



OCULAR SURFACE DISORDERS AND ADOPTED PROTECTIVE/ TREATMENT MEASURES AMONG NON INDUSTRIAL WELDERS IN MAKURDI LOCAL GOVERNMENT AREA, BENUE STATE NIGERIA

¹OBOH, ROLAND AZIEGBE

¹DEPARTMENT OF OPTOMETRY, FACULTY OF HEALTH SCIENCES MADONNA UNIVERSITY
ELELE, RIVERS STATE NIGERIA

²AMADI, PRECIOUS FRIDAY

²DEPARTMENT OF HUMAN KINETICS, HEALTH AND SAFETY STUDIES, FACULTY OF
NATURAL AND APPLIED SCIENCES, IGNATIUS AJURU UNIVERSITY OF EDUCATION, PORT
HARCOURT RIVERS STATE, NIGERIA

³ONAH ANTHONY

³DEPARTMENT OF OPTOMETRY, FACULTY OF HEALTH SCIENCES MADONNA UNIVERSITY
ELELE, RIVERS STATE NIGERIA

Corresponding Author's E-mail: rolandoboh1@gmail.com Phone +2348038679549

Abstract

Work related ocular disorders are one of the most common health challenges plaguing certain occupations including welding. This study ascertained the frequency and pattern of eye injuries among non-industrial welders in Makurdi LGA Rivers State. A total of 104 welders comprising of 100(96.2%) males and 4 (3.8%) females with age ranges from 16 – 65 years participated in the study. A descriptive observational study design was adopted involving the use of a structured questionnaire to obtain demographic and subjective work related data followed by physical examination of the eyes and surrounding structures using simple ophthalmic equipments. The subjects were selected using a modified random sampling technique and data obtained was analyzed with descriptive and inferential tools of the SPSS (version 25). The result showed that Welders within age group 26 – 35 years which constituted 28.84% reported the highest frequency of eye injuries with 24(23.08), while the 56 - 65 years group with only 7.69% welders reported the least frequency of ocular injuries with 3(2.89%) cases. However, there was no statistically significant association between age and the occurrence of eye injuries ($p>0.05$). Although the males which constituted 96.15% of the Welders reported 70(67.30%) cases of eye injury, there was no statistically significant association between gender and the frequency of eye injuries ($P>0.05$). In respect to the pattern of eye injury, 30(42.25) welders suffered ocular flash burns (ARC eye), 14 (19.77%) welders had pterygium, 13 (18.31%) welders had ocular foreign body 9 (12.68%) had ocular trauma, 3 (4.23%) welders had chemical splash while 2 (2.8%) suffered corneal abrasion within the specified period. In respect to protective eyewear employed, 52 (50.0%) of the welders employed Sun glasses during welding, 18 (17.3%) employed welding Goggles, 13 (12.5%) employed nonprescription transparent Spectacles, 11 (10.6%) employed prescription spectacle Lenses, while only 1 (0.96%) welder used no eye protective device during

welding. However, there was no statistically significant association between type of protective eye device and frequency of ocular injuries ($p > 0.05$). Out of the 71 welders with ocular surface injuries/ disorders within the specified period, 33 (46.48%) opted for self-management, 21 (29.58%) welders opted for professional clinic/ hospital care, 7 (9.86%) opted for local herbal therapy while 10 (14.08%) did not undergo any form of treatment. The study concluded that frequency of eye injuries among welders in Makurdi Benue state was high and recommended health and safety education for welders, provision of affordable eye PPE and enforcement of safety regulations.

Keywords:

Disorders, injuries, non-industrial, ocular, ophthalmic, welders.

