KNOWLEDGE AND PREVENTIVE PRACTICES BY WELDERS EXPOSED TO WELDING AGENTS IN LAGELU LOCAL GOVERNMENT, IBADAN, OYO STATE

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CERTIFICATION

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DEDICATION

This project work is dedicated to the Almighty God. And to my Husband, Sanya Adeoye , my children; Temitope, Oluwatimlehin, Aderonke, Adesewa, Tanitoluwa, Taiwo and Kehinde , my parents; Mr Michael (Late) and Mrs Gladys Aina and my siblings ; Anthonia, Anthony , Vincent, Adebayo, Oluwakemi, Oritoke.

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ABSTRACT

Welding is an important industrial process. The commonly used type is the electric arc welding. Welding, when done inappropriately, poses as serious a danger to the health and safety of the welders and people around them. To help protect safety of welders during welding, there is the need to use personal protective equipment. There is dearth of information on the welder's knowledge about exposure to welding agents. This study assessed welders' knowledge of welding to the exposure to welding agents, possession and utilization of personal protective equipment (PPE) in Lagelu Local Government, Oyo State, Nigeria.

This was a community-based cross sectional study design. A multistage sampling technique was used to select 150 welders in Lagelu Local Government Area of Oyo state, Nigeria. A self-administered pre-tested questionnaire and checklist were used to collect data from the response on demographic characteristics, work experience and exposure information, awareness of occupational hazards, awareness of PPE and hazards, use of PPE and acute health effects experienced as a result of failure to use personal protective equipment. Data were analysed using descriptive (frequencies) and inferential statistics, Chi square and logistic linear equation at $P \leq 0.005$ with the aid of the Statistical Package for Social Sciences (SPSS) statistical software, Version 18 (SPSS Inc, Chicago, Illinois, USA).

Mean age to be 43.2 ± 13.6 years revealed that most of the respondents had secondary education and were predominantly apprenticeship-trained (82.7%) whose work experience ranged from less than 30 years to 60 years. More than two thirds (69.0%) were aware of the hazardous nature of the welding job and (46.0%) know the importance of using PPE especially the eye goggles (94.0%). Overall, majority had a good knowledge (87.0%) about the use of PPE but some saw PPE as a waste of time (4.6%) and as a source of discomfort (6.6%). The most commonly mentioned health symptoms associated with not using PPE were general body weakness (89.0%) and cough (72.0%), 92.7% reportedly experienced eye problems from flash light during welding, welding fumes and gases. Most of the welders had eye goggles (67.0%). Respondents with secondary or higher education were nearly three times (OR = 2.78, p = 0.138) likely to have fair/good knowledge of effects of welding agents. The study showed that (97.0%) of the welders are aware of at least one hazard of welding.

Welders in this study are aware of the hazards involved in their chosen profession and value of personal protective equipment (PPE) but their awareness did not translate to large possession of PPE except eye goggles. Their lack of use of the PPE keeps them exposed to health effects of welding which is a cause of concern and measures to prevent welders' continuous exposure to hazards, acute health issues and injury should be further devised. Preventive occupational education with active involvement of the welders' association combined with legislative enforcement of the use of personal protective equipment should be implemented.

Keywords: Welding, welding agents, hazard, risk.

Word count: 479

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GLOSSARY OF ABBREVIATION

ISCO:	International Standard Classification of Occupation
WHO:	World Health Organization
OSHA:	Occupational Safety and Health Administration
PPE:	Personal Protective Equipment
ESAB:	Elektriska Svetsnings –Aktiebolaget
PPED:	Personal Protective Eye Device
NIW:	Nigeria Institute of welders
RA	Research Assistance

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Welding as a profession has taken a popular turn over the years. According to Brown (2012), welding is the method of typically joining two or more metals through the use of heat. When heat is applied, the metals melt and after cooling, create a strong connection between the metal parts. Welding is an important tool for maintenance and construction. It is also used in shipyards, civil engineering structures, transportation, domestic as well as in petrochemical industry Misty (2015). Welding is an indispensible trade in modern society Brown (2012). According to Standard Classification of occupations, welders are workers who join and cut metal parts using flame or electric arc or other sources of heat. (ILO, 1968). Welding profession requires the use of agents and equipment.

In welding profession, the use of electrodes and other welding agents cannot be avoided. The profession is however not excluded from hazards. In the cause of using the necessary tools, exposure to hazards abound. Welding fumes forms part of the hazards associated to the hazards of welding among other hazards from exposure, which are essentially a mixture of metallic oxides, fluorides, which are contaminants and people need to be protected from them (Brown, 2012) .

The workplace where man operates from is his environment and physical injuries as well as psychosocial hazards abound there. The welding profession is not excused from these hazards (Awosan et.al, 2017). These risks and hazards affect not only the welders directly involved in the job; other people around the welding process are affected too. To protect these welders against these hazards, there are appropriate Personal Protective Equipment (PPE) that must be used (Awosan et al, 2017). These PPE include: gloves, protective eye goggles, shield apron amongst others. The World Health Organization (2013) observed that there is the need for welders to possess a good knowledge of welding using electrodes and other agents and that welding process should be carried out to reduce exposure to the hazards to avoid untimely deaths ,injuries and accident WHO (2011). The agents and equipment used by welders, the physical injuries and psychosocial hazards that they are exposed to and

knowledge of welding health hazards and possession and utilization of personal protective equipment (PPE) have become important public health issues worthy of investigation in Nigeria.

1.2 Statement of the problem

In recent time, there have been growing concerns, about the accidents arising from the hazardous effects of welding agents to the welding profession. Reports on studies in Nigeria show that there is a high rate of work related accidents and illnesses among welders. Okuga et al (2012) in a study showed that welders are reported to have 92.0% reported cases of injuries or illnesses related to their job with cuts and burns accounting for 73.0% cumulatively. Backache and chest pain record 14.0% eye injuries 6.0%, heaving 6.0%. Welding is a constantly developing profession but the knowledge and preventive practices of how to handle welding agents properly and understanding the dangers of being exposed to the use as well as the health implication is imperative. Although Awosan (2017) reported 99.3% and 70.0% awareness level of welders on the hazard involved in the welding profession in Sokoto. However in the same study, the knowledge the welders have about the utilization of preventive equipment is rather low, 3.3%, which was responsible for high incidence of accident as high as 99.3%. According to Robert (2012) the hazard of using electrodes was as high as 35.9%.

Most of the available literature addressing the use of welding agents among welders, attribute poor knowledge and practices to the loss of eye sight which invariably leads to ill health. However, the ill–health effects associated with improper use of welding agents goes beyond poor/loss of eye sight as other effects associated to the use of welding among welders vary and in varying complications such as death. Oduntan (1998) in his study laid emphasis on eye safety practices among welders in Nigeria where 65.3% of the respondents were reported not to use protection during welding and it concluded that a large proportion of Nigerian welders do not use eye protection. All the above illustrate the challenges facing welder.

1.3 Justification

Lack of adequate use of information about the composition of welding agents and its health implications have necessitated the need to investigate how well the people involved in the use of welding agents, especially welders, are aware of the hazards involved. The measures taken towards protection while using welding agents need to be looked into and this study has produced necessary evidence on these challenges.

Secondly, the data generated from this study are useful for designing training interventions to improve the knowledge of welders on the need for safety in the use of welding agents.

Thirdly, the welders associations are in a position to make use of the findings of this study to plan programs that will help improve the knowledge and preventive practices of welders exposed to welding agents particularly in Lagelu Local Government Area of Oyo State.

1.4 Research Questions

The following are the research questions that guide the conduct of the research.

1. What is the level of knowledge of welders on the use of welding agents, their hazards and effects among welders in Lagelu Local Government Area of Oyo State.
2. What do the welders know about safety practices and preventive equipment and their importance in Lagelu Local Government Area of Oyo State?
3. What are the reasons responsible for the non-use of protective equipment by the welders in Lagelu Local Government Area of Oyo State?
4. How do the welders actually carry out the welding processes that affect their health during welding activities in Lagelu Local Government of Oyo State.

1.5 Objectives of the Statement

1.5.1 Broad Objectives

The broad objective of this study is to investigate the knowledge and preventive practices of welders exposed to welding agent in Lagelu Local Government Area of Oyo State

1.5.2 Specific Objectives

1) To assess the knowledge of the use of welding agents, the hazards and effect among welders in Lagelu Local Government Area of Oyo State.
2) To identify preventive and safely practices among the welders in Lagelu Local Government Area of Oyo State.
3) To understand the factors responsible for lack of use of preventive equipment in Lagelu Local Government Area of Oyo State.

4) To explain the welding practices that endanger welders' health in Lagelu Local Government Area of Oyo State.

1.6 Research Hypotheses

The following null hypotheses will be tested

1) There is no significant association between the socio-demographic characteristics of the welders and the use of welding agents.
2) There is no significant relationship between knowledge of respondents and the use of welding agents.
3) There is no significant relationship between respondent's awareness of the potential health risk associated with the use of welding agents and their preventive practices.
4) There is no significant relationship between respondent's knowledge on PPE and actual use age of PPE.

Operation Definition of words

Welder: An occupation that involves the joining of metals

Welding agents: Materials used in carrying out welding

Hazard: A source of danger to health

Risk: A possibility of something causing harm

CHAPTER TWO

LITERATURE REVIEW

Conceptual Review

2.1 Concept of Welding

Welding according to Brown (2012), is a method of typically joining two or more steel using heat. The heat makes the metal melt and when it is cooled, creates a strong connection between the metals. Also, welding may involve using agents (filler or flux) and may occur on the clean stock metals, new metals with residual compounds from manufactured and used metal.

Welding is seen as an indispensable trade in the present days. As a result of urbanization and industrialization, the demand for welding needs have increased. Awosan et al (2017). Welding operation is a highly engineered process that has evolved with evolving technology. In many developing countries, welding has become one of the most important occupational groups, owing to rapid urbanization and industrialization. Welding is an essential part of everyday life, from cars to high rise office building, airplanes to rockets, populous to highways, none of it would be possible without welding. As a result, large populations of people are involved in welding Ashby (2002).

The International Standard Classification of Occupation (ISCO) defined welders as workers who join metal parts using flame or electric arc and other sources of heat. The commonest welding technologies used in small scale industries are arch welding and oxy-fuel gas welding. Welding is a common industrial process but one with the potential to be extremely harmful, and detrimental to the health of welders, Ashby (2002). It is a generic term that describes various processes of joining metal Abugad (2009). Welding is a complex technical process widely applied in modern industry, Meyer (2000). Welding involves the process in which metal or other thermoplastic materials are joined together by the application of heat or pressure, or both with or without the use of filler metal, Sultan (2011).

The World Health Organization (WHO) considers the workplace a priority setting for health promotion in the 21st century. Like other settings where WHO has developed health-

promoting initiatives (schools, cities, hospitals, and industries), the workplace can have a very positive impact on the health and well-being of workers, their families, communities, and society at large WHO 2011. Newer methods of welding are replacing the old methods in industrialised nations. In arc-welding, an electric current flows between . electrode and the pieces of metal to be welded. The temperature is about 4000^0C when the pieces fuse together. Most conventional arc-welding is done manually by means of a covered consumable electrode held in an electrode holder.

During welding, the metal arc used produces heat from electrodes for bonding metals, heat coming from the opening of the electric arc is used to melt the electrodes and the flux. This process releases gaseous discharge upon melting that encases the electrodes. All welding processes produce fumes and gases, but more fumes are produced during manual arc welding. Welding fumes are vapours that originate from metals and electrodes' metallic compounds reacting with air and then condense, forming particles, Erabor et al (2001). These fumes when given off may be dangerous, especially to the respiratory system. In view of this, precautions are required for protection from hazards of ozone, carbon-monoxide and. phosgene (Erabor et al, 2001).

Welders are responsible for permanently joining pieces of metal by applying heat, using filler metal or by fusion process, join parts being manufactured, build structures and repair damaged or worn parts. Welders use various welding and cutting processes to join structural steel and cut metal in vessels, piping and other components and also fabricate parts, tools, machines and equipment used in the construction and manufacturing industries. They specialize in certain types of welding such as custom fabrication, pressure vessel, pipeline, structural welding, and machinery and equipment repair (Maheshrengaji, 2014).

Generally speaking, a welder should be able to: set trade machinery e.g. presses, shears, plasma cutters, oxy fuel cutting torches, grinders, drills to bend, cut and form metal components, analyse and interpret blue print, drawing, perform calculations with trade shop formulas, plan task sequence to cut steel effectively, make the assembly process by fitting metal sections, fasten tack welding, bolting and riveting, utilizes material handling, rigging, hoisting and lifting equipment to relocate completed assembly safely, performs duties with care and precision Maheshrengaji (2014).Welding, a hazardous profession has multiple factors that can endanger the health of welders. These factors include: heat, burns, radiation

(ultraviolet, visible and infrared), noise, fumes, gases, electrocution; uncomfortable postures involved in the work; high variability in the chemical composition of welding fumes, which differs according to the workplace, methods employed, surrounding environment and the routes through which these harmful substances enter the body. Some of the effects of welding on health include photokeratitis or arc eye, metal fume fever, decrease in lung function, pneumoconiosis, asthma, photodermatitis and fertility abnormalities (Vaidya, 2009).

2.1.1. Types of Welding

There are different types of welding which depend on metal substance to be used and application of other variety of metals. Over fifty different processes but differ in heat, pressure, and type of equipment to be used. Different literatures have different classifications having about five categories (Golbabei and Khadem, 2015). The most common and known types of welding include:

Shielded Metal Arc Welding: Also known as Manual Metal Arc welding or stick electrode welding is one of the oldest, simplest, and most versatile arc welding processes used for carbon steel welding and low alloy welding. In manual metal arc, the electrode is held manually, and the electric arc flows between the electrode and the base metal. The intended requirements include; a wide range of metal s, welding positioning and electrodes can be used in different weather conditions contrary to other processes (Weman, 2003).

Gas Metal Arc Welding or Metal Inert Gas welding: This type of welding is used for most types of metals and faster than shielded metal arc. It can be used to weld vehicles, cranes, cranes, bridges and others. It involves the flow of an electric arc between the same metal used for most types of metals. It may be applied to weld vehicles, pressure vessels, cranes, bridges mild steel , low alloy, stainless steel, aluminum, copper, nikel and alloys and others (Kopeliovich, 2014).

Gas Tungsten Arc Welding: Also known as tungsten inert gas welding. Gas tungsten arc is used to weld metals such as aluminum, magnesium, carbon steel, stainless steel, brass, silver and copper-nickel alloys. Gas tungsten arc welds are highly resistant to corrosion and cracking over long time periods. However, this welding is suitable to weld thin materials and produces a high quality weld for most metals. The concentration of heat takes place in a small zone, resulting in the minimal thermal distortion of work piece (Weman, 2009).

Submerged Arc Welding: This is a highly-productive welding method used to weld thick plates of carbon steel and low alloy steels. This welding process is usually used for large structures such as large tubes, cylindrical vessels, and plates in shipyards (Kopeliovich, 2014).

Plasma Arc Welding: In plasma arc welding surgical equipment, jet engine blades, and instruments required for food and dairy industry are welded (Weman, 2003).

2.1.2. Welding agents:

There are basically four major agents (not limited to these four needed by welders to carry out their occupation. These four agents include:

Coated electrodes: Most welding is done using shielded metal arc welding using coated electrodes. These electrodes are made to certain national or international standards which specify the wire gauge, material composition and rules.

Welding rods and wires: Welding agents include wires and rods used in short lengths. These wires conducts current.

Shielding Gases: The chemical components of shielding gases help to increase the strength and hardness of steel. It ensures purity during welding.

Welding flux: These fluxes serve as a good conductor and concentrates heat within a relatively small welding zone. They are acidic.

2.1.3.Welding hazards

When safety at work is at risk, there is need to protect welders from hazards and health risks. Safety during welding starts with understanding what could go wrong when one is not protected.

Electric Shock

A welder can get shocked either by touching an electrode circuit that has voltage while welding metals or from a direct fall from height . The voltage goes between the metal objects and the welder. The higher the voltage, the higher the current and the higher the risk of an electric shock that will result in injury or death. The voltage range for secondary shock is 20 to 100 volts and any volt in between is dangerous. When the shock occurs, the person

holding the wire will most likely be made to hold onto the wire not letting go In order to avoid electric shock, a welder can do the following:

i. Inspect welding equipment and electrode holder before proceeding to work.

ii. Perform lockout and tag out procedures when performing repairs. Only qualified repair technicians should service or repair welding equipment.

iii. Do not touch the metal parts of the electrode holder with skin or wet clothing. (Kathie Martineli 2018, John Petkovsek (2016), David McKeown (2018).

Noise Hazards

Welding as a process requires fabricating and manufacturing something. Carrying out this process exposes welders to loud prolonged noises making it a hazard. A noise becomes loud when it is above 85 dB(A) whereas cutting, hammering, guillotining all form part of welding and the process that produce noise level as loud as over 100 Db(A). This can be damaging to the ear resulting in hearing impairment as a result of regular or immediate exposure to the loud noise. Welders should not be exposed to noise levels above peak level limit of 87dB especially if the welders wear hearing protection (McKeown, 2018).

Noise-induced hearing loss can have the following side effects:

- Ringing in the ears, known as tinnitus.
- Occasional dizziness, known as vertigo.
- Increased heart rate.
- Increased blood pressure (Martineli, 2018)

Exposure to UV and IR Radiation

Looking at the intense bloom of UV light produced when welding, without appropriate PPE or welding curtains, can result in a painful and sometimes long-lasting condition called arc-eye. Many factors can affect the severity of a flash burn injury, such as distance, duration and the angle of penetration. Long-term exposure to arc flashes could also potentially result in cataracts and lead to a loss of vision.

Other forms of eye damage include:

- Foreign bodies entering the eye, including grit, sparks and dust.

- Particulate fumes (Martineli, 2018)

2.1.4. Health effect of welding

The adverse health effects of welding are due to welding agents, and thus difficult to attribute to a single-fume contaminant. Studies of industrial workers have revealed occupational diseases which seem to be the result of exposure to welding emissions. Respiratory disorders range from deterioration of pulmonary function, dryness of the throat, coughing, tightness in the chest, wheezing, and difficulty in breathing to chronic bronchitis, (Antonini, 2003), Hsu Shen, 2006).

The different organs of the body are affected by welding include the following:

Effects on Respiratory System – Inhaling the gases and particles from welding may lead to acute or chronic respiratory diseases. The parameters that cause reaction in the respiratory organ depend on the nature of the inhaled matter, the size, concentration, shape, concentration of particles, duration of exposure and individual susceptibility. Chronic bronchitis, interstitial lung disease, asthma, pneumoconiosis, lung cancer, and lung functions abnormalities are some hazardous effects on respiratory systems. Welding metals and degree of concentration affect the pulmonary based on the differences in welding metals and their concentrations (Anthonini, 2003).

Effects on Kidney- Pesch et al, (2000), indicated that there was an excess carcinogenic risk involved with soldering, welding, milling in females making it gender-specific susceptibility of the kidneys, Peach at al, 2000. Welders exposed to heavy metals like cadmium and nickel have also experienced kidney damage (Gosner and Hoga, 2011).

Effects on Skin - Erythema, pterygium, non-melanocytic skin cancer, and malignant melanoma are the adverse health effects of welding on the skin among which erythema is a common one. The intense ultra violet rays as well as visible and infrared radiations are produced by welding arc machines, its exposure to can lead to short- and long-term injuries to the skin Al-Khlaiwi (2003), Erhabor et al (2001), Globabaei and Monireh (2014).

Effects on the eyes - Most welding processes emit intense ultraviolet rays which have adverse effects on the eyes, may be induced by these optical radiations. These responses of the human eye to ultra violet radiation are commonly known as snow blindness or welder's flash A-Meo and AlKhlawi (2003), (Globabaei and Monireh, 2014).

Effects on Reproductive System: According to new investigations, damages to male reproduction system have been reported less than before, probably because of decreasing the exposure levels in the developed countries. However, some special tasks like stainless steel welding may impair welders' reproduction system (Globabaei and Monireh, 2014). A study by Bonde Eshowedt al(1999) suggested that mild steel welding, but not stainless one, resulted in significant effects on the fertility over the years. Mortensen (1988), observed a greater risk for poor sperm quality among welders compared to controls, especially welders who worked with stainless steel. Therefore, welding in general, and specifically with stainless steel, may cause the reduced sperm quality. According to Sheiner (2003), impaired semen parameters can be associated with the exposures to lead and mercury which are components of welding agents.

