among welders in coastal south India also reported that although goggles and face masks were available to more than 95% of the welders, less than half of them utilized goggles (n=86, 43%) and around two-thirds of them utilize face masks (n=136, 67.3%) for 4–7 days in the preceding week. Gloves were available to 108 welders out of whom 35 (32.4%) used them for 4–7 days in the preceding week. None of them had apron and air filter.

Again, Adu (2011) in his study, "research survey of current welding practices in selected metal welding industries / engineering firms in Ghana", reported that for availability of safety or personal protective equipment used by welders in industry, the responses were that 107 (53.50%) of the industries had fire extinguishers while 93 (46.50%) did not have, 93 (46.50%) had first aid box while 107 (53.50%) did not have. A total of 88 (44.00%) used respirators while 112 (56.00%) did not have and therefore did not use them, 188 (94.00%) had proper welding goggles while 12 (6.00%) did not have proper welding goggles. A total of 167 (83.50%) had welding gloves while 33 (16.50%) did not have. A total of 177 (88.50%) had welding screens or shield while 23 (11.50%) did not use. A total of 114 (57.00%) had welding aprons and welding jackets while 86 (43.00%) did not have. Lastly, a total of 91 (45.50%) had safety boots while 109 (54.50%) did not have.

2.3 Types of Safety Measures Adopted and Applied by Wayside Welders

The Department of Labour Wellington, New Zealand (2006) states that safety as work practices are generally written methods outlining how to perform a task with minimum risk to people, equipment, materials, environment, and processes. Some practices that can prevent hazards among welders include good housekeeping, personal protective equipment (PPE), and availability of first aid, some principles such as assuming that every surface is hot and the rest. Certain work, especially where safety critical items are fabricated, requires a high level of skill and competency (e.g. welding pressure vessels) where as a high skill level may not be so critical in some general purpose welding.

It is always recommended to identify hazards before undertaking any work process to able to control hazards in the work setting, and to aid in the selection of the most suitable preventive measures. Elimination is considered the best way to prevent or control exposure to harmful substances or situations at work, although the method may not be practical in many work situations. In welding, elimination may involve the removal of risk factor completely by robotisation of the process – this process is not well developed yet. Other methods of prevention include engineering controls i.e. local exhaust ventilation; substitution i.e. substitution of welding method and materials with safer options; administrative controls i.e. work- rest schedules and safe work procedures. As the last of prevention, when no other approach is feasible, or when the degree of safety achieved by other options is considered inadequate, PPE can be used by exposed workers as means of protection of hazards (Alli, 2008).

Bhumika et al. (2014) in their research on Occupational Injuries and Safety Measures adopted by welding workers: a cross sectional study in south India discovered that only 24.4% of the welders had undergone professional training, most of the workers were not professionally trained. Only 15% of the work area had fire extinguishers. 48.7% of the workers always used the personal protective equipment, PPE. In the same research, around 73% of the welding workers maintained their equipment regularly which was a protective factor that must be mandated at work places of welding workers. Welders who had first aid kit in workplace were 38% and 19% of the welders used safety manual.

Welding PPE is regarded to provide protection for the whole body from dangerous exposures. For eye and face protection, a welding helmet, hand shield and goggles are needed. Eye protection needs to be fitted with the right type of filter lenses to protect the yes from radiation. Respirators or face masks protect the welder‟s respiratory system. The respiratory PPE should be fitted with the correct type of cartridge or filter for the chemicals (i.e. welding fume gases) or substances (i.e. dust) in the environment as a matter of importance. Exposed skin of the body trunk is protected by means of fire/flame resistant clothing and aprons. Rubber soled safety boots and insulated gloves protect the welder‟s feet and hands, respectively. In addition, ear plugs or ear muffs are required to protect the hearing of welders (Canadian Centre for Occupational Health and Safety, 2015). Welding screens can be used to prevent the people working in the same area where welding is taking place from exposure to stray welding arc rays.

Some selected requirements for assuring the safety of welding, cutting and brazing by the Occupational Safety and Health Administration (OSHA) Standard 29 CFR 1910.252 as preventive measures as cited by Singh & Anand (2013) include:

i. Compressed gas cylinders must be kept away from radiators and other heat sources and stored upright in a well-ventilated, dry location at least 20 feet from highly combustible materials such as oil. Cylinders should be kept from elevators, stairs, or other spaces where they can be knocked over or damaged.

ii. Piping systems must be tested and proved gastight at one-and-half times the maximum operating pressure, and shall be thoroughly purged with air, before being placed in service. Service piping systems must be protected by pressure relief devices.

iii. Hoses showing leaks, burns, worn places, or other defects must be repaired or replaced.

iv. Cutters and welders should be suitably trained in the safe operation of their equipment and the same use of the process.

v. The welder must be enclosed in an individual booth, or by non-combustible screens, that are painted with a finish of low reflectivity such as zinc oxide or lamp black (to absorb ultraviolet radiation). Other people next to the welding area must be protected by non-combustible or flame proof screens or to be required to wear appropriate goggles. The booths or screens must permit air circulation at the floor level.

vi. All movable fire hazards in the vicinity of the welding operations should be taken to a safe place. If all the fire hazards cannot be moved, guards must be used to contain heat, sparks and slag.

vii. Suitable fire extinguishing equipment should be maintained ready for instant use.

viii. Firewatchers are required whenever welding or cutting is performed in a location where other than a minor fire might develop. A fire watch must be maintained for at least half an hour after completion of welding or cutting operations to detect and extinguish possible smoldering fires.

ix. Eye protection must be used during all arc welding or arc cutting operations, gas welding, oxygen cutting, resistance welding, or brazing operations (the proper shade number should be selected).

x. Warning labels are required for all filler metals and fluxes containing fluorine compounds.

Adu (2011) in his study, „‟research survey of current welding practices in selected metal welding industries/ engineering firms in Ghana", reported that for insurance for welders out of the 200 industries surveyed, 63 (31.50%) of the firms responded that they had insurance for their welders. The remaining 137 (68.50%) responded they did not have insurance for the welders.

Appiah (2014) in his research "workplace safety and accidents among artisans at Kokompe - Accra, Ghana", reported that some of the respondents indicated that first aid was given to injured workers in the cases of minor cuts. The nature of first aid treatment was in the forms of injection violet, plasters and bandages which were usually bought from near-by pharmacy shops. That meant that masters did not keep first aid boxes at the work sites.

Welding processes code of practice (2012) suggests maintenance of equipment as a safety measure adoption. It is a must to ensure that any equipment used in welding is adequately maintained. Electrical equipment such as power sources, generators and welding machines and devices like ventilation systems and equipment must be properly installed, maintained, repaired and tested.

Equipment used with compressed gases, including regulators, must be properly maintained to prevent hazards such as gas leaks. Persons with management or control of workplaces must ensure that gas cylinders are regularly inspected by a competent person. They should frequently check whether cylinders and regulators are visibly damaged or corroded, and whether they are within test date. Gas pipes, hoses and tubing can easily become damaged over time so these should also be inspected regularly.

PPE must be maintained to be in good working order and kept clean and hygienic. Some types of personal protective equipment have a limited life span and need to be replaced periodically, while other types of personal protective equipment may become damaged or ineffective if stored incorrectly. For example, some respirators and filters can absorb toxins and contaminants in the air when stored between uses. PPE should be stored in a clean environment to avoid contamination or damage or according to instructions provided by the manufacturer.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This section provides details on the choice of the study area, research design, data sources, population, sampling and sample determination, data collection methods and also provides an introduction to the data analysis. Again the chapter describes the research instrument and their application and ends by giving considerations to some ethical issues.

3.1 Study Area

The study was conducted in the Jaman North District of Ghana. The Jaman North district is located between latitude 7‟40„„N and 8‟27„„N and longitude 2‟30„„W. Physically, the district is located to the North-Western part of the Brong Ahafo Region, Ghana. It also shares boundaries with Tain District to the North-East, Jaman South District to the south - West and South-East to the Berekum District. It is bordered to the La Cote d‟ Ivoire on the East. Its district capital (Sampa) is located about 119km from Sunyani the regional capital and it is 504km from Accra which is the capital city of Ghana (Ghana Statistical Service (GSS), 2014).