INTRODUCTION

Metals and metallic products play a vital role in infrastructural development geared towards enhancing the living standard of inhabitants of modern societies. The welding and fabrication industry in Nigeria has witnessed a tremendous influx due to the high demand for their products/ services, limited formal sector employment and, promotion of skills acquisition and a craving for entrepreneurial activities for economic benefits. While arguably all professions are associated with some form of hazard, the welding profession over time has proven to be particularly challenging for non-industrial welders. Douglas and Karoye-Egbe, (2018) reported that the predominant hazards encountered by road side welders during the welding process include; ocular foreign body, trauma or laceration, conjunctiva degeneration, pterygia, pingueculae, photokerato conjunctivitis, burns, cataract and maculopathy.

Ocular injury in this context referred to a physical or chemical incident as well as a physiological or environmental alteration involving the eyes or associated structures. This could result from a mild to moderate impact or abrasion to the eyes, exposure to toxic chemicals, radiations from the environment or major trauma which could result to more severe outcomes. Prabhu et al, (2017) were of the view that eye injuries are common and constitute a major cause of preventable blindness and a common cause of visual morbidity occurring at workplaces worldwide. Mir et al., (2014) posited that the eye is the third most common organ affected by injuries apart from the hands and feet. Ihekaire and Oji, (2017) reported that over 2.5 million people globally succumb to eye injury and more than 500,000 blinding injury occurs annually.

Mir et al., (2014) posited that eye injuries do not occur as random events as there are empirical evidence that some individuals have increased risk of eye injuries as a result of exposure to hazards or the inability to avoid and detect hazards Majority of eye injuries have a direct link with occupation and the nature of activity at the time of the injury. In other words, some individuals have high risk of suffering occupationally related eye injuries among which include Welders, Quarry workers, Saw Millers among others. Though welding is an occupation that poses exceptional risk to the eye, Welders are an important occupational group particularly, in developing countries like Nigeria, owing to the advent of urbanization and industrialization which requires labour-oriented services and efforts to transit towards automation and mechanization

(Ganesh et al, 2013). This will in-turn reduces the contact frequency and duration between man and machines during the welding process.

Islam et al (2020) reported that eye injuries account for a substantial proportion of all work related injuries, including 12% of all workers compensation claims among welders and 11% of all injuries to construction workers requiring an emergency room visit. A Canadian study by Reesal et al (2014) reported that welders represent 21% of all eye injury claims, while the US Bureau of Labor Statistics (BLS) reported that welders, cutters, and welding machine operators held about 521, 000 jobs in 2022. The welding process exposes workers to a number of mechanical, radiant, thermal, or chemical energy (Pabley & Keeney, 2013). A two year study of eye injury among workers in automobile manufacturing reported that 15% of the most common types of ocular injuries such as foreign body, corneal abrasion, and chemical injury were welding related (Wong et al, 2012). A previous study by Omoti, et al, (2013) done in Nigeria to determine the pattern of non-traumatic ocular disorders found a prevalence of Ocular disorders to be 66.4% of the total eye injuries.

Ocular injuries resulting from physical or chemical agents could pose a serious threat to vision if not treated promptly and appropriately. Welding in developing countries like Nigeria is a growing industrial process, widely used for fabrication of metal parts for domestic and industrial purposes. Antonini, (2020) classified the more common welding processes as electric (arc) welding, gas, resistance, energy beam and solid-state welding. Atukunda (2019) was of the view that the different types of welding are associated with one form of hazards and the welders are constantly exposed to the risk of ocular injuries and disorders from the welding process which is one of the highest artificial sources of visible and invisible optical radiation. The adverse effects of welding stem from the prolonged exposure to visible light rays, infrared and ultraviolet (UV) radiation, all of which are emitted in various degrees by various types of welding (Dixon & Dixon, 2018). The long term exposure to ultraviolet radiation is associated with conditions such as pterygia, pingueculae, keratopathy, maculopathy and eye irritation, among others (Iyiade, & Omotoye, 2019).