Effects on the nervous system Memory loss, jerking, ataxia and neurofibrillary degeneration have been attributed to exposure to aluminium. The accumulation of aluminium in the brain may develop some neuropathological conditions, including amyotrophic lateral sclerosis, Parkinsonian dementia, dialysis encephalopathy and senile plaques of Alzheimer's disease Kegan and Learnonth (2007). Welders are also exposed to high concentrations of carbon monoxide and nitrogen dioxide. Carbon monoxide can cause the neurological impairments of memory, attention, and visual evoked potentials. Both central and peripheral nervous system damages may be induced by exposure to welding fumes (Bowler, 2003).

Other health problems - Welding on surfaces covered with asbestos insulation may lead to risk of asbestosis, lung cancer, mesothelioma, and other asbestos-related diseases in exposed welders. High prevalence of musculoskeletal complaints (back injuries, shoulder pain, tendonitis, carpal tunnel syndrome, and white finger) is seen in welders. As much as there are different welding techniques, they either fall under electric arc welding or oxy-fuel. They produce many hazards during the welding processes creating avenue for contaminants found in the welding fumes and ultraviolet radiation. These are Group 1 carcinogens causing cancer. According to Cancer Council (2019), these welding processes involve the use of multiple metals and chemicals which can lead to exposure to chemical agents as fumes and gases which if not properly controlled could result in temporary or permanent physical injury, short or long-term adverse health effects, discomfort and even death (Cancer Council, 2019).

2.1.4. PPE and Preventive Practices

When safety at work is at risk, there is need to protect one from hazards and health risks. Safety during welding starts with understanding what could go wrong when one is not protected. There are different types of PPE that are recommended for use to protect against welding hazards. Some PPE recommended by the welding process code of practice in Australia, 2016 are itemized and summarised below:

PPE Type		Recommendations
Eyes, face and head protection (e.g. goggles, helmets, hand shields and protective filters)	Light, radiation, burns from hot debris and sparks	• Workers should always have their eyes, face and/or head protected whenever they are welding. • Filters for eye protectors - Filters for protection against radiation generated in welding and allied operations.
Hearing protection (e.g. ear muffs and ear plugs) Hearing loss • Ear plugs or ear muffs may be required to minimise the risks of noise.	Hearing loss	• Ear plugs or ear muffs may be required to minimise the risks of noise. • Acoustics - Hearing protection and Occupational noise management
Gloves/ gauntlets	Heat, ultraviolet light and burns from hot debris and sparks	• Gloves should be fire resistant and protect exposed skin on the hands and wrists.
Clothing (e.g. flame resistant long sleeved shirts, long trousers, aprons and leather spats)	Heat, ultraviolet light and burns from hot debris and sparks	• Avoid clothing that has the potential to capture hot sparks and metals, for example in pockets or other folds. Clothing should be made of natural fibres.
Foot protection (e.g. boots and shoes)	Hot metal debris, other metal debris and electric shock	• Foot protection should be non-slip and be heat and fire resistant. • Avoid using foot protection that has the potential to capture hot sparks and metal debris, for example in laces or in open style shoes.
Screens	Exposure to the rays of an arc during electric welding operations	• Opaque or appropriate translucent screens can be used to protect the health and safety of people within the vicinity of welding. • Light-transmitting screens and curtains for welding operations.
Respiratory protective devices (face respirators and air supplied respirators)	Dusts, hazardous fumes, gases and chemicals and oxygen depleted atmospheres	• Respirators should be fitted for each person individually and if one is to be used by another operator, it must be disinfected and refitted before use. The tightness of all connections and the condition of the face piece, headbands and valves should be checked before each use. Air supplied respirators may be required in some situations, e.g.

		confined spaces.

*Welding Process Code of Practice 2016 in Austraila

2.2 Theoretical Review

2.2.1. Knowledge and Effect of the Use of Welding Agents

Awosan (2017) in a study carried out in Sokoto on welders disclosed that welder knowledge of the agents they use in welding is high based on the study carried out on awareness of hazards in welding. Pourtaghi (2012) indicated that a lot of pollutants affect human health during welding which cause several diseases among welders. In the research carried out on the effect of welding by Pourtaghi (2012), it was reported that effects such as abnormal breathing, coughing wheezing sputum, reduction in pulmonary strength were common among the welders and in similar studies on lung cancer. In India, a research by Maheshrengary (2004) revealed that welders are prone to accidents especially these who are trained on the job as they expense musculoskeletal injury due to awkward posture during welding.

Erabor et al (2001) also reported some various degrees of accidents and health related effects during their research in Ile-Ife. These include eye irritation, skin irritation, cough and sputum production. Arch welding, according to Erabor (2001) releases gases which are toxic respiratory irritants. The process exposes welders to ultraviolet radiation. Marta et al (2014) disclosed that there are health hazards attached to welding which include respiratory disorders, cardiovascular disorders which are as a result of exposure to welding agents.

Sabitu (2009) verified that the awareness of welders concerning the health hazards attached to using welding agents is high. According to the occupational safety and health Administration OSHA, (2008), a compound called manganese, produced during welding is linked with respiratory disorders and impairs respiratory function, causes likely responsible for asthma , cardio vascular disorders and decreased expiratory and cardiovascular flow (El-Zein 2003, Yildiz 2013).

Furthermore there are some studies that revealed that the prevalence of ignorance among welders with regards to the health hazard and safety of their profession is low Syed et al (2018). This is based on the study carried out in Pakistan to assess the awareness of health hazards among welders and even when they experience health problems, they either ignore or do nothing about it or resort to one form of home remedy or the other. This is in contrast with what was discovered in Nigeria where the welders in places like Kaduna, Sabitu (2009)

and Benin Isah (2006) the level of awareness is high. The study also showed that lung disease as a result of welding over a period of time is noticed among welders, Sabitu (2009).

According to Gebrezgiabher (2019), welders in Tigray Region of Ethiopia were considered knowledgeable about the health hazard in their profession. However, Taha (2000) explains that accidents and injuries were the main hazard that were reported in the study in Khobar attributing low levels of education and lack of health education and non-use of PPE as factors for its high rate. The study also shows that welders in the area (Al-khobar) are exposed to exhausts, welding fumes and absorption of these toxic substances occuring through inhaling, ingesting and direct skin contact with the welding agents leading to health problems like lung disease, dermatitis and eczema, malignant mesothelioma and cancer of the lungs and bladder. The welders in Al-kobar had adequate knowledge about occupational hazards and protective measures.

Singh et al (2016) discussed the lung health among welder in their study. According to them, welding fumes affect the lungs explaining the types of experience felt. These include metal lung, fever lung injection. Welders are exposed to a number of gases, metals and fumes which make them prone to elevated risk of diverse health ailments that include neurological disorders, bronchitis and pneumonia, lung cancer especially lung cancer (Singh et al 2016) . Marat et al (2016), investigated to find a relationship between lung cancer and exposure to welding activity. The result revealed a relationship between welding as a determinant of risk of a lung cancer.

Singh (2016) concluded that welders are exposed to a number of gases, nascent metals and fumes that cause serious health hazard among welders. Also that welders are most likely at risk of different health aliments including respiratory problems, lung cancer which is the highest from their study, Budhathoki (2014) mentioned that welding is a hazardous profession with a multiplicity of endangering factors that include heat, gases and electrocution etc. These hazards result in arc eye, metal fume fever, at poor lung function, asthma, infertility. The study also revealed that welders were aware of at least one hazard associated with welding.

Furthermore Amani et al (2017) identified different types of welders' health risks. These include pulmonary edema, chronic bronchitis, lung cancer, rhinitis, asthma, injuries and

cardiovascular disorders. The study explained also that work experience played a crucial part in incidences of damage at work for instance, eye injuries (which happen to be every high) was as a result of radiations from welding. So also is working in environment that have dust, smoke, gases and too much vapour, expose welders to the risk of developing lung disease, same is poor ventilation and heated work place. Because welding results in movement of tiny particles is the air, pulmonary diseases can develop. According to Amani et al (2017), of great worry is the fact that, inhaling fumes do not present effect on short term bases. Welding process exposes welders to various diseases and illness especially with work experiences but once the level of the awareness of the risks increases, it is believed that the health behaviour will also improve. The study in Iran that investigated on occupational injuries among welders reported that welding processes directly affects the amount of attention to safety points.

2.2.2 Safety and Use of Personal Protective Equipment among welders

Welding is a hazardous profession which exposes workers to various kinds of physical and chemical hazards in the absence of judicious and effective use of Personal Protective Equipment (PPE), unwanted exposure can lead to a variety of disease conditions among the welders. The use of recommended PPE at all times minimizes exposure to these hazards. The use of PPE is acknowledged worldwide as an efficacious measure against the inhalation of welding fumes and gases, minimizing harmful effects on workers' bodies. According to Elektriska svetsnings –Aktiebolaget (ESAB 2009) , the most frequently used PPE items are welding masks, respiration systems, safety glasses, protective welding gloves, leather jackets, sleeves and hoods, and boots, ESAB (2009).

The use or non- use of Personal Protective Equipment (PPE) for example safety goggles, masks, helmets) may lead to intervention because the rate of accidents is high, Lombardi et al (2005). The researchers further explained that welding activity has the tendencies to affect other workers and the perimeter around this work should be considered hazardous. For instance, that area between welding activities and other workers could be 100 square feet (10 by 10) or greater though this distance could be influenced by the confined nature of some welding work. Apparently, workers near welding activity would also benefit from training in the proper use of PPE, as most work related ocular injuries are potentially preventable Lombardi et al (2005).

Traumatic eye injuries, according to Lombardi et al (2005), in a study carried out, continues to be an important occupational health and safety issue for workers who are engaged in the welding processes, Lombardi et al (2005). In the study on welding related occupational eye injuries: a narrative, it was observed that welders comprise a large population workers engaged in welding related activities and the rate of accidents is equally high. The proportion of eye injuries to welders is similar to most other studies, Lombardi et al (2005).

Developing preventive strategies aimed at reducing welding related eye injuries requires a detailed understanding of injury circumstances such as is provided in the study. For example, exposure to ultra-violent light continually causes burns to welders, there is need to suggest a better implement and known strategy such as UV light shields. There is need to carry out more studies that will help to determine the important barriers to the use of known prevention strategies (for example, PPE use) this will help to identify potentially modifiable worker related, work environment, and work equipment. These intended studies will help reduce the burden of eye injuries and the potential risk of long term serious consequences, Lombardi (2015).

Apart from the socio-economic and psychological costs of injury (Mancini et al., 2005), work-related eye injuries constitute a significant strain on the public health care system and the nation's health budge protective eye devices (PPEDs), machine-incorporated eye protective systems, and established preventive efficacy of PPEDs (Bull, 2007; Forst et al., 2006; Torp, Grogaard, Moen, & Bratveit, 2005; Verma et al., 2011), barriers to their optimal utilization remain largely unaddressed worldwide (Lipscomb, 2000; Okoye & Umeh, 2002; Omolase & Mahmoud, 2007). Lack of PPED utilization has led to a high incidence of otherwise preventable welders' occupational eye injuries (Lipscomb, 2000; Okoye & Umeh, 2002; Omolase & Mahmoud, 2007) and morbidity (Wang, Yang, Wang, & Shunqing, 2006).

Primary preventive actions are developed and organized to avoid or help minimize risks posed to the heath of individuals. Public policies to a large extent, express preventive measures given priorities, Regulatory Standard 34 (2014). In the specific case presented here, primary prevention focuses on reducing diseases caused by the exposure of welders and future workers to harmful compounds. In this context, the primary preventive measure discussed in this study is risk communication, Cezar-Vaz (2015). This measure is aimed at enhancing the well-being of these workers and future workers exposed to risks caused by

exposure to diseases such as respiratory disorders as reported in studies conducted in Denmark , Sorensen et al (2007), Iran Hasani et al (2012) and Malaysia, Hariri et al (2013) and cardiovascular disorders as reported by studies conducted in the United States, Fang (2009), communication is used as a primary prevention tool to advise future workers concerning the exposure of welding fumes being associated with respiratory and cardiovascular disorders, Cezar-Vaz (2015). Therefore, risk communication is seen as a primary preventive measure intended to reduce exposure of individuals to welding fumes in their future working place and even, apprentices are sensitized to self-care and can also become role models to their future co-workers.

The use of PPE is acknowledged worldwide as an efficacious measure against the inhalation of welding fumes and gases, minimizing harmful effects on workers' bodies. According to ESAB Elektriska svetsnings –Aktiebolaget (ESAB) (2009), the most frequently used PPE items are welding masks, respiration systems, safety glasses, protective welding gloves, leather jackets, sleeves and hoods, and boots.

In the study by Cezar-Vaz et al(2015), safety glasses were used to protect against ultraviolet radiation. The infrequent use of this item was associated with a clearer perception that welding fumes lead to respiratory disorders. The study was conducted in a teaching environment where PPE is a requirement for apprentices to attend practical classes; however, the institution does not provide this specific item. The need for safety glasses was reinforced during risk communication and the non-use of safety glasses led apprentices to identify respiratory disorders as being triggered by welding fumes and also to reflect upon the need for these protective item. Therefore, knowledge regarding the use of PPE as a primary preventive measure, serves as a determinant for the behavior of apprentices and their raised awareness regarding the use of safety glasses is an important marker of the risk communication strategy implemented in this study Cezar-Vaz (2015).

Another study conducted by Okeigbe et al (2012) with 271 Nigerian welders, reported that 37 (13.7%) individuals did not use safety glasses). One intervention study addressing 285 Nigerian welders reports low awareness on the part of welders in regard to the use of PPE, both in the intervention group and the control group, except for the use of safety glasses and gloves, Adewoye et al (2014). Even studies without evidence that using the entire set of equipment is a guarantee of full protection should encourage the use of PPE as a primary

preventive measure, in comparison with the case of a specific study that aimed to determine efficacy of filters used as respiratory protection during welding to reduce inhalation of particles and gases, Chen et al (2013).

Furthermore, Chen et al reported that the four devices focused on in their study (surgical masks, cotton masks, activated charcoal masks and N95 respirator masks) efficiently blocked the inhaling of particles during welding but were not efficient enough to block gases during welding, Chen et al (2013). Evidence highlights controversies regarding the use of PPE as an occupational primary preventive measure, Cez- Vas (2015). In Pakistan according to Hassan et al (2018), the health status of the welders is negatively affected by a lack of safety measures. Simple safety practices such as the use of eye goggles, protective heat-resistant clothing, face masks, and immediate first aid are said not to be used but the availability would reduce the developing of life-threatening complications.

2.2.3 Factors affecting usage and non-usage of PPE among welders

For each of the Personal Protective Eye Device (PPED) investigated in Kaduna, the participants' awareness rates were high. The participants' possession rates for eye goggles were high, PPED awareness rates and possession rates but "presumed lack of need" as the major barriers to PPED been variously reported. Mahmoud, 2007; Sabitu et al., 2009) limited PPED has been identified as a potent barrier to regular use of PPED. The major reasons for non-use were "inconvenience of use" and "presumed lack of protective benefit." Even though the overall utilization rate could not be compared with previous reports due to lack of equivalent correlative data, the observed between-device differences in utilization rates is consistent with the utilization pattern reported in other parts of Nigeria (Sabitu et al., 2009). Toovercome barriers to utilization, the authors suggest improvements in the ergonomics of PPED (Forst et al., 2006; Sabitu et al., 2009).

Furthermore, welders' socio-demography and job characteristics apparently influence their hazard awareness and utilization of PPEDs (Sabitu et al., 2009). Although the majority of previous Nigerian reports were on commercial and freelance welders, the only related report in the study area of southeastern Nigeria focused on industrial (formal sector). In Pakistan, the poor economy of the country has played a major role in the non-availability and the difficulty in affordability of the necessary and important protective devices. The substandard quality and lack of proper protective measures may be one of the causes of eye injuries

among this labor class. The problems of visibility and comfort of ocular protective devices have been well (Hassan, 2017).

The study carried out by Jani and Mazumdar (2004) reasoned that welders comply poorly with the use of protective gear stated by majority of welders in this study was ignorance of its importance as also reported in other studies Okeigbemen et al(2012) where he stated that unavailability and improper usage, unavailability. inability to use it because of improper training, inconvenience to wear the PPE and work at the same time, Mazundar (2004) and Bhmika et al (2012), unable to see clearly with eye goggles. According to Kumar et al (2015), some factors responsible for welders not using PPE is that they feel it is not required or compulsory. Few participants in this study also complained about inconvenience to wear the equipment at work.

Some of these problems complained about have been solved with the introduction of more user friendly safety gears are now available. For instance, face shield can be strapped to head while working, leaving both hands free, one to hold the metals to be fused and the other to hold the welding gun. There is also\improvement in the design of eye goggles used which improves visibility and reduces discomfort during usage. Goggles with auto-darkening filters have come up which change automatically from clear to darkened state after the welding arc is struck, Proctor (1989). Suitable protectors should be used when welding, especially when flying particles are involved, so with molten metals, acids acaustic liquids, chemical liquids, gases or vapours, bioaerosols, or potentially injurious high radiation.

Sheikh (1991) included that some welders do not use eye goggles because of the discomfort and poor visibility associated with the usage. These problems of visibility and discomfort of ocular protective devices have already been addressed with the improvements made in eyewear to reduce the incidences of ocular injuries among welders. Auto-darkening filters have being incorporated into protective devices. They automatically change from clear to a dark states when the welding arc is struck, ensuring uninterrupted work by the welder, Bradshw (2010). Accidents and cut injuries were also the main hazards in small industries. Part of the reasons for these are low levels of education, lack of health education and the nonuse of PPE. More reasons include the passive attitude and negligence of employers and employees, non availability of PPE and adequate legislation, Gebrezgiabher (2019).

Safety of welders during welding

According the World Health Organization, the work place is a priority setting for health promotion in the 21st century. This is with agreement with other settings where WHO has developed health-promoting initiatives (schools, cities, hospitals, industries),it is believed that, their families community and society at large, WHO (2011), the workplace can have a positive impact on the health and well-being of workers.

In order to increase production and productivity, there is need for safe work and workplace, hence promotion and protection of safe work and workplace are the complementary aspects of industrial development, Upadhyaya (2002). However, industrial occupations may give room for unsafe work and work environment because of the inherent sources of hazard present in their material, process, technologies, or products. These hazards may pose the risk of accidents and work related disease to the people within the industrial premises in particular and the general public in the vicinity and the environment in general, Gebrezgiabher (2019).

Welding workers who have work regulation are 69% less likely not to have knowledge on occupational hazards as compared to workers without work regulation. The study in Axum and Adwa towns of Tigray Region in Ethiopia aimed to determine workers level of awareness towards occupational hazards and their adherence to safety measures revealed that health and safety training showed significant association with knowledge level of respondents, Gebrezgiabher (2019). And is supported by a study carried out in China in which the largest differences of mean score were found in the factors of safety (Ma and Yuan 2009).

Following some literature reviews on occupational safety and health training, the benefits of safety training reflects in the increase in the welders' knowledge concerning hazards and safety practices at work (Cohen and Michael (1998). The use of training and supervision during hazardous tasks has increased safety knowledge; safety training also had a significant association with personal protective equipment usage to increase knowledge and safety practice, safety raining is a common factor for welders Gebrezgiabher (2019). Hazards in small industries are mainly accident and injuries and largely due to low levels of education, lack of health education and the non-use of PPE. There is a need for training and health education in occupational health and safety for employers and workers through a joint program between institutional training over apprenticeship, there is need to strengthen

refresher training to improve usage of protective gears (Taha, 2000). Safety policies need to be instituted and employers need to provide ergonomically suitable and affordable PPEs at work site. Periodically, health inspectors need to check efficacy and compliance with safety devices at work places.

This is because, encouraging the workers to use protective equipment in order to increase their awareness on the proper use of safety equipment, is an effective step to prevent work ocular injuries .In this study, injuries such as harmful effects of looking at radiations from welding or entering iron fold to eye account for the largest percentage of eye injuries, American Welding Society (2008). Also low performance of protective eye glasses and lack of quality control of these devices increased the injuries among the welders (American Welding Society, 2008).

