

**ASSESSMENT OF EFFECT OF THE USE OF PROTECTIVE GOGGLES  
AMONGST WELDERS IN IKPOBA-OKHA AND OVIA NORTHEAST LOCAL  
GOVERNMENT AREA OF EDO STATE**

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**BENIN CITY, EDO STATE**

**OCTOBER, 2025**

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**A RESEARCH PROJECT SUBMITTED TO THE FACULTY OF OPTOMETRY,  
UNIVERSITY OF BENIN IN PARTIAL FULFILMENT OF THE REQUIREMENT  
FOR THE AWARD OF DOCTOR OF OPTOMETRY(OD) DEGREE**

**OCTOBER, 2025**

**CERTIFICATION AND APPROVAL**

This is to certify that this research project titled: **ASSESSMENT OF EFFECT OF THE USE OF PROTECTIVE GOGGLES AMONGST WELDERS IN IKPOBA-OKHA AND OVIA NORTHEAST LOCAL GOVERNMENT AREA OF EDO STATE** was carried out by **AKODE FATIMA OSARUGUE** in the Faculty of Optometry, University of Benin in partial fulfillment of the requirement for the **DOCTOR OF OPTOMETRY (OD)** degree in the 2024/2025 Academic Session.

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**DATE**

## **DEDICATION**

This project is dedicated to God Almighty, the source of all wisdom and strength. Your guidance has illuminated my path, providing me with the courage to pursue my dreams and the perseverance to overcome challenges.

## ACKNOWLEDGEMENTS

I would like to begin by expressing my deepest gratitude to God Almighty for His infinite wisdom and guidance throughout this project. His presence has been a constant source of strength, providing me with the courage to persevere through challenges and the clarity to pursue my goals with determination. I am truly thankful for the blessings and support that have accompanied me on this journey.

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## ABSTRACT

**Background:** Welding is central to Nigeria's economic development, supporting sectors like construction, manufacturing, and automobile repair. These processes also generate a reasonable occupational risks. Although protective ocular goggles reduced these risks, adherence among welders is inconsistent, for example, in informal sectors such as Ikpoba-Okha and Ovia North-East LGAs of Edo State, where safety regulations are weakly enforced.

**Purpose:** This study assessed welders' awareness of ocular hazards, the extent and consistency of use of goggle, influencing factors, and the prevalence of welding-related eye injuries in the study areas. **Methods:** A descriptive cross-sectional design was employed, involving 90, practitioners and apprentice welders aged between 18 to 55 years with at least four years of experience. Participants were recruited through systematic sampling. **Data**

**Analysis:** Data were analyzed using SPSS version 22. Descriptive statistics summarized awareness and practice. Chi-square tests assessed associations between use of goggle with variables such as age, education, prior injury, and training. Logistic regression identified aof consistent goggle use, with significance set at  $p < 0.05$ . **Results:** Findings revealed high awareness of ocular hazards (98.6%) but with inconsistent usage of googles: 47.5% always, 22.6% sometimes, and 29.9% rarely. Determinants of compliance of protective goggles included age, education, history of injury, affordability, quality, availability of goggles, and training. **Contribution to Knowledge:** This study highlighted a persistent gap between knowledge and practice which underscored the need for multifaceted interventions such as high-quality goggles, structured training, and stronger regulatory enforcement.

**Keywords:** Welding; Ocular injuries; Protective goggles; Occupational health.

## CHAPTER ONE

### 1.0 INTRODUCTION

The act of Welding includes sectors such as construction, manufacturing, and automobile repair. Its applications range from erecting high-rise buildings to fabricating intricate machinery, making it indispensable to infrastructural growth and economic advancement worldwide. In Nigeria, welding also plays a critical role in the informal economy, providing livelihoods for thousands of skilled and semi-skilled workers. However, behind the sparks and molten metal lies a silent but significant public health concern: welding-related ocular injuries. It is a process that involves the fusion of metals under high temperatures and remains indispensable across various industrial sectors, e.g, from construction and manufacturing to shipbuilding and automobile repair. While welding is vital to infrastructural growth and economic development, it is accompanied by an array of occupational hazards, which include ocular injuries. Eye injuries in a welder's workshop may be usually severe but preventable. The act of welding exposes workers to a combination of high-intensity light emissions, including ultraviolet (UV), visible, and infrared (IR) radiation, and physical hazards such as flying debris, hot metal splashes, and chemical fumes. These hazards can cause both acute and chronic eye conditions, from temporary photokeratitis (“welder’s flash”) to irreversible vision loss caused by cataracts or retinal damage. In many cases, injuries occur not due to lack of knowledge about the dangers, but because of inadequate or inconsistent use of protective ocular devices.

This issue is particularly pronounced in low- and middle-income countries (LMICs) like Nigeria, where occupational safety regulations are weakly enforced, access to certified protective equipment is limited, and health and safety training is often minimal. Welders in such settings frequently operate in unregulated environments, sometimes without even the most basic eye protection. The resulting ocular injuries not only diminish workers' quality of life but also lead to loss of income, reduced productivity, and increased healthcare costs, impacting families and communities at large.

According to Agu *et al.*, (2021), the informal sector in Nigeria, which employs a large proportion of welders, is particularly vulnerable due to poor regulation, lack of standardized equipment, and minimal health and safety training. Consequently, workers operate in hazardous conditions without adequate protection, resulting in a significant burden of occupational eye injuries. Studies in different parts of Nigeria and sub-Saharan Africa have consistently highlighted the prevalence of these injuries and the low usage rates of protective eyewear (Onyekwelu *et al.* , 2019; Yego *et al.* , 2020; Oboh & Ofagbor, 2022).

Given these challenges, examining the usage of protective ocular goggles among welders in specific high-activity areas such as the Ikpoba-Okha and Ovia North-East LGAs of Edo State is crucial. Understanding the extent of adherence to safety practices, the factors influencing usage, and the prevalence of related injuries will provide evidence for targeted interventions that can prevent needless vision loss.

## **1.1 BACKGROUND KNOWLEDGE**

Welding is a fabrication process that joins metals or thermoplastics by causing coalescence, typically through the application of heat, pressure, or both. Different welding techniques are employed depending on the materials involved, the required strength of the joint, and the

intended application. Broadly, welders can be categorized based on their primary energy source and method:

1. **Electric Welders (Welding Arc):** These welders use an electric arc to generate intense heat, melting the workpieces at the joint. The most common methods include Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW or MIG), and Gas Tungsten Arc Welding (GTAW or TIG). Arc welding is widely used for its versatility and ability to join a variety of metals in construction, manufacturing, and repairs. However, the process produces intense ultraviolet (UV) and infrared (IR) radiation, as well as visible light, which pose significant ocular hazards.

This research focuses specifically on electrical welders (arc welders) in the Ikpoba-Okha and Ovia North-East LGAs of Edo State. These workers are predominant in local construction and metal fabrication businesses, often operating in roadside workshops or informal industrial clusters. Arc welding's intense light emissions and frequent production of hot debris make ocular protection especially critical. The study examines their level of awareness, adherence to protective goggle use, and prevalence of ocular injuries.

2. **Gas Welders (Chemical Welders):** Gas welding, such as oxy-acetylene welding, relies on the combustion of fuel gases (e.g., acetylene) with oxygen to produce a flame hot enough to melt the workpieces. While the visible light emitted is less intense than that from arc welding, the risk of eye injury remains due to bright light, heat, and potential exposure to hot sparks and molten metal.
3. **Other Specialized Welders:** Techniques such as laser welding, electron beam welding, and friction stir welding are used in high-precision industries like aerospace and medical device manufacturing. While these methods also carry eye safety risks,

they require specialized environments and are less common in informal or small-scale operations in Nigeria.

Manufacturers use arc welding as a vital production method to weld metals by generating high temperatures to reshape them. The fabrication serves multiple industries, including construction and industrial facilities worldwide (Lei *et al.* , 2020). The economic benefits of welding are substantial; however, its implementation leads to numerous occupational health hazards that can severely affect the eyes. When welding with electric arcs, workers should wear protective measures because the welding arc produces multiple types of radiation, from ultraviolet (UV) to infrared radiation (IR) waves (Tadesse *et al.* , 2016).

The human eye shows high susceptibility to radiation and mechanical injuries because of its fragile structure, together with repeated exposure to external hazards. Among the group of welders, work-related health problems frequently present as eye injuries. Different eye injuries encompass both light wounds, such as conjunctival irritation and foreign body sensations, alongside significant problems consisting of photokeratitis alongside chronic dry eye, cataracts, and eventual permanent vision deterioration (Omokhodion and Umar, 2017). Multiple research studies have established that welders working in Nigerian informal sectors without proper health services or protective equipment face elevated risks (Akinlolu *et al.* , 2020).

The main preventive technique against these threats involves using protective ocular goggles. Welding eye protection devices protect the eyes from harsh light and radiative emissions as well as flying particles in the environment. The use of protective goggles by welders during their work schedule proved effective in decreasing ocular injuries, according to research (Hassan *et al.* , 2017). Protection gear exists, yet workers from developing countries show low adherence to safety regulations because their regions lack proper enforcement of

occupational safety standards (Abubakar *et al.* , 2025). The Factories Act in Nigeria supports worker safety, but weak implementation allows local community workers to either lack protective equipment or choose not to use it, according to Orikpete & Ewim (2023).

Specifically, in the Ikpoba-Okha and Ovia North-East Local Government Areas of Edo State, welding is a common trade, yet anecdotal evidence suggests poor adherence to safety practices among practitioners. This raises concerns about the prevalence of preventable ocular injuries within these communities. Understanding the extent of protective goggle usage and its effect on eye health among welders in these areas is crucial for designing effective interventions.