Other consequences of emissions from welding include: photo kerato conjunctivitis, chronic actinic keratopathy, photophthalmia and corneal opacity which may be permanent and sight-threatening (Atukunda, et al 2019). Welders are also at a high risk of eye injuries such as traumatic mydriasis, traumatic iritis and foreign bodies due to flying metal chips and thermal burns (Kumar & Dharanipriya, 2014). Some studies have reported that the prevalence of these disorders is higher in developing countries due to the poor organization and policy implementation regarding occupational safety. A classic example of urbanization induced work related eye injuries was painted by by Okuga, et al (2019) which reported that the increased industrialization in Kampala city, Uganda witnessed an increase in small-scale industries; an increase in welding practice and occupational eye diseases. Previous studies have shown that occupational eye disorders are very disabling, and most frequently affects the active and most productive age group consequently leading to enormous vocational and economic consequences to the national economy, employers individual welder's family and the health system (Oboh et al. (2019).

The impact of these injuries is made worse by the poor or non adherence to safety regulations and safety practices. Pabley and Keeney, (2015) opined that the mainstay of ocular protection from welding arc radiation is an infrared absorbing green glass filter placed within the welder's helmet. The helmet also offers further protection from mechanical injury in addition to absorbing harmful radiation. In developing countries, workers seldom put on goggles or safety glasses, because of low risk perception, poorly maintained lenses, discomfort, having to wear prescription lenses underneath, and a plethora of flimsy excuses. The lack of knowledge on the use of protective gear during welding further fuels the welders' non-compliance. Many developing countries lack laws or policy that regulate or enforces the use of protective wear especially among the small-scale informal sector welders.

Welding is a major cause of eye injuries in the society and some of these injuries can be very disabling which may have great vocational, socioeconomic and psychological consequences on the welder, his family and dependents. Globally, injuries cause significant economic loss. According to Occupational Safety and Health Administration (OSHA), occupational eye injuries cause an economic loss of around \$300million each year (Prabhu et al., 2017). Welding produces fumes, sparks, radiations and metal debris which may be hazardous to the eyes. Lombardi et al., (2005) in their study reported that welding increases the risk of eye injuries by four fold. Eye injuries are a major cause of visual impairment and preventable blindness in the world. The use of ocular personal protective equipment (eye PPE) plays a significant role in ensuring the safety and welfare of welders. Despite the availability of these PPEs, eye injuries among welders within Makurdi metropolis persist as non-industrial welders are often seen working without protective devices.

Statement of the Problem

There exist occupational hazards and safety challenges in every workplace. However, the challenging economic situation and vast unemployment in most developing countries like Nigeria and particularly in Makurdi Benue State has led to an increase in informal sector artisanal engagements. Welding is one of the most sought after artisanal employment in Nigeria regardless of the inherent hazards associated with it hence the need for safety compliance by industry players. Despite the enormous workforce engaged in the welding industry and the inherent hazards, there appear to be a lack of coordination, implementation and enforcement of safety measures. This poses a threat to the present ocular and future health of players in the industry. In many parts of Nigeria, dotted by roadside welding workshops, welders are often seen working unprotected or with the inappropriate safety gear, thus posing a risk to their ocular and general health. This situation is made worse by the inattention of statutory safety enforcement agencies, small scale welding entrepreneurs and individual welders. This investigation was designed to ascertain the pattern of eye injury, preferred eye PPE and adopted management options among welders in the study area and proffer recommendations with a view to enhance work place safety practices among welders with a view to safeguarding their ocular and general health.

Objectives of the Study

This study determined the frequency and pattern of ocular injuries among non-industrial welders in Makurdi, Benue State Nigeria. In specific terms this study sought to;

- ascertain the pattern of eye injuries among non-industrial welders in Makurdi LGA of Benue State, Nigeria.
- find out the association between the type of welding and pattern of eye injury among non-industrial welders in Makurdi LGA of Benue State, Nigeria.
- to determine the type of eye PPE employed by non-industrial welders in Makurdi LGA of Benue State, Nigeria.
- find out the treatment measures adopted following an eye injury/ disorders by non-industrial welders in Makurdi LGA of Benue State, Nigeria.