Musculoskeletal disorders in the workplace occur due to poor conditions. One of the causes of this problem is the tools that people use at work, which should be standardized. Working in a good body condition, using the suitable tools in accordance with the principles of ergonomics, the availability of the tools, reducing repetitive tasks and taking care of body fatigue while working are the most important management strategies of musculoskeletal injuries. According to a national study conducted in 2004 by Ministry of Health. Welders' workplace safety should be such that workplace safety, increase in knowledge the dangers and need to comply with safety standards, business skills courses, use of PPE, solving health insurance and quality control of safety equipment are highly recommended (Armani, 2017).

2.2.4 Welding safety practice in Nigeria

The Nigeria Institute of Welders is the authorised national body, a member of the International Institute of welding and the only one duly registered in the country and globally recognised for ensuring global best practises in the field of welding. The body sees to the supervision of welding education and qualification of personnel through its collaboration and capacity building. Welders are all over the places especially in a lot of streets and most of them do not have workshops but operate outdoor. This is because they do not have the capital to set up structures for their workshop. According to the Institute of welders, the welders are supposed to as a matter of regulation, have protective equipment to use in their workshops. (NIW, 2014). These include:

- **Cover all and leather aprons**: to protect their bodies form burns possible as a result of burns from small globes of metal falling on them and heat of ultraviolet radiation from the work.
- **Leather gloves**: To protect the hands against heat splatter and radiation.
- **Head/Hand shield**: To protect the welders head and eyes from radiation. The shields protect the face, top of the head and the throat of the welders. The filter glass prevents radiation from damaging the eyes. The welder is supposed to choose the one that suits.
- **Screen**: The institute recommends the use of screens to prevent rays of the arc affecting other person in the vicinity as people other than the welders are prone to the hazard associated with the visible arc.
- Local respirators, fume extractors, face masks to prevent the welders from harmful effect of gases/fumes to control the levels below the maximum allowable concentrations. Adequate supply of air is necessary.

2.3 Theoretical framework

The theoretical framework used to further explain this study, in order to capture and measure all necessary variables relevant to the use of welding agents among welders is the preede-proceed model. The model is a diagnostic instrument used to analyse certain behaviours. The model considers factors influencing health related behaviours. The model was designed by Lawrence Green and his colleagues .The precede-proceed model assumes that reseach participants play an active role in defining the problem, settings of problem eradication and identifying appropriate strategies for solving the problems Green and Kreuter (2005). The Precede aspect of the model is employed to further explain this study. Thee model would be used to determine the research problem and how the problem can be solved in order to facilitate educational programmes to help welders understand the hazards involved in using welding agents and the importance of using personal protective equipment in Lagelu Local Government of Oyo State. Factors influencing the welders' behaviour and intervention programmes that will help welders make their safety while welding important.

The predisposing, reinforcing and enabling factors that enable human behaviour will be considered in the precede model. Phase one are those factors that influence people's behaviour, they include knowledge, beliefs, attitude, prevention practices, norms and values.

Phase two involves identifying the health determinants of these problems and needs. Phase three involves analysing the behavioural and environmental determinants of health problems Phase four, the factors that predispose to, reinforce and enable the behaviours and lifestyles are identified. Phase five involves ascertaining the health promotion, health education and policy-related interventions that would best suit in encouraging the desired changes in behaviour or environments (Green and Kreuter, 1999).

The major focus of this study is on knowledge and practices to diagnonise the behaviour of welders in relation to their preventive practices to explain where intervention is needed. This is represented in figure 1

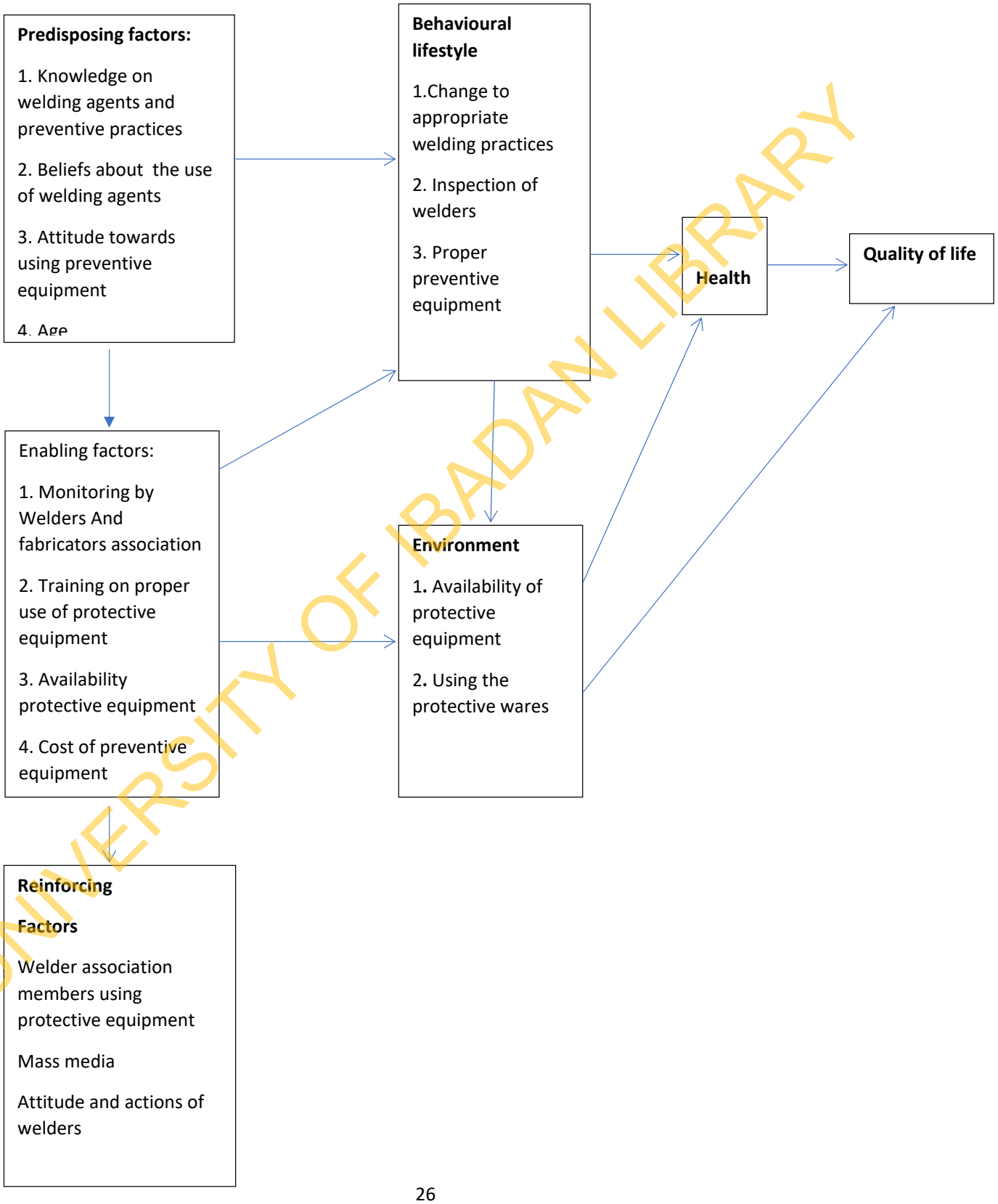
Predisposing factors: These are intrinsic factors that consist of behavioural antecedents that provide the rational for their behaviour to be performed. These include factors as: value, knowledge, attitude, norms, beliefs and practices that can influence their health actions. The welders knowledge, beliefs and customs on how they should guard their safety at work can be appraised and reasons for the gaps using the PRECEDE model. The factors are associated with other factors which support the occurrence. For the purpose of this research, the knowledge and preventive practices of welders will be measured and tested for any significant association with the enabling factors of expected outcome among this study population.

Enabling factor: This refers to the factors in the environment that are needed to be available in order to carry out a particular behaviour, programs, money, skills, resources needed preventive practices (Green and Kreuter, 2005)

Reinforcing factors: These are outcomes and behaviours which come into play when a behaviour has been initiated to encourage persistence of behaviour by providing punishment, rewards or incentives on a continuous basis as the case may be. Examples include: peer support, health personnel, neighbours (Green and Kreuter, 2005).

This is represented in Figure 1

Figure 2.1: Precede-Procede Model



CHAPTER THREE

METHODOLOGY

3.1 Study design

Descriptive cross-sectional survey design was adopted for this study. The cross-sectional design was used since the study involves assessing factors relating to exposure and outcome.

3.2 Study Site/Area

The study site for this research is Lagelu Local Government Area of Ibadan of Oyo state. The local government area is one of the oldest in the state; Lagelu Local Government Area has 14 wards which is the largest in Oyo state. The local government has an estimated population of 171,548. It has a land area of 416 square kilometres. It shares boundaries with Egbeda, Ibadan Nonrth, Akinyele and Ibadan North East. Lagelu Local Government Area consists of towns and villages that include: Monatan, Lagun, Ejioku, Iyanaoffa, Elegbaada, Oyedeji, Kelebe,Sagbe,Kutayi, Olorunda, Ogburo, Apatere, Lalupon, Ogunremi,Olowode, Ile-Igbon, Olode The local government was created in 1976 with its headquarters at Iyana-offa. The vast majority of the population are from the Yoruba Ethnic group resulting in the people speaking Yoruba. The major religions practiced in Lagelu are Christianity and Islam. The people of Lagelu are mostly agriculturalists engaging in cultivation of crops such as cassava, maize, cocoa, vegetables, yams and kolanut. They also take part in other commercial activities like textile weaving, cloth dyeing, preparation of roots and herbs. Welding is one of the occupations engaged in by community members in Lagelu and they are found in different areas of the local government.

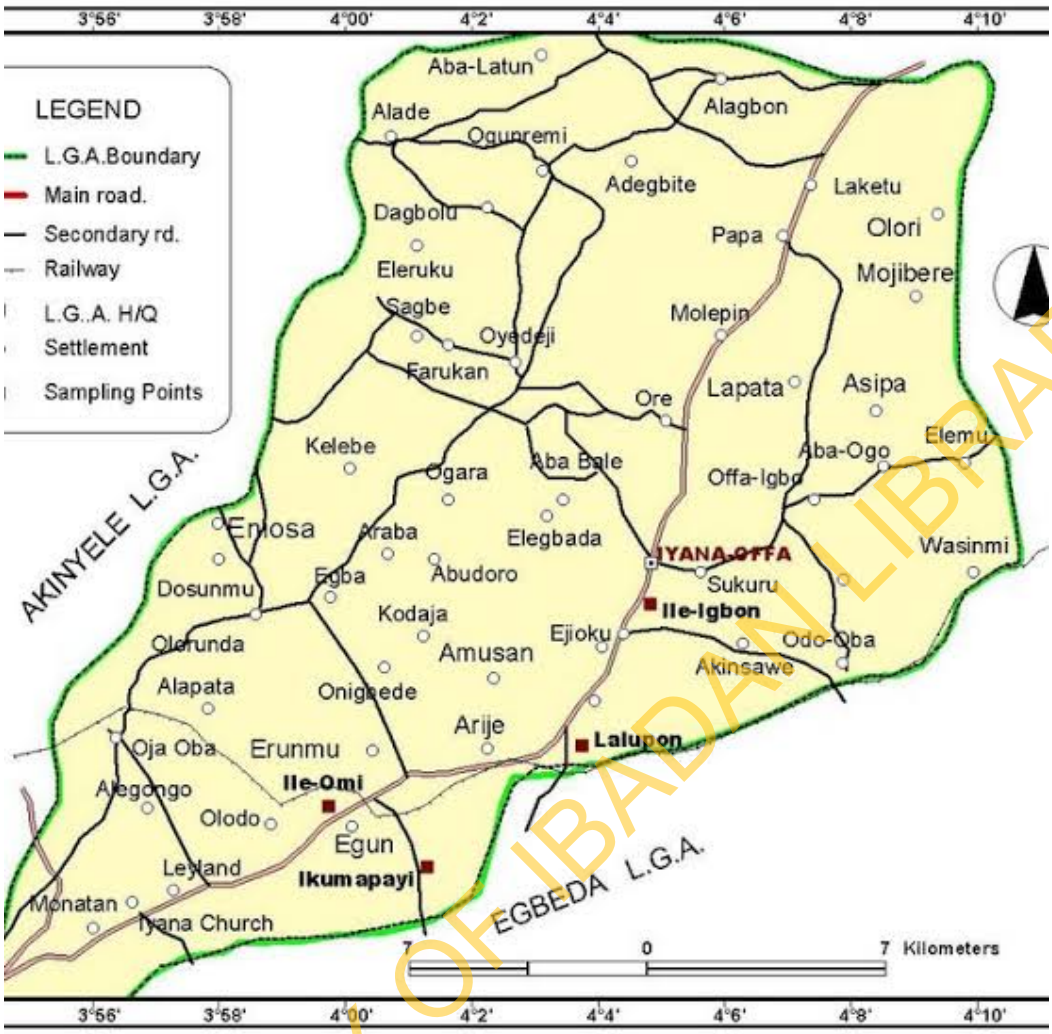


Figure 3.1 Map of Lagelu Local Government Area of Oyo State

3.3 Study population

The study population were adult welders between the ages of twenty- five to sixty years are welding workshop owners in Lagelu Local Government Area of Oyo state. The professionals are referred to here as adult males between the ages of twenty-five and sixty years (25 years – 60years) who are welders. 150 welders were randomly selected from each ward in Lagelu LGA which include : Ajara/ Opeodu, Apatere/ Kufi/ Ogunbode/ Ogo, Arulogun/ Ehin/ Kelebe, Ejioku/ Igbon/ Ariku,Lagelu Market /Kajola/ Gbena, Lagun, Lalupon I, Lalupon II, Lalupon III, Ofa- Igbo, Ogunjana/ Owode/ Ogburo, Ogunremi/ Ogunsina, Oyedeji/ Olode/ Kutayi, Sagbe/ Pabiekun

3.4 Inclusion criterion

The respondents selected for this study are adult welders who are welding workshop owners.

3.5 Exclusion criterion

Apprentices who work in the welding workshops yet to attain freedom from their masters were excluded from the study.

3.6 Sample size determination

The sample size from this study is estimated as follows:

$N = \frac{z^2pq}{d^2}$

Where

n = sample size

Z^2 = standardised normal deviation which is a constant 1.96 at 95% confidence interval

P= 26% = 0.26 (health hazard from the use of welding agents by welders)

q = 1-P (1 - 0.377104) = 0.74;

P = 0.05 at 95% Confidence Interval

$N = \frac{z^2pq}{d^2} = \frac{1.96 \times 0.26 \times 0.74}{0.0025}$

N=150

None response rate of 10% of sample size will be added as follows:

150+15=165

3.7 Sample Procedure

A multi-stage sampling procedure was used to select respondents. The following stages were used for the sampling technique for this study:

Stage One: Seven wards out of the fourteen wards in the local government were randomly selected (simple random sampling) using balloting, numbers were assigned to each ward. The following wards were selected; Lagun, Lalupon, Ejioku/Igbon/Ariku, Apatere/Kuffi/ Ogunbode/Ogo, Lagelu market/Kajola/Gbena, Ajara/Opeodu, Arulogun

Stage two: Two communities were selected from each ward making fourteen commuSnities

Stage three: All the welding workshops in the communities were counted to recruit all the welding respondents for this study.

Total sampling was used to assess all the welders in workshops in the communities

3.8 Recruitment of Research Assistants

Considering the wide geographical spread of this study, involving visits to six wards and spread across communities within the word to recruit welders, it became necessary to recruit research and train research h assistants (RAs) who would help in data collection. A five man team of researchers comprising of the principal investigator was constituted. The following selection criteria was used to select the four (out of the five) RAs for training with the aim to select four hereafter.

1. Educational qualification of the assistants were at least ordinary national diploma 9 OND), BSc, in a health/science related field,
2. The candidate were fluent in English and Yoruba languages
3. Interpersonal and good communication skills.
4. Report writing skills.
5. Ability to devote odd hours to research work while it lasted.

3.9 Training of Research Assistants

The research assistants were trained for two days 23rd and 24th of October 2019. The training manual and timetable were developed and approved by the supervisor. The training was for three hours (from 10:00am to 1:00pm) for each day at the conference room, department of Public Health, University of Ibadan. Training materials were given to the RAs . The sessions introduced them to the research study, objectives and methodology and the data collection was done using role playing (the role play featured entry process, seeking consent of the potential cases for the study, confidentiality assurance and the administration of the questionnaire). Active training was adapted. These methods include: participatory discussion, demonstration and return demonstration, role play, and lectures for participatory

involvement. Staff members of the department were on ground to supervise the activities of the training.

Negotiations and logistics were agreed upon. Stipends were paid to the research assistance and the research assistance were assigned roles and duties and they were supervised directly by the researcher. Each research assistant was given a copy of the field manual copies of the questionnaire and ethical approval from the state Ministry of Health in a clear folder.

3.10 Data collection Method

A quantitative data collection method was used for this study. A semi-structured interviewer administered questionnaire was used in the wards in the local Government Area by the researcher and four other trained research assistants. The questionnaire was divided into four sections which are:

Section A - Socio-demographic characteristics of respondents.

Section B - Knowledge of the hazard of welding agents in welding.

Section C – Knowledge of the health hazard practices of respondents.

Section D – Factors influencing the non-use of the protective equipment.

Section E – V Health symptoms associated with lack of use of PPE.

Short observation of the welders at work was carried out using an observation questionnaire. This was used to help match the welders' responses with their use of personal preventive equipment.

3.11 Validity of instrument

In order to determine the validity of the instrument, an extensive review of literature to ensure appropriate content and face validity was done in order to identify necessary variables to be included in the instrument for measurement. The instrument was given to experts including my supervisor in the Faculty of Public Health to ascertain the quality of the instrument.

The drafted questionnaire was field tested among 10% of the sample size that is 15 out of the welders in Akure, Ondo state capital.

3.12 Reliability of instrument

Reliability of an instrument is a measure of the consistency in measurement of the instrument that is meant to measure a particular concept. It becomes reliable when after several administration of the instrument the similar results are achieved under similar conditions. In order to establish the reliability of the instrument, the researcher administered

the constructed questionnaire to 10% of the total population on a representative population but was not included in the final analysis of the work. The pre-test for this work was carried out at Akure, the Ondo State Capital which served as a representation for the intended population. A Cronbach Alpha measurement and reliability co-efficient measure was used determine how reliable the instrument was. 0.7-1.0 coefficient was achieved.

3.13 Data management and analysis

Data collected was checked for completeness and accuracy and also they were sorted, cleaned and coded. This data was processed and analysed using the Statistical Packages of SPSS version 23. Every correct response to the questions in each section was scored1 and wrong responses will be scored 0. For each of the sections, 50% score and above was considered as good while below 50% was scored as poor. To test the significance in difference between the categorical variable like the knowledge of the use of welding agents, variables which have more influence on the health prevention practices of the respondents were confirmed through the use of regression analysis.

3.14 Study limitation

This study has limitation due to the fact that only welders were recruited to take part in this study. The welders are themselves owners of these workshops where the welding activities take place. However, the people around the workshops, who are also exposed to the hazard of using welding were not a part of this study.

3.15 Ethical approval

Ethical approval was sought and obtained from the Oyo Ministry of Health Research Ethics Committee. Informed consent was obtained from the respondents after it was duly explained to them. The informed consent spelt out the title of the study, justification for the study as well as how the study will be beneficial at the end of the study. Verbal information consent was sought from those who could not read or write.

CHAPTER FOUR

RESULTS

4.1 Respondents Socio-demographics characteristics

The socio-demographics information of the respondents, as presented on Table 4.1 revealed the mean age among the respondents was 43.2±13.6 years; and almost a quarter were in each age category of 30 – 39 years (24.0%) and 40 – 49 years (26.0%). In respect to level of education most respondents, 63% had attained secondary education, and 21.0% attained not more than primary education. Majority of the respondents are (63.0%) were married.

Majority of the welders who participated on this study were from the Yoruba ethnic group (96%), other respondents were from the Igbo and Hausa ethnic groups – 3.0% and 1.0% respectively. Distribution of the respondents according to their monthly income revealed an overall range of monthly earning of 50,000 to 90,000 naira; one-third (33.0%) earned between 100,000 and 150,000 per month and only about 3% earned more than 150,000 naira monthly. Majority of the respondents affirmed they had had a welder training (89.0%) with many 133, reportedly received apprenticeship (83.0%) or technical training (15.0%).