### **1.1.1 Nature and Types of Ocular Hazards in Welding**

Welding exposes workers to various ocular hazards, primarily due to the emission of intense light and the generation of particulate matter. The UV radiation emitted during welding can cause photokeratitis, commonly known as "welder's flash," characterized by pain, redness, and temporary vision loss. Infrared radiation and visible light can also contribute to retinal burns and cataract formation over prolonged exposure.

Mechanical injuries are another concern. The process often involves the ejection of metal fragments, slag, and sparks, which can penetrate the eye and cause corneal abrasions or more severe trauma. Chemical exposures, such as fumes and gases produced during welding, can lead to conjunctivitis and other inflammatory conditions.

A study in Nekede, Imo State, was carried out as a descriptive and cross-sectional survey. A questionnaire was distributed among the 260 welders participating in the study, and an eye screening exercise was also carried out. Ocular hazards/injuries found among the welders due to non-use of eye protectors included foreign bodies (30.7%), conjunctivitis (20.3%),

pterygium (13.4%), arc-eye injury/trauma (12.6%), cataract (10.0%), chemical injury/burns (7.4%), uveitis (4.3%), and corneal abrasion (1.3%) (Mary *et al.* , 2020). These statistics highlight the multifaceted nature of ocular hazards in the welding industry.

### **1.1.2 Prevalence and Patterns of Ocular Injuries Among Welders**

The prevalence of ocular injuries among welders in Nigeria remains alarmingly high. In Yenagoa, Bayelsa State, a study involving 212 welders reported that 43.4% had experienced work-related eye injuries. The most frequent types of injury were burns (42%) and foreign body entry (32%), primarily resulting from exposure to flying metal particles and intense welding arc rays. Although 96.2% of respondents were aware of the risks of ocular injury, only 28.4% consistently used protective eyewear (Douglas & Koroye-Egbe *et al.* , 2018).

These findings highlight a systemic gap in eye safety practices among welders, where awareness does not necessarily translate to compliance. The high incidence of preventable injuries continues to impact both the productivity and overall well-being of welders while straining local healthcare systems.

### **1.1.3 Epidemiology of Welding-Related Ocular Injuries**

Globally, welding accounts for a substantial share of occupational eye trauma. In developing countries, the risk is exacerbated by unregulated work environments and limited access to protective gear. A systematic review by Atalay *et al.*, (2024) found that the overall prevalence of ocular protection practice among small-scale welders in sub-Saharan Africa was 53.71% (95% CI: 42.54, 64.88); nearly half do not consistently use any form of ocular protection. In Nigeria specifically, self-reported compliance often overstates actual usage rates; for example, Obarhoro *et al.*, (2020) found that while 82% of welders claimed to use goggles, only a fraction wore them consistently throughout their workday.

These statistics point to a serious public health concern, as repeated or unprotected exposure to welding arcs can lead to both immediate and long-term visual impairment. Chronic exposure without adequate protection can result in irreversible ocular damage, impacting not only the individual's health and productivity but also their family's economic stability. Moreover, because many welders are the primary breadwinners in their families, vision loss has broader socioeconomic repercussions.

#### **1.1.4 Importance of Protective Goggles and Factors Hindering Their Use**

Protective goggles are designed to shield the eyes from both radiative and mechanical threats during welding. The American National Standards Institute (ANSI Z87.1) outlines minimum protective requirements for welding goggles, including resistance to UV and IR radiation and impact resistance. However, Rahmani *et al.*, (2016) highlighted that many commercially available goggles in developing regions may not meet these critical safety standards. In their laboratory evaluation of four randomly sourced plastic welding protectors from the Iranian market, only one product, the Uvex Futura (Shade No. 4), successfully met the ANSI Z87.1 transmission criteria

Aside from quality concerns, behavioral and systemic barriers also hinder consistent goggle usage. Welders often cite discomfort, heat, fogging, and visual limitations as reasons for avoiding goggles. Other factors include cost, lack of availability, and cultural misconceptions about risk; some welders believe injuries are a matter of fate rather than preventable occurrences (Birhan *et al.*, 2024).

In Port Harcourt, Nigeria, Oboh and Ofagbor (2022) reported that while 88.3% of welders understood the risks associated with their occupation, only 5.8% used goggles regularly. This gap between knowledge and practice underscores a significant behavioral health challenge.

Despite the known risks, the use of protective eye devices among welders in Nigeria remains suboptimal. In Yenagoa, a study with 212 participants showed that only 28.4% of welders reported using protective eyewear (Douglas & Koroye-Egbe, 2018).

Several factors contribute to this low utilization rate. Discomfort, poor visibility, and lack of awareness are commonly cited reasons for not wearing protective equipment. Additionally, the cost and availability of quality protective gear can be prohibitive for many welders, especially those in informal settings.

### **1.1.5 Factors Influencing the Use of Protective Eye Goggles**

Several factors influence welders' use of protective eye goggles, including awareness, education, and accessibility. A study in Delta State, Nigeria, involving 390 welders, revealed that although 62.6% were aware of compliance guidelines, only 57.7% used eye goggles regularly. The main barriers were lack of training (35.2%) and inadequate supply of PPE (20.5%). The study found significant relationships between age, education level, and use of protective equipment ( $\chi^2 = 233.893$ ;  $p < 0.05$ ). (Obarhoro *et al.*, 2020).

1. **Awareness and Education:** Knowledge of ocular hazards and the protective role of goggles significantly affects compliance. Welders with higher awareness levels are more likely to own and use protective devices.
2. **Previous Ocular Injury:** Experiencing an eye injury often increases the likelihood of consistent protective equipment use, as injury acts as a personal motivator.
3. **Formal Training:** Participation in safety training programs enhances understanding of correct usage and the importance of eye protection.

4. **Socioeconomic Status and Income Level:** Higher-income welders are more likely to afford quality protective gear, while low-income welders may prioritize other expenses.
5. **Cost and Availability of Goggles:** Limited access to affordable, standard-compliant goggles reduces usage rates, especially in informal sector workshops.
6. **Comfort and Ergonomics:** Complaints about discomfort, heat, fogging, and visual limitations discourage consistent use.
7. **Quality of Goggles:** Substandard goggles that fail ANSI Z87.1 criteria for UV, visible, and IR protection offer inadequate safety, reducing welders' trust in their effectiveness.
8. **Workplace Culture and Peer Influence:** In environments where safety compliance is not enforced or socially encouraged, welders may be less motivated to wear goggles.
9. **Regulatory Enforcement:** Weak implementation of occupational safety laws allows unsafe practices to persist.

### **1.1.6 Health and Economic Implications of Ocular Injuries**

Ocular injuries among welders have significant health and economic consequences. Vision impairment can lead to decreased productivity, loss of income, and increased medical expenses. In severe cases, permanent blindness can occur, which will drastically affect the quality of life.

From an economic perspective, the cumulative effect of these injuries includes increased healthcare costs and potential loss of skilled labor. The broader impact extends to families and communities, especially when the injured individual is a primary breadwinner.

### **1.1.7 Socio-economic and Educational Determinants**

Several socioeconomic variables influence the likelihood of using protective goggles. These include age, education, income, work experience, and type of employment (i.e., apprentice vs. master welder). Belete *et al.*, (2023) and Atalay *et al.*, (2024) found that welders with formal training or prior experience of ocular injury were more likely to adopt protective measures. Furthermore, those with higher income levels or access to subsidized protective equipment showed greater compliance.

In the Nigerian context, welders with little or no formal education often lack sufficient awareness of occupational hazards or how to mitigate them effectively. Apprentices, who form a significant portion of the workforce in local government areas like Ikpoba-Okha and Ovia North-East in Edo State, frequently work without supervision or formal safety instruction. Thus, occupational safety practices become informal, inconsistent, and often nonexistent.

### **1.1.8 Regulatory Framework and Occupational Safety Policies**

Occupational safety and health in Nigeria are governed by the Factories Act of 1990, which mandates the use of personal protective equipment (PPE) in hazardous work environments. However, weak enforcement mechanisms and poor awareness of the law among workers and employers render it ineffective. Orikpete & Ewim (2023) highlighted systemic regulatory lapses in Nigerian factories, particularly within the informal sector.

Efforts by public health authorities and non-governmental organizations (NGOs) to distribute protective gear and conduct awareness campaigns have shown some success but remain insufficient in scale. Additionally, there is limited empirical data from local communities to inform these interventions. The current study seeks to fill this gap by focusing on two highly

industrialized LGAs in Edo State, where anecdotal evidence suggests high welding activity but low adherence to safety practices.

## **1.2 STATEMENT OF PROBLEM**

Observing the the high burden of preventable eye injuries among welders in local communities, particularly in Ikpoba-Okha and Ovia North-East LGAs of Edo State, stimulated my interest in this area of research. In spite of the importance of welding to economic survival, many practitioners either neglect or inconsistently use protective goggles, often underestimating the risks of intense radiation, flying metal fragments, and chemical fumes. The scarcity of local data on safety practices and ocular injuries further highlighted the need for a systematic study to understand awareness, usage patterns, and barriers to protective goggle compliance among welders in these areas.

### **1.3.1 AIM**

To determine the effect of the use of protective ocular goggles amongst welders in the Ikpoba-Okha and Ovia North-East LGAs of Edo State.

### **1.3.2 OBJECTIVES OF STUDY**

1. To determine the level of awareness of ocular hazards associated with the occupation of welding among welders in the 2 LGAs.
2. To ascertain the usage of protective ocular goggles among welders.
3. To identify factors influencing the use of protective ocular goggles among welders.