The District is largely composed of two main ethnic groups, the Bonos and the Nafanas. The Bonos constitute the majority of the population and the Nafanas (Nfantra) are the minority group. The three traditional councils in the Jaman North District are the Nafana (with its headquarters at Sampa), Suma (Headquarters at Suma Ahenkro) and Kwatwoma (with its headquarters at Seketia) (Ghana Statistical Service (GSS), 2014).

The population of Jaman North, according to the 2010 Population and Housing Census, is 83,059 representing 3.6 percent of the region‟s population. Males constitute 48.1 percent and females represent 51.9 percent. The proportion of the population living in urban localities (52.5%) is slightly higher than that living in rural localities (47.5) of the district. The population of the district is youthful (almost 40.0% of the population is below 15 years) depicting a broad base population pyramid which tapers off with a small number of elderly persons (60 years and older) representing 7.6 percent. The total age dependency ratio for the district is 83.6, the age dependency ratio for rural localities is higher (92.5) than that of urban localities (76.2) (Ghana Statistical Service (GSS), 2014).

Of the employed population, the highest proportion (71.6%) is engaged as skilled agricultural, forestry and fishery workers. The second highest are those engaged in service and sales. Those engaged in craft and related trades constitute 10.0 percent and 4.4 percent are engaged as professionals. The private informal sector is the largest employer in the district, employing 91.5 percent of the population. Public sector is the next highest employer, engaging 5.6 percent of the employed population (Ghana Statistical Service (GSS), 2014). The map of the research area is shown as figure 1 in Appendix I.

3.2 Study Design

The research used the qualitative research design. Qualitative research was used because it makes the information collection on opinions, perceptions and knowledge of a particular individual flexible. Burns & Grove (2003, p.19) describe a qualitative approach as “a systematic subjective approach used to describe life experiences and situations to give them meaning”. Holloway and Wheeler (2002, p.30) refer to

qualitative research as "a form of social enquiry that focuses on the way people interpret and make sense of their experience and the world in which they live". The goal of qualitative studies is a comprehensive summarization, in everyday terms, of specific events experienced by individuals or groups of individuals. Researchers use the qualitative approach to explore the behaviour, perspectives, experiences and feelings of people and emphasise the understanding of these elements.

The rationale for using a qualitative approach in this research was to assess the opinion of wayside welders" application of safety measures in welding. A qualitative approach was appropriate to capture the opinions of the wayside welders" application safety measures in welding.

3.3 Study Population

The target population for this research work was wayside welders in the Jaman North District. The study included masters/supervisors, apprentices, and helpers in the same workshop/stand premises where welding activities take place.

3.4 Sample and Sampling Procedure

Snowball non-probability sampling method was used in this research in that a small number of individual wayside welders were identified by the researcher. The wayside welders helped me to identify other welders who also identified others until a sizeable sample of wayside welders in the Jaman North District was obtained. Identified participants were accessed from their respective town areas where they operate. The welders were identified by my visit to their workshops/stands and information from other wayside welders since there was no information on them from the local assembly.

From my visits and information from other wayside welders a total of 57 wayside welders were used for the study. Thus: Sampa (17), Kabile (two), Jamera (four), Suma Ahenkro (five), Koti (three), Morle (one), Asiri (four), Goka (five), Asuokor-Akoata (one), Kokoa (10), and Duadaso 1& 2 (five).

3.5 Instrument for Data Collection

3.5.1 Pilot Study

A pilot study was conducted on fifteen wayside welders in Sampa and Suma Ahenkro towns in Jaman North District to ensure that the data collection instruments to be administered to the welders was consistent and follows a logical pattern such that responses do not contradict with the objectives of the study. The pilot test enabled the researcher to identify the weaknesses pertaining to ambiguities in wording. It also enabled the researcher ascertain the length of time for responses to the interview schedule and observation checklist.

3.6 Data Collection

For the places visited to take data the master in charge was approached first before going to the welders. In other instances, the owner (i.e. also the person in charge) was the only welder. The purpose of the study and the population of interest were explained to the master during the introductions. When permission was granted, guidance was sought with regard to location of welding shops/stands. In some instances, the master gave a general introduction of the researcher to the welders before the data collection. All welding stands/workshops in the areas visited were considered for inclusion in the study.

3.6.1 Workplace Inspections

A pretested checklist was used during workplace inspections to collect data on work related health hazards and personal protective equipment used (Checklist, Appendix VI). The checklist was used to take notes on the personal protective equipment mentioned in the interviews. Also, notes were taken during inspections on general indoor and outdoor work environments and work habits. The checklist was adapted from the welding health and safety assessment tool developed by the Department of Labour of New Zealand as well as the hazard assessment checklist of workplace safety and health hazards developed by the California Department of Industrial Relations. In addition, photographs of personal protective equipment used, work setup and machinery were taken with permission. These were used in the report and also shown to the supervisors as observations made during data collection.

3.6.2 Interviews

To ensure privacy and independence of the responses given, the welders were interviewed one at a time, not in a group. The researcher introduced himself before the interview and asked the participant their language of preference which was the language used during the interview. In most of the cases I used the Bono (Twi). The purpose of the study and other relevant information for the participants included on the information sheet were read and explained to the participants. If the participants had any questions or concerns regarding the study, these were addressed until the participant was content and convinced with the information provided. Consent was then obtained to participate in the study before collecting any data from them. If any of the welders refused to give consent, I thanked and the moved on to the next welder until all the welding stands in the area were visited.

During the interviews, a structured interview guide with closed and open ended questions was used to collect data (Interview Guide, Appendix V). The questions in the interview guide were designed based on a review of related literature on safety measures awareness level among wayside welders, types of safety devices / personal protective equipment used by wayside welders and safety measures adopted and applied by wayside welders This approach of designing the interview guide was used because no standardized questionnaires on the topic were available. The structured interview guide was divided into sections which included demographic and welding training questions (i.e. sex, age, level of education, marital status and type of welding training), general information on welding questions (i.e. activities undertaken, welding method used, shop/welding experience, products made and materials used) and open ended questions on safety measure awareness level among wayside welders to avoid occupational hazards or injuries.

The interview guide also included questions on the availability of safety devices / personal protective equipment (PPE) for the application of safety measures by wayside welders. In addition, welders were asked about types of safety measures adopted and applied. The instructions and questions in the interview guide were read out to the participants and their responses were entered by the investigator.

3.6.3 Field Work Experience

A number of experiences were encountered during interactions with the respondents. One main observation made was that, some of the respondents in Sampa town were not willing to be interviewed. They explained that they had granted similar interviews to previous researchers who promised to reward them with money and or gifts but failed to do so after gathering the information they needed. As a result, they

demanded some form of remuneration before granting the interview. The researcher therefore had to provide snacks and sometimes lunch for most respondents. Secondly, some apprentices were very uncomfortable with and intimidated by the presence of their masters when responding to questions especially regarding the availability of PPE. In such circumstance, the questions were explained to the extent possible, that respondents answered them objectively. To achieve this, the researcher had to ask some of the questions in respondents‟ local dialect.

Finally, for places where the master was the only one there, the researcher had to wait for several hours before a respondent could be available to be interviewed. Some of the respondents were also reluctant to grant the interview because they did not see any improvement in their conditions of work after granting audience to similar researches.

3.7 Data Analysis

Data analysis in qualitative research consists of preparing and organizing the data that is text data as in transcripts, or images as in photographs for analysis, then reducing the data into themes through a process of coding and condensing the codes, and finally representing the data in figures, tables or a discussion (Creswell, 2007).

The data collected were collated and edited in order to address all questions. After editing the data from the interview schedule, responses for closed-ended questions were coded. After editing and coding, the Statistical Product and Service Solutions (SPSS, version 25) software was used to generate descriptive statistics in the form of frequency distributions and graphs for further interpretation. Qualitative data obtained from interviews was transcribed and put into themes before analysing the content.