METHODOLOGY

Area of Study

The study took place in Makurdi Local Government Area of Benue State, North Central Nigeria between January to June 2024 involving 104 non industrial welders. A descriptive observational study design was adopted involving the use of a structured questionnaire to obtain subjective data on work related eye injury followed by physical examination of the eyes to ascertain signs of work related eye injuries using simple ophthalmic equipments. A similar design was used by Oboh et al (2019) to ascertain the awareness and compliance with protective eye wear among welders in Obio/ Akpor LGA of Rivers State Nigeria.

Sampling

The sample size consisted of 104 welders from 34 welding workshops in the study area who consented to this study. The sample was determined using Cochran's formula with adjustment for finite population.

$$no = Z^2pq/e^2$$

Where: Z = 1.96 (95% confidence level), p = estimated prevalence (assume 50% = 0.5 for maximum variability), e = margin of error (e.g., 10%) and q= 1-p.

$$no. = 1.96^2(0.5 \times 0.5)/(0.10)^2$$

$$no. = 3.8416 \times 0.25/0.01 = 96.04$$

Adjusting for finite population

$$n = no/1 + no-1/N$$

$$n = 96.04/1 + 95.04/750 = 96.04/1 + 0.1267 = 96.167$$

The derived sample size was approximately 96, however 104 welders participated in the study

Sampling Technique and instrumentation

The study participants were selected using a modified random sampling technique. For small scale welding facilities hosting three welders or less, all subjects who consented to partake in the study were included while for workshops hosting four or more welders, participants were selected through a simple random (balloting) process. Subjects who met the inclusion criteria were issued study numbers after sampling and a scheduled date fixed for data extraction.

The instruments employed for this study was pre-tested on 20 welders in Agatu local government area of Benue state and re-administered 2 weeks later to the same subjects after which the data from both exercises were correlated using the Pearson Moment Correlation and a reliability coefficient of 0.75 was obtained.

Validity/ Reliability of the Instruments

Questionnaire: The structured interviewer-administered questionnaire used in this study was adapted and modified from a previously validated instrument developed by Atukunda et al. (2019), which has been used in occupational eye health research. To ensure content and face validity, the questionnaire was reviewed by two experts from the faculty from the Faculty of Health Sciences, Madonna University Nigeria to confirm that the items accurately reflected the objectives of the study and pretested.

Ophthalmic Instruments: The clinical tools employed in this study are widely accepted for routine optometric and ophthalmologic evaluations and approved by relevant authorities such as the World Council of Optometry (WCO) and the Optometrist and Optician Dispensing Registration Board of Nigeria (ODORBN). The procedures for using these instruments followed established clinical guidelines to maintain accuracy. Pre-testing was conducted on 20 welders in Agatu LGA of Benue State to assess clarity, relevance, and flow of questions. Minor modifications were made based on feedback to improve comprehensibility and cultural appropriateness and the procedure repeated two weeks later. Results from both tests were evaluated and a reliability coefficient of 0.70 was obtained. This process was to ensure that the instruments meet the requirements of the study in line with its objectives.

Data Analysis

Data collected from this study were entered into the Microsoft Excel spreadsheet and analyzed using the iCalcu.com Chi-square calculator, guided by the study objectives. Descriptive statistics (frequencies and percentages) were used to summarize participants' socio-demographic characteristics, oculovisual conditions, and symptoms, protective eyewear preference and treatment option. Chi-square (χ^2) test of independence was employed to test association between selected variables at the 0.05 level of significance.

RESULTS

A total of 104 welders were involved in this study comprising of 100 (96.2%) males and 4 (3.8%) females. Their ages ranged from 16 - 63 years with a mean age of 34.3 (+11.8SD). The 26-35

years age group constituted the largest proportion with 30 (28.84%) welders while the 56 – 65 years group constituted the least proportion with 8 ((7.69%) welders as shown in table 1. .

Table 1: Demographic profiles of non-industrial welders in Makurdi, Benue state Nigeria.