## **1.4 RESEARCH QUESTIONS**

1. What is the level of awareness of ocular hazards associated with the occupation of welding in Ikpoba-Okha and Ovia North-East LGAs

2. How frequently do welders use protective ocular goggles
3. What factors influence the use or non-use of protective ocular goggles among welders in the study areas
4. What strategies can be recommended to encourage the usage of protective ocular goggles among welders

### **1.5 SIGNIFICANCE OF THE STUDY**

1. The study will provide valuable data on the prevalence of ocular injuries among welders in Ikpoba-Okha and Ovia North-East LGAs and the extent of protective ocular goggle usage, helping to fill existing gaps in occupational health research.
2. Findings from the study will assist policymakers, public health officials, and occupational safety regulators in developing targeted interventions and policies to promote eye safety practices among welders.
3. The study aims to increase awareness among welders and the public about the risks of ocular injuries and the significance of the consistent use of protective goggles.
4. The study aims to enhance workplace safety standards and decrease preventable eye injuries by identifying factors influencing goggle use.
5. The findings can serve as a baseline for future, more extensive research on ocular health and safety practices among welders in other regions of Nigeria and beyond.

### **1.6 DEFINITION OF TERMS**

1. Welding: A process of fabrication that joins materials, usually metals or thermoplastics, by applying heat, pressure, or both, to produce a strong joint.

2. Arc Welding: A welding process that uses an electric arc to melt and fuse metals at the joint.
3. Ultraviolet Radiation (UV): Invisible electromagnetic radiation with wavelengths shorter than visible light, capable of causing eye damage such as photokeratitis and cataracts.
4. Infrared Radiation (IR): Electromagnetic radiation with wavelengths longer than visible light, which can cause thermal injury to the retina and lens.
5. Photokeratitis: A painful, temporary eye condition caused by overexposure to ultraviolet rays, also known as “welder’s flash.”
6. ANSI Z87.1 Standard: A set of guidelines by the American National Standards Institute specifying safety requirements for eye and face protection devices, including welding goggles.
7. Protective Ocular Goggles: Specialized eyewear designed to shield the eyes from harmful radiation, bright light, and mechanical hazards during welding.
8. Impact Resistance: The ability of protective eyewear to withstand mechanical forces from flying particles or debris without breaking.
9. Transmittance: The measure of how much light passes through a material, used to assess the protective capability of welding lenses against harmful rays.
10. Occupational Hazard: Any workplace condition that poses a risk to the health or safety of workers.
11. Personal Protective Equipment (PPE): Gear worn to minimize exposure to hazards that cause workplace injuries or illnesses, such as welding goggles, gloves, and helmets.

12. Metal Fumes: Microscopic particles formed when metals are vaporized during welding and then condense in the air; they can be inhaled or come into contact with the eyes, causing respiratory problems and ocular irritation.
13. Ocular Injury: Any form of damage to the eye caused by trauma, radiation, or chemical exposure.
14. Compliance: The degree to which individuals adhere to recommended safety practices, such as the consistent use of protective goggles.
15. Visual Acuity: The clarity or sharpness of vision, which can be impaired by welding-related eye injuries.
16. Occupational Safety Regulation: Legal standards designed to ensure safe and healthy working conditions in various industries, including welding.
17. Ergonomics: The design and arrangement of equipment to maximize comfort, efficiency, and safety for workers.
18. Informal Sector Welding: Small-scale welding operations are often carried out in unregulated environments without strict safety enforcement.
19. Radiative Hazards: Dangers posed by exposure to harmful light radiation, including UV, visible, and IR rays during welding.
20. Barriers to PPE Use: Factors such as cost, availability, discomfort, and lack of awareness prevent workers from using safety equipment consistently.

## CHAPTER TWO

### 2.0 LITERATURE REVIEW

#### **Awareness and Utilization of Protective Eye Devices**

Ihekaire & Oji (2017) conducted a descriptive study of 100 welders aged 18–35 in Nekede Mechanic Village, Imo State, Nigeria. Clinical assessments using ophthalmoscopes and visual acuity charts revealed that 48% of participants exhibited corneal injuries—pterygium, pinguecula, corneal opacity, limbal changes, or photokeratitis. Protective eyewear use was minimal: only 2% used it consistently, 14% often, 41% occasionally, and 43% never. Notably, mere 1.3% of injuries occurred in regular users, while 46.1% and 38.1% occurred among occasional and non-users, respectively. The findings illuminate how non-compliance underpins injury risk, and the authors advocate for rigorous safety orientation and strict compliance enforcement in informal welding settings.

Mary *et al.*, (2020) conducted a study in Umualum, Owerri West, Imo State, Nigeria, assessing welders' knowledge, attitudes, and practices regarding eye protection. The study revealed that 86.2% of the 260 welders surveyed were aware that using eye protectors could prevent work-related ocular injuries. However, despite this high level of awareness, the consistent use of protective eyewear was low, with only 34.2% of participants reporting regular use

Chukwuoha *et al.*, (2020) investigated ocular hazards among 260 welders in Nekede, Imo State. The cross-sectional clinical and questionnaire-based assessment revealed that the welders suffered a spectrum of ocular injuries: foreign bodies (30.7%), conjunctivitis (20.3%), pterygium (13.4%), arc-eye injury/trauma (12.6%), cataract (10.0%), chemical burns (7.4%),

uveitis (4.3%), and corneal abrasion (1.3%). These findings highlight the multifaceted risks welders face, many of which are preventable through consistent use of eye protection.

In a related Knowledge Attitude Practice (KAP) study among the same group, Chukwuoha *et al.*, (2020) found that while 86.2% demonstrated high knowledge of eye protection, only 59.2% displayed positive attitudes, and merely 34.2% consistently used protective eyewear. Moreover, age, education level, and duration of service were significantly associated with both knowledge and attitude ( $p < 0.001$ ), indicating critical socioeconomic and demographic influences on compliance.

Esu & Ekanem (2021) conducted a descriptive cross-sectional study among 116 small-scale welders in Calabar South, Cross River State. Interviewer-administered questionnaires and observational checklists revealed that 69.8% were aware of PPE; 83.6% had access to PPE at work. Yet, only 14.4% reported consistent use. While safety goggles, gloves, boots, and coveralls were identified, the most frequently used “PPE” observed were sunglasses, which are inadequate for welding protection. The study calls for stricter enforcement of occupational safety regulations and tailored PPE awareness efforts in informal sector.

Ugwu & Adamu (2023) examined 105 welders in Biu, Borno State, focusing on awareness of welding radiation hazards and compliance with eye protection use. Using structured questionnaires and chi-square analysis, they found no statistically significant relationship between compliance and variables such as age or years of experience. This suggests that behavioral inertia or systemic neglect, rather than demographic factors, may be key drivers of low compliance.

Oboh & Ofagbor (2022) carried out a mixed-methods assessment of welders in Port Harcourt’s mechanic and steel villages, combining clinical screening with questionnaires to evaluate ocular symptoms and protective eyewear compliance. While full quantitative data

were not publicly accessible, the study reported that eye-related complaints were common (e.g., sandy sensation, cloudy vision, painful red eyes) and that ocular surface abnormalities such as pinguecula, pterygium, conjunctival discoloration, and corneal opacity were notable. Compliance varied, and age was significantly linked to symptom prevalence. The study advocates for policy development, vocational training improvements, and informal sector health protections including possible health insurance for artisans.

### **Determinants and Barriers to Compliance**

Belete, Assefa, and Tegegn (2023) examined protective behavior among 396 welders in Gondar, Ethiopia. Despite 86% having access to PPE, only 56.8% practiced good ocular protection behavior. Multivariate analysis revealed that job training (AOR = 4.90), previous ocular injury (AOR = 4.20), and perceived affordability (AOR = 2.30) significantly influenced compliance. Gas welders were less likely to adopt safe practices (AOR = 0.26). These findings align with regional trends, indicating that socioeconomic and experiential factors are pivotal in shaping safety behavior. The study suggests that exposure to occupational hazards may itself function as a motivator for future protective practices.

Birhan *et al.*, (2024) found similarly poor compliance in Southern Ethiopia, with only 43.6% of 339 welders using certified protective eyewear. A significant number (10.9%) used no protection at all, and many resorted to sunglasses. The lack of formal standards and insufficient hazard awareness were cited as major challenges. These findings resonate with studies across Africa, reflecting a persistent regulatory and educational vacuum in the informal sector. In addition, the study highlights the structural absence of occupational health monitoring mechanisms, further exacerbating poor compliance.

Ifeanyi, Ejidike, and Ugwu (2022) analyzed the influence of demographic factors on eye protection compliance among 101 welders in Abakaliki, Nigeria. Using chi-square tests, they

found no significant association between compliance and variables such as age, education, or experience. This challenges commonly held assumptions and suggests that psychosocial and institutional factors may be more influential than demographic attributes. Their findings encourage a re-evaluation of intervention strategies to focus more on risk perception, social influence, and workplace culture rather than solely on demographic targeting.

Mary *et al.*, (2020), in a KAP study in Imo State, Nigeria, surveyed 260 welders and found a knowledge-practice gap. Although 86.2% were aware of the protective benefits of eye devices, only 34.2% used them consistently. Attitudinal barriers and poor safety culture contributed to low compliance. The study found significant associations between knowledge and both age and education, although these findings contrast with those of Ifeanyi *et al.*, (2022), indicating possible regional differences. Their research underscores the value of continuous and localized occupational health education tailored to individual communities' attitudes and perceptions.