3.8 Ethical Issues

According to Creswell (2007) regardless of the approach to qualitative inquiry, a qualitative researcher faces many ethical issues that surface during data collection in the field and analysis and dissemination of qualitative reports. In every study involving life especially with humans, ethical considerations come to play.

In the process collecting the data, respondents were adequately educated about what was being investigated to enhance the chances of their participation in the first place. Secondly, I ensured that no participant was hurt through the revelation of facts that would embarrass him / her. Again, all respondents‟ identity remained confidential and they were assured of their right to withdraw from the study at any time. The researcher ensured that no respondent was under any pressure or discomfort before, during, and/or after participating in the study. Lastly, some of the welders were unknown to the researcher, they were initially unwilling to co-operate with the researcher. Some of the welders asked if I was „Anas‟, the investigative journalist. However, I convinced my respondents that I was pursuing a genuine intellectual exercise devoid of any deception by showing them a letter from the head of my department and my student‟s identity card.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This chapter presents the findings, interpretation and discussion according to the objectives of the study. The aim of the study was to assess wayside welder"s application of safety measures in welding, with Jaman-North as the case study. The chapter is organized into five sections. The first section presents the welding locations visited and pictures of work environment. Section 2, has the demographic and general information of the respondents. The third section contains data on one of the objectives of the study which was to assess safety measure awareness level among wayside welders to avoid occupational hazards or injuries. The fourth section covers the availability of safety devices/personal protective equipment (PPE) for the application of safety measures by wayside welders. Finally, section five presents data on types of safety measures adopted and applied by wayside welders and discussion. Data is presented using descriptive statistics such as frequencies, percentages, tables and graphs.

Table 1: Welding locations

Location	Number of welders	(%)
Asuokor-Akoata	01	1.8
Morle	01	1.8
Duadaso 2	01	1.8
Kabile	02	3.5
Koti	03	5.26
Asiri	04	7.02
Jamera	04	7.02
Duadaso1	04	7.02
Goka	05	8.77
Suma- Ahenkro	05	8.77
Kokoa	10	17.54
Sampa	17	29.82
Total	**57**	**100**

4.1 General and Demographic Data

Gender, age, educational level and marital status of respondents

Table 2: Age and Marital Status of Respondents

Age of Respondents in years	Marital Status of Respondents		
	Single	Married	Total
10-20	23	0	23
21-30	9	10	19
31-40	10	13	14
31-40	0	1	1
Total	**33**	**24**	**57**

The Table 2 above compares the age and the marital status of the respondents for the study. As regards their ages, four age ranges were given. A Majority of 23 respondents were found within the age bracket of 10-20 years and none of these respondents was married. Those found in age bracket 21-30 recorded the second highest of 19 responses. Out if this, 10 were married while the remaining 9 were singles.

In all a majority of 33 welders out of the total of 57 were single with only 24 married. The above comparison of welders‟ age and their marital status was to see if welders‟ spouses or marital responsibility would have any correlation in their application of safety measures.

The next item on the interview guide was set out to seek the educational background of the wayside welders as well their gender. The Table 3 gives a cross sectional analysis of the two items in question.

Table 3: Gender and Educational Level of Respondents

Educational level	Gender of Respondents		
	Male	**Female**	**Total**
Primary	9	0	**9**
Basic	39	0	**39**
Secondary	5	0	**5**
Tertiary	1	0	**1**
None	3	0	**3**
Total	**57**	**0**	**57**

From the analysis, all 57 welders interviewed were males with no female (Table 3). Nine of the welders had received education up to the primary level. A majority of the welders had received basic education (n = 39, 68.4 %, Table 3). Five of them had secondary education and only one had tertiary education. Welders who had no formal education at all numbered up to three. In conclusion, about 95 percent of the respondents had some form of formal education. As regards welders" gender, Sabitu et al. (2009) remarks that males tend to select themselves more into more hazardous jobs like welding which confirms why all respondents interviewed in this study were males. Again, Adu (2011) captured that all 200 (100%) welders used a research were male welders and no female welders. This finally confirms the fact that males are well into welding than females as the finding states.

The educational level of the welders revealed that 54 (94.7%) had some form of education with only three welders who had no education at all. Adu (2011), reports that the majority of the welders were school dropouts having terminated their secondary school education. The latter"s assertion confirms the finding of this research that though welders had some form of education, they terminated their education before reaching the tertiary level.

Table 4: Type of welder and mode of welder training

Type of welder	Mode of Welder Training			
	Technical training	Apprenticeship training	Total	Percent (%)
Electric arc	3	46	49	86.0
Gas/oxyacetylene	0	7	7	12.3
Both	0	1	1	1.8
Total	**3**	**54**	**57**	**100.0**

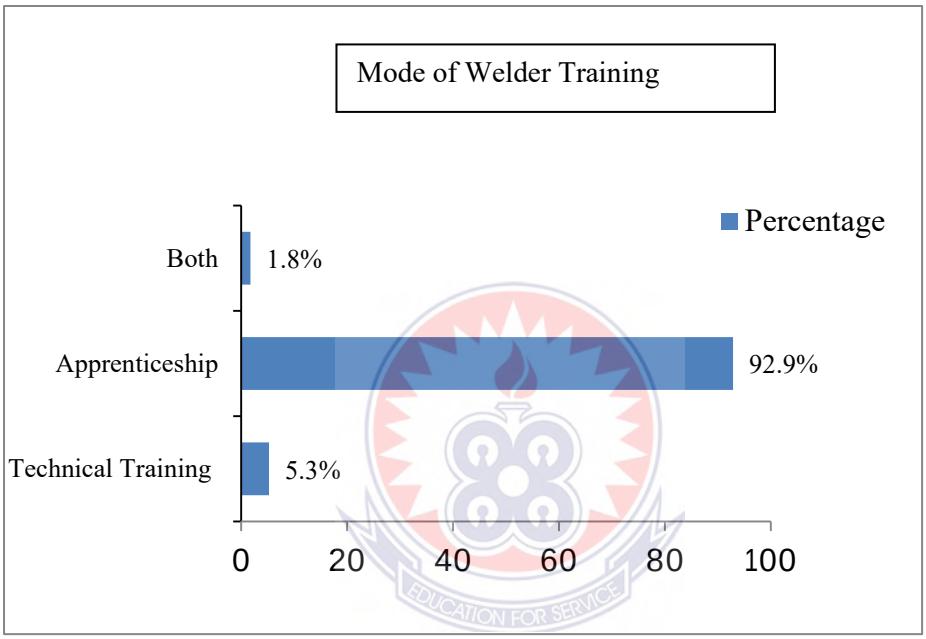

Figure 1: Bar Chart showing mode of welder training

Figure 1 shows the mode of welder training and the type of welder. Welding types were classified based on the source of heat for melting the metal or filler. The classifications were; combustion of a fuel gas with air or oxygen to produce a flame; an electric arc produced by an electrode between the electrode and work piece. The third category was the combination of both.

The most common type of welders by this category, from the table, were the electric arc welders who numbered 49 (86.0%) this welding is a type of welding that involves the use of a consumable welding rod coated with a flux; the rod decomposes upon

heating and releases shielding gases for the arc - melting the rod and work piece in the process to form a pool of molten metal. It is the most commonly used welding method in the electric arc welding category and is also the most commonly used method in wayside welders. Other category of welders interviewed were the Gas/oxyacetylene welders numbering seven representing 12.3% this type of welders.

Figure 1 shows the mode of training on the job. The majority of 54 welders interviewed said they acquired their training through apprenticeship. The remaining three had their training through technical education with none of the respondent acquiring their skills through both.

The type of welder training revealed that most of the welders trained through apprenticeship. This confirms Sabitu et al. (2009) and Tagurum et al. (2018), that welders were mostly trained through apprenticeship.