Table 4.1: Socio-demographic Information

Socio-demographic information	Frequency (n = 150)	Percent
Age Group (43.2 ± 13.6)		
≤ 30 years	26	17.3
30 – 39 years	36	24.0
40 – 49 years	39	26.0
50 – 59 years	26	17.3
60 years or more	23	15.3
Level of Education		
Non-formal education	16	10.7
Primary education	31	20.7
Secondary education	95	63.3
Tertiary education	8	5.3
Marital Status		
Single	50	33.4
Married	95	63.3
Separated/Divorced	5	3.3
Ethnicity		
Yoruba	144	96.0
Igbo	5	3.3
Hausa	1	0.7
Monthly Income		
Less than N50,000	28	18.7
N50,000 – N90,000	68	45.3
N100,000 – N150,000	49	32.7
Above N150,000	5	3.3
Trained as Welder		
Yes	133	88.7
No	17	11.3
Type of Training Received (n = 133)		
Apprenticeship training	110	82.7
Technical training	20	15.0
Other training	3	2.3

Exposure to welding agents information of the respondents

Slightly more than half of the respondents (52.0%) had spent 10 years or less in the welding profession and 11 – 15 years (21.0%), while 13% had been in the profession for over 20 years. About a third of the respondents (36.0%) reported working 9 – 10 hours per day, while exactly half indicated they worked 5 – 8 hours daily (50.0%). The commonest method of welding used among the welders was manual metal arc (91.0%).

Most of the welders reportedly engaged in the cutting aspect of welding (73.0%) and grinding (71.0%); other aspects they had worked on were, painting (20.0%), hammering (19.0%), and cleaning (11.0%). Equipment and resources used by these welders in their profession mentioned in the course of this study were majorly, electricity (71.0%), electrode (45.0%), cutting machine (41.0%), and Tung (39.0%); other resources mentioned were clipping hammer & brushes (12.0%), paint (11.0%) and welding transformer (9.0%). Others are shown in table 4.2. The most common products produced by the interviewed welders was construction works (76.0%); repairs and maintenance (39.0%) building of household equipment (21.0%) and manufacturing works (17.0%).See table 4.2.

Table 4.2: Exposure to welding agents information of welders (N=150)

	Frequency (n = 150)	Percentage
Duration since working as welder		
< 5 years	17	11.3
5 – 10 years	63	42.0
11 – 15 years	32	21.3
16 – 20 years	18	12.0
Over 20 years	20	13.3
Number of hours worked daily		
< 5 hours	8	5.3
5 – 6 hours	39	26.0
7 – 8 hours	36	24.0
9 – 10 hours	54	36.0
11 -12 hours	13	8.7
Methods of welding used		
Manual Metal Arc (MMA)	137	91.3
Gas welding	6	4.0
Both (MMA & Gas)	3	2.0
Others (Electric, Fabrication, Saw blade)	4	2.7
Equipment and Resources used (multiple responses)		
Electricity	106	70.7
Electrode	67	44.7
Cutting machine	61	40.7
Tung	59	39.3
Chipping hammer & brushes	18	12.0
Paint	16	10.7
Welding transformer	13	8.7
Gas	9	6.0
Carbide	9	6.0

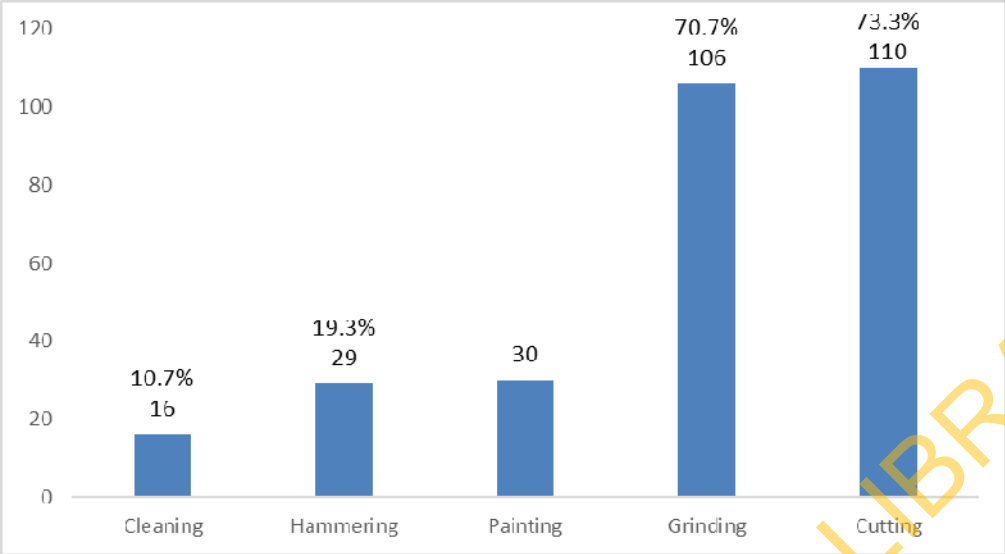


Fig 4.1 Aspects of welding engaged in

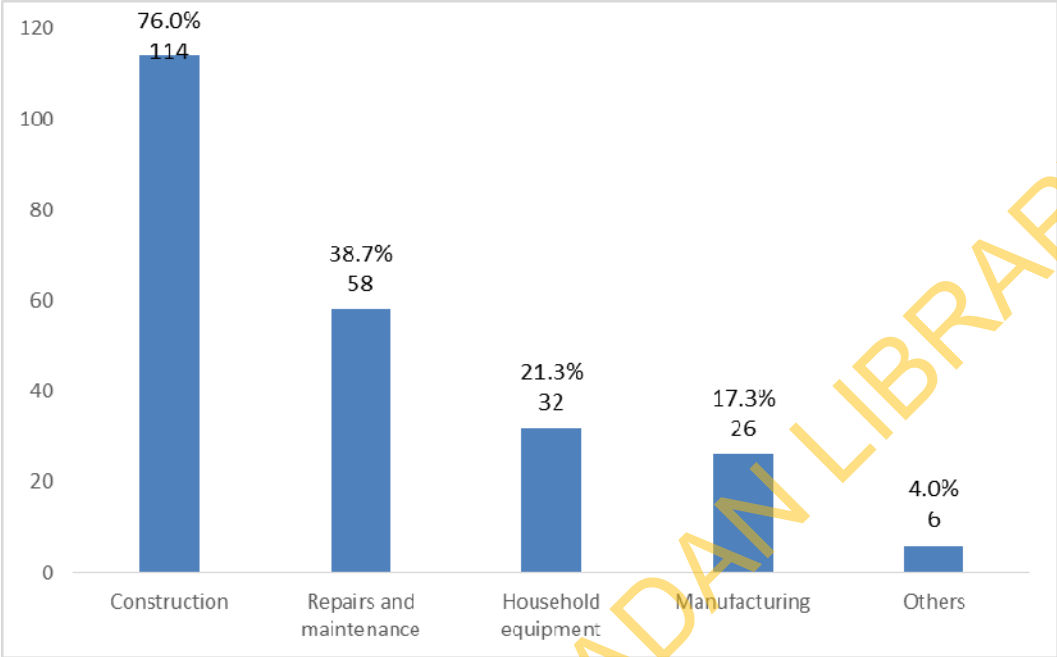


Figure 4.2 Welding products in workshops

Knowledge of Welding Agents

The study also revealed the respondents knowledge level on welding and welding agents; it was revealing that about 42.0% correctly mentioned some types of welding practiced in their profession and only 20% remarkably mentioned the right welding agents used. With respect to measures to be taken by the welders to ensure safety; most of them were knowledgeable about wearing the personal protective equipment (61.0%), 28.0% knew about preventing naked wires to avoid electric shock and keeping all equipment safe from danger (26.0%). Very few (10.0%) reported ensuring their environment is tidy as a safety measure while 9.0% reported removing all sharp objects as one of their known safety measures.

Generally, the respondents' overall knowledge on welding and welding agents revealed that are more than half (57.0%) had fair knowledge, while one-third (33.0%) had a good knowledge level (see table 4.3 for others).

Table 4.3: Respondents' knowledge on welding and welding agents (N150)

	Frequency	Percent
Types of welding		
None correctly answered	87	58.0
At least one correctly answered	63	42.0
Types of welding agents		
None correctly answered	120	80.0
At least one correctly answered	30	20.0
Measures to ensure safety (*multiple options*)		
Wearing the Personal Protective Equipment	91	60.7
Ensure there is no naked wire to avoid shock	42	28.0
Keep all equipment safe from danger	39	26.0
Ensure environment is tidy	15	10.0
Remove all sharp objects	14	9.3

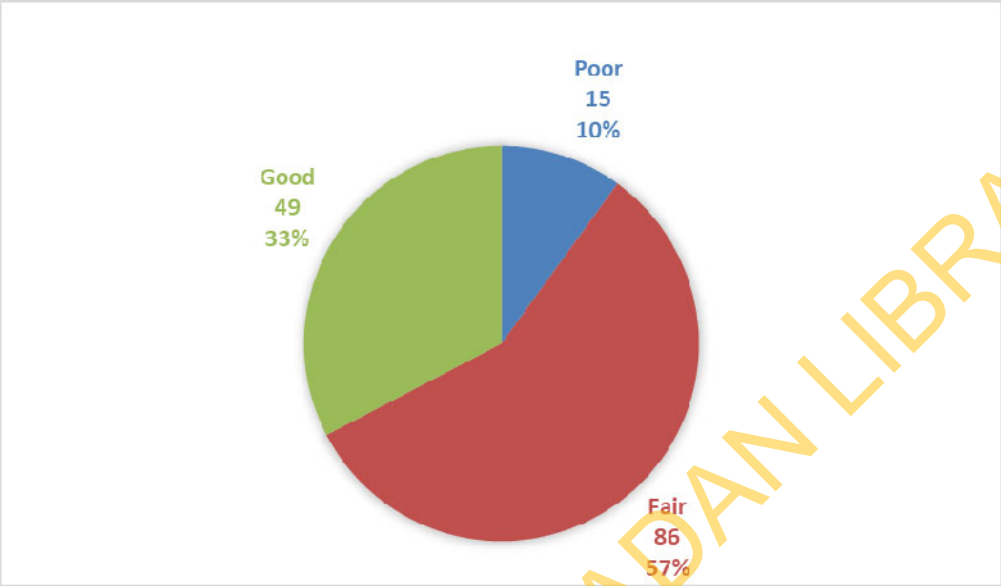


Figure 4.3: Level of knowledge on welding and welding agents

Knowledge on Effects of Welding and Welding Agents

The welders also answered questions with respect to what they knew about effects of welding and welding agents, to themselves and other persons. Common effects of their profession on people around their workplaces known to the welders, were; injury to people (29.0%), danger to health (27.0%) and accidents (13.0%). The welders also acknowledged some consequences of the lack of safety to them; this include eye damage/problems (93.0%), electric shock around the workplace (90.0%), burns(70.0%), explosion of cylinders/flashback (30.0%) and poor health conditions such as asthma (3.0%).

Almost all the respondents acknowledged that welding flash or bright light was a known cause of injury to them (97.0%); more than three-quarter acknowledged electricity (80.0%) and sharp edges/metals (78.0%) were also major source of injury in the welding works,; about two-thirds (65.0%) remarked noise from cutting metals can also be a potential source of injury in welding works; 44.0% indicated heat, fire or explosions could be a source of injury; 43.0% reported flying sparks or particles are also cause of injury concerns (other causes of injury mentioned are shown in the table 3)

On a general assessment, the level of knowledge of the respondents (Figure 4.5) show that more than two-thirds were fairly knowledgeable (69.0%) and about one-quarter (24.0%) were poorly knowledgeable about the effects of welding and welding agents (see table 4.3).

Table 4.4: Respondents' knowledge on effects of welding and welding agents

	Frequency (n = 150)	Percent
Effects of welding work on people around *		
Injury	44	29.3
Danger to health	41	27.3
Accidents	19	12.7
Consequences of lack of safety to welders *		
Eye damage/problems	139	92.7
Electric shock	135	90.0
Burns	105	70.0
Explosion of cylinders/flashback	45	30.0
Asthma	4	2.7
Cause of injury in welding works *		
Bright light/Welding flash	145	96.7
Electricity	120	80.0
Sharp edges/metals	117	78.0
Noise from cutting metals	98	65.3
Heat, fire or explosions	66	44.0
Flying sparks/particles	65	43.3
Gas explosion	56	37.3
Welding fumes and gases	48	32.0
Falling objects	39	26.0
Vibrations	34	22.7
Uncomfortable work postures	32	21.3

*Multiple options

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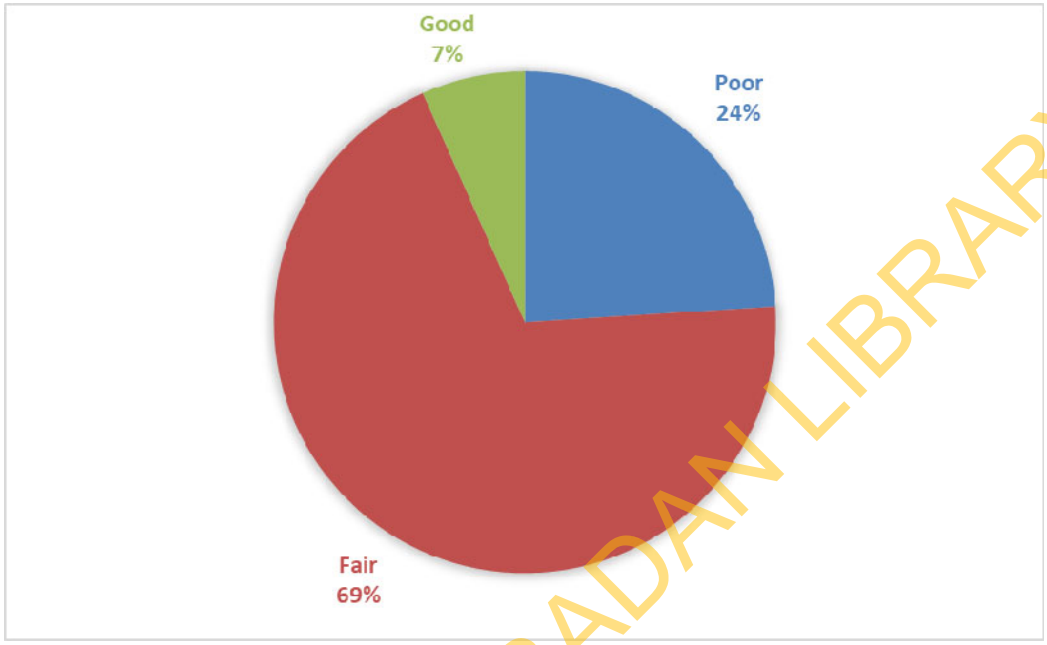

Figure 4.4: Level of knowledge on effects of welding and agents

Knowledge on Use of Personal Protective Equipment (PPE)

Knowledge of the respondents on benefits of using the PPE and equipment that are actually for protective purposes in welding was revealed in the study. Almost half of the respondents mentioned that the PPE is beneficial in protecting them from harm (46%); below a quarter rightly acknowledged that the PPE protects them from health hazards (23%) and y 16% indicated that the PPE helps improve their safety at work (see table 4.4);

Some equipment correctly identified as PPEs by most respondents were: goggles (97%), welding helmet (83%), coverall (80%), insulated gloves (75%), and rubber soled-steel toe cap-safety boots (60%). Fewer proportion of respondents identified respirator/face mask (35%), fire extinguisher (27%), hand shield (23%), and ear muffs/ear plugs (23%). Some of the respondents wrongly indicated tools used in welding as protective equipment; this include mostly pliers (up to 87%), spanner (up to 71%) (see table 4.5)

On a general scale, the respondents' knowledge on PPE, as revealed on Figure 6, was mostly fair (96%), while 6% had a good knowledge level of PPE and its usage.

Table 4.5: Respondents' knowledge on personal protective equipment

	Frequency (n = 150)	Percentage
Benefits of PPE (*Multiple options*)		
Protection from harm	69	46.0
Protection from health hazards	35	23.3
Improves safety at work	24	16.0
Prevention from death	7	4.7
Personal Protective Equipment known to the welders (*Multiple options*)		
Goggles	146	97.3
Welding Helmet	125	83.3
Coverall	120	80.0
Insulated gloves	112	74.7
Rubber soled, steel toe cap, safety boots	90	60.0
Respirator/Face mask	53	35.3
Fire extinguisher	40	26.7
Hand shield	34	22.7
Ear muffs/Ear plugs	34	22.7
Equipment wrongly identified as Personal Protective Equipment (PPE) (*Multiple options*)		
Pliers	131	87.3
Spanner	106	70.7
Radio	11	7.3
Fan	2	1.3

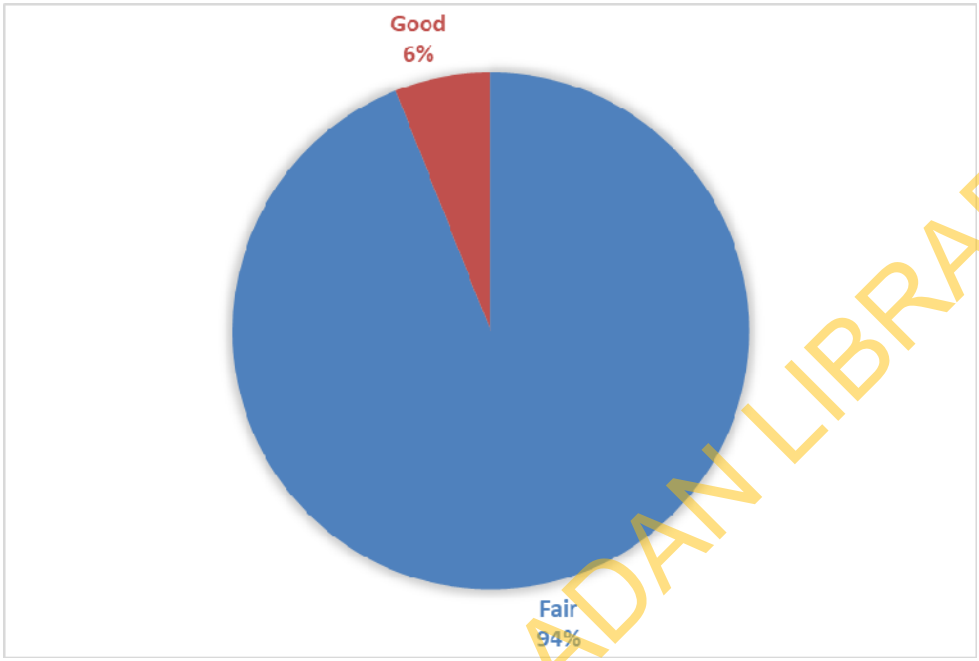

Figure 4.5: Level of knowledge on effects of welding and agents

Respondents' Personal Preventive Practice

Actual usage of PPE was also uncovered from the study> As presented in Figure 7, more than nine in every ten respondents remarked they had used the safety goggles (94.0%), insulated safety gloves (92,0%), and work suit/coverall (92.0%). More than three-quarters mentioned they had used protective equipment such as safety boots (85.0%) and welding helmets (82.0%). However, less than half mentioned having used equipment such as the welding shield (45%), face-masks/respirators (39.0%), and ear muffs (27.0%). Below a quarter mentioned using other protective equipment like ear plugs (24.0%), respirators (22.0%), and leather apron (21.0%).