### **Policy and Practice Implications**

A meta-analysis by Atalay, Gebeyehu, and Gelaw (2024) synthesizing 17 sub-Saharan studies reported an average compliance rate of just 53.71% (95% CI: 42.54–64.88%), confirming widespread underuse of protective eyewear across the region. Beyond poor compliance, technical deficiencies in available gear further complicate prevention. Rahmani *et al.*, (2016), for example, evaluated various protectors against ANSI Z87.1 standards and found only the Uvex (T1) fully compliant, while others exceeded acceptable transmittance thresholds—raising concerns about substandard equipment. In Nigeria, Ihekaire and Oji (2017) reinforced these risks in a descriptive study of 100 welders aged 18–35 in Nekede Mechanic Village, nearly half (48%) presented with corneal injuries such as pterygium, pinguecula, corneal opacity, limbal changes, and photokeratitis. Protective eyewear use was

alarming inconsistent, with only 2% reporting regular use compared to 43% who never used protection. Injury prevalence strongly mirrored compliance patterns in just 1.3% of cases among consistent users versus 46.1% and 38.1% among occasional and non-users, respectively. Together, these findings highlight a dual challenge: both the underuse of PPE and the questionable safety performance of available devices, underscoring the urgent need for rigorous safety education, reliable equipment supply, and strict enforcement of compliance in informal welding settings.

The collective findings suggest a pressing need for multifaceted interventions. Atalay *et al.*, (2024) advocate for mandatory safety training and equipment provision, economic interventions, such as subsidies for certified protective gear (Birhan *et al.* , 2024), are essential to addressing affordability issues. Furthermore, there is a need for standardized enforcement mechanisms, particularly in informal sectors where regulatory oversight is weak or absent.

The insights gained from the occupational eye health literature have broader relevance, particularly for addressing similar gaps in protective behavior in other at-risk populations, such as youth exposed to blue light. As with welders, targeted education, ergonomic improvement of protective devices, and behavior-focused communication are critical to improving compliance. These strategies could also benefit school-based or tech-using populations who exhibit low adherence to preventive measures despite awareness.

In conclusion, while awareness of ocular protection among welders is relatively high, actual usage remains inconsistent due to a complex interplay of behavioral, economic, technical, and systemic barriers. Addressing these challenges requires coordinated policy, training, and health promotion strategies tailored to the realities of informal occupational sectors in sub-Saharan Africa. Continued research and evaluation are necessary to adapt interventions to specific populations and contexts, thereby increasing their effectiveness and sustainability over time.

## **CHAPTER THREE**

### **3.0 MATERIALS AND METHODS**

#### **3.1 RESEARCH DESIGN**

This study employed a descriptive cross-sectional design. It involved collecting data from a population at a single point in time and making inferences based on the data collected.

#### **3.2 STUDY LOCATION**

The study was conducted in Ikpoba-Okha and Ovia North-East Local Government Areas (LGAs) of Edo State, Nigeria.

#### **3.3 SAMPLING TECHNIQUE**

The study utilized a systematic sampling technique to select participants. This technique ensured an even spread across the population and reduced selection bias.

#### **3.4 SAMPLE SIZE**

The study population comprised 90 professional and apprentice welders who were actively engaged in welding activities within the two selected LGAs. It included individuals over 18 who had been welding for a minimum of 4 years.

#### **INCLUSION CRITERIA**

- Welders aged 18 years and above
- Cooperative and consenting practitioner.
- Active in the profession for a minimum of 4 years
- Welders Operating within the designated LGAs

## **EXCLUSION CRITERIA**

- Welders aged below 18 years
- Uncooperative and non-consenting practitioner.
- Individuals who haven't been active in the profession for up to 4 years
- Welders outside the selected LGAs.

## **3.5 STUDY DURATION**

The study was conducted within a period of three months.

## **3.6 RESEARCH MATERIALS**

- Structured and pre-tested questionnaire
- Visual acuity chart (e.g., Snellen chart)
- Penlight (For external Examination)
- Ocular examination tools: ophthalmoscope for internal examination
- Consent forms
- Data collection sheets

## **3.7 DESCRIPTION OF PROCEDURE**

Participants were approached at their workplaces, and the purpose of the study was explained to them. Informed consent was obtained before enrollment. A structured questionnaire was administered to obtain data on socio-demographics, use of protective goggles, awareness of ocular hazards, frequency and pattern of goggle use, and any history of ocular injuries. Where possible, visual inspection of the eye and existing ocular PPE was conducted to corroborate responses.

### **3.8 ETHICAL CONSIDERATIONS**

Ethical clearance was obtained from the Unit of Research and Ethics Committee of the Faculty of Optometry, University of Benin, Benin City, in accordance with the tenets of the Declaration of Helsinki. This ensured that all procedures performed on each subject did not go against the public interest or inflict unnecessary harm on them.

Informed consent of all participants was obtained before any data was collected from them to ensure their full cooperation.

### **3.9 LIMITATIONS OF STUDY**

- The quantitative data, influenced by social desirability bias, may have resulted in over-reporting of goggle use.
- The study's short duration and focus on only two LGAs limit its applicability to welders in other areas.

## CHAPTER FOUR

### 4.0 RESULTS

#### Section A: Demographic Information

A total of 90 welders participated in the study. The distribution of respondents by age, education level, and years of experience is shown below. Respondents were predominantly within the 26–35-year age group (34.4%), followed by those aged 36–45 years (28.9%). Smaller proportions were aged 46–55 years (18.9%) and 18–25 years (17.8%). The age distribution was therefore skewed toward younger adults, indicating that most respondents were adults with moderate to long-term experience.

**Table 4.1: Demographic Characteristics of Respondents**

Variable	Category	Frequency	Percentage
<b>Age (Years)</b>	18–25	16	17.8
	26–35	31	34.4
	36–45	26	28.9
	46–55	17	18.9
	<b>Total</b>		90
<b>Education Level</b>	Primary	36	40.0
	Secondary	54	60.0
	<b>Total</b>	90	100.0
<b>Years of Experience</b>	4–7 years	18	20.0
	8–11 years	36	40.0
	12–15 years	26	28.9
	16 years and above	10	11.1
	<b>Total</b>	90	100.0

In terms of educational background, a total of 54 of respondents (60%) had completed secondary education, while 36 (40%) had attained only primary education. No participant reported tertiary education, indicating that most welders in the area operate with limited formal education.

In terms of work experience, the highest number of respondents (40%) reported 8-11 years of experience, followed by 28.9% with 12-15 years. Then, 11.1% had worked for 16 years and above in the welding profession. This reflects a workforce dominated by skilled mid-level professionals.

**Section B: Awareness and Knowledge of Ocular Hazards**

All respondents indicated awareness of potential eye injuries associated with welding and demonstrated knowledge of the purpose of protective ocular goggles. Similarly, all participants had been informed about the role of goggles in preventing eye injuries.

**Table 4.2: Awareness and Knowledge of Ocular Hazards**

<b>Variable</b>	<b>Response</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Awareness of eye injury risks</b>	Yes	90	100.0
<b>Total</b>		90	100.0
<b>Knowledge of protective goggles</b>	Yes	90	100.0
<b>Total</b>		90	100.0
<b>Informed about goggles</b>	Yes	90	100.0
<b>Total</b>		90	100.0
<b>Perception of seriousness</b>	Slightly Serious	19	21.1
	Very Serious	71	78.9
<b>Total</b>		90	100.0

All respondents (100%) indicated awareness of the potential risk of eye injuries associated with the welding profession. Similarly, every participant acknowledged knowing the purpose of protective ocular goggles and reported having been informed about their role in preventing eye injuries.

Most respondents (78.9%) regarded eye injuries as very serious, while 19% regarded this as slightly serious, indicating high awareness and risk perception.

**Section C: Usage of Protective Goggles and Injury Experience**  
**Table 4.3: Frequency of Use and Injury Experience**

Variable	Response	Frequency	Percentage
Current use of goggles	Yes	90	100.0
	<b>Total</b>	90	100.0
Frequency of use	Always	43	47.8
	Sometimes	24	26.7
	Rarely	23	25.6
<b>Total</b>		90	100
Ever had eye injury	Yes	6	6.7
	No	84	93.3
<b>Total</b>		90	100
Type of injury	Burns	4	4.4
	Foreign objects	2	2.2
<b>Total</b>		90	100
Goggles helped prevent injury	Yes	89	98.9
	No	1	1.1
<b>Total</b>		90	100

All respondents (100%) in the study reported that they currently use protective ocular goggles while welding. However, their consistency of use of protective ocular goggles varied. Less than half of the welders (47.8%) stated that they *always* wore goggles during welding. A considerable proportion (26.7%) admitted to wearing goggles *sometimes*, while 25.6% reported using them only *rarely*. 93.3% of the respondents reported no eye injury while few respondents (6.7%) reported eye injuries, mainly burns and foreign objects. Almost all users

(98.9%) confirmed goggles were effective in injury prevention, underscoring their importance.