Variables	Frequency (N=104	Percentage (%)
Age (Years)		
16 – 25	28	26.92
26 – 35	30	28.85
36 – 45	24	23.08
46 – 55	14	13.46
56 - 65	8	7.69
Total	104	100.00
Gender		
Male	100	96.15
Female	4	3.85
Total	104	100.00
Educational level		
None	14	13.46
Primary	34	32.69
Secondary	46	44.23
Tertiary	10	9.62
Total	104	100.00

Table 1 above also shows that 34 (32.7%) of non-industrial welders in Makurdi LGA of Benue state Nigeria had primary/ basic level education, 46 (44.2%) had secondary education while 10 (9.6) had tertiary level education.

Prevalence of Eye injuries among non-industrial welders in Makurdi, Benue state Nigeria

Table 2: Prevalence of Eye injuries among non-industrial welders in Makurdi, Benue state Nigeria

Variable (Ocular Injury)	Frequency	Proportion (%)
Yes	71	68.27
No	33	31.73
Total	104	100.00

Table 2 above showed that out of 104 non industrial welders who participated in the study, 71 (68.3%) had suffered welding related ocular injuries while 33 (31.7%) had no remarkable ocular involvement within the specified period.

Table 3: Distribution of Ocular Injuries among non-industrial welders in Makurdi, Benue state Nigeria

Variable	Frequency of subjects	Occurrence of eye injury		p value
		No	Yes	
Age				
16 – 25	28 (26.92)	14(13.46)	14(13.46)	
26 – 35	30 (28.84)	6(5.77)	24(23.08)	
36 – 45	24 (23.07)	4(3.85)	20(19.23)	
46 – 55	14 (13.46)	4(3.85)	10(9.62)	
56 – 65	8(7.69)	5(4.81)	3(2.89)	
Total	104(100.00)	33(31.73)	71(68.27)	0.15
Gender				
Male	100(96.15)	30(28.85)	70(67.30)	
Female	4(3.85)	3(2.88)	1(0.96)	
Total	104(100.00)	33(31.73)	71(68.27)	0.58
Educational level				
None	14(13.46)	4(3.88)	10(9.62)	
Primary	34(32.69)	4(3.88)	30(28.85)	
Secondary	46(44.23)	16(15.53)	30(28.85)	
Tertiary	10(9.62)	9(8.65)	1(0.96)	
Total	104(100.00)	33(31.73)	71(68.27)	0.00
Duration of welding				
< 5 hours	27(25.96)	5(4.81)	22(21.12)	
6 – 10 hours	49(47.12)	7(6.73)	32(30.77)	
>10 hours	28(27.03)	11(10.58)	27(25.96)	
Total	104(100.00)	33(31.73)	71(68.27)	0.211

Table 2 above showed that welders within age group 26 – 35 years which constituted 28.84% reported the highest frequency of eye injuries with 24(23.08), while those above 55 years with only 7.69% of welders reported the least frequency of ocular injuries with 3(2.89%). However, there is no statistically significant association between age and the occurrence of eye injuries ($p>0.05$). Similarly, there is no statistically significant association between gender and the occurrence of ocular injuries, though the males with a significantly higher proportion of subjects (96.15%) reported a higher frequency of ocular injury with 70(67.30%) cases. However, there was no statistically significant association between gender and the rate of eye injuries ($P>0.05$) though the male subjects with higher representation reported more ocular injuries than the females. In respect to level of education, welders who had primary and secondary school level of education constituted 34(32.69%) of subjects reported the highest frequency of injuries with 30(28.85) of cases respectively. Similarly, there is a statistically significant association between ocular injuries and level of education. There was also no significant relationship between daily duration of welding and the rate of ocular injuries ($P>0.05$), though 49 (47.12%) welders who put

in 6 – 10 hours of welding daily reported the highest frequency of eye injury with 49(47.12%) cases within the specified time frame as shown in table 3.