Table 5: Category of Welding and Welding / Shop Experience

Welding/shop experience	**Category of welding**			
	Repairs and maintenance	**Others**	**Total**	**Percent (%)**
Less than a yr	0	5	**5**	**8.8**
1-10yrs	6	43	**49**	**86.0**
11-20yrs	1	0	**1**	**1.8**
21-30yrs	0	2	**2**	**3.5**
Total	**7**	**50**	**57**	**100.0**

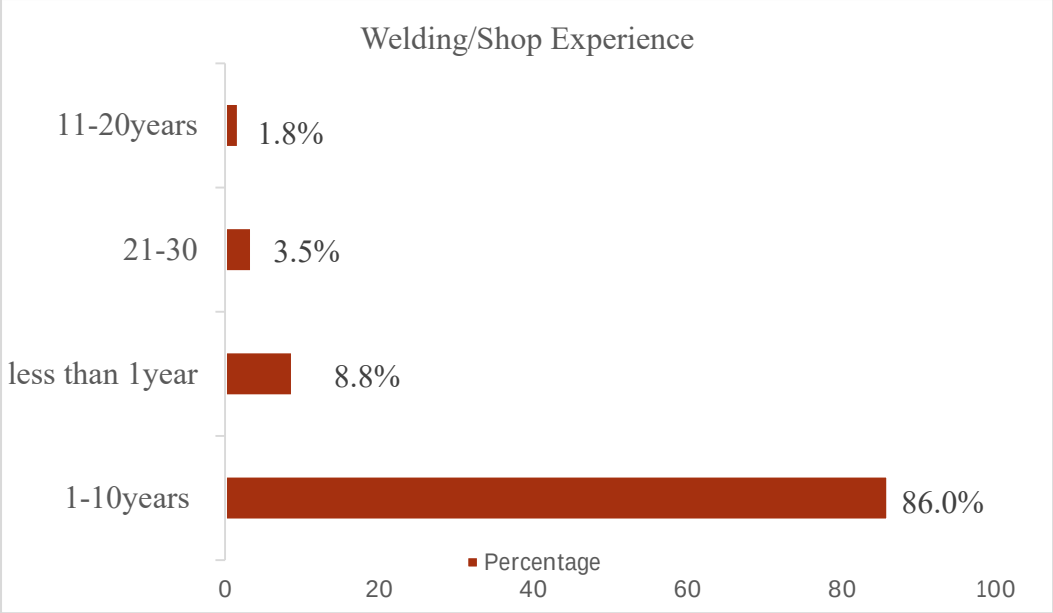

Figure 2: Showing welding /shop experience of welders

Figure 2 shows the category of welding and their welding shop/ experience. Welders interviewed were grouped into two main categories: welders who do maintenance and repair work and those who were into others such as manufacturing and construction. The majority of 50 (87.7%) respondents fell in the category of *Others* with only seven representing 12.2% engaging in repairs and maintenances alone.

Figure 2 shows the respondents shop experience after training. Those whose shop experience was less than a year were five representing 8.8% of the respondents. Those with 1-11years experience in welding after training had the majority of 49 (86%) respondents. Welders with 11-20years experience had one representing 1.8% and those with 21-30years were two representing 3.5% of the respondents.

Welders grouping according to what they actually do resulted in the fact that majority of the welders were into other welding activities which includes; repairs and maintenance, constructions and manufacturing. This also confirms the assertion made by Adu (2011) that;

In Ghana, welding is extensively used in the manufacturing industry, construction industry and for maintenance and repairs.

The above assertion adds credence to the reason for having a majority of the welders into manufacturing.

4.2 Safety Measures Awareness Level among Wayside Welders to Avoid Injuries

The section 3 of the interview guide sort to find the awareness level of safety measures amongst the wayside welders and the figure below shows the analysis of the responses obtained.

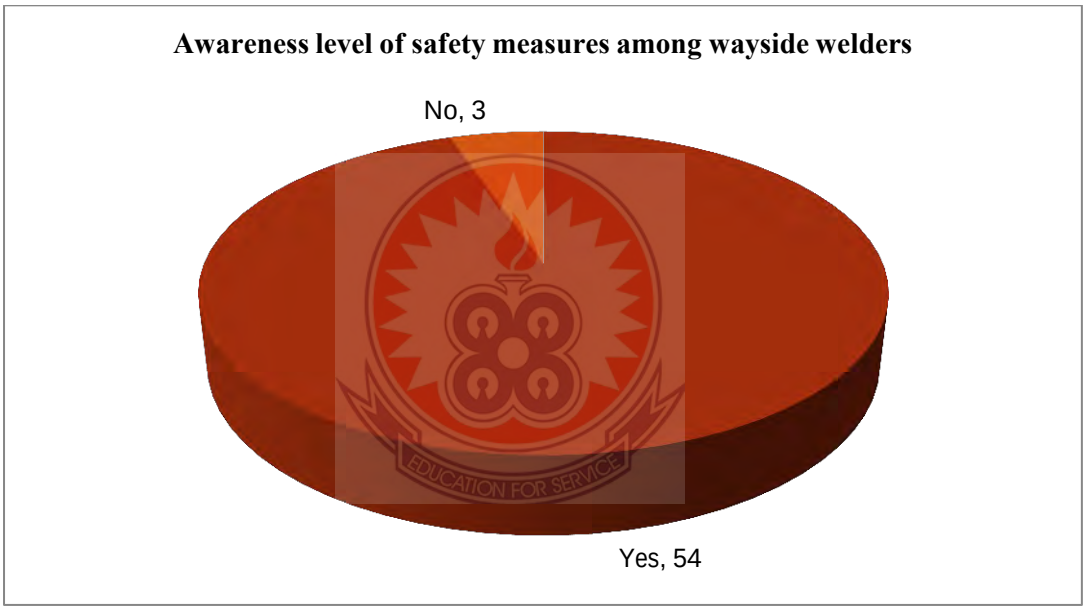

Figure 3: Pie Chart showing safety measures awareness level among wayside welders

Respondents were to answer to a Yes and No question. Yes, to mean, they were aware of safety measures and No to mean they were not aware of the safety measures. As many as 54 (94%) welders responded that they were aware of safety measures. Only three representing 5% of the respondents answered No to mean they were not aware of safety measures. This shows that most wayside welders were aware of safety measures. This finding disagrees with Kumar et al. (2013), which asserts that welders were more aware of hazards (n=174, 83.3%) than safety measures (n=134, 64.1%).

4.3 Analysis of Welders' Responses on Safety Measures Known to Avoid Occupational Hazards

Appendix III contains the responses welders gave when they were asked of which safety measures they were aware of. 53 (93.0%) knew the use of protective devices-PPEs. 35 (61.4%) responded that they were aware of carefulness being safety measure. 32 (56.1%) said they were aware of good housekeeping as a safe measure. Other measures welders said they were aware of included following safe working procedures 23 (40.4%), working on dry surfaces and jobs 21(36.8%), proper installation, examination and maintenance of tools and equipment 20 (35.1%) and others 16 (28.1%). Measures which recorded low awareness among welders included the concentrating on work 16 (26.3%), proper work posture 12 (21.1%) and use of safety equipment were nine representing 15.8%. Regulation of gas mixtures, professional training, exhaust ventilating use, insurance for workplace and personnel and the use of warning signs all recorded less than 10% of the responses.

The above finding regarding the majority of welders using PPES agrees with Sabitu et al., (2009), Kumar et al., (2013) and Buonanno et al., (2011) who report that majority of welders used personal protective devices.

On welders‟ awareness on good housekeeping, proper work postures, exhaust ventilation use, Proper installation, examination and maintenance of tools and equipment and working on dry surfaces and jobs, the findings confirms with what Balchin & Castner (1993) advocate. As regards the use of first aid kits, the welders‟ responses to their use of first aid kits agree with what Adu (2011), reports in his research. Also, Appiah (2014) adds that nature of first aid treatment welders were

fond of was in the forms of injection violet, plasters and bandages which were usually bought from near-by pharmacy shops. That meant that masters did not keep first aid boxes at the work sites.

Also on the use of protective device / PPE, Proper installation, examination and maintenance of tools and equipment, Professional training and the Use of first aid kit. Bhumika et al. (2014) also recommends the use of the above listed safety measures.