**Section D: Factors Influencing Frequency of Goggle Use**  
**Table 4.4: Chi-Square Tests for Determinants of Goggle Use**

Factor	Category	Always	Rarely	Sometimes	Total	Chi-Square ( $\chi^2$ , df, p)
<b>Age</b>	18–25 yrs	0	10	6	16	$\chi^2=45.88$ , df=6, p<.001
	26–35 yrs	0	21	21	31	
	36–45 yrs	18	7	1	26	
	46–55 yrs	5	5	7	17	
	<b>Total</b>	23	43	24	90	
<b>Education</b>	Primary	5	11	20	36	$\chi^2=25.70$ , df=2, p<.001
	Secondary	18	32	4	54	
	<b>Total</b>	23	43	24	90	
<b>Experience</b>	4 – 7 yrs	0	10	8	18	$\chi^2 = 60.22$ , df = 6, p < .001
	8 – 11 yrs	0	28	8	36	
	12 – 15 yrs	18	0	8	26	
	16+ yrs	5	5	0	10	
	<b>Total</b>	23	43	24	90	
<b>Availability</b>	Goggles available	1	37	19	57	$\chi^2 = 46.60$ , df = 2, p < .001
	Not available	22	6	5	33	
	<b>Total</b>	23	43	24	90	
<b>Free provision of Goggles</b>	Yes	1	4	9	14	$\chi^2 = 58.61$ , df = 4, p < .001
	No	0	33	10	43	
	Not applicable	22	6	5	33	
	<b>Total</b>	23	43	24	90	
<b>Quality of Goggles</b>	Average	18	6	3	27	$\chi^2 = 80.92$ , df = 4, p < .001
	Good	4	1	17	22	
	Excellent	1	36	4	41	
	<b>Total</b>	23	43	24	90	
<b>Affordability of Goggles</b>	Affordable	8	10	14	32	$\chi^2 = 12.37$ , df = 4, p<.001
	Expensive	15	32	8	55	
	Very Expensive	0	1	2	3	
	<b>Total</b>	23	43	24	90	
<b>Training</b>	Yes	1	28	6	35	$\chi^2 = 25.94$ , df = 2, p < .001
	No	22	15	18	55	

	<b>Total</b>	23	43	24	90	
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All eight variables showed statistically significant associations with frequency of goggle use ( $p < 0.05$ ). This indicates that factors such as age, education, experience, and accessibility directly affect compliance. Availability, quality, and affordability had particularly strong influences, while formal training proved essential for regular usage.

### **Section E: Recommendation Strategies to Encourage the Use of Google**

**Table 4.5: Suggestions for Improving Goggle Use**

<b>Suggestion</b>	<b>Frequency</b>	<b>Percentage age</b>
<b>Awareness campaigns</b>	66	73.3
<b>Free goggles</b>	11	12.2
<b>Affordability</b>	6	6.7
<b>Reduced cost, more comfort</b>	5	5.6
<b>Enforced laws</b>	1	1.1
<b>Total</b>	90	100.0

Most of the respondents (73.3%) emphasized increasing awareness as the best approach to encourage goggle use. Some of the respondents recommended free (12.2%) or affordable goggles (6.7%) while few recommended design improvements for comfort (5.6%). Only a small proportion (1.1%) supported stricter law enforcement.

In conclusion, the findings revealed high awareness of ocular hazards and universal knowledge of goggles among welders. However, consistent usage was limited. Chi-square analysis confirmed that education, experience, age, availability, affordability, and training all

significantly influenced compliance. Overall, behavioral and structural interventions are needed to improve protective goggle usage among welders.

## CHAPTER FIVE

### 5.0 DISCUSSION

This study assessed the effect of usage of protective ocular goggles among welders in Ikpoba-Okha and Ovia North-East Local Government Areas of Edo State. The results presented in Chapter Four are discussed here, with comparisons to relevant literature reviewed in Chapter Two. The discussion also addresses the objectives of the study and provides answers to the research questions posed in Chapter One.

Table 4.1 shows that a total of 90 welders participated in the study. The age distribution indicates that respondents were concentrated in the younger and middle-aged groups: 18–25 years (16; 17.8%), 26–35 years (31; 34.4%), 36–45 years (26; 28.9%) and 46–55 years (17; 18.9%). This pattern suggests that welding in the study area is largely practiced by adults in the economically productive age groups, consistent with apprenticeship and vocational entry into the trade. The education profile in the same table indicates that 54 respondents (60.0%) had completed secondary education while 36 (40.0%) had only primary education, confirming that most participants had limited formal education beyond the secondary level. Years of experience were also clustered in mid-career ranges: 8–11 years (40.0%), 12–15 years (28.9%), 4–7 years (20.0%) and 16+ years (11.1%). The demographic characteristics of respondents is typical of small-scale and informal welding communities described in the Nigerian literature (Ihekaire & Oji, 2017; Okeigbemen et al ., 2012).

Table 4.2 shows that awareness of ocular hazards was virtually universal in this sample: 90 respondents (100.0%) indicated awareness of eye injury risks, 90 (100.0%) reported knowledge of protective goggles, and all 90 (100.0%) had been informed about their use. Perception of seriousness was high (78.9% regarded eye injuries as “very serious,” while

21.1% regarded them as “slightly serious”). These figures confirm that awareness and risk perception are strong among welders in the study area. This high awareness echoes the findings from Mary *et al.*, (2020) in Imo State, where most welders also recognized the risks but did not always translate this into protective behaviour.

Despite universal awareness, Table 4.3 reveals variation in actual practice. All respondents (100.0%) reported current goggle use in some form, but frequency varied: 43 (47.8%) reported *always* wearing goggles during welding, 24 (26.7%) reported *sometimes*, and 23 (25.6%) reported *rarely*. Reported eye injuries were relatively uncommon: 6 respondents (6.7%) reported having experienced an eye injury (burns: 4.4%, foreign objects: 2.2%), while 84 (93.3%) reported no injury. Nearly all respondents who used goggles (89; 98.9%) believed the goggles helped prevent injury. It is clear from Table 4.3 that there is a persistent gap between awareness/ownership and consistent use, supporting the common finding that knowledge alone is insufficient to guarantee protective practice (Mary et al ., 2020; Oboh & Ofagbor, 2022).

Table 4.4 reports chi-square analyses examining determinants of frequency of goggle use. The table shows statistically significant associations between frequency of use and age ( $\chi^2 = 45.88$ ,  $df = 6$ ,  $p < .001$ ), education ( $\chi^2 = 25.70$ ,  $df = 2$ ,  $p < .001$ ), years of experience ( $\chi^2 = 60.22$ ,  $df = 6$ ,  $p < .001$ ), availability of goggles ( $\chi^2 = 46.60$ ,  $df = 2$ ,  $p < .001$ ), free provision of goggles ( $\chi^2 = 58.61$ ,  $df = 4$ ,  $p < .001$ ), quality of goggles ( $\chi^2 = 80.92$ ,  $df = 4$ ,  $p < .001$ ), affordability ( $\chi^2 = 12.37$ ,  $df = 4$ ,  $p < .001$ ) and training on proper goggle usage ( $\chi^2 = 25.94$ ,  $df = 2$ ,  $p < .001$ ). These results indicate that several socio-demographic and workplace factors are significantly associated with how often welders wear protective goggles. In particular, the strong  $\chi^2$  values for quality, free provision and experience highlight that practical workplace conditions (having good quality goggles available, and receiving them free or affordably) and

prior exposure/experience are powerful drivers of compliance. This mirrors the pattern reported in other Nigerian studies where availability, affordability and prior injury or training affected PPE compliance (Ihekaire & Oji, 2017).

Interpreting the direction of association from the data shows meaningful patterns: respondents with greater formal education tended to show higher rates of consistent use, and training on proper goggle usage was associated with more frequent use. Availability and free provision were also strongly linked with higher frequency of use, underscoring that access and cost are practical barriers. Quality of goggles was the strongest single workplace predictor in Table 4.4, implying that poor-quality or uncomfortable equipment discourages regular use even among those aware of the risks. This supports calls for distribution of higher quality, ergonomically acceptable protective goggles.

Table 4.5 summarises respondents' suggested strategies for improving use of goggles: 66 respondents (73.3%) favoured expanded awareness campaigns, 11 (12.2%) recommended provision of free goggles, 6 (6.7%) suggested affordability measures, 5 (5.6%) called for improved comfort/design, and 1 (1.1%) proposed stricter enforcement of laws. These preferences highlight that welders value information and practical support more than punitive measures; most asked for improved awareness and access rather than enforcement alone.

Overall, the study shows that: (1) awareness of ocular hazards in Ikpoba-Okha and Ovia North-East is very high (Table 4.2); (2) ownership/use exists in principle but consistent use is far from universal (Table 4.3); (3) workplace and socioeconomic factors which include availability, affordability, quality, and training, are strongly associated with frequency of use (Table 4.4); and (4) welders themselves prioritise awareness, access and comfort as ways to improve compliance (Table 4.5). These findings achieve the study objectives by documenting awareness, quantifying usage patterns and identifying determinants of compliance.

When compared with prior Nigerian studies, the pattern is consistent: earlier reports (Mary et al., 2020; Oboh & Ofagbor, 2022) similarly found high awareness but low or inconsistent use, and highlighted availability, affordability, comfort and poor enforcement as barriers. The present study reinforces these conclusions with local, up-to-date data and strengthens the evidence base for interventions targeting access to quality goggles and training for welders.

Like every research, this study was not without its limitations. First, the study relied on self-reported information from respondents regarding their awareness and use of protective goggles. Such responses may be subject to bias, as some welders might have exaggerated their compliance with protective practices. In addition, ocular injuries were reported based on the welders' accounts rather than through clinical examinations, which may not fully capture the extent or severity of injuries. Another limitation was the cross-sectional design of the study, which only provided a glance of goggle usage and ocular injury at one point in time; it therefore could not establish cause'. Despite these limitations, the findings provide valuable insights into the awareness, usage, and challenges associated with protective goggle use among welders in the study areas, and they serve as a useful foundation for further research.

## CHAPTER SIX

### 6.0 CONCLUSION & RECOMMENDATION

This study examined the effect of protective ocular goggle usage among welders in Ikpoba-Okha and Ovia North-East LGAs of Edo State. It established that although welders are generally aware of ocular hazards, their level of compliance with protective goggle usage is low. Many welders possess goggles and understand their protective benefits, yet only a portion of them use them regularly during welding activities. This inconsistency demonstrates a clear gap between awareness and practice, indicating that knowledge of hazards alone does not guarantee safe behaviour. Consequently, ocular injuries such as conjunctivitis, photokeratitis, corneal abrasions, and foreign body entry were common.