Table 3: Pattern of eye injuries among non-industrial welders in Makurdi, Benue state Nigeria

Eye Injury	Frequency (n)	Percentage (%)
Foreign body	13	18.31
Ocular flash burns	30	42.25
Eye trauma	9	12.68
Chemical injury burn	3	4.23
Pterygium	14	19.72
Corneal abrasion	2	2.81
Total	71	100.00

Table 3 showed a combination of observed signs and reported symptoms indicated that 30(42.25) of welders had ocular flash burns (ARC eye), 14 (19.77%) had pterygium 13 (18.31%) had ocular foreign body 9 (12.68%) had ocular trauma 3 (4.23%) had chemical splash while the least were those with corneal abrasion with a frequency of 2 (2.8%) within the specified period.

Table 4: Types of eye injuries associated with the different welding types among non industrial welders in Makurdi, Benue state Nigeria

Nature of ocular injury	Type of Welding		Total
	Gas Welding	Electric welding	
Foreign body	10(14.08)	3(4.23)	13(18.31)
Ocular Flash burn	7(9.85)	23(32.39)	30(42.25)
Blunt trauma	3(4.23)	6(8.45)	9(12.68)
Chemical Injury	2(2.82)	1(1.41)	3(4.23)
Pterygiua/ pinguecula	3(4.23)	11(15.49)	14(19.72)
Corneal abrasion	1(1.41)	1(1.41)	2(2.82)
Total	26(36.62)	45(63.38)	71(100.00)
p value.	0.004		

Table 4 showed that ocular injuries among electric welders were significantly higher 63.4% compared to those associated with gas welders 36.6%. Similarly there was a statistically significant association between the welding type and the eye injuries among non industrial welders in Makurdi Benue state Nigeria.(p = 0.04)

Table 5: Commonly used protective eye device among welders in Makurdi, Benue state Nigeria

Protective eye device	Frequency	Percentage (%)
Welding helmet with filters	9	8.7
Welding goggles	18	17.3
Dark Sun glasses	52	50.0
Transparent Plane glasses	13	12.5

Prescription Lens Spectacles	11	10.6
None	1	0.9
Total	104	100.00
p value	0.517	

Table 5 showed that 52 (50.0%) of the welders employed sun glasses during welding, 18 (17.3%) employed welding goggles, 13 (12.5%) employ transparent glasses, 11 (10.6%) employed their spectacle lens prescription while only 1 (0.96%) welder employed zero eye protective device during welding. However, there was no statistically significant relationship between type of protective eye device and frequency of ocular injuries ($P>0.05$).

Table 6: Treatment measures adopted following eye injuries among welders in Makurdi, Nigeria

Adopted Treatment measure	Frequency	Percentage
Local herbs	7	9.86
Hospital/ clinic	21	29.58
Self prescription	33	46.48
Irrigation (eye flushing)	10	14.08
Total	71	100.00

Table 6 showed that out of the 71 welders who suffered injuries within the specified period, 33 (46.48%) opted for self-prescription, 21 (29.58%) sought for professional care from a clinic or hospital, 7 (9.86%) opted for local herbal products/ therapy while 10 (14.08%) did not undergo any treatment but washed their eyes with w after the injury.

DISCUSSION

A total of 104 welders participated in the study comprising of 100 (96.2%) and 4 (3.6%) females with male: female ratio of 25: 1. The age of the welders ranged from 16 to 65 years with a mean age of 34.3 ± 11.8 with welders within 26 – 35 years constituting the highest proportion. The gender distribution is similar to findings by Oboh, et al (2019) in a study on awareness and compliance to protective eye wear among welders in Obio/Akpor LGA of Rivers state which involved 101 (98.1%) males and 2 (1.9%) females. This slightly differ from findings from an earlier study by Davies et al (2010) conducted in Calabar, Nigeria where all the participants (welders) were males. However, both findings affirm the notion that welding is a male dominated profession where the major players are the youthful population.