Table 6: Causes of injuries or hazard

Item	Yes		No	
	FQ	%	FQ	%
Bright light	43	74.5	14	24.6
Welding fumes and gasses	42	73.7	15	26.3
Noise	20	35.1	37	64.9
Heats, fires or explosions	36	63.2	21	36.8
Sharp edges or metals	40	70.2	17	29.8
Flying sparks/ particles	24	42.1	33	57.8
Falling objects	9	15.8	48	84.2
Uncomfortable work posture	12	21.1	45	78.9
Others	24	42.1	33	57.9

Table 6 shows the common causes of injuries admitted by the respondents. From the table, a majority of 48 (84.2%) respondents disagreed that falling objects caused injuries at their workplace with only nine representing 15.8% admitting it. The highest cause of injuries, according to the interview, was bright light with 43 (75.4%) while 14 (24.6%) said NO. Welding fumes and gasses recorded 42 (73.7%) YES responses and only 15 (26.3%) saying it did not cause illness to them. Sharp edges or metals had 40 (70.2%). Heats, fire or explosions recorded 36 (63.2%), other categories had 24 (42.1%), noise had 20 (35.1%) and uncomfortable work posture had 12 (21.0%).

The findings on the causes of injuries as stated in the analysis above were mostly from bright lights, heats or fires / explosions, fumes and gases as well as noise. All these were reported in Z"gambo (2015) as being cause of injuries.

Table 7: Injuries and illness / diseases experienced by wayside welders

Type of injury	Frequency	Percentage (%)
Arc eye	45	79.0
Cuts	50	87.7
Electric shocks	7	12.3
Burns	35	61.4
Fume fever	10	17.5
Catarrh	7	12.3
None	2	3.5
Skin rashes	4	7.0
Severe sun heat	5	8.8
Fatigue	2	3.5
dumbness	1	1.8
Severe headache	1	1.8
Road accident	1	1.8
Stroke	1	1.8
Finger amputation	1	1.8

The most common injury or illness wayside welders experience as reported during the interview were cuts on the hands/arms (n = 50, 87.7%) arc eye also recoded 45 (79%) of the responses. Burns formed the third frequent illness faced by these wayside welders with 35 (61.4%) other illness like catarrh 10 (17.5%), fume fever was seven representing 12.3% and severe sun heats recorded five representing 8.8%. Finger amputation, road accidents, severe headache and dumbness recorded the lowest response of one representing 1.8%.

On injuries sustained by the welders, Sabitu et al. (2009) and Appiah (2014), could not agree less on the fact that the most common injuries welders face was cuts. Some of these cuts are mostly on their hands and fingers. Other injuries such as arc eye and burns which were the second common injuries of welders as acknowledged by Appiah, Sabitu, Z"gambo (2014; 2009; 2015) were also confirmed in this study.

4.4 Safety Devices/Equipment Availability and Application

This section (4) of the chapter looks at the third item on the interview guide which sort to know the availability and application of safety equipment and PPES by welders.

Table 8: Showing welders use of safety equipment

Safety Devices	Frequency	Percentage (%)
Fire extinguisher	4	7.0
First Aid Box	6	10.5
Others (Break Fluid, Water, Sand)	4	7.0
None	43	75.5

Table 8 shows the responses of welders on the use of the equipment. As many as 43 welders admitted not making use of safety equipment such as fire extinguisher, first aid box, and others. Only six respondents representing 10.5% of wayside welders had first aid box, with fire extinguisher recording four responses representing 7.0%. On welders use of safety equipment, Adu (2011) in his study, "research survey of current welding practices in selected metal welding industries/ engineering firms in Ghana", reported that industries had fire extinguishers and first aid box. However, wayside welders interviewed in this study had different view regarding the use of those equipment. They were of the view that such equipment was only for the use of welders in industrial working areas.

Table 9: Showing welders use of PPES for eyes and face

PPES for Eyes / Face	Frequency	Percentage (%)
Safety googles	4	7.0
Welding shields	0	0
Welding Helmet	0	0
Others (sun glasses)	53	93.0

PPES for eyes/face such as safety goggles had four responses representing 7.0% available for use. However, others such as sun glasses had the majority use of 53 (93.0%). Budhathoki et al. (2014) recorded that while welding goggles/eye shields were the most commonly reported PPE for use. The part of this study which agrees with Budhathoki et al. (2014) is the fact that welders in both studies used, though not recommended, Sunglasses as protective and were used as a personal protective device as reviewed in the literature. Also welders reported being aware about welding goggles/eye shields as PPE but none of the welders used welding masks to protect themselves from inhaling gases while.

Table 10: Showing Welders Use of PPES for Ears / hearing

PPES For Ears	Frequency	Percentage (%)
Ear muff	7	12.3
Ear plug	0	0
None	50	87.7

PPES for ears / hearing; ear muff and ear plug had seven responses representing 12.3% and none available for use recorded 50 (87.7%). This shows that welders did nothing to protect their ears while at work. The above assertion is confirmed in Appiah (2014) that the high level of noise was a concern raised by most of the artisans interviewed. Though they complained that it was a major problem there was nothing they could do about it since noising-making is one of their occupational hazards.

Table 11: Showing welders use of PPES for Nose and Mouth

PPES for Nose / Mouth	Frequency	Percentage (%)
Face mask	0	0
Respirators	4	7.0
None	53	93.0

The use of PPES for nose and mouth for protection among wayside welders while working was also summed in the above. The finding established that the required PPES for such purpose were not available. PPES for nose and or mouth protection recorded 53(93.0%) „No" responses. This means that wayside welders did not protect themselves from welding fumes which when inhaled endangers one"s health. Though aware of the resultant implications, the respondents simply disregarded protecting themselves against respiratory diseases which stems from inhaling these gases. Only four of them representing 7.0% admitted using respirators and face masks. The attitude of welders in this study as regards the use of PPES for face disagrees with Buonanno et al. (2011) which states if the eyes are exposed to the light of the arc, even for quit short periods, arc eye may develop. Therefore, helmets or hand-held shields with appropriate filter lenses and cover plates must be used by welders and nearby personnel when viewing the arc. Again, welders" use of respirators is rather contrary to Balchin & Castner (1993) who advocate guarding ones nose against the possibility of inhaling toxic fumes by wearing suitable respirators.

Table 12: Showing Welders Use of PPES for Feet

PPES For Feet	Frequency	Percentage (%)
Safety shoes	23	40.3
Ordinary shoes	3	5.3
Others(slippers)	28	49.1
None	3	5.3

Table 12 shows the analysis of welders" use of PPES for feet. The safety shoes recorded 23 (40.3%) of the respondents, with three respondents representing 5.5% wearing ordinary shoes to protect their feet. As many as 28 (49.1%) used ordinary slippers with three of them using nothing to protect their feet despite their awareness

of its safety measures. Welders‟ nonuse of required PPES for feet agrees with both Budhathoki et al. (2014) and Sabitu et al. (2008) which report that less than 41% of welders used the required PPES to protect their feet.

Table 13: Showing Welders Use of PPES for hands

PPES For hands	Frequency	Percentage (%)
Insulated safety gloves	6	10.5
Others (cotton gloves)	7	12.3
None	44	77.2

As regards PPES for hands, a majority of 44 (77.2%) did not use anything to protect their hands. They worked with their bare hands. Kumar et al. (2013) confirms that gloves were available to 108 welders yet only 32.4% put them to use while working. This signifies that the majority of the welders in that study just as in this work did not protect their hands as a form of safety measure.

Table 14: Showing Welders Use of PPES for Body

PPES For Body	Frequency	Percentage (%)
Work suit/overall	8	14.0
Leather Apron	0	0
Ordinary clothes	49	86.0

Wayside welders were found to use ordinary clothes much more than the required PPES for the body. With overall recorded 14.0% representing eight respondents and ordinary clothes recorded 49(86.0%). Adu (2011) reported that 57.0% of welders in formal welding industries nationwide had welding aprons and welding jackets while 86 (43.00%) did not have confirming the assertion wayside welders hold that some PPES were only meant for those in the industries.