The study further revealed that several factors influence the use of protective goggles among welders. These include level of education, years of experience, affordability and availability of goggles, quality and comfort of the equipment, and prior training on occupational safety. Welders with more experience and those who have previously suffered eye injuries tend to be more compliant with protective practices, while apprentices and those with limited income or training are less likely to use goggles consistently. These findings align with earlier reports in Nigeria and other developing countries, where awareness is generally high, but compliance is hindered by economic, behavioural, and institutional barriers.

In conclusion, welding remains a high-risk occupation for ocular injuries in Edo State, largely due to poor compliance with protective practices. Addressing this problem requires interventions that improve awareness, affordability, and enforcement of protective goggle usage.

## **6.0 RECOMMENDATION**

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

1. Health education campaigns should be intensified to educate welders and emphasize on the risks of ocular hazards and the need for consistent protective goggle usage.
2. Apprenticeship programs should include structured training on occupational health and safety, emphasizing the prevention of ocular injuries.
3. Further research should be conducted in other LGA of Edo State and Nigeria to provide broader evidence for policy formulation and intervention strategies.

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## APPENDIX



Statement	Response	Frequency	Percent
Are you aware of the potential risk of eye injuries in welding?	No	3	1.4
	Yes	218	98.6
	Total	221	100.0

### Awareness of ocular hazards among respondents

Statement	Response	Frequency	Percent
Do you know what protective ocular goggles are used for?	Yes	221	100
	No	0	0
	Total	221	100.0

### Types of eye injuries perceived by respondents

Also, there was a universal awareness that reflects the high recognition of occupational hazards and prevention of eye injuries among welders in the study.

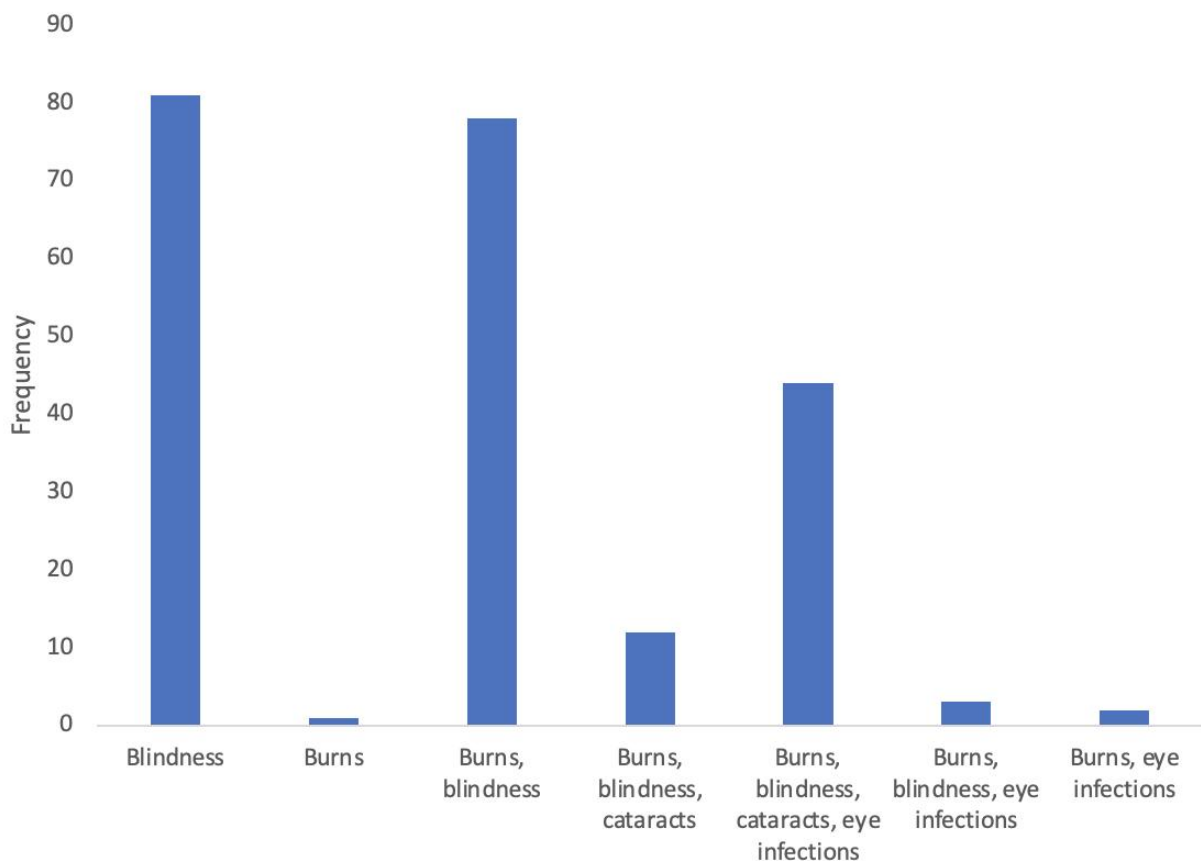
Statement	Response	Frequency	Percent
Have you ever been informed	Yes	221	100.0

about the use of protective goggles in preventing eye injuries?	No	0	0
	Total	221	100

Effectiveness of protective goggles in preventing injuries

Types of Eye Injury	Frequency	Percent
Burns, eye infections	2	.9
Burns, blindness, eye infections	3	1.4
Burns, blindness, cataracts, eye infections	44	19.9
Burns, blindness, cataracts	12	5.4
Burns, blindness	78	35.3
Burns	1	.5
Blindness	81	36.7
Total	221	100.0

What types of eye injuries do you think can result from welding?

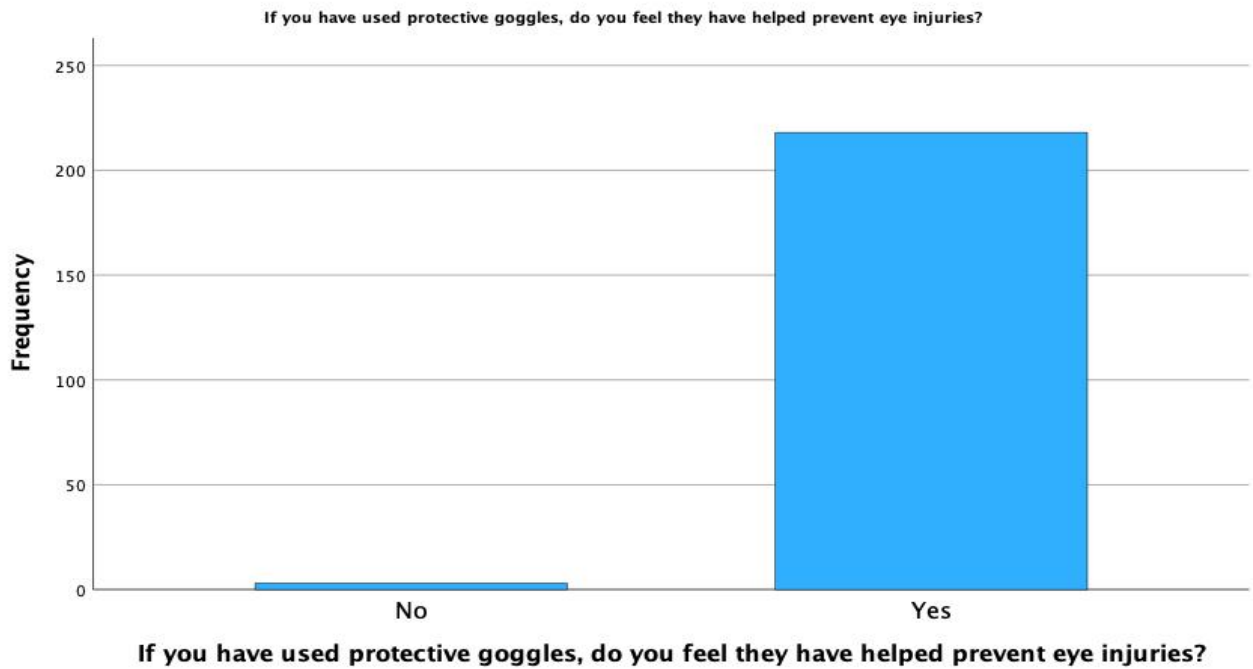


What types of eye injuries do you think can result from welding?

Statement	Response	Frequency	Percent
If you have used protective goggles, do you feel they have helped prevent eye	No	3	1.4
	Yes	218	98.6

injuries?	Total	221	100.0
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If you have used protective goggles, do you feel they have helped prevent eye injuries?



If you have used protective goggles, do you feel they have helped prevent eye injuries?