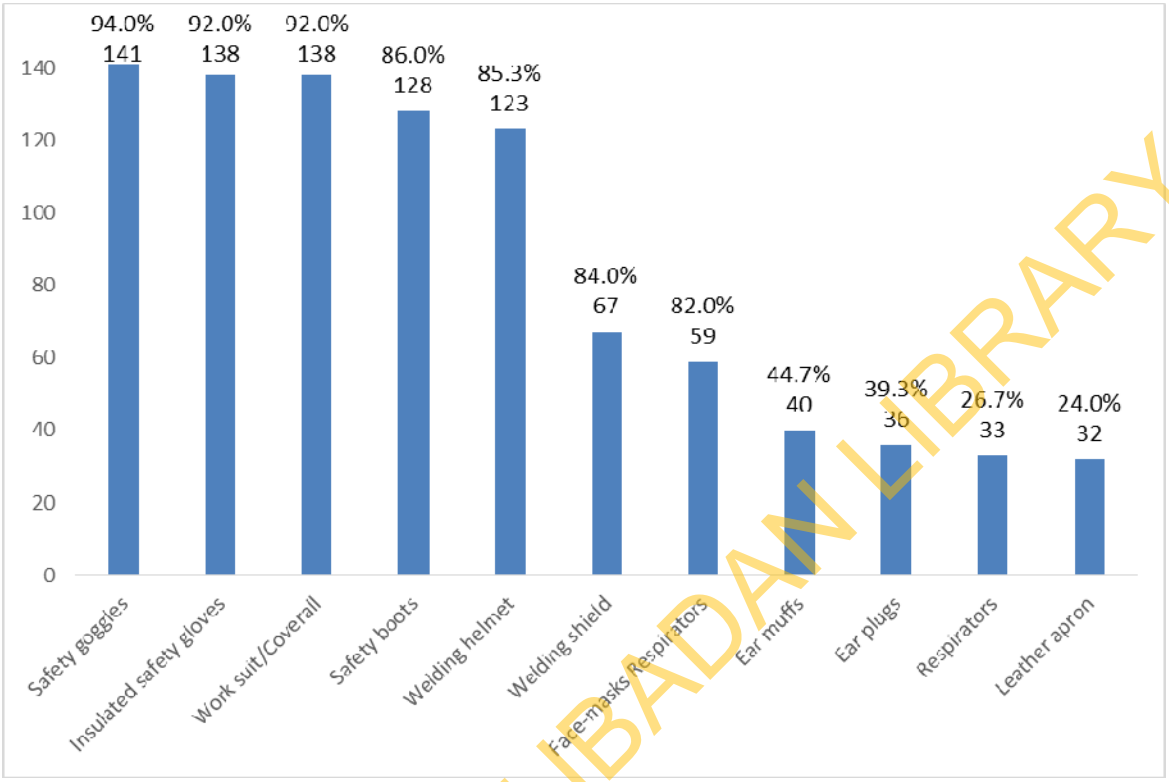

Figure 4.6: PPE used by welders at work

Table 4.6: Frequency of Usage of PPE

	Always (%)	Sometimes(%)	Never (%)
Safety Goggles	131 (87.3)	10 (6.7)	9 (6.0)
Welding Shield	20 (13.3)	47 (31.3)	83 (55.3)
Ear muffs	14 (9.3)	26 (17.3)	110 (73.4)
Ear plugs	8 (5.3)	28 (18.7)	114 (76.0)
Face-masks respirators	21(14.0)	38 (25.3)	91 (60.7)
Respirators	10 (6.7)	23 (15.3)	117 (78.0)
Safety boots	47 (31.3)	71 (47.3)	32 (21.4)
Insulated safety gloves	70 (46.7)	58 (38.7)	22 (14.6)
Work suit/coverall	39 (26.0)	89 (59.3)	22 (14.7)
Leather apron	4 (2.7)	28 (18.7)	118 (78.6)

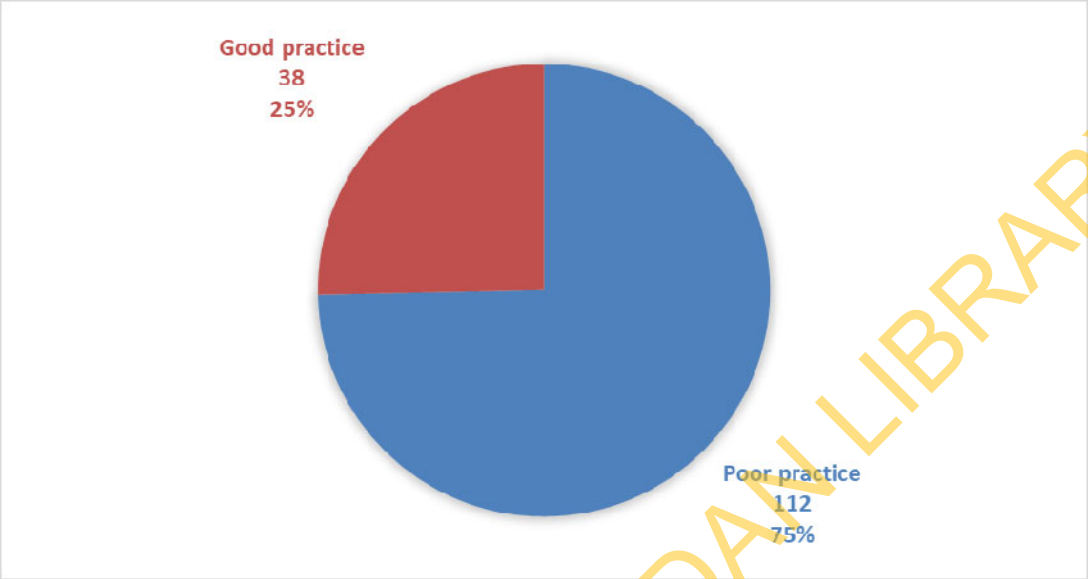

Figure 4.6: Preventive practice and usage of PPE among welders

Health Symptoms Associated With Non-Usage of PPE by Respondents

Health symptoms that have emerged from not using the protective equipment, as reported by the welders, is presented on Figure 10. The commonly mentioned symptoms associated with non-usage were general body weakness (89.0%) and cough (72.0%); others were sneezing after welding work (32.0%), having a stuffy nose (32.0%), body chills and fever (32.0%), having a running nose (21.0%), shortness of breath (19.0%), wheezing (17.0%), flu-like symptoms (12.0%) and sweet metallic taste in the mouth (7.0%).

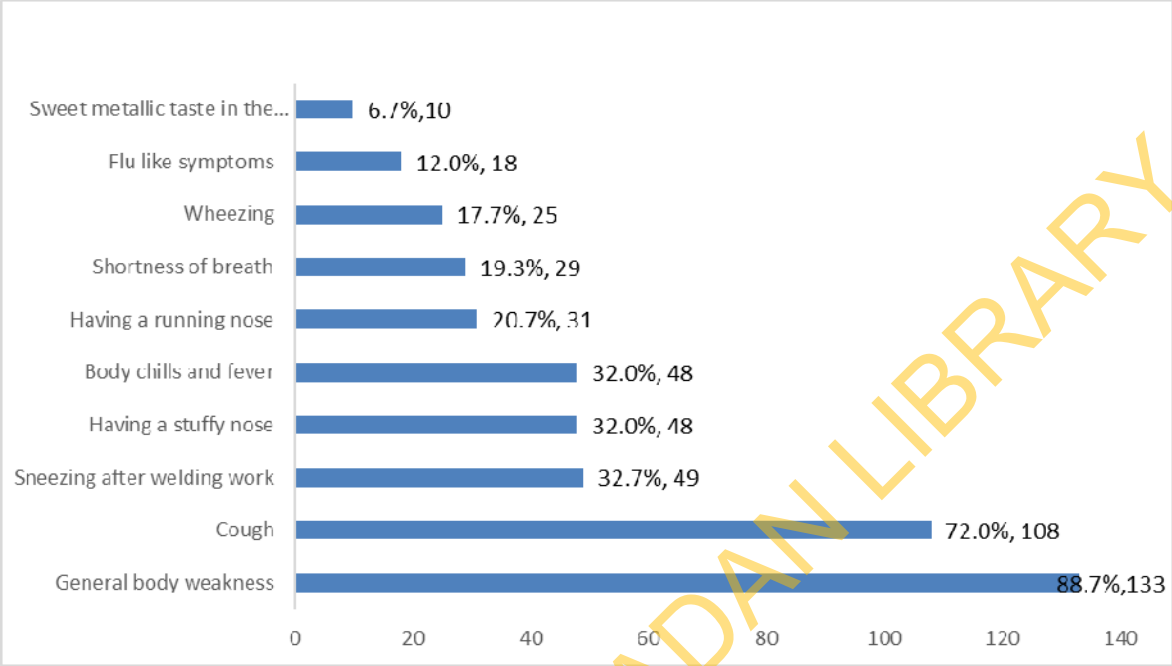

Figure 4.7: Health Symptoms from non-usage of PPE

Available Equipment and Condition Of Working Area

In the course of the study, the researcher assessed available equipment at the welders' workshops at time of visit. About two-thirds (67.0%) had their goggles available, almost half had their gloves available (51.0%); less than half visibly had their apron/coverall available (38.0%) and safety boots (29.0%); very few had a respirator/nose guard (13.0%), up-to-date fire extinguisher (9.0%), and first aid box (2.0%). See figure 11).

Observation of the conditions at the workshops at time of visitation showed that more than half had a work environment free from flammable material (59.0%); half were observed to have their electrodes removed from the holder, when not in use (50.0%); almost half had their workshops properly ventilated; 40.0% had their work area well lit up; 31.0% had a well-arranged and tidy work area; 13.0% had hazardous materials within their workshop labeled; while 7.0% had insurance policy, See figure 12)

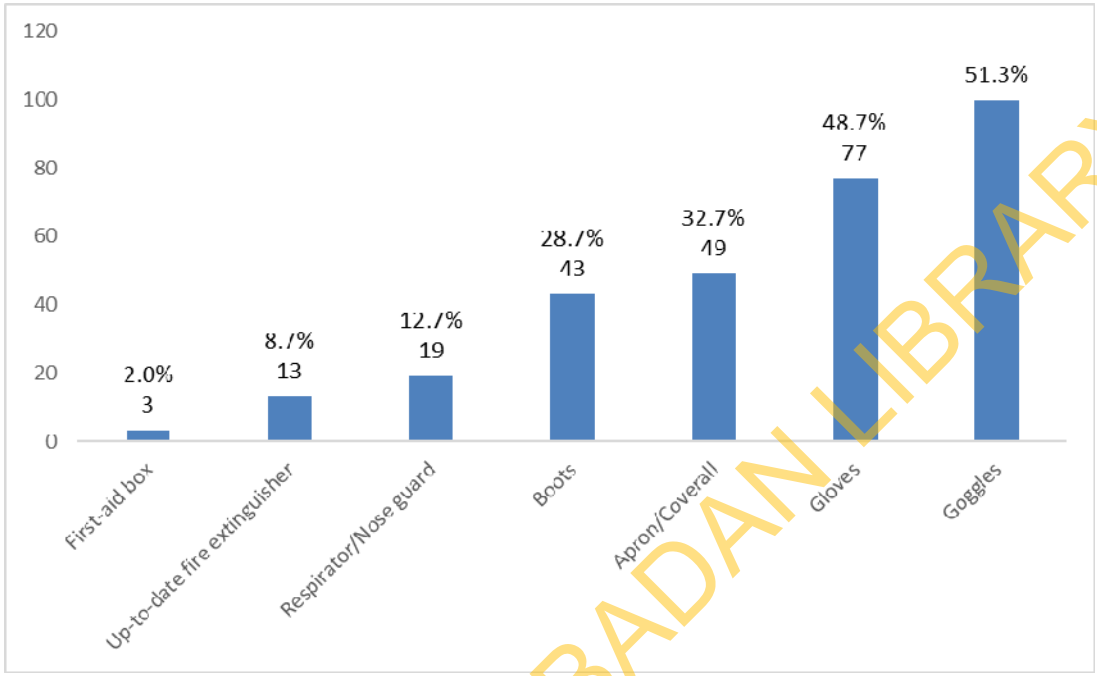

Figure 4.8: Checklist of equipment found at welders' workshops

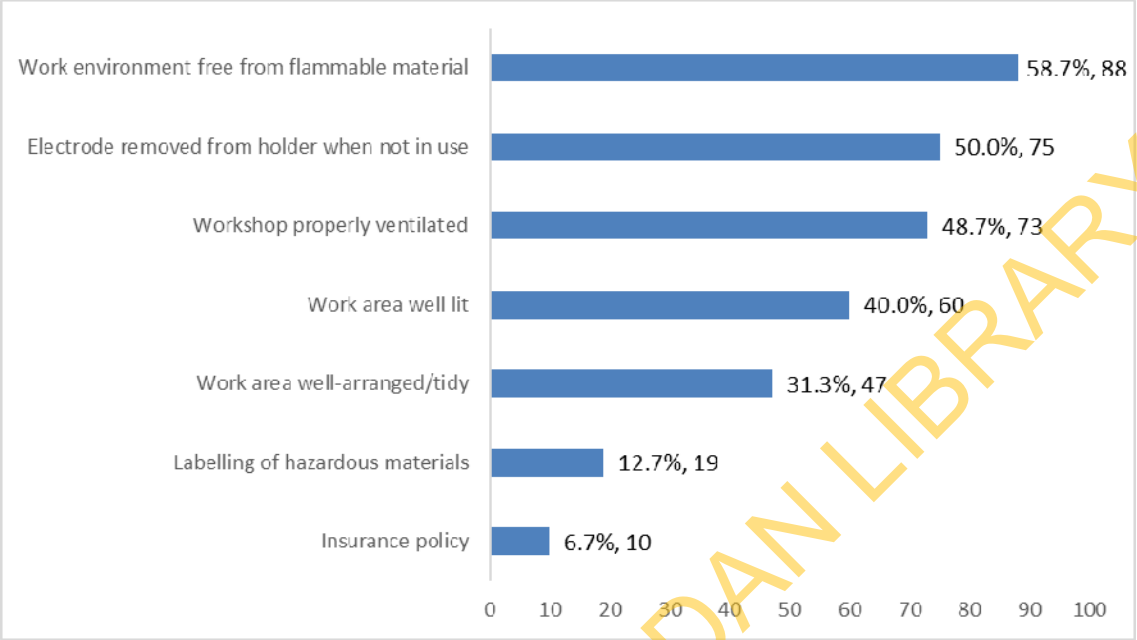

Figure 4.9: Checklist for proper working conditions observed at welders' workshops

Test of Hypotheses

Hypothesis 1: There is no association between welder's background information (age, level of education, monthly income, training received, years of experience, welding products worked on) and knowledge on welding & agents.

The test of hypothesis to find out association between the welders' background information and their knowledge on welding & welding agents, Table 8, revealed that there was a statistically significant association between knowledge on welding agents and engaging in repairs & maintenance ($p = 0.001$); a significant association was also observed between the welders' knowledge on welding & agents and engaging in manufacturing works ($p = 0.034$).

Notable from the result was that: exactly half of those who engaged in repair and maintenance had a fair knowledge while 48% had a good knowledge; conversely, most of the welders who engaged in manufacturing works (54.0%) had a good knowledge, while 42.0% had a fair knowledge.

Other background information not associated with knowledge on welding and welding agents were age group of the welders ($p = 0.872$), level of education of the welders ($p = 0.094$), monthly income ($p = 0.551$), type of welder training received ($p = 0.569$), years of experience as welder ($p = 0.259$), engaging in construction works ($p = 0.137$), and working on household equipment ($p = 0.553$).

Table 4.7: Hypothesis 1

	Knowledge on welding & agents			Chi-square	p-value
	Poor(%)	Fair(%)	Good(%)		
Age Group					
≤ 30 years	3 (11.5)	14 (53.8)	9 (34.6)		
30 – 39 years	6 (16.7)	18 (50.0)	12 (33.3		
40 – 49 years	3 (7.7)	23 (59.0)	13 (33.3)	3.83	0.872
50 – 59 years	2 (7.7)	17 (65.4)	7 (26.9)		
JHU 60 years or more	1 (4.3)	14 (60.9)	8 (34.8)		
Education					
Below secondary	1 (2.1)	29 (61.7)	17 (36.2)	4.73	0.094
Secondary or higher	14 (13.6)	57 (55.3\)	32 (31.1)		
Monthly Income					
Less than N50,000	4 (14.3)	13 (46.4)	11 (39.3)		
N50,000 –N90,000	6 (8.8)	38 (55.9)	24 (35.3)	3.04	0.551
Above N100,000	5 (9.3)	35 (64.8)	14 (25.9)		
Welder Training Received					
Apprenticeship training	7 (6.4)	63 (57.3)	40 (36.4)	1.13	0.569
Technical training	2 (10.0)	13 (65.0)	5 (25.0)		
Years of Experience as Welder					
≤ 5 years	3 (17.6)	9 (52.9)	5 (29.4)		
5 – 10 years	7 (11.1)	34 (54.0)	22 (34.9)		
11 – 15 years	3 (9.4)	21 (65.6)	8 (25.0)	10.09	0.259
16 – 20 years	2 (11.1)	13 (72.2)	3 (16.7)		
Over 20 years	0	9 945.0)	11 (55.0)		
Products worked on in workshop					
Repairs and maintenance	1 (1.7)	29 (50.0)	28 (48.3)	14.42	0.001
Construction	10 (8.8)	62 (54.4)	42 (36.8)	3.97	0.137
Manufacturing	1 (3.8)	11 (42.3)	14 (53.8)	6.75	0.034
Household equipment	3 (9.4)	16 (50.0)	13 (40.6)	1.18	0.553

To test for association between background information (age, level of education, monthly income, training received, years of experience, welding products worked on) and knowledge on effects of welding, In Table 9, it was exposed that the welders' knowledge level in this aspect, was significantly related to their level of education (p = 0.004), monthly income (p = 0.032), welder training received (p = 0.015), and engaging in manufacturing works (p = 0.026). Noteworthy was that, about 10.0% of the welders who had attained at least secondary education had a good knowledge on the effects of welding agents, none of those with below secondary education had a good knowledge (0.0%); none of the lowest income level welders had a good knowledge on effects of welding (0.0%), whereas, about 12.0% and 4.0% from the middle and highest income level, respectively, had a good knowledge level; up to 20.0% of those with technical training had a good knowledge on the effects of welding (20.0%), while just 4.0% of those who had an apprenticeship training had a good knowledge; about 15.0% of the welders who had engaged in manufacturing works had a good knowledge on the effects of welding agents.

Factors such as age group (p = 0.810), years of experience (p = 0.459), engaging in repairs and maintenance (p = 0.903), engaging in construction works (p = 0.562), and making household equipment (p = 0.084) were not significantly associated with respondent's knowledge on effects of welding.

Table 4.8: Hypothesis 1

	Knowledge on effects of welding agents			Chi-square	p-value
	Poor (%)	Fair (%)	Good (%)		
Age Group					
≤ 30 years	6 (23.1)	18 (69.2)	2 (7.7)		
30 – 39 years	5 (13.9)	29 (80.6)	2 (5.6		
40 – 49 years	10 (25.6)	27 (69.2)	2 (5.1)	4.49	0.810
50 – 59 years	9 (34.6)	15 (57.7)	2 (7.7)		
60 years or more	6 (26.1)	15 (65.2)	2 (8.7)		
Education					
Below secondary	18 (38.3)	29 (61.7)	0	10.97	0.004
Secondary or higher	18 (17.5)	75 (72.8)	10 (9.7)		
Monthly Income					
Less than N50,000	3 (10.7)	25 (89.3)	0		
N50,000 – N90,000	16 (23.5)	44 (64.7)	8 (11.8)	10.53	0.032
Above N100,000	17 (31.5)	35 (64.8)	2 (3.7)		
Welder Training Received					
Apprenticeship training	29 (26.4)	77 (70.0)	4 (3.6)	8.46	0.015
Technical training	6 (30.0)	10 (50.0)	4 (20.0)		
Years of Experience as Welder					
≤ 5 years	3 (17.6)	12 (70.6)	2 (11.8)		
5 – 10 years	15 (23.8)	46 (73.0)	2 (3.2)		
11 – 15 years	10 (31.3)	18 (56.3)	4 (12.5)	7.75	0.459
16 – 20 years	3 (16.7)	13 (72.2)	2 (11.1)		
Over 20 years	5 (25.0)	15 (75.0)	0		
Products worked on in workshop					
Repairs and maintenance	15 (25.9)	39 (67.2)	4 (6.9)	0.20	0.903
Construction	27 (23.7)	78 (68.4)	9 (7.9)	1.15	0.562
Manufacturing	2 (7.)	20 (76.9)	4 (15.4)	7.33	0.026
Household equipment	3 (9.4)	27 (84.4)	2 (6.3)	4.96	0.084

The test of association between the welders' background information (age, level of education, monthly income, training received, years of experience, welding products worked on) and knowledge on PPE was significantly associated with the kind of training they received (p = 0.001); while a quarter of those who had a technical training were found to have a good knowledge about PPE and its usage, only 4% from those who had an apprenticeship training had a good knowledge..

Factors such as age group (p = 0.826), level of education (p = 0.894), monthly income (p = 0.333), years of experience as welder (p = 0.293), working on repairs & maintenance (p = 0.075), working constructions (p = 0.898), working on manufacturing tools (p = 0.191), and engaging in building of household equipment (p = 0.107).