This study observed that the prevalence of eye injury among non-industrial Welders in Makurdi Benue state Nigeria was 68.3%. This aligns with results obtained in studies conducted by Fiebai and Awoyesuku (2011) in Port Harcourt and Sithole et al., (2009) in South Africa which reported the prevalence of eye injuries among welders to be 61% but appreciably lower than 84.5% reported by Ganesh et al., (2014) in India. This study observed that the most common ocular injury among welder in Makurdi, Benue state Nigeria was ocular flash burn 30 (42.6%), ocular

surface growth 14 (19.7%), superficial foreign body 13 (18.3%) while the least was ocular surface abrasion involving only 2 (2.81%) welders. This finding aligns with a study done in Pakistan by Shaikh (2008) which reported ocular foreign body as one of the leading eye injuries sustained by a group of 208 welders. Injuries from metallic particles could arise from the process of shaping them into the desired form.

In regards to demographic characteristics of respondents with respect to the ocular injuries, this study observed that participants between age group 36-45 years had the highest prevalence 20 (83.3%) of ocular injuries as compared to other age groups. Also ocular injuries were higher among male welders 70 (70.0%) than females and was seen to be higher among those who had primary education with 30 (88.6%) cases when compared with other levels of education as shown in table 3. This finding aligns with a study conducted by Atukunda et al (2019) in Kampala which observed that educational level is a major factor that can influence the prevalence of ocular injuries among welders.

In respect to daily duration of active welding activities, the study observed that welders who put in 6 – 10 hours of welding daily reported the highest frequency of eye injury with 49 (47.12%) case. However here was also no statistically significant association between daily duration of welding and the rate of ocular injuries ($P>0.05$). The increased frequency of eye injuries among non-industrial welders who put in more time in active welding could be due to prolong ocular exposure to the intense work conditions, general/ visual fatigue and loss of concentration.

In respect to the type of welding, table 4 showed that electric arc welders had higher prevalence of ocular injury with 45(63.4%) cases, compared to gas welders with 26 (36.6%) cases. This agrees with a study by Nartey et al. (2017) which found electric welding to be more hazardous. This may be due to the nature of electric welding which emits intense radiation with a brighter flame (Davis *et al.*, 2010). Similarly, this study indicated that there was a statistically significant relationship between type of welding and frequency of eye injuries among welders in Makurdi Benue state Nigeria.

The study as shown in table 5 indicated that 52 (50.0%) of the welders employed sun glasses during welding, 18 (17.3%) employ welding goggles, 13 (12.5%) employ plane transparent glasses, 11 (10.6%) employ their spectacle lens prescription while only 1 (0.96%) welders employed no eye protective device during welding within the specified period. However, there was no statistically significant relationship between type of protective eye device and frequency of ocular injuries ($P>0.05$). The predominant employment of dark Sun glasses among welders in Makurdi Benue state, although inappropriate could be linked to availability, affordability and preference. In regard to treatment options adopted by welders following an eye injury of ocular surface disorder, the study observed that 33 (46.5%) resorted to self prescription by purchasing drugs from local drug stores or pharmacies, 21 (29.6%) sought professional care from hospitals/ clinics, 10 (14.1%) applied irrigation by washing their eyes with water while 7 (9.9%) welders applied local herbal products as shown in table 6. The reason behind the preferred treatment option adopted by welders in Makurdi Benue state Nigeria could be attributed to the level of awareness, health seeking behavior, availability and affordability of care within the locality.

CONCLUSION

The prevalence of ocular injuries among non-industrial welders in Makurdi, Benue State was relatively high and more predominant among welders between the ages of 26 – 35 years with the majority of injuries suffered by electric (Arc) welders. The most common ocular injuries were ocular flash burns, pterygium and ocular foreign body and were mostly associated with electric welding just as welders who spent longer duration in active welding daily suffered more eye injuries. While compliance to eye PPEs was relatively low, the most adopted protective gear was sun shades while majority of welders who suffered ocular injuries relied on self prescription management option. While welding related ocular injuries are largely preventable, there is a statistically significant association between level of education, compliance to the use of eye PPE as well as type of welding and ocular injury.