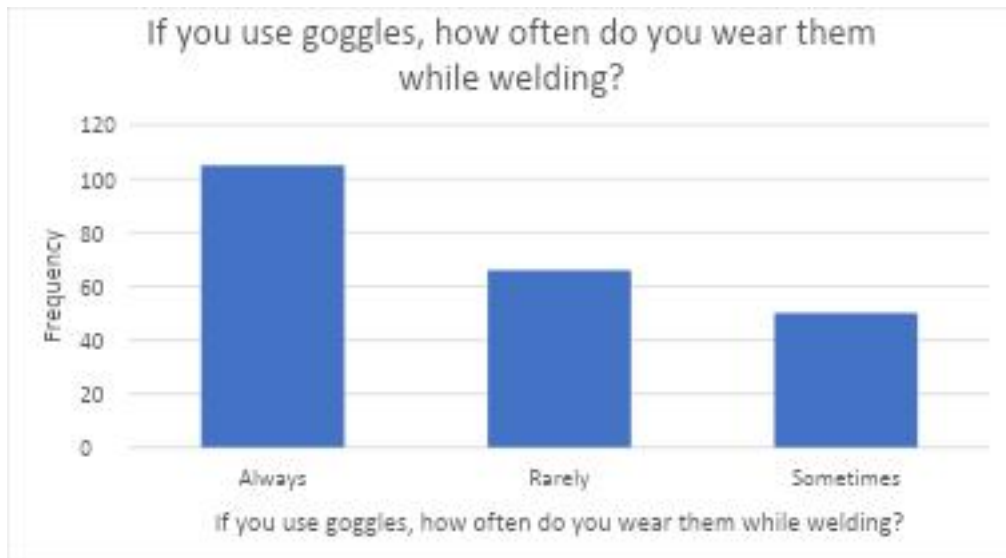
Statement	Response	Frequency	Percent
Do you currently use protective ocular goggles while welding?	No	3	1.4
	Yes	218	98.6
	Total	221	100.0

Current use of protective ocular goggles while welding by respondents

Statement	Response	Frequency	Percent
If you use goggles, how often do you wear them while welding?	Always	105	47.5
	Rarely	66	29.9
	Sometimes	50	22.6

	Total	221	100.0
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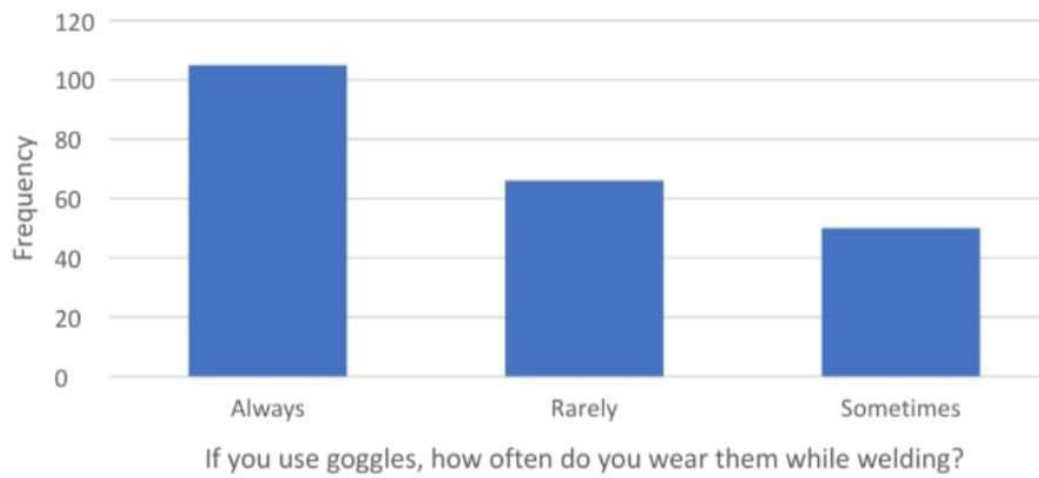
Frequency of goggle use among respondents



Frequency of goggle use among respondents

Statement	Response	Frequency	Percent
Have you ever experienced an eye injury while welding?	No	207	93.7
	Yes	14	6.3
	Total	221	100.0

If you use goggles, how often do you wear them while welding?



Respondents that had eye injuries while welding

Statement	Response	Frequency	Percent
If yes, what type of eye injury did you experience?	None	207	93.7
	Burns	8	3.6
	Foreign objects in the eye	6	2.7
	Total	221	100.0

Variation in eye injuries of respondents while wedding

**Section D: To identify factors influencing the frequency of use of protective ocular goggles among welders.**

Age (years)	Always	Rarely	Sometimes	Total
18–25	24	0	12	36
26–35	33	0	17	50
36–45	27	43	3	73
46–55	21	23	18	62
Total	105	66	50	221

Table 13: Age and Frequency of Goggle Use

Chi-Square = 74.76, df = 6, p < .001

Age was strongly associated with frequency of use ( $\chi^2=74.76$ ,  $df=6$ ,  $p<.001$ ). Younger welders, particularly those aged 18–35 years, reported the highest rates of always wearing goggles, while older welders (36–55 years) were more likely to report using them rarely or sometimes. This suggests that younger welders may be more receptive to occupational safety practices, whereas older welders may have developed complacency over time.

Education Level	Always	Rarely	Sometimes	Total
Primary	34	23	45	102
Secondary	71	43	5	119
Total	105	66	50	221

Table 14: Education and Frequency of Goggle Use

Chi-Square = 50.09, df = 2, p < .001

Education level also played a significant role ( $\chi^2=50.09$ ,  $df=2$ ,  $p<.001$ ). Welders with secondary education were more consistent in always using goggles compared to those with only primary education, indicating that higher educational attainment is linked with better adherence to safety practices.

Experience	Always	Rarely	Sometimes	Total
2–5 years	24	0	15	39
6–10 years	60	0	14	74
11–15 years	0	43	21	64
16+ years	21	23	0	44
Total	105	66	50	221

Table 15: Years of Experience and Frequency of Goggle Use

Chi-Square = 138.24, df = 6, p < .001

Years of experience showed one of the strongest associations ( $\chi^2=138.24$ ,  $df=6$ ,  $p<.001$ ). Welders with 6–10 years of experience were the most consistent users, while those with 11–15 years of experience reported the lowest compliance, mostly using goggles rarely.

Interestingly, welders with more than 16 years of experience showed moderate compliance, while the least experienced group (2–5 years) demonstrated mixed behaviors. These results may reflect a pattern where mid-level and highly experienced welders underestimate their risk exposure compared to those earlier in their careers.

Eye Injury	Always	Rarely	Sometimes	Total
No	97	66	44	207
Yes	8	0	6	14
Total	105	66	50	221

Table 16: Eye Injury Experience and Frequency of Goggle Use

Chi-Square = 7.46, df = 2, p = .024

Eye injury experience was also associated with frequency of use ( $\chi^2=7.46$ ,  $df=2$ ,  $p=.024$ ). Welders who had sustained an eye injury were less likely to report rarely using goggles and more likely to report sometimes or always using them. Prior injury, therefore, appears to reinforce safe practices.

Goggles Available	Always	Rarely	Sometimes	Total
No	24	64	13	101
Yes	81	2	37	120
Total	105	66	50	221

Table 17: Availability of Goggles and Frequency of Use

Chi-Square = 99.81, df = 2, p < .001

Workplace factors emerged as some of the strongest determinants of goggle use. Availability of goggles was highly significant ( $\chi^2=99.81$ ,  $df=2$ ,  $p<.001$ ). Welders who had access to

goggles in their workplaces were much more likely to always use them than those without access

Provided Free	Always	Rarely	Sometimes	Total
No	63	0	19	82
Not Applicable	24	64	13	101
Yes	18	2	18	38
Total	105	66	50	221

Table 18: Free Provision of Goggles and Frequency of Use

Chi-Square = 111.51, df = 4, p < .001

Free provision of goggles also had a strong effect ( $\chi^2=111.51$ ,  $df=4$ ,  $p<.001$ ). Welders who received free goggles reported higher rates of consistent use compared to those who had to purchase their own equipment.

Quality	Always	Rarely	Sometimes	Total
Average	24	51	10	85
Good	3	13	35	51
Excellent	78	2	5	85
Total	105	66	50	221

Table 19: Quality of Goggles and Frequency of Use

Chi-Square = 170.67, df = 4, p < .001

The quality of goggles was the single strongest predictor of compliance ( $\chi^2=170.67$ ,  $df=4$ ,  $p<.001$ ). Welders who rated their goggles as “excellent” reported always using them, while those with “average” or “poor-quality” goggles showed much lower compliance. This

underscores the importance of ensuring that not only are goggles available, but that they meet appropriate quality standards.

Affordability	Always	Rarely	Sometimes	Total
Affordable	33	28	31	92
Expensive	71	38	14	123
Very Expensive	1	0	5	6
Total	105	66	50	221

Table 20: Affordability and Frequency of Use

Chi-Square = 30.00, df = 4, p < .001

Affordability was another important factor ( $\chi^2=30.00$ ,  $df=4$ ,  $p<.001$ ). Welders who considered goggles affordable were more consistent in their use compared to those who regarded them as expensive or very expensive, highlighting cost as a practical barrier to safety compliance.

Training	Always	Rarely	Sometimes	Total
No	46	64	38	148
Yes	59	2	12	73
Total	105	66	50	221

Table 21: Training on Proper Usage and Frequency of Use

Chi-Square = 54.16, df = 2, p < .001

Training on the proper usage of goggles was strongly linked with compliance ( $\chi^2=54.16$ ,  $df=2$ ,  $p<.001$ ). Welders who had received formal training were far more likely to report always wearing goggles compared to untrained welders. This finding emphasizes the critical role of structured training programs in reinforcing safe practices.