Table 4.9: Hypothesis 1

	Knowledge on PPE		Chi-square	p-value
	Fair (%)	Good (%)		
Age Group				
< 30 years	25 (96.2)	1 (3.8)		
30 – 39 years	35 (97.2)	1 (2.8		
40 – 49 years	36 (92.3	3 (7.7)	1.50	0.826
50 – 59 years	24 (92.3)	2 (7.7)		
60 years or more	21 (91.3)	2 (8.7)		
Education				
Below secondary	44 (93.6)	3 (6.4)	0.02	0.894
Secondary or higher	97 (94.2)	6 (5.8)		
Monthly Income				
Less than N50,000	28 (100)	0		
N50,000 – N90,000	63 (92)	5 (7.4)	2.20	0.333
Above N100,000	50 (92.6)	4 (7.4)		
Welder Training Received				
Apprenticeship training	106 (96.4)	4 (3.6)	11.99	0.001
Technical training	15 (75.0)	5 (25.0)		
Years of Experience as Welder				
< 5 years	17 (100)	0		
5 – 10 years	61 (96.8)	2 (3.2)		
11 – 15 years	28 (87.5)	4 (12.5)	4.95	0.293
16 – 20 years	17 (94.4)	1 (5.6)		
Over 20 years	18 (90.0)	2 (10.0)		
Products worked on in workshop				
Repairs and maintenance	52 (89.7)	6 (10.3)	3.17	0.075
Construction	107 (93.9)	7 (6.1)	0.02	0.898
Manufacturing	23 (88.5)	3 (11.5)	1.71	0.191
Household equipment	32 (100.0)	0	2.60	0.107

Hypothesis 2: There is no association between respondents' socio-demographics and practice/usage of PPE

To test for factors (age, level of education, monthly income, training received, years of experience, welding products worked on) associated with actual practice/usage of PPE among the welders, Table 11; it was found that level of education of the welders ($p = 0.001$), the type of welder training received ($p = 0.021$) and engaging in repairs and maintenance ($p = 0.010$) were significant associates of the level at which the practiced PPE usage. The result further revealed that one-third (33.0%) of those having at least secondary or higher education had a good PPE usage level, not more than 8.0% of welders having below the secondary education level had a similar good usage level for PPE; up to 40.0% of the welders that underwent a technical training had a good usage level for PPE while 17.0% of those having apprenticeship training had a good practice level; just 14.0% of those who engaged in repairs and maintenance maintained a good practice for PPE usage.

Other factors were not significantly associated with PPE usage level include, age group ($p = 0.579$), monthly income ($p = 0.654$), years of experience as welders ($p = 0.058$), engaging in construction works ($p = 0.409$), engaging in manufacturing works ($p = 0.200$) and building household equipment ($p = 0.682$).

Table 4.10: Hypothesis 2

	Practice/Usage of PPE		Chi-square	p-value
	Poor (%)	Good (%)		
Age Group				
⩽ 30 years	22 (84.6)	4 (15.4)		
30 – 39 years	27 (75.0)	9 (25.0)		
40 – 49 years	26 (66.7)	13 (33.3)	2.87	0.579
50 – 59 years	19 (73.1)	7 (26.9)		
60 years or more	18 (78.3)	5 (21.7)		
Education				
Below secondary	43 (91.5)	4 (8.5)	10.24	0.001
Secondary or higher	69 (67.0)	34 (33.0)		
Monthly Income				
Less than N50,000	19 (67.9)	9 (32.1)		
N50,000 – N90,000	52 (76.5)	16 (23.5)	0.85	0.654
Above N100,000	41 (75.9)	13 (24.1		
Welder Training Received				
Apprenticeship training	91 (82.7)	19 (17.3)	5.31	0.021
Technical training	12 (60)	8 (40)		
Years of Experience as Welder				
⩽ 5 years	11 (64.7)	6 (35.3)		
5 – 10 years	50 (79.4)	13 (20.6)		
11 – 15 years	20 (62.5)	12 (37.5)	9.11	0.058
16 – 20 years	12 (66.7)	6 (33.3)		
Over 20 years	19 (95.0)	1 (5.0)		
Products worked on in workshop				
Repairs and maintenance	50 (86.2)	8 (13.8)	6.66	0.010
Construction	87 (76.3)	27 (23.7)	0.68	0.409
Manufacturing	22 (84.6)	4 (15.4)	1.65	0.200
Household equipment	23 (71.9)	9 (28.1)	0.17	0.682

Hypothesis 3: There is no relationship between respondents' knowledge on effects of welding agents and actual usage of PPE

The welders' knowledge level on the effects of welding agents and actual usage of the PPE were found to be significantly associated ($p < 0.001$), Table 12. Notable was that, the proportion of welders who had a good practice level on PPE usage increased by increasing categories of knowledge – 70.0% of those with good knowledge had maintained a good practice for using the PPE, 28.0% of those with fair knowledge had a good practice level, while 6.0% of those with poor knowledge had a good practice for PPE usage.

Table 4.11: Hypothesis 3

	Practice/Usage of PPE		Chi-square	p-value
	Poor (%)	**Good (%)**		
Knowledge on effects of welding agent				
Poor knowledge	34 (94.4)	2 (5.6)		
Fair knowledge	75 (72.1)	29 (27.9)	18.35	< 0.001
Good knowledge	3 (30.0)	7 (70.0)		

Hypothesis 4: There is no relationship between respondents' knowledge on PPE and actual usage of PPE

There was no statistically significant association between the welders' knowledge on PPE and actual PPE usage (p = 1.00; Fishers exact). Notable was that, while 25% of those with a fair knowledge on PPE were rated to have a good practice level for PPE, not more than 22% of those with good knowledge had a good practice rating for the PPE.

Table 4.12: Hypothesis 4

	Practice/Usage of PPE		Chi-square	p-value
	Poor (%)	Good (%)		
Knowledge on PPE				
Fair knowledge	105 (74.5)	36 (25.5)	0.05	1.00[Fi]
Good knowledge	7 (77.8)	2 (22.2)		

Logistic Regression on Factors Associated with Practice/Usage of PPE

Considering the 4 factors that were identified to be significantly associated with PPE usage, the unadjusted logistic regression showed that welders who had at least secondary education had 5 times the chances of being rated good with PPE usage, as compared to those having below secondary education (OR = 5.30, p = 0.003); welders with technical training were three times more likely to have a good rating for PPE usage than those with apprenticeship training (OR = 3.19, p = 0.026); welders engaged in repairs and maintenance works were 67.0% less likely to have a good PPE usage than those who did not engage in repairs and maintenance, but other aspects of welding (OR 0.33, p = 0.012); welders with fair knowledge on the effects of welding agents were about 7 times more likely (OR = 6.47, p = 0.013) and those with good knowledge were up to 40 times more likely (OR = 39.67, p < 0.001) to have a good PPE usage rating, when compared to those with poor knowledge on effects of welding agents.

Having adjusted for possible confounders, it was found that the chances for those having secondary or higher education were about three times (OR = 2.78, p = 0.138); the likelihood for those who had a technical training were about two and half times (OR = 2.49, p = 0.130); having a fair knowledge and good knowledge on effects of welding agents gave an odds-ratio estimate of about 4.5 and 15 respectively (Fair: OR = 4.48, p = 0.064; Good: OR = 15.33, p = 0.011).

Table 4.13: Factors associated with practice/usage of PPE

	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Education				
Below secondary	1		1	
Secondary or higher	5.30 (1.76 – 15.97)	0.003	2.78 (0.73 – 10.62)	0.134
Welder Training Received				
Apprenticeship training	1		1	
Technical training	3.19 (1.15 – 8.87)	0.026	2.49 (0.76 – 8.09)	0.130
Products worked on in workshop (Repair & maintenance)				
No	1		1	
Yes	0.33 (0.14 – 0.79)	0.012	0.41 (0.15 – 1.14)	0.088
Knowledge on effects of welding agent				
Poor knowledge	1		1	
Fair knowledge	6.57 (1.48 – 29.14)	0.013	4.48 (0.92 – 21.88)	0.064
Good knowledge	39.67 (5.56 – 283.14)	< 0.001	15.33 (1.85 – 127.28)	0.011

CHAPTER FIVE

DISCUSSIONS, CONCLUSION AND RECOMMENDATION

5.1 Discussions

5.1.1 Socio-demographic characteristics

The welders in this study were males. This is however not surprising as the occupation is mostly dominated by males in Nigeria. The finding of this study corroborates those of Awosan et al (2017) and Sabitu et al (2009) in which all the respondents are males though in contrast to the findings in Ile-Ife, Adewoye et al (2011) females were reported to be 0.7%. This could be related to difference in socio-cultural factors in the study areas

The location of the study, Lagelu Local Government Area of Oyo state is a Yoruba speaking region, this has accounted for the majority of the respondents been Yoruba. This is similar to the study carried out in Owo by Omolase and Mamood in 2007 and another study carried out by Adewoye et al (2019). Noted among the welders in this study is the age of the respondents. The mean age was 43.2 ± 13.6 years; less than a quarter were in each age category of 30 – 39 years (24.0%) and 40 – 49 years (26.0%). This is in contrast to the mean age in the study by Awosan et al (2017) where the mean age is 30.98 ± 9.42 and 39± 18 in the study by Adewoye et al (2011).

Also, from the study, a vast majority of the welders had a form of formal education. Most of them had secondary education. This has been shown to have an impact on their PPE usage level, those who had below secondary school education also had some level of usage but those who attended not more than 8.0% of welders having below the secondary education some level of usage level for PPE but those who attended technical school had a high usage level for PPE. This study revealed that the welders knowledge level is associated with the type of education they received (p = 0.001).According to findings by Budhathoki in Napal (2013), Sabitu et al in Kaduna (2009) which are similar to the findings of this study, knowledge is associated with type of education received.

Furthermore, a high proportion of welders in this study, affirmed that they trained to become welders through apprenticeship under an experienced welder which is similar to the findings

in Kaduna as documented by Sabitu et al in (2007) where it was suggested that this could be a cost saving measure. A probability for the preference for apprenticeship training could also be that not much of formal education is required but more of physical experience while training.

5.1.2 Knowledge of welders on the use of welding agents, their hazards and effects

Welders in this study are aware (69%) of the hazardous nature of their job to them and the people around them leading to eye damage, burns, injuries, poor health conditions as a result of not using PPE caused by welding flash, electric shock, sharp objects, noise, explosions among others. In the study carried out in Nepal, Buhdathoki et al (2013), Kaduna and the study in Benin ,The welders were aware of one or more hazards of welding. These findings though not consistent in figures, Kaduna 77.9% and Benin findings 91.6%, the fact however remains that the welders are aware of some hazards of welding. It was however noted that excessive light/flash light was the most common hazard experienced among welders leading to eye problem across this study and other studies; Sabitu et al (2009), Okojie et al, Geberzgiabher et al (2019) Tadesse et al (2016), Z'gambo (2015). The commonly mentioned health symptoms associated with not using PPE in this study were general body weakness (89%) and cough (72%), others were sneezing after welding work , having a stuffy nose, body chills and fever, having a running nose, shortness of breath, wheezing, flu-like symptoms and sweet metallic taste in the mouth. All these symptoms are associated with negative effect of the exposure to the welding agents such as electrodes, paints, flux because of the harmful chemicals found in them. Zein et al (2003), in their study in Canada identified some of these symptoms mentioned above as they affect the respiratory organs and majorly due to welding agents. Isah and Okojie (2006), in Benin also identified these symptoms too. It is most likely that these symptoms are not given much attention because the welders see them as “normal” and would most likely visit the hospital for treatment and check-up.

5.1.3 Safety practices and preventive equipment and their importance

PPE usage is believed to be useful to welders in this study. 46% believe that PPE are important as they are for protective purposes against harm, health hazards and for safety purpose and they were able to accurately. The PPE that was most identified and claimed to be used is the eye goggles (94%) followed by the helmet and insulated hand gloves and the PPE as observed from the study. On the scale, the welders had a fair knowledge of the PPE while 6% had good knowledge and use. However, from the study carried out by Adewoye et

al (2011), Z'gambo (2015), respondents believe using the PPE are actually for protective purposes in welding.. The eye goggles is seen as the highest used (though some use sunglasses instead of the recommended welding goggles as observed in Eze et al (2015,) which could be largely due to the negative effect that the welding flash has on the eyes for without the eyes, there will be no welding. Fewer proportion of respondents in this study identified respirator/face mask (35%), fire extinguisher (27%), hand shield (23%), and ear muffs/ear plugs (23%). %) as equipment needed for protection during weldingthis could be largely due to them not using the equipment all. This is so in studies by Ajayi et al (2011) Eze et al (2015),

5.1.4 Factors responsible for the non-use of protective equipment

Respondents in this study had reasons for not using protective equipment. The respondents believe that using PPE is a cause for discomfort. Sheikh (1991) in his study that some welders do not use eye goggles because of the discomfort and poor visibility associated with the usage. The major reason, according to Sabitu (2009) is "inconvenience of use." on the other hand.

Even though the overall utilization rate could not be compared with previous reports due to lack of equivalent correlative data, the observed between-device differences in utilization rates is consistent with the utilization pattern reported in other parts of Nigeria (Sabitu et al., 2009). To overcome barriers to utilization, the authors suggest improvements in the ergonomics of PPED (Forst et al 2006; Sabitu et al 2009;)

5.2 Implications of the study for Public Health

Inadequate knowledge and preventive practices of welders in doing their job expose the welders and even people around them to dangers especially health wise. Information gathered from this study can be used by public health practitioners to revise information available on safety guidelines in order to improve intervention by way of continuous education and training in order to combat welders' workplace hazards which will promote good standard amongst the welders.

The outcome will also help address the critical gaps between personal preventive equipment and possession and also between possession and utilization through provision of cost free PPE or at highly subsidized PPE with enhanced ergonomics to enhance their uses invariably making provision for legislative enforcement of their uses.

5.3 Conclusion:

This study set out to assess the level of awareness of hazards, effects and use of preventive equipment and the preventive practices by welders in their exposure to welding agents. It also sought to understand factors responsible for not using the preventive equipment. The result of The finding shows that there is association between the socio-demographics of the respondents and the use of welding agents, use of personal protective equipment and the hazards encountered when the equipment are not used. The findings in the study also revealed that there is an association factor responsible for the possession of PPE and actual use of PPE.

5.4 Recommendations

From this study, there are areas that need to be looked into to help welders improve on their use of personal protective equipment in other to protect them from the dangers attributable to not using the PPE. To this end, the following are recommended:

1. Welders need to improve on their knowledge in using personal preventive equipment and practice using it always so when they train incoming apprentices, the apprentices will also get used to using the PPE from the onset so that they can also hand such practices down to the next generation of welders. This is based on the findings that most of the welders did not train in the formal setting.
2. Association of welders and blacksmiths, the umbrella body of welders should endeavour to develop strategies to educate welders regularly through giving them information that will improve their health education; keep them updated on recent trends in welding safety; encourage regular health check-ups and preventing health hazards resulting from exposure to welding agents by partnering with health workers and relevant stakeholders.
3. The welder's work place is a setting for health promotion; to this end, regular intervention programmes targeted at welders should be encouraged to save lives as even non welders also experience dangers to their health due exposure to welding practices around them.

REFERENCES

Adeoye K.R; Adeyemi A. O; Ibirongbe D.O; Babatunde O.A. and Ibrahim T. 2013Knowledge on the health effect of welding smoke, use of PPE among electric-arc welders in Ilorin South, North Central Nigeria JASR ,PP. 924-932

Adewoye K.R; Awoyemi A.O; Babatunde O.A; Atoyebi O.A. Salami S.K; and Issa F.Y. Effect of health education intervention on the awareness and use of personal protective equipments among small scale electric arc welders in Ilorin, Nigeria. *Indian J. Occup. Environ. Med.* 2014, *18*, 3–8.

AGA. FACTS ABOUT Fume and gases. AGA (a member of Linde Group), Report No. 110199 0912 – 1.3 HL.

Ahmad I; Balkhyour M.; Abokhashabah T.M; Ismail I.M; and Rehan M. 2017. Workplace safety and health conditions and facilities in small industries in Jeddah, Saudi Arabia Journal of Safety Stu., 3 pp. 37-52hh

Ajayi I.A; and Omotoye Olusola J. 2012. Pattern of eye diseases among welders in a Nigeria community. Afr Health Sci.;12:210-16

Ajayi I.A; Adeoye A.O; Bekibele C.O; Onakpoya O.H; and Omotoye O.J. 2011 Awareness and utilization of protective eye device among welders in a southwestern Nigeria community Ann. Afr. Med., 10; pp. 294-299 A-Meo S; and Al-Khlaiwi T. 2003. Health Hazards of Welding Fumes. Saudi medical journal.; 24: 1-25.

American Welding Society eds. 2008 Personal protective equipment (PPE) for welding and cutting, safety and health fact sheet no 33 http://www.aws.org/technical/facts/FACT-33.pdf (accessed 15 Jan 2019).

American Welding Society 2009. Specification for tungsten and oxide dispersed tungsten electrodes for arc welding and cutting; AWS A5.12M/A5.12:

Antonini J.M. 2003 Health effects of welding, Crit Rev Toxicol 33:61–103

Ashby S.H. 2014. Welding fume in the workplace. Prof. Safety 2002. Available online: https://www.aiha.org/localsections/html/NTS/0602News1.pdf (accessed on 14 July

Asogwa S.E. 1981 The training for and Practice of Occupational Health in Developing Countries. J Soc Occup Med; 31: 79-81.

AWS 2005. Committee on Filler Metals and Allied Materials. *Specification for Carbon Steel Electrodes for Flux Cored Arc Welding*; American Welding Society: Miami, FL, USA.

Balasubramanian V; Adalarasu ; and. Regulapati R. 2009. Comparing dynamic and stationary standing postures in an assembly task. *Int. J. Ind. Ergon; 39*, 649–654.

Balkhyour M.A; and Goknil M.K. 2010. Total fume and metal concentrations during welding in selected factories in Jeddah, Saudi Arabia. *Int. Journal of Environ. Res. Public Health*, *7*, 2978-2987.

Barrington W.W; Angle C.R; Willcockson N.K; Padula M.A; and Korn T.I. 1998. Autonomic function in manganese alloy workers. *Environ. Res.*; *78*, 50–58.

Bellido-Milla D; Hernandez-Artiga M.P; Hidalgo-Hidalgo de Cisneros J.L; and Muñoz-Leyva J.A. 1995 Analytical study of hygiene hazards involved in naval industry welding processes. *Appl. Occup. Environ. Hyg.*, *10*, 912–926.

Benway E.A. 2010 As national welder shortage looms, proper training becomes a critical asset. *Plant Eng.*, *64*, 43–45.

Bethencourt M; Botana F.J; Cano M.J; and Marcos M. 2004. Advanced generation of green conversion coatings for aluminium alloys. *Appl. Surf. Sci.*, *238*, 278–281.

Bhumika N; Prabhu G.V; Ferreira A.M; Kulkarni M.K; Vaz F.S; and Singh Z. 2012.Respiratory morbidity among welders in the shipbuilding industry, Goa. Indian J Occup Environ Med;16:63-65.

Boissini J.P; Peyresblanques J; Rollin, J.P; and Beaufils D. 2002. The vision of welders in France. *French Journal of Ophthalmology*, *25*, 807-812.

Bonde J.P; Hanse K.S; and Levine R.J. 1990 Fertility among Danish male welders. Scand J Work Environ Health; 16 (5): 315-22.

Bonde J.P. 1990. Subfertility in relation to welding. A case referent study among male welders. Dan Med Bull: 37 (1): 105-8.

Bonow C.A; Cezar-Vaz M.R.; Silva L.R; Rocha, L.P; and Turik C. 2014. Health disorders related to learning the welding trade: Assessment of approaches to risk communication. *Rev. Latino-Am. Enfermagem*, *22*, 43–50.

Boojar M.M; and Goodarzi F.A. 2002. Longitudinal follow-up of pulmonary function and respiratory symptoms in workers exposed to manganese. *J. Occup. Environ. Med.*, *44*, 282-290.

Bowler R,M; Gysens S; Diamond E; Booty A; Hartney C; and Roels H.A. 2003 Neuropsychological Sequelae of Exposure to Welding Fumes in a Group of Occupationally Exposed Men. Int J Hyg Environ Health; 206: 517- 29.