4.5 Type of Safety Measures Adopted and Applied

Appendix IV shows the result of interview questions on the safety measures adopted and applied by wayside welders. From the responses, the most applied measure was the use of PPEs with 50 (87.7%) responses. Next measure adopted was safe working procedures with 40 (70.2%) welders adopting it for use. Welders also adopted good housekeeping as a safety measure with 36 (63.2%) welders using it. Thirty-five of the welders representing 61.4% also adopted working on dry surfaces as a safety measure. Other measures included work-rest schedule with 26 (45.6%) responses. Proper handling of electrode cable, allowing only authorized personnel to use welding machines had 23 (40.4%). Measures welders admitted not using frequently included the use of safety manuals with all 57 (100%) welders admitting they don"t use. 56 (98.2%) said they did not adopt the use of Safety warnings as a measure to avoid injuries. Finally, 52 respondents also admitted not insuring workers as a form of safety measure.

The analysis from the above concludes that good housekeeping, PPE use, first aid kits, high level skill and competence were most adopted as safety measures by welders. This agrees with the report by the department of Labour Wellington, New Zealand (2006).

Welders responses to the adoption and application of Local Exhaust Ventilation, Work- Rest Schedule, Safe Work Procedures and Use of PPES, also agrees with Alli (2008) which states that the above mentioned safety measures were adopted by welders in the study.

Also, the use of suitable fire extinguisher, use of first aid kits, Use of safety manual by welders in this finding confirms that of Bhuminka et al. (2014) in a research conducted.

On workplace and personnel Insurance adoption by welders in this study, Adu (2011) also stated in his research that welders adopted the said measure as a safety precaution.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Overview of the Chapter

This chapter provides a summary of the purpose, methodology and the results of the study. It contains conclusion based on all the findings in the main work. The researcher‟s insights gained regarding study findings and limitations is included in this section of the study. Finally, suggestions and recommendations for further studies are presented for the interested parties.

5.1 Summary of the Findings

This subsection gives a summary of the study findings in relation to the objectives of the study. It addresses the level of awareness on application of safety measures to avoid injuries, the types of safety measures available and the types of safety measures adopted and applied.

On the first objective of the study, it was established that 53 (93.0%) welders were aware of safety measures. Also, 35 (61.4%) knew the use of protective devices-PPEs. 32 (56.1%) said they were aware of good housekeeping as a safety measure. Other measures welders said they were aware of included the following; safe working procedures 23 (40.4%), working on dry surfaces and jobs 21 (36.8%), proper installation, examination and maintenance of tools and equipment 20 (35.1%) and others 16 (28.1%). Measures which recorded low awareness among welders included the concentrating on work with 16 (26.3%) responses, proper work posture 12 (21.1%) and use of safety equipment recorded nine representing 15.8% of the respondents.

The study also established that though welders were aware of safety measures, forty-three admitted not making use of safety equipment such as fire extinguisher, first aid box, and others. Six had first aid boxes, four had fire extinguishers and four had others (Break fluid, Water and Sand).

For PPES for eyes/face; four had safety goggles whiles the majority of the respondents being 53 uses sun glasses which is not recommended PPES for eyes/face. PPES for ears/hearing; seven respondents use ear muff whiles nobody uses ear plug and 53 of the respondents uses neither ear muff nor ear plug. Also PPES for nose/mouth; nobody was using facemask, while four of the respondents were using respirators and 53 were neither using facemask nor respirators. This means that wayside welders did not protect themselves from welding fumes which when inhaled endangers one‟s health. Though wayside welders are aware of the resultant implications, the respondents simply disregarded protecting themselves against respiratory diseases which stems from inhaling these gases but only four admitted using respirators.

Required PPES for feet recorded 23 (40.4%) safety shoes with three representing 5.5% of respondents were wearing ordinary shoes to protect their feet. As many as 28 (49.1%) used ordinary slippers with three of the respondents using nothing to protect their feet despite their awareness of its safety measures. As regards PPES for hands, a majority of 44 (77.2%) did not use anything to protect their hands. They worked with their bare hands.

Wayside welders were found to use ordinary clothes much more than the required PPES for the body with worksuit/overall recording eight representing 14.0% of the respondents and the majority being 86.0% were using ordinary clothes.

On the third objective of the study which was to find safety measures adopted and applied, the study found out that the most applied safety measure was the use of PPEs with 50 (87.7%) responses. The next measure adopted was safe working procedures with 40 (70.2%) welders adopting it for use. Welders also adopted good housekeeping as a safety measure with 36 (63.2%) of the respondents. Thirty-five representing 61.4% of the respondents also adopted to working on dry surfaces as a safety measure. Other measures included work-rest schedule with 26 (45.6%) responses. Proper handling of electrode cable, allowing only authorized personnel to use welding machines had 23 (40.4%). Measures welders admitted not using frequently included the use of safety manuals with all 57 (100%) welders admitting they don't use. 56 (98.2%) said they did not adopt the use of Safety warnings as a measure to avoid injuries. Finally, 52 respondents also admitted not insuring workers as a form of safety measure.

5.2 Conclusions

This study has resulted into the following conclusions; Welders were aware of importance of safety measures in their work. However, their awareness does not translate into application of these safety measures. The study established that the welders were more aware of the use of PPES than the other known safety measures. Also, the conditions under which most of the welders operate are unsafe.

5.3 Recommendations

In view of the findings discussed in this study, the following recommendations were made. That welders undergo safety training: they could be trained on welding Sparks and the risk of fire, Guards and protective barriers, Hazardous fumes and ventilation, the use of respirators and other protective equipment, Eye protection (welding helmets, filters, glasses and goggles), Proper welding safety procedures. This could help remind welders of a number of hazards associated with welding, and provide the information needed to work safely during welding operations.

PPE should be used to provide the following types of protection: Electric shock protection; PPE that help to reduce the risk of electric shock during manual electric arc welding operation should include protective clothing, insulated welding gloves, safety shoes or boots, and insulated mats. The equipment should be kept dry.

Eye and face protection; suitable eye and face protectors should be provided to and used by the welding worker and other affected workers. Goggles, welding helmets, handheld shields, or other suitable eye protectors having the proper lens shade for the welding work being done should be worn or used by workers during the welding operations. Electric arc welding usually produces intense electromagnetic radiations, filters of high shade levels are usually required. Welding helmet is preferred to handheld screen as the latter may be improperly held.

Respiratory protection; the primary defence against respiratory hazards is to control the contamination at source and prevent it from entering the breathing zone of workers. Respiratory protection should only be used when engineering controls are not feasible to control exposure to airborne contaminants. For selecting an appropriate

respirator, an exposure assessment should be conducted to determine the type and amount of hazardous exposure, with factors such as the welding task, the worker characteristics, the working environment, the equipment characteristics and its limitations taken into account. As wearing of respiratory protection equipment may pose a physical burden, the wearer should be medically fit for the purpose.

Skin and body protection; skin and body protection includes protection to the head, face, hands, feet, body and personal clothing. The major objective is to provide workers protection against burns by the flame, hot slag or work piece. The protective gears should be made of flame retardant materials and should be selected according to nature, volume and location of the welding work. These include facemasks, hats/helmets, aprons, gloves, gauntlets, spats, safety shoes, etc.

Hearing protection; in manual electric arc welding operations, high level of noise may come from associated work processes such as cutting, grinding and chipping. Noise should be controlled at the source whenever feasible. If the noise hazard cannot be reduced to acceptable levels by engineering control methods, such as shielding the noise source, approved ear protectors should be provided to and used by all affected workers.

To ensure the safety and health of the workers;

1. Suitable personal protective equipment should be selected and provided to workers to cater for the different hazards encountered.
2. Proper and adequate training on the proper use of the PPE should be provided to workers; and PPE should be properly cleaned, stored and maintained to ensure its effectiveness.