## **SECTION E: Recommendation strategies to encourage the use of goggle**

Statement	Response	Frequency	Percent
If you do not use goggles, what is the main reason?		154	69.7
	Goggles are uncomfortable	45	20.4
	Goggles are uncomfortable, goggles are not available	22	10.0
	Total	221	100.0

Table 22: Reasons of respondents not using ocular goggles while welding

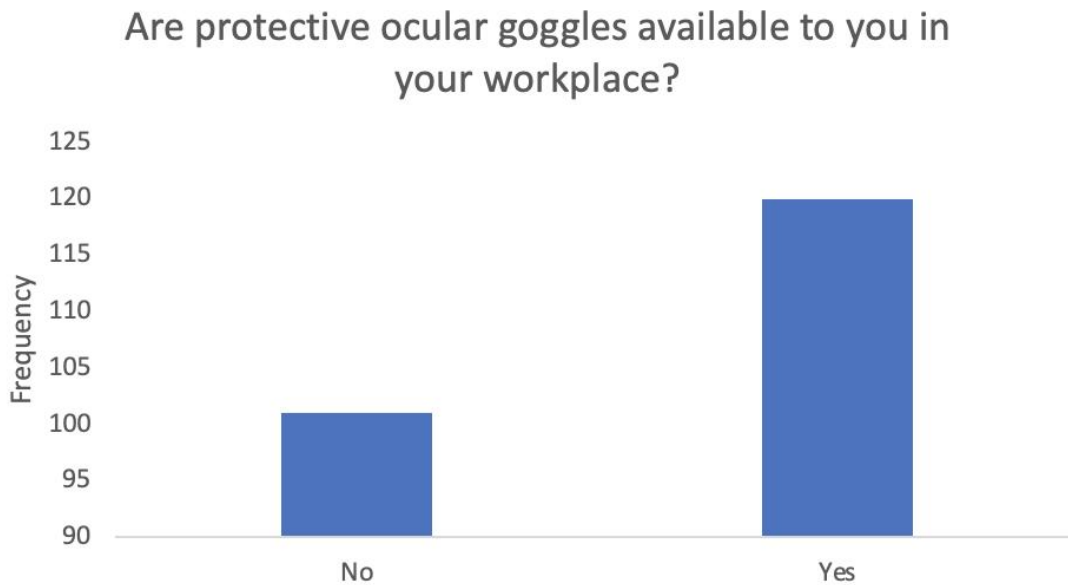


Figure 8: Availability of protective ocular goggles in the workplace of respondents

Statement	Response	Frequency	Percent
Are protective ocular goggles available to you in your workplace?	No	101	45.7
	Yes	120	54.3
	Total	221	100.0

Table 23:

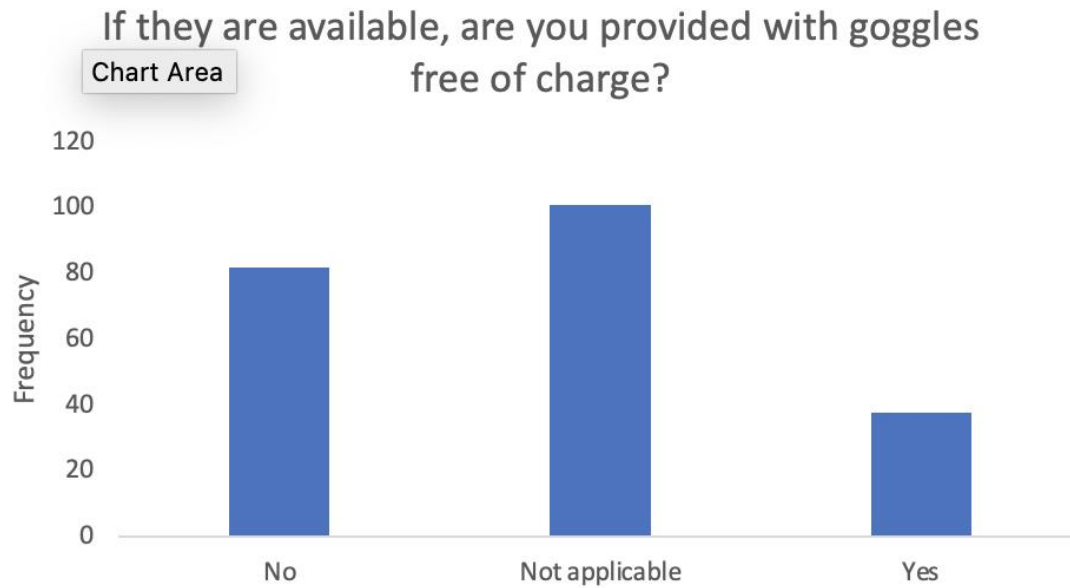


Figure 9: Availability of protective ocular goggles in the workplace of respondents

Statement	Response	Frequency	Percent
If they are available, are you provided with goggles free of charge?	No	82	37.1
	Not applicable	101	45.7
	Yes	38	17.2
	Total	221	100.0

Table 24: Frequency of free provision of goggles for respondents

Statement	Response	Frequency	Percent
If yes, how affordable are the goggles in your area?	Affordable	92	41.6
	Expensive	123	55.7
	Very expensive	6	2.7
	Total	221	100.0

Table 25: Affordability of goggles in the study area

Statement	Response	Frequency	Percent
How would you rate the quality of the protective goggles provided?		85	38.5
	Average	51	23.1
	Good	85	38.5

	Total	221	100.0
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Table 26: Rating of protective ocular goggles provided by the respondents

Statement	Response	Frequency	Percent
Have you ever received formal training on the proper usage of protective goggles in welding?	No	148	67.0
	Yes	73	33.0
	Total	221	100.0

Table 27: Reception of formal training on the proper usage of protective goggles in welding by the respondents

**Would you be interested in attending a training program on eye protection in welding?**

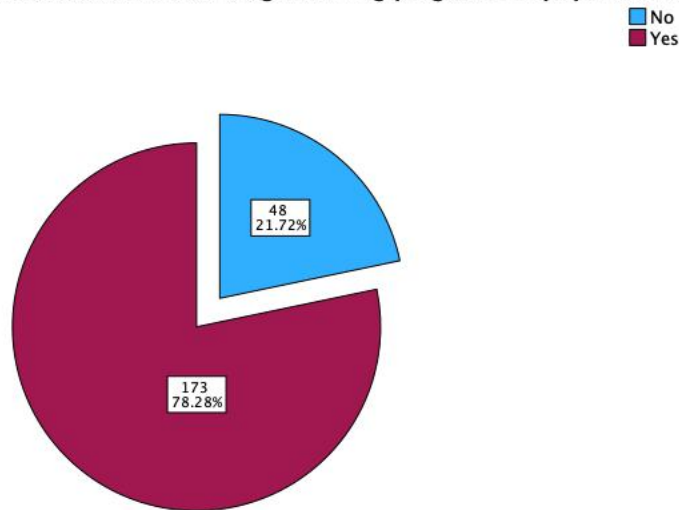


Figure 10:

Statement	Response	Frequency	Percent
Would you be interested in attending a training program on eye protection in welding?	No	48	21.7
	Yes	173	78.3
	Total	221	100.0

Table 28: Interest of the respondents in attending a training program on eye protection in welding

Opinion	Frequency	Percent
Awareness	160	72.4

Affordability	9	4.1
Enforced laws	2	.9
Free goggles	32	14.5
Reduced cost	2	.9
Reduced cost, enforced laws	2	.9
Reduced cost, more comfortable	14	6.3
Total	221	100.0

Table 29: Opinion of the respondents on what can be done to increase the use of protective ocular goggles among welders

**Structured Questionnaire on the Effect of Protective Ocular Goggle Usage Amongst Welders was adapted from Okeigbemen *et al.*, (2012)**

**Demographic Information:**

**1. Age:**

- 18–25     26–35     36–45     46–55

**2. Level of Education:**

- No formal education     Primary education     Secondary education     Tertiary education

**3. Years of Experience as a Welder:**

- 4–7 years     8–11 years     12–15 years     16 years and above

**Section 1: History of Eye Injuries and Protective Goggles**

**5. Are you aware of the potential risk of eye injuries in welding?**

- Yes     No

**6. Do you know what protective ocular goggles are used for?**

- Yes     No

**7. Have you ever been informed about the use of protective goggles in preventing eye injuries?**

- Yes     No

**8. How serious do you think eye injuries are for welders?**

- Not serious     Slightly serious     Very serious

**9. What types of eye injuries do you think can result from welding? (Check all that apply.)**

- Burns     Blindness     Cataracts     Eye infections     None of the above

**Section 2: Usage of Protective Ocular Goggles**

**10. Do you currently use protective ocular goggles while welding?**

- Yes     No

**11. If you use goggles, how often do you wear them while welding?**

- Always     Sometimes     Rarely     Never

**12. If you do not use goggles, what is the main reason? (Check all that apply)**

- Goggles are uncomfortable     Goggles are not available     I don't believe they are necessary     I am not aware of the benefits     Other (please specify): \_\_\_\_\_

**13. Have you ever experienced an eye injury while welding?**

- Yes     No

**14. If yes, what type of eye injury did you experience? (Check all that apply)**

- Burns     Foreign objects in the eye     Temporary blindness     Other (please specify):  
\_\_\_\_\_

**15. If you have used protective goggles, do you feel they have helped prevent eye injuries?**

- Yes     No     Not sure

### **Section 3: Availability and Accessibility of Goggles**

**16. Are protective ocular goggles available to you in your workplace?**

- Yes     No

**17. If they are available, are you provided with goggles free of charge?**

- Yes     No     Not applicable

**18. How would you rate the quality of the protective goggles provided?**

- Excellent     Good     Average     Poor

**19. Have you ever purchased protective ocular goggles for yourself?**

- Yes     No

**20. If yes, how affordable are the goggles in your area?**

- Very affordable     Affordable     Expensive     Very expensive

#### **Section 4: Awareness and Training**

**21. Have you ever received formal training on the proper usage of protective goggles in welding?**

- Yes     No

**22. Would you be interested in attending a training program on eye protection in welding?**

- Yes     No

#### **Section 5: General Comments**

**23. In your opinion, what can be done to increase the use of protective ocular goggles among welders?**