Bradshaw L.M; Fishwick D; and Slater T. Pearce N. 1985 Chronic bronchitis, work related respiratory symptoms, and pulmonary function in welders in Am J Public Health; 75: 881-883. Budhathoki S.;. Singh S.B; Sagtani R.A; Niraula S.R; and Pokharel P.K. 2014. Awareness of occupational hazards and use of safety measures among welders: a crosssectional study from eastern Nepal. BMJ Open:e004646.Bull N. 2007. Mandatory use of eye protection prevents eye injuries in the metal industry. *Occupational Medicine*, *57*, 605-606. doi:10.1093/ occ med/kqm083

Bull N; Hovdin G; Riise T; and Moen B.E. 2004. Can work-related eye injuries be avoided? *Tidsskr Laegeforen*, *124*, 2776-2779.

Cezar-Vaz M.R; Bonow C.A; Rocha L.P; Almeida M.C.V; Severo L.O; Vaz J.C; and Turik, C. 2012. Risk Communication as a Tool for Training Apprentice Welders: A study about risk perception and occupational accidents. *Sci. World J.*, doi:10.1100/2012/140564.

Chen H.;. Chung S.H; and Jhuo M.L. 2013. Efficiency of different respiratory protective devices for removal of particulate and gaseous reactive oxygen species from welding fumes. *Arch. Environ. Occup. Health*, *68*, 101–106.

Chobanian A.V; Bakris G.L; Black H.R; Cushman W.C; Green L.A; Izzo J.L; 2003. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: The JNC 7 Report. JAMA. 2003;289:2573-5.

Cohen A;; and J. C. Michael. 1998. Assessing Occupational Safety and Health Training. A Literature Review, DHHS, Vol. 54, DHHS, Washington, DC, USA.

Contreas G.R; Rousseau R; and Chan-Yeung M. 1991. Occupational respiratory diseases in British Columbia, Canada in Occup Environ Med 1994;51:710–12.

Davies K.G; Asanga U; Nku C.O; and Osim, E.E. 2007. Effect of chronic exposure to welding light on Calabar welders. *Nigerian Journal of Physiology Sciences*, *22*(1-2), 55-58.

De Flora S. 2000. Threshold Mechanisms and Site Specificity in Chromium (VI) Carcinogenesis. Carcinogenesis; 21 (4): 533-41.

Debia M; Weichenthal S; and Dufresne A. 2014. Ultrafine particles exposure in apprentice welders. *J. Occup. Environ. Hyg.: 11*, D1–D9.

Division of Workers' Compensation. 2012. Welding Hazards Safety Program. In: Texas Department of Insurance, editor.

Dixon A.; and. Dixon B.F. 2004. Ultraviolet radiation from welding and possible risk of ocular and skin malignancy. *Medical Journal of Australia*, *181*: 155-157. doi:10.1.1.151.7366

El-Batawi M.A. 1981. Special Problems of Occupational Health in the developing Countries. In: Schilling RSF, editor. Occupational Health Practice. London: Butterworths; p. 27-46.

El-Zein M; Malo J.L; Infante-Rivard C; abd Gautrin D. 2003. Prevalence and association of welding related systemic and respiratory symptoms in welders. Occup Environ Med 2003;60:655–61.

El-Zein M; Malo J.L; Infante-Rivard C; and Gautrin D. 2005. Is metal fume fever a determinant of welding related respiratory symptoms and/or increased bronchial responsiveness? A longitudinal study. Occup. Environ. Med: 62,688-694.

El-Zein M; Malo J.L; Infante-Rivard C; and Gautrin D. 2003. Incidence of probable occupational asthma and changes in airway calibre and responsiveness in apprentice welders. Eur. Respir J: 22,513-518. Erdely A; Hulderman T; Salmen-Muniz R; Liston A; Zeidler-Erdely P.C; Chen B.T; Stone S; Frazer D.G; Antonini J.M; and Simeonova P. 2011. Inhalation exposure of gas-metal arc stainless steel welding fume increased atherosclerotic lesions in apolipoprotein E knockout mice. *Toxicol. Lett.*, *204*, 12–16.

Erhabor G.; Fatusi S; abd Obembe O.B. 2001 Pulmonary functions in ARC-welders in Ile-Ife, Nigeria. Ast Afr Med J.; 78 (9): 461-4.

Erin L.C. 2010. "Gender, occupational health and safety practices, and injury among saskatchewan farm adolescents," M.S. thesis, Queen's University, Kingston, ON, Canada, September 2010.

Ernst E; and Bonde J.P. Sex. 1992. Hormones and epidymal sperm parameters in rats following sub-chronic treatment with hexavalent chromium. Hum Exp Toxicol; 11 (4): 255-8.

ESAB Welding & Cutting Products. 2009 *Precautions and Safe Practices for Arc Welding, Cutting and Gouging*; ESAB Welding & Cutting Products: Florence, SC, USA.

Eze B.I; Okoye O; and Aguwa E.N. 2015. Awareness and Utilization of Welders' Personal Protective Eye Devices and Associated Factors Finding and Lessons From a Nigerian Population. Workplace Health Saf;63(4):170–78.

Fang S.C; Cavallari J.M; Eisen E.A; Chen J.C; Mittleman M.A; and Christiani D.C. 2009 Vascular function, inflammation, and variations in cardiac autonomic responses to particulate matter among welders. *Am. J. Epidemiol.*, *169*, 848–856.

Fang S.C; Eisen E.A; Cavallari J.M; Mittleman, M.; and. Christiani D.C. 2010**.** Circulating adhesion molecules after short-term exposure to particulate matter among welders. *Occup. Environ. Med*: *67*, 11–16.

Fiebai B; and Awoyesuku E. Ocular injuries among industrial welders in Port Harcourt, Nigeria. Clin Ophthalmol;5:1261-63.

Forrest K.Y.Z; Cali J.M; and Cavill W.J. 2008. Use of protective eyewear in U.S. adults: Results from the 2002 National Health Interview Survey. *Ophthalmic Epidemiology*, *15*(1), 37-41:10.1080/09286580701609247

Forst L; Lacey S; Chen H.Y; Jimenez R; Bauer S; Skinner S; and Conroy L. 2004. Effectiveness of community health workers for promoting use of safety eyewear by Latino farm workers. *American Journal of Industrial Medicine*, *46*, 607-613. doi:10.1002/ajim.20103

Forst L; Noth I.M; Lacey S; Baue, S; Skinner S; Petrea R; and Zanoni J. 2006. Barriers and benefits of protective eyewear use by Latino farm workers. *Journal of Agromedicine*, *11*(2), 11-17. doi:10.1300/ J096v11n02_04

Gao B; Tao C; Ye J; Ning J; Mei X; Jiang Z; Chen S; and She D. 2014 Measurement of operator exposure to chlorpyrifos. *Pest. Manag. Sci.*, *70*, 636–641.

Gbiri C.A; Osho A.O; and Olumiji A. 2012. Prevalence, pattern and impact of work-related musculoskeletal disorders on functional performance of welders in a nigeria ruralurban center. Journal of Occupational Health and Epidemiology;1:87-94.

Golbabaei F; Seyedsomea M; Ghahri A; Shirkhanloo H; Khadem M; Hassani; Sadeghi N; and Dinari B. 2017 Assessment of Welders Exposure to Carcinogen Metals from Manual Metal Arc Welding in Gas Transmission Pipelines, Iran. Iranian J Publ Health. 2

Gomes J; Albuquerque P; Miranda R; and Vieira T. 2011. On the toxicological effects of airborne nanoparticles from welding processes. IIW European-South American School of Welding and Correlated Processes 18 –20th May 2011, Brazil.

Gomes J.F.P; Albuquerque P.C.S; Miranda R.M.M; and Vieira MTF. 2012. Determination of airborne nanoparticles from welding operations. Journal of Toxicology and Environmental Health, Part A; 75 (13-15): 747-55.

Gun R; and Ryan C. 1994. A case-control study of possible risk factors in the causation of occupational injury. Safety Science 18, 1–13

Haluza D; Moshammer H; and Hochgatterer, K. 2014. Dust is in the air. Part II: Effects of occupational exposure to welding fumes on lung function in a 9-year study. *Lung 192*, 111–117.

Hansen E.S. 1989. Mortality of auto mechanics: A ten-year followup. Scand J Work Environ Health; 15: 43-46.

Hariri A; Paiman N.A; Leman A.M; and Yusof, M.Z.M. 2013. Pulmonary adverse effects of weld bonding process by Malaysia's. Automobile assembly welders. *Procedia Eng. 68*, 299–304.

Harker C; Matheson A.B; Ross J.AS; and Seaton A. 1991. Accidents in the workplace. J Soc Occup Med; 41: 73-76.

Hartmann L; Bauer M; Bertram J; Gube M; Lenz K; Reisgen U; Schettgen T; Kraus T; and Brand P. 2014. Assessment of the biological effects of welding fumes emitted from metal inert gas welding processes of aluminium and zinc-plated materials in humans. *Int. J. Hyg. Environ. Health*, *217*, 160–168.

Hassani H; Golbabaei F; Ghahri A; Hosseini M; Shirkhanloo H; Dinari B; Eskandari D; amd Fallahi M. 2012. Occupational exposure to manganese-containing welding fumes and pulmonary function indices among natural gas transmission pipeline welders. *J. Occup. Health*; *54*, 316– 322.

http://www. canoshweb.org/sites/canoshweb.org/files/odp/html/rp5.htm (accessed 20 Jun 2011).

Huang L; Ban J; Sun K; Han Y; Yuan Z; and Bi J. 2013. The influence of public perception on risk acceptance of the chemical industry and the assistance for risk communication. *Saf. Sci.*, *51*, 232–240.

Ibfelt E; Bonde J.P; and Hansen J. 2010. Exposure to metal welding fume particles and risk for cardiovascular disease in Denmark: A prospective cohort study. *Occup. Environ. Med.*, *67*, 772–777.

Ibitayo O.O. 2006. Egyptian farmers' attitudes and behaviours regarding agricultural pesticides: Implications for pesticide risk communication. *Risk Anal.*, *26*, 989–995.

International Agency for Research on Cancer (IARC). 1987. Welding fumes and gases. lARC Monograhs 49.

Iregren A. 1999. Manganese neurotoxicity in industrial exposures: proof of effects, critical exposure level, and sensitive tests. Neurotoxicology.; 20 (2-3): 315-23.

Isah E.C; and Okojie O.H. 2006. Occupational health problems of welders in Benin City, Nigeria. J Med Biomed Res;5:64–9.

Jani V; amd Mazumdar V.S. 2004. Prevalence of respiratory morbidity among welders in unorganized sector of Baroda city. Indian J Occup Environ Med;8:16-21.

Keane M; Siert A; Stone S; Chen B; Slaven J; and Cumpston A. et al. 2012. Selecting Processes to Minimize Hexavalent Chromium from Stainless Steel Welding. Welding Journal; 91: 241s-246s.

Keegan G; Learmonth I.D; amd Case C.P. 2007. Orthopaedic metals and their potential toxicity in the arthroplasty patient. The Journal of Bone and Joint Surgery.; 89-B (5): 567-73.

Kopeliovich D. 2012. Classification of welding processes: substech; [updated 2014/09/03]. Available from: http://www.substech.com/dokuwiki/doku/php

Kumar S.G.A; and Kar S.S. 2013, Awareness of occupational injuries and utilization of safety measures among welders in coastal South India Int. J. Occup. Environ. Med., 4 pp. 172-177

Kumar S.G; D haranipriya A; and Kar S.S. 2013. Awareness of occupational injuries and utilization of safety measures among welders in coastal South India. Int J Occup Environ Med;4:172-77.

Kumar S.G; amd Dharanipriya A. 2014. Prevalence and pattern of occupational injuries at workplace among welders in coastal South India. Indian J Occup Environ Med.;18:135-39.

Kumie A. 2016. "Occupational health and safety in Ethiopia: a review of situational analysis and needs assessment," Ethiopian Journal of Health Development, vol. 30, no. 1, pp. 17–27.

Lan J; and Liu, Y.M. 2011. Effect of welding on cardiovascular function of welders. *Occup. Health*, *12*, 1356–1358.

Leoni T. 2010. What drives the perception of health and safety risks in the workplace? Evidence from European labour markets. *Empírica*, *37*, 165–195.

LePrevost C.E; Storm J.F; Blanchard M.R; Asuaje C.R; and Cope W.G. 2013. Engaging Latino farmworkers in the development of symbols to improve pesticide safety and health education and risk communication. *J. Immigr. Minor. Health*, *15*, 975–981.

Li G.J; Zhang L.L; Lu L; Wu P; and Zheng W. 2004. Occupational exposure to welding fume among welders: Alterations of manganese, iron, zinc, copper, and lead in body fluids and the oxidative stress status. *J. Occup. Environ. Med.*, *46*, 241–248.

Lipscom H.J. 2000. Effectiveness of interventions to prevent work-related eye injuries. *American Journal of Preventive Medicine*, *18*(4), 27-32.

Liss G.M. 1996. In: Ministry of Labour. eds. Health effect of welding and cutting fume—an update. Toronto, Ontario.

Lombardi D.A; Pannala R; Sorock G.S; Wellman H; Courtney T.K; Verma S;and Smith G. S. 2005. Welding-related occupational eye injuries: A narrative analysis. *Injury Prevention*, *11*, 174-179. doi:10.1136/IP.2004.007088

Lombardi D.A; Verma S.K; Brennan M.J; and Perry M.J. 2009. Factors influencing worker use of personal protective eyewear. *Accident Analysis & Prevention*, *41*, 755-762. doi:10.1016/j.aap.03.017

Ma Q; and Yuan J. 2009. "Exploratory study on safety climate in Chinese manufacturing enterprises," Safety Science, vol. 47, no. 7, pp. 1043–1046

Maiti J; and Bhattacherjee A. 1999. Evaluation of risk of occupational injuries among underground coal mine workers through multinomial logit analysis. Journal of Safety Research 30, 93–101.

Makison Booth C; Clayton M; Crook B; and Gawn J.M. 2013. Effectiveness of surgical masks against influenza bioaerosols. *J. Hosp. Infect; 84*, 22–26.

Mancini G; Baldarsseroni A; Laff G; Curti S; Matholi S; and Violante F.S. 2005. Prevention of work-related injuries: Long term assessment of the effectiveness of a multi-component intervention among metal workers. *Occupational & Environmental Medicine*, *62*, 830-835. doi:10.1136/oem.2004.019570

Mangal A; Kumar B; Panesar S; Talwar R; Raut D; and Singh S. 2014. Updated BG Prasad socioeconomic classification: A commentary. Indian J Public Health;59:42-44.

Mansouri N; Atbi F; Moharamnezhad N' Rahbaran D.A; and Alahiari M. 2008. Gravimetric and analytical evaluation of welding fume in an automobile part manufacturing factory. *J. Res. Health Sci.*, *8*, 1–8.

Marek K; and Starzynski Z. 1994. Pneumoconiosis in Poland. Int J Occup Med Environ Health;7:13-21.

Mariutti G; and Matzeu M. 1988 Measurement of ultraviolet radiation emitted from welding arcs. Health Phys; 54 (5).

McGonagle A.K; and Kath L.M. 2010. Work-safety tension, perceived risk, and worker injuries: a mesomediational model. Journal of Safety Research; 41, 475–479

Medical Research Council Committee on the Aetiology of Chronic Bronchitis. Standard Questionnaire on Respiratory Symptoms. Brit. Med. J. 1960; 11: 1665-8.

Mortensen J.T. 1999. Risk for reduced sperm quality among metal workers, with special reference to welders. Scand J Work Environ Health; 14 (1): 27-30.

National Occupational Health and Safety Commission. Welding: Fumes and Gases. In: Commonwealth of Australia, editor: Ambassador Press Pty Ltd; 1990.Norm M; amd Franck C. 1991. Long term changes in the outer part of the eye in welders. Prevalence of spheroid degeneration, pinguecula, pteryguim and cornea cicatrices. Acta Ophthalmol (Copenh);69:382–6.

Occupational safety and health, August2011, http://en. wikipedia.org/wiki/Occupational_safety_and_health.

Oduntan A.O. 1998. A survey of eye safety practices among welders in Nigeria. *Clinical and Experimental Optometry*, *81*(2), 29-33. doi:10.1111/j.1444-0938.1998.tb06767.xOkeigbemen V.E; Omoti A.E; and Ovienria W. 2012. Pattern of ocular injuries and use of protective eye devices among welders. Journal of Medicine and Biomedical Research;11:5-13.

Okoye O.I; and Umeh R.E. 2002 Eye health of industrial workers in South Eastern Nigeria. West Afr J Med;21:132-37.

Omolase C.O; and Mahmoud A.O. 2007. The welder's protective goggle: An evaluation of its appreciation. Nigerian Journal of Surgical Sciences, 17, 54-58.

Omoti A.E; 2004. Ocular trauma in Benin City, Nigeria. Afr J Trauma;2:67-71.

OSHA 2008. *Chemical Sampling Information: Welding Fumes (Total Particulate)*; U.S. Department of Labour, OSHA: Washington, DC, USA,

Park K. 2015. Park's textbook of preventive and social medicine. 23rd Edition. M/s Banarsidas Bhanot Publishers. Jabalpur.

Peters R.G; Covello, V.T; and McCallum D.V. 1992. The determinants of trust and credibility in environmental risk communication: An empirical study. *Risk Anal.* 1997, *17*, 43–54.

Pidgeon N.F; Hood C; Jones D; Turner B; and Gibson R. 1992. Risk perception. In *Risk Analysis, Perception and Management*; The Royal Society: London, UK; Chapter 5, pp. 89–134.

Pollitt D. 2011, Apprentices prove their worth at TIS Cumbria: Cost-effective way to combat skill shortage. Human resour. *Manag. Int. Dig;19*, 15–17.

Qian Y; Willeke K; Grinshpun S.A; Donnelly J; and Coffey C.C 1998, Performance of N95 respirators: Filtration efficiency for airbone microbial and inert particles. *Am. Ind. Hyg. Assoc. J.;59*, 128– 132.

Ramos M.F. 1999. Prevention of work related;injuries: A look at eye protection and suggested prevention strategies. 2014. *Journal of Ophthalmic Nursing Technology*, *18*(3), 117-119. *Regulatory Standard 34—Conditions and Work Environment in the Construction Industry and Ship Repair*; Ministry of Labor and Employment: Brasília, Brazil, (In Portuguese)

Rongo L.M.; Barten F; and Msamangal G.I, et al. 2004. Occupational exposure and health problems in small-scale industry workers in Dar es Salaam, Tanzania: a situation analysis. Occup Med;54:42–6.

Sabitu K; Iliyasu Z; and Dauda M.M. 2009. Awareness of occupational hazards and utilization of safety measures among welders in Kaduna Metropolis, Northern Nigeria. Ann Afr Med;8:46–51.

Sastry S.M; Copeland R.Al; Mezghebe H.M; Siram S.M.; Spencer M; and Cowan, C. L. 1995. Consumer product-related ocular trauma. *Journal of National Medical Association*, *87*, 349-352.

Sferlazza S.J; and Beckett W.S. 1991. The respiratory health of welders. Am Rev Respir Dis;143:1134–48.

Shaikh M.A. 2001. Hazard perception and occupational injuries in the welders and lathe machine operators of Rawalpindi and Islamabad. *Journal of Pakistan Medical Association*, *51*(2), 71-74.

Shaikh M.A. Shaikh, I.A. 2005. Occupational injuries in welders: Results from a six month follow-up study. *Journal of Ayub Medical College Abbottabad*, *17*(2), 9-11.

Shaikh T.Q. and Bhojani, F. A. 1991. Occupational injuries and perceptions of hazards among roadside welding workers. *Journal of Pakistan Medical Association*, *41*(8), 187-188. doi:10.4103/0019-5278.134953

Shannon H; and Manning D. 1980. Differences between lost-time and non-lost time industrial accidents. Journal of Occupational Accidents 2, 265–272.

Sharifian S.A. Loukzadeh Z. Shojaoddiny-Ardekani A. Aminian O. 2011. Pulmonary adverse effects of welding fume in automobile assembly welders. *Acta Med. Iran*; *49*, 98–102.

Shehade S.A, Roberts P.J, Difey B.L. et al. 1987. Photodermatitis due to spot welding. Br J Dermatol;117:117–19.

Sheiner EK Sheiner E, Hammel R.D. Potashnik G. Carel R. 2003. Effect of Occupational Exposures on Male Fertility: Literature Review. Industrial Health.; 41: 55-62.