3. To start any arc welding operation, there should be a complete inspection of equipment to prevent injury to the operator and co-workers. In general, the instruction manual should be read and understood. Also warning and instructions on the equipment nameplates and decals as well as the consumables labels and material safety data sheets should be read.
4. If equipment is need of repair or not working properly or any unsafe condition, the supervisor should be given notice.
5. Suitable fire-fighting equipment such fire extinguishers and buckets of sand should be provided near the work area and be ready for use. In case there are combustible materials in the vicinity of work but cannot be removed as far as reasonably practicable, it should be necessary to appoint fire watchers. They should be present during the welding operations and for suitable periods afterwards.
6. It is essential to always maintain a high standard of housekeeping at the workplace. A tidy workplace can substantially reduce the risks of accidents. Some of the points to note in providing a safe working environment for manual electric arc welding operations include; Welding equipment, cables, and other equipment should be suitably placed to avoid imposing hazards, e.g. electric shock, tripping, et., on the welding workers and others; Proper warning signs and notices should be displayed at the welding equipment and workplace as appropriate to alert the welding workers on the DOs and DON'Ts, e.g. use of personal protective equipment, fire hazard, etc.
7. The welding worker and other workers in the vicinity of welding workplace should be protected from the heat, radiation, sparks and welding spatters by suitable screens and shields; Any water ponding, flooding or dripping /

splashing of water in the welding workplace and its vicinity should be avoided.

8. Welder‟s First Aid Kit which is durable and made of sturdy plastic case with a rubber gasket should be used for protection. Welder‟s kit should include ½ oz. Industrial Eye Drops and 1oz. Eye Wash. Welder‟s first aid kit focuses on a wide range of injuries common to welders such as minor cuts, sprains, welder‟s arc and other common eye irritations.

5.4 Suggestions for Further Study

i. The study focused on assessing the wayside welders‟ application of safety measures in welding. It is also important to focus on the welder in the formal sector also to see their level of application of safety measures.

ii. Again, a study on the effects of noncompliance to the use of safety measures on welders in their old should also be carried out in the Jaman-North district.

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APPENDIX I

MAP OF THE BRONG AHAFO REGION OF GHANA SHOWING THE RESEARCH AREA

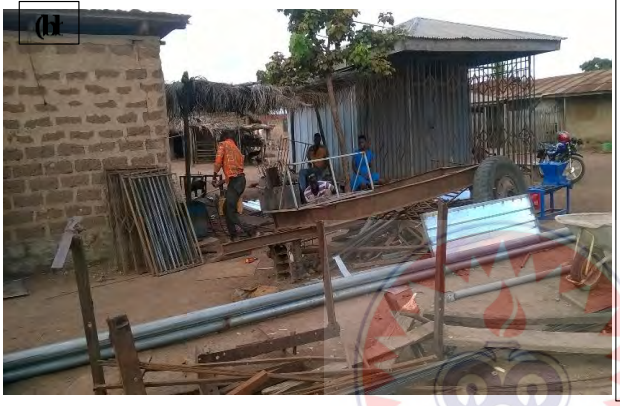
Source: Ghana Statistical Service (2014)

APPENDIX II

PICTURES FROM THE FIELD

(a) Welding equipment in Open area.

-Note the gas on in the open area.



(b) Welders at work in open workplace

-The workplace is disorganized.

(c) Welders working on roadside

-Note the bare in the open work

-To the left of the picture is the road

(d) Welders display work area.

-Unsafe structure

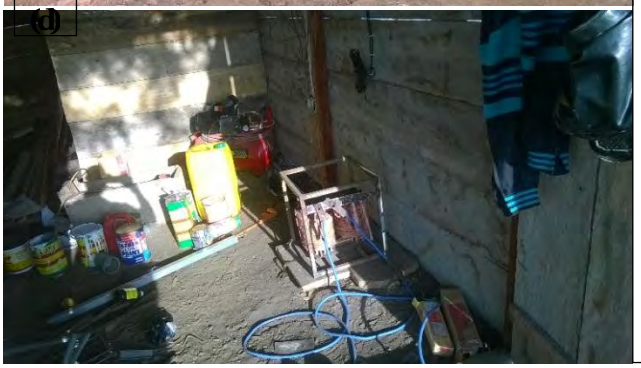
Work Areas of Welders

(a) An arc welder without applying PPES for eyes -

(b) A Gaswelder at at work in open without applying safety equipment

Some welders working without applying PPES

(c) Some welding machines Used
- Note the welding cables used.



(d) A welding machine

Some of the welding machines used by the welders

APPENDIX III

SAFETY MEASURES KNOWN BY WAYSIDE WELDERS TO AVOID OCCUPATIONAL HAZARDS

S/N	ITEM STATEMENT	YES		NO	
		Fq	%	Fq	%
1.	Good housekeeping	32	56.1	25	43.9
2.	Use of protective device/PPE	53	93.0	4	7.0
3.	Proper work postures	12	21.1	45	78.9
4.	Use of safety equipment	9	15.8	48	84.2
5.	Carefulness	35	61.4	22	38.6
6.	Exhaust ventilation use	4	7.0	53	93.0
7.	Proper installation, examination and maintenance of tools and equipment	20	35.1	37	64.9
8.	Concentrating on the work	15	26.3	42	73.7
9.	Following safe work procedure	23	40.4	34	59.6
10.	Use of safety and warning signs	1	1.8	56	98.2
11.	Working on dry surfaces and jobs	21	36.8	36	63.2
12.	Insurance for workplace and personnel	3	5.3	54	94.7
13.	Professional training	5	8.8	52	91.2
14.	Use of first aid kit	1	1.8	56	98.2
15.	Regulation of gas mixtures	6	10.5	51	89.5
16.	Checking gas leakage on pipes and valves	5	8.8	52	91.2
17.	Others	16	28.1	41	71.9

APPENDIX IV
TYPES OF SAFETY MEASURES ADOPTED AND APPLIED BY WAYSIDE WELDERS

S/N	ITEM STATEMENT	YES		NO	
		Fq	%	Fq	%
1.	Safe work procedures	40	70.2	17	29.8
2.	Good housekeeping	36	63.2	21	36.8
3.	First aid kit	5	8.8	52	91.2
4.	Use of PPES	50	87.7	7	12.3
5.	PPES maintenance and storage	19	33.3	38	66.7
6.	Training on PPE usage	2	3.5	55	96.5
7.	Work- rest schedule	26	45.6	31	54.4
8.	Use of suitable fire extinguisher	5	8.8	52	91.2
9.	Reduction of noise with Engr. control	4	7.0	53	93.0
10.	Use of safety manual	0	0	57	100
11.	Proper handling of gas welding equipment	6	10.5	51	89.5
13.	Provision of safety and warning sign	0	0	57	100
14.	Workplace and personnel Insurance	4	7.0	53	93.0
15.	Only authorized personnel using welding machine	23	40.4	34	59.6
16.	Operator‟s instructional manual use	1	1.8	56	98.2
17.	Working dry surfaces and jobs	35	61.4	22	38.6
18.	Proper handling of electrode cable	22	40.4	34	59.6

APPENDIX V

STRUCTURED INTERVIEW GUIDE

UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE EDUCATION

TOPIC: ASSESSING WAYSIDE WELDERS‟ APPLICATION OF SAFETY MEASURES IN WELDING: A CASE STUDY OF JAMAN NORTH DISTRICT.

Dear respondent, I am a final year postgraduate student conducting a research on: assessing wayside welders‟ application of safety measures in welding: a case study of Jaman North District. The study is a requirement for the award of Master of Technology Education degree (Mechanical option). Your responses to the questions below are very important to the outcome of the research, which is totally for academic purpose. Please, your responses will be treated with absolute confidentiality.

Thank you for taking the time to assist me in my research.

ID Number…… Town …….

Position at workplace .....…… Name of workshop…….……

Date of Interview …….