Sheppard B. Janoske M. Liu B. 2012. *Understanding Risk Communication Theory: A Guide for Emergency Managers and Communicators. Report to Human Factors/Behavioral Sciences Division, Science and Technology Directorate, U.S. Department of Homeland Security*; National Consortium for the Study of Terrorism and Responses to Terrorism: College Park, MD, USA.

Singh S.B. 2007. Study of morbidity patterns among the workers of jute mill in eastern Nepal [MD Thesis]. Dharan, Nepal, B.P. Koirala Institute of Health Sciences, .

Sjöberg L. 2000. The methodology of risk perception research. *Qual. Quant.*, *34*, 407–418.

Sjöberg L. Moen B.E., Rundmo T. 2004. *Explaining Risk Perception: An Evaluation of the Psychometric Paradigm in Risk Perception Research*; Norwegian University of Science and Technology, Department of Psychology: Trondheim, Norway,.

Slovic P. 2000. *The Perception of Risk*; Earthscan Publications: London, England.

Smith E.M, Miller E.R. Woolson R.F, Brown C.K. Zakhari S, Andersaon R.S. 1981 Bladder Cancer risk among auto and truck mechanics and chemically related occupations American Welding Society, eds. Effects of welding on health. Vol II. Miami, FL. 1981. Cited by Antonini JM. Health effects of welding. Crit Rev Toxicol;33:61–103.

Sorensen A.R. Thulstrup A.M. Hansen J. Ramlau-Hansen C.H. Meersohn A. Skytthe A. Bonde J.P. 2007**.** Risk of lung cancer according to mild steel and stainless steel welding. *Scand. J. Work Environ. Health*; *33*, 379–386.

Sowards J.W, Ramirez A.J, Lippold J.C, Dickinson D.W. 2008. Characterization Procedure for the Analysis of Arc Welding Fume. Welding Research.; 87: 76-83S.

Stellmann J.M. 1998. Ecyclopedia of Occupational Health and Safety, Vol. II, International Labour Office, Geneva, Switzerland,.

Sultan A.M. 2011. "Health hazards of welding fumes," August; http://repository. ksu.edu.sa/jspui/bi_Harzard_welding fumes.pdf.

Tadesse S. Bezabih K. Destaw B. 2016. Awareness of occupational hazards and associated factors among welders in Lideta Sub-City, Addis Ababa, Ethiopia. *J Occup Med Toxicol* 11, 15 doi:10.1186/s12995-016-0105-x

Tenkate T.D. 1999. Occupational exposure to ultraviolet radiation: a health risk assessment. Rev Environ Health; 14 (4): 187-209.

Tierney M.P. 2003. Analysis of mine injuries associated with maintenance and repair in metal and non-metal mines. U. S. Department of the Interior, Mining Enforcement

and Safety Administration. 1977 cited by: Antonini JM. Health effects of welding. Crit Rev Toxicol;33:61–103.

Torp S; Grogaar J.B; Moen B.E; and Bratveit M. 2005. The impact of organizational factors on workers' use of personal protective equipment: A multilevel approach. *Journal of Occupational and Environmental Medicine*;*47*, 827-837. doi:10.1093/occmed/kqn161

U.S. Department of Health and Human Services. 2002. *Communicating in a Crisis: Risk Communication Guidelines for Public Officials*; Department of Health and Human Services: Washington, DC, USA.

U.S. Public Health Service. 1995. *Risk Communication: Working with Individuals and Communities to Weigh the Odds*; Prevention Report: Washington, DC, USA.

Upadhyaya U. 2002. "Occupational health, safety and environment 6 in the construction sector," in Issue of the World of Work in Nepal, General Federation of Nepalese Trade Unions, Kathmandu, Nepal,

Verma A; Mark R. Quandt S.A; Robinson E.N Grz ywacz J.G; and Arcury T. A. 2011. Eye health and safety among Latino farm workers. *Journal of Agromedicine*, *16*, 143-152. doi:10.1080/10599 24X.554772

Voke J. 2007. Radiation effect on the eye-ocular effect of ultraviolet radiation. Optom Today 1999;8:30–5. Cited by: Davies K.G, Asana U, Nku C.O, et al. Ocular effects of chronic exposure to welding light on Calabar welders. Niger J Physiol Sci;22:55–8.

Waldron H.A. 1994. Non neo-plastic disorders due to metallic, chemical and physical agents. In: Parkes WR. ed. Occupational lung disorders. 3rd edition. Oxford: Butterworth-Heinemann Ltd:629–31.

Walls C.B; and Dryson, E.W. 2002. Failure after 5years of self-regulation: A health and safety audit of New Zealand engineering companies carrying out welding. *Occupational Medicine*, *52*, 305-309.

Wang X; Yang Y; Wang X; and Shunqing X. 2006. The effects of occupational exposure to metals on the nervous system function of welders. *Journal of Occupational Health*, *48*(3), 100-106. doi:10.1539/ joh.48.100

Weman K. 2003. Welding processes handbook. Bington Hall, Abington Cambridge, England Woodhead Publishing Ltd and CRC Press LLC.

WHO "The health promoting work place," August 2011, http://www.cepis.org.pe/bvsast/ i/fulltext/whp/whp.html.

World Health Organisation. Global Health Risks, Mortality and Burden of diseases attributable to major health risks. Geneva: WHO; 2009. Available from: http:// www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full. pdf [Cited on 2015 Oct 2].

World Health Organization (WHO) 2008. *The World Health Report 2008: Primary Health Care now More than Ever*; WHO: Geneva, Switzerland.

Yildiz, M.; Kocabay G. 2013**.** Unreported cardiac arrhythmias in aluminium worker. *Forensic Leg. Med.*, *20*, 760–762.

Yu, T. S. I;, Liu, H.k and Hui, K. 2004. A case-control study of eye injuries in the workplace in Hong Kong. *Ophthalmology*, *111*(1), 70-74. doi:10.1016/j.ophtha.2003.05.018

Z'gambo J. 2015. Occupational hazards and use of personal protective equipment among small scale welders in Lusaka, Zambia (Master's thesis, The University of Bergen).

Zhao Y.A; and Shusterman D. 2012**.** Occupational rhinitis and other work-related upper respiratory tract conditions. *Clin. Chest Med.*, *33*, 637–647.

APPENDIX 1

QUESTIONNAIRE

I am a student of the above institution and I kindly need you to fill this questionnaire administered to you. It is to gather information on the '**Knowledge and preventive practices of the use of welding agents by welders in Lagelu Local Government'**. Please note that your participation in this study is entirely voluntary. Each questionnaire has been given a CODE NUMBER to conceal your identity. All information that would be collected during this study will be treated with utmost confidentiality.

Your participation in this study is very important as it would help to better understand welders knowledge on the use of welding agents and preventive practices. Please also note that there are no right or wrong answers to the questions asked or the statements made. The time needed to complete this questionnaire is approximately 20-25 minutes. Your willingness to be interviewed implies you have given consent to participate.

Thank you for cooperating.

Thank you.

Serial Number----------

Section A

1) Age as at last birthday ( )

2) Educational Level: i) Primary School( ) (ii) Secondary iii) Tertiary iv) Others

3) What is your marital status: Single ( ) Married ( ) Seperated ( ) Divorced ( ) Widowed ( )

4) Ethnicity:

5) Average monthly income: (i) Less than N50,000….. (ii) N50,000- N90,000…. (iii) N100,000 – N150,000……. (iv) Above N200,000

6) How did you train to become a welder? i Apprenticeship training ( ) ii. Technical training_____ (iii) Other _____

SECTION B: EXPOSURE INFORMATION

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

7. For how long have you worked as a welder or in a welding workshop?
   (i) <5 years----(ii) 5–10 years--- (iii) 11- 15 years….. (iv) 16-20 years…(v) Over 20 years
8. How many hours of work do you do daily? <5 hours ( ) 5-6 hours ( ) 7-8 hours ( ) 9-10 hours ( ) 11-12 hours ( )
9. What aspect of welding do you engage in? i Grinding ( ) ii. Painting ( ) iii. Cutting ( ) iv. Hammering ( ) v. Cleaning ( ) vi. Other activities_____
10. What welding methods do you normally use?
    i. Manual Metal Arc (MMA) Welding ( ) ii. Gas Welding ( ) iii. Others _____
11. What products do you normally make or do you work on in your workshop?

(a) Repairs and maintenance…. (b) Construction… (c) Manufacturing…..
(d) Household equipment….. (e) Others specify……

12. Which of the following do you use? (i) Electricity…. (ii) Gas…. (iii) electrode…. (iv) carbide…. (v) chipping hammer and brushes…. (vi) welding transformer…. (vii) tung…. (vii) cutting machine…. (ix) paint…

13. Knowledge on the use of welding agents, their health hazards and use of protective equipment

14. Mention three types of welding you know (i) -------- (ii)------- (iii) ----------

15. What are the welding agents you use?

16. What do you understand to be a Personal Protective Equipment?

17. Benefits of using PPE (**Interviewer any three from the list a-f in this section below should not be read it out to the welder. The welder should say what he knows**)
(a)Protection from harm (b) Protection from health hazards (c)Prevention from death (d) improves safety at work.

18. Three measures you take to ensure your safety at work? (i) ---------- (ii) ---------- (iii)----------
(a) Ensure that there is no naked wire to avoid shock (b) wear PPE (c) Remove all sharp objects (d) ensure environment is tidy (f)keep all equipment safe from danger

19. Does your work as a welder affect people around you? Yes ( ) No ( )

20. Mention three effects of your welding work on people around you (i)----------
(ii)---------- (iii)---------- (May be one of the following but not to be mentioned to the welder :a)Injury (b)Accidents (c) danger to health

21. What can lack of safety measures in the welding workshop cause to the welder?
(a) Burns ( )
(b) Electric shock ( )
(c) Eye damage/problems ( )
(d) Explosion of cylinders/Flashback ( )
(e) Asthma
(f) Cancer
Others……..

22. Tick which of the list below you know can cause injury or harm to your health and/or the health of others?

Welding activity	**Yes**	**No**
a) Bright light /Welding flash		
b) Erosion		
c) Gas expolsion		
d) Electricity		
c) welding fumes and gases		
f) Noise from cutting metals		
g) Vibrations		
h) Heat, fire or explosion		
i) Sharp edges/metals		
j) Flying sparks/particles		
k) Failing objects		

l) Uncomfortable work postures		

23. From the list below, choose the personal protective equipment that you know applies to welders for protection during welding?

Welding helmet		Pliers	
Seat belt		Ear muffs/ear plugs	
Spanner		Rubber soled, steel toe cap, safety boots	
Respirators/face mask		Insulated gloves	
Hand shield		Goggles	
Coverall		Fire extinguisher	
Radio		Fan	

Others_____

24. Use of Personal Preventive Equipment (PPE), factors influencing use or lack of use and associated health symptoms Possession of PPE and frequency of use

PPE	**Uses**	**Frequency**		
		Always	**Sometimes**	**Never**
Safety goggles				
Welding shield				
Welding helmet				
Ear muffs				
Ear plugs				
Face masks Respirators				
Respirators				
Safety boots				
Ordinary shoes				
Insulated safety gloves				
Work suit/coverall				
Leather apron				
Ordinary clothes				

25. Factors responsible for the use/lack of use of PPE

Factors affecting use/lack of use of PPE	**Agree**	**Disagree**	**Unsure**
It is important to use PPE for welders' safety			
Using PPE causes delay during welding			
PPE is only for the educated			
I am willing to learn to use PPE if given the training			

All PPE cause discomfort (mention the ones that cause discomfort)			
I do not use PPE because it is expensive			
I will use PPE if I am freely given			
I am ready to pay in instalments for PPE if available			
I am aware of the benefits of using PPE but I will not use it			
My friends who are welders use PPE			
I cannot do without PPE			
I forget to use PPE			
Using PPE is not effective			

26. Health symptoms associated with non-use of PPE

Health symptoms		Frequency in five years Yes	No			Frequency in five years Yes	No
Cough				Sweet metallic taste in the mouth			
Wheezing				Body chills and fever			
Having a stuffy nose				Shortness of breath			
Sneezing after welding work				Having a running nose			
Sneezing after welding work.				General body weakness.			
Flu like symptoms							

Checklist of welders in Lagelu Local Government Area

Premises assessment	Yes	No		Yes	No
Glooves			Workshop properly ventilated		
Boots			First aid box available		
Labeling of hazardous materials			Workshop premises indoor or outdoor		
Work area well lit					
Work area well arranged/tidy					
Apron/Coverall					
Goggles					
Is the work environment free from flammable material					
Respirator/Nose guard					
Currently on any insurance policy					
Are electrodes removed from the holder when not in use?					
Up to date fire extinguisher					

Other observation----------

APPENDIX 2

ÌWÉ ÌBÉÈRÈ

LORII AYẸWO NIPA IMỌ ATI AWỌN IṢE IDIWỌ LILO TI AWỌN IRIN ISE ALURINMORIN NIPA ISẸ AWỌN AJORINMORN NI IJỌBA AGBEGBE LAGELU.
Mo jẹ́ akẹ̀ẹ́kọ́ làtí ile ìwé giga Yunifàsitìi tí Ile Ibadan, Koleeji tí onítọjú pélu òògùn, ní abala tí óhún rísí èto ìlera àwọn ará ìlú ẹka tí àtí n risi eto nípa idanilẹkọọ ati igbega eto ilera. Mo nse ìwadìí lóríi ayẹwo nipa imọ ati awọn iṣe idiwọ lilo ti awọn irin ise alurinmorin nipa isẹ awọn ajorinmorn ni Ijọba Agbegbe Lagelu, ni ilu Ibadan, Ipinlẹ Ọyọ, Orile Ede Naijiriya.".

Mo nse ìwadìí yìí gẹgẹ bi akẹẹkọ lati gba iwe erii yunifasitii ti ipele giga. Àlàyé tí a ba gba lati inu iwadi yi ni yí o wulo lati di awọn alafo ati idiwọ ti o wa fun ọna ti awọn eleto ileran ń gba lati se agbega ilera awon ara ilu, paapa julo awon onise Ajorinmorin.
Ẹ jọwọ ẹ ṣe akiyesi wipe ẹ o nilo lati kọ orukọ, adirẹsi ati nọmba erọ tẹlifoonu yin si ara iwe ibeere yii.Ki ẹ fi okan balẹ lati ṣafihan iwoye yin ati wipe gbogbo àlàyé tí ẹba si se fún mi ninu iwadi yi ni yìí o wa ni ipamọ larin emi àtí ẹyìín, mi ko sini se afihan rẹ fún ẹnikẹni. Mo mọ ríri ìrànlọwọ yín nípa gbígbà láti kópa nínúu ìwadìí yìí pẹlú dídáhùn si awọn ibeere ti o wa ninu iwe ibeere ìwadìí yìí pelu otitọ inu ati ododo.

A dupẹ lọwọ yin fun ifọwọsowọpọ yin
Njẹ a le bẹrẹ ni bayi?
Bẹẹni [ ] (Eleyi tumọ si wipe ati gbaṣẹ lọwọ olukopa) Ọjọ Igbaṣẹ: _____
Bẹẹkọ [ ] (Ti o ba jẹ bẹẹkọ, ẹ jọwọ ẹ fopin si ibeere yi)
Ohunka idanimọ iwe ibeere: _____

APPENDIX 3

Knowledge And Preventive Practices of Welders Toward The Exposure to Welding Agents In Lagelu Local Informed Consent Form

Introduction

You are invited to take part in a research study. Before you decide whether to participate, you need to understand why the research is being done and what it would involve. Please take the time to read or to listen as I read the following information. You may talk to others about the study if you wish. Please ask me if there is anything that is not clear, or if you would like more information. When all of your questions have been answered and you feel that you understand this study, you will be asked if you wish to participate in the study and if yes, to sign this 'Informed Consent Form'. You will be given a signed copy to keep.

Purpose of the Study and Study Requirements

What is the study? The purpose of the study is to explore the knowledge and preventive practices of Welders towards the Use of welding agents. Welders use some agents which are hazardous to their health. Welding agents such as electrodes, paints, electricity, gas pose a threat to health.

Why have I been invited to take part? You have been invited to take part because you are a welder and you use these welding agents and are exposed to the hazards of using these agents.

What will happen if I take part? If you agree to take part in the study, we will ask you to sign an informed consent form. You will also be asked to respond to questions about welding agents, preventive practices and health symptoms you may be exposed to.

How long will interview last? This will take about 30 minutes.

We may contact you again if we require further clarification on some of the responses you have provided or if you are selected again when we are checking to ensure that all those that were selected for interview were actually interviewed.

Risks: There are no risks associated with this study.

Costs to the participants: Your participation in this research will not cost you anything other than your time of answering a few questions during the interview.

Benefit: The goal of this study is to understand how the use of welding agents are hazards to you as a welder and the preventive practices used by welders. The study has the potential to encourage the use of personal protective equipment by welders to prevent exposure to negative health effects.

Confidentiality: All information collected will be treated as anonymous. It will not be linked to the respondents in any way.

Voluntariness: Participation in this research study is entirely voluntary and participants can withdraw at any time.

Alternatives to participant: If any respondent chooses not to participate, this will not affect him/her in any way.

Consequences of participants' decision to withdraw from the research and orderly termination of participation: The participant can choose to withdraw from the research at any time. Please note that some of the information that has been obtained about you before you chose to withdraw may be modified or used in reports and publications. These cannot be removed anymore. However, the researcher promise to make an effort in good faith to comply with your wishes as much as is practicable.
What happens to the research participants when research is over: The researcher will inform you of the outcome of the research through the Nursing Council, Oyo State branch and journal articles.

Statement of the person obtaining informed consent:
I have fully explained this research to _____ and have given sufficient information, including about risks and benefits, to make an informed decision.

Name: ……..
Date: ……
Signature: ……..

Statement of the person giving consent:
I have read the description of the research and have had it translated into a language I understand. I have also talked it over with the researcher to my satisfaction. I understand that my participation is voluntary. I know enough about the purpose, methods, risks and benefits of the research study to judge that I want to take part in it. I understand that I may freely stop being part of this study at any time. I have received a copy of this consent form and additional information sheet to keep for myself.

Name: ……..
Date: ……
Signature: ……..

Detail contact information including a contact address, telephone, fax, e-mail and any other contact information of researcher, institutional HREC and head of the institution:
This research has been approved by the Oyo State Ethical Review Research Committee and the Chairman of this committee can be contacted at the Directorate of Planning, Research and Statistics, Ministry of Health, Secretariat, Ibadan.
My supervisor, Professor Oladimeji Oladepo, Department of Health Promotion And Education, Faculty of Public Health, College of Medicine University of Ibadan can also be reached.

In addition, if you have any question about participation in this research, you can contact Mrs. Adeoye Margaret Adejoke, Department of Health Promotion And Education, Faculty of Public Health, College of Medicine, University of Ibadan, Phone №: 08034879076,
e-mail: peggystevenss90@gmail.com .

PLEASE KEEP A COPY OF THE SIGNED INFORMED CONSENT

TELEGRAMS..... TELEPHONE.....

MINISTRY OF HEALTH

DEPARTMENT OF PLANNING, RESEARCH & STATISTICS DIVISION

PRIVATE MAIL BAG NO. 5027, OYO STATE OF NIGERIA

Your Ref. No. .....

All communications should be addressed to the Honorable Commissioner quoting

Our Ref. No. AD 13/479/1636

21st January, 2020

The Principal Investigator,
Department of Health Promotion and Education,
Faculty of Public Health,
College of Medicine,
University of Ibadan.

Attention: Adeoye Margaret

ETHICS APPROVAL FOR THE IMPLEMENTATION
OF YOUR RESEARCH PROPOSAL IN OYO STATE

This is to acknowledge that your Research Proposal titled: "Knowledge and Preventive Practices of Welders toward the Exposure to Welding Agents in Lagelu Local Government Area of Oyo State." has been reviewed by the Oyo State Ethics Review Committee.

2. The committee has noted your compliance. In the light of this, I am pleased to convey to you the full approval by the committee for the implementation of the Research Proposal in Oyo State, Nigeria.

3. Please note that the National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations, in line with this, the Committee will monitor closely and follow up the implementation of the research study. However, the Ministry of Health would like to have a copy of the results and conclusions of findings as this will help in policy making in the health sector.

4. Wishing you all the best.

Signature & Date

Dr. Abbas Gbolahan
Director, Planning, Research & Statistics
Secretary, Oyo State, Research Ethics Review Committee