Questions:

SECTION A: Demographic and General Information

[Please tick (∨) and fill in where appropriate]

1. Gender: a. Male ( ) b. Female ( )
2. Age: ……
3. Educational level:
   a. Primary ( ) b. Basic( ) c. Secondary ( ) d. Tertiary ( ) e. None ( )

4. Marital status: a. Single ( ) b. married ( ) c. widowed ( )

   d. divorced ( ) e. others, please specify …….

5. Type of welder: a. Electric arc b. gas/ oxyacetylene c. both

   d. others, specify ……..

6. How did you train to become a welder?

   a. Technical training ( ) b. apprenticeship training ( )

   c. Others, specify ……..

7. For how many years have been welding after training?

   a. <1yr ( ) b. 1-5yrs ( ) c. 6-10yrs ( ) d. 11-15yrs ( ) e. abov16yrs ( )

8. How many years has your shop/stand been practicing welding?

   a. <1yr ( ) b.1-10yrs ( ) c. 11-20yrs ( ) d. 21-30yrs ( ) e. above 30yrs ( )

9. What category of welding does your shop / stand do?

   a. Manufacturing ( ) b. repairs and maintenance ( )

   c. construction ( ) d. others, specify ……..

SECTION B: Safety Measures Awareness Level among Wayside Welders to Avoid Occupational Hazards or Injuries

[Please tick (√) and fill in where appropriate]

10. Are you aware of safety measures in welding? Yes ( ) No ( )

11. Which of the following safety measures do you know can be used to prevent/ reduce occupational hazards in welding?

    a. Good housekeeping ( )

    b. Use of protective device such as welding screen/booth ( )

    c. Proper work postures ( )

    d. Use of fire safety equipment/materials ( )

e. Carefulness ( )

f. Local exhaust ventilation use ( )

g. Proper installation, examination and maintenance of tools and equipment ( )

h. Regular use of safety equipment

i. Work-rest schedules

j. Professional training

k. Safe working structures and manuals

l. Avoiding contact with live conduction in welding circuit

m. Avoiding working in hot or damp surroundings

n. Use of engineering control to reduce excessive noise levels

o. Use of personal protective equipment, PPEs

p. First aid kit use

q. Proper handling, cleaning and storage of PPEs

r. Use of warning signs and labels

s. Insurance for welders and workplace

t. Use of safe work procedures and safety manuals

u. Others, specify ……..

12. In your welding work, what do you know can cause injuries /harm to your health and your fellow workers?

a. Bright light ( ) b. Electricity ( ) c. Welding fumes and gases ( )

d. Vibration ( ) e. Noise ( ) f. Heat, fire or explosions ( )

g. Sharp edges/metals ( ) h. Flying sparks or particles ( )

i. Falling objects ( ) j. Uncomfortable work postures ( )

k. Others, specify ……

13. What are the some of the injuries and diseases/illness you experience from your work?……

……

……

SECTION C: The Available Safety Devices/Equipment (PPE) for the Application of Safety Measures by Wayside Welders

[Please tick (√) and fill in where appropriate]

14. Which of the following safety equipment do you have and use at your workplace?

a. Fire extinguisher ( ) b. First aid box ( ) c. Welding screens/booths ( )

d. Others, (please specify) ……..

15. Do you use anything to protect your eyes and face welding?

Yes ( ) No ( ) [If yes, specify]

Safety goggles ( ) Welding shield ( ) Welding helmet ( )

Others, specify ……..

16. Do you use anything to protect your ears or hearing when welding?

Yes ( ) No ( ) [If yes, specify]

Ear muffs ( ) Ear plugs ( )

Others ……..…….

17. Do you use anything to cover your nose/mouth or to help you breathe when welding?

Yes ( ) No ( ) [If yes, specify]

Face masks ( ) Respirators ( )

Others ……

18. What type of shoes do you wear when welding?

Safety shoes ( ) Ordinary shoes ( ) Others …….

19. Do you use anything to protect your hands welding?

Yes ( ) No ( ) [If yes, specify]

Insulated safety gloves ( ) Others ……..

20. Do you use anything to cover your body when welding?

Yes ( ) No ( ) [If yes, specify]

Work suit or coverall ( ) Leather apron ( ) Ordinary clothes ( )

Others ……

SECTION D: Types of Safety Measures Adopted and Applied

[Please tick (√) and fill in where appropriate]

21. Do you follow safe working procedures? Yes ( ) No ( )

22. Do you keep your workshop in order? Yes ( ) No ( )

23. Do you have first aid kit in use? Yes ( ) No ( )

24. Do you use PPEs while at work? Yes ( ) No ( )

25. Do you clean, maintain and store properly your PPEs? Yes ( ) No ( )

26. Are you trained on the use of the Personal Protective Equipment? Yes ( ) No ( )

27. Do you have off-days? Yes ( ) No ( )

If yes, how long is your off-days per week or month? …….

28. Do you have suitable fire extinguishing equipment available for immediate use?

Yes ( ) No ( )

29. Do you follow steps to use engineering controls to reduce excessive noise levels?

Yes ( ) No ( )

30. Do you use Safety manual when welding? Yes ( ) No ( )

31. Do you carefully handle and store cylinders, safety valves, relief valves, and the like, to prevent damage? Yes ( ) No ( )

32. Do you provide warning and safety signs? Yes ( ) No ( )

33. Have insured yourself and your workplace? Yes ( ) No ( )

34. Are only authorized and trained personnel permitted to use welding, cutting or brazing equipment? Yes ( ) No ( )

35. Do all operator have a copy of the appropriate operating instructions and are they directed to follow them? Yes ( ) No ( )

36. When floors are wet down, are personnel protected from possible electrical shock? Yes ( ) No ( )

37. Do you prevent a welder from coiling or looping welding electrode cable around his body? Yes ( ) No ( )

SECTION F: Recommendations for Future Action

38. What are your suggestions to improve safety measures application at your workplace?

_____

_____

_____

APPENDIX VI

OBSERVATION CHECKLIST

Assessing wayside welders‟ application of safety measures in welding: A case study of Jaman North District

Name of workplace_____ Date of Observation_____

Town _____ Assessment by_____

1. Number of workers in the premise _____
2. Activities taking place in the in the area: Welding ( ) Sanding ( ) Cutting ( ) Hammering ( ) Painting ( ) Cleaning ( ) Grinding ( )

   Other_____
3. Type of welding method used i. Manual Metal Arc (MMA) Welding ( )

   ii. Gas welding ( ) iii. Other (specify)_____
4. Materials used in welding and welded on

   Specify:_____
5. Work related exposures in the work environment

   Airborne dust/fumes/gases ( ) Flying particles ( ) Extreme heat ( )

   Chemical splashes ( ) Intense light ( ) Sharp and rough edges ( )

   Falling objects ( ) Slippery surfaces ( ) Solvents ( ) Noise ( )

   Vibrations ( ) Other _____
6. Note the PPE that is used.

   Face and Eye protection Goggles ( ) Welding shield ( ) Welding helmet ( )

   Other_____

   (a) Is eye protection provided with the correct filter lenses Yes ( ) No ( )

   (b) Hearing protection

   Ear muffs ( ) Ear plugs ( ) Other_____

(c) Lung and respiratory airways protection

Respirators ( ) Face masks ( ) Other_____

(d) Body trunk (exposed skin) protection

Fire/flame resistant apron ( ) Fire/flame resistant work suit/coverall ( )

Other_____

(e) Feet and Hands

Safety boots ( ) Safety gloves ( )

Other_____

Comment on provided PPE _____

_____

			YES	NO	COMMENT
7.	Are work areas;	Well lit			
		Properly ventilated			
		Well arranged			
		Tidy			
8.	Are hazardous materials properly labelled?				
9.	Are safety data sheet available?				
10.	Is the work environment free from flammable material?				
11.	Are electrodes removed from the holder when not in use?				
12.	If gas is used, are the cylinders properly secured?				
13.	Are shields/screens used to confine welding processes from other workers?				
14.	Is suitable certified fire extinguishing equipment available?				
15.	Are there safety signs or placards provided?				
16.	Is there any well-equipped first aid equipment available?				

Adapted from Cal/OSHA (2014) Hazards assessment checklist