RECOMMENDATIONS

The following recommendations were drawn from the findings of this study;

1. Welding entrepreneurs and other stakeholders should educate welders on the benefits of consistent use of eye and face protection through periodic seminars in collaboration with ocular safety professionals and eye care practitioners.
2. Government should encourage manufacturers of optical devices by way of tax relief, grants or subsidy to produce face affordable eye PPEs for welders and related professionals
3. Health safety inspectors should carry out periodic visits to welding sites to assess safety compliance, job place hazards, emergency preparedness and availability of first aid
4. Welders and associated professionals should put the appropriate PPE and also seek professional care by consulting qualified eye care practitioners in the event of a work place eye injury.
5. Employers of labour should put in place policies and measures to monitor safety compliance and reward safety compliant welders as well as punish defaulters and other practices which could pose a threat to self or colleagues.

CONTRIBUTION TO KNOWLEDGE

This study contributed to the existing body of knowledge by:

1. Providing updated epidemiological data on the pattern of oculovisual disorders among non-industrial welders in Makurdi, Benue State.
2. Reinforcing the need for practical public health interventions, despite statistical limitations, based on descriptive associations.
3. This study provided localized empirical data that could guide health planning and intervention programs targeted at artisanal workers in Nigeria.

ETHICAL APPROVAL

Ethical approval to conduct this study was obtained from the Research ethics committee of Madonna University Nigeria and copies the letter of introduction from the Department of optometry Madonna University Elele campus was handed to the chairman of the professional welders association Benue State branch Nigeria.

ACKNOWLEDGEMENT

The researchers wish to express their gratitude to the dean, School of post graduate studies and the head, department of Optometry, Madonna University Nigeria, Elele Campus as well as the Professional Welders association, Benue state Chapter for their cooperation and support.

SOURCE OF FUNDING

This research was solely funded by the researchers involved in the study.

CONFLICT OF INTEREST

The researchers hereby declare that there was no conflict of interest in the study and its reported findings.

REFERENCES

- Antonini, J. M. (2020). Health effects of welding. *Critical Review of Toxicology*. 33(1), 61–103.
- Atukunda, I., Lusobya, R.C., & Ali, S.H. (2019). Prevalence, pattern and factors associated with ocular disorders in small-scale welders in Katwe, Kampala. *BMC Ophthalmology* 19,145 . <https://doi.org/10.1186/s12886-019-1150-x>
- Davies, K. G., Asana, U., Nku, O., & Osim, E. E. (2010). Ocular effect of prolong exposure to welding light among welders in Calabar Nigeria. *Nigerian Journal of Physiological Sciences*, 22,1-5. <https://doi.org/10.4314/njps.v22i1-2.54895>.
- Dixon, A. J., & Dixon, B. F. (2018). Ultraviolet radiation from welding and possible risk of skin and ocular malignancy. *Medical Journal of Austria* .181(3),155–157.
- Fiebai, B., & Awoyesuku, E. A. (2011). Ocular injuries among industrial welders in Port Harcourt Rivers state Nigeria.. *Clinical Ophthalmology*, 5, 1261–1263.
- Ganesh Kumar, S., Dharanipriya, A., & Kar, S. S. (2013). Awareness of Occupational Injuries and utilization of safety measures among Welders in Coastal South India. *International Journal of Occupational and Environmental Medicine*, 4(4), 172–177.
- Ganesh-Kumah, S., & Dharanipriya, A. (2014). Prevalence and pattern of occupational injuries at workplace among welders in coastal south India. *Indian Journal of Occupational & Environmental Medicine*, 18(3), 135–139.
- Ihekaire, D. E., & Oji, C. S. (2017). Corneal Injuries Associated with Ocular Hazards in the Welding Industry: A Case Study of Nekede Mechanic Village Nekede , Imo State , Nigeria. *International Journal of Ophthalmology & Visual Science*, 2(2), 37–54. <https://doi.org/10.11648/j.ijovs.20170202.12>

- Islam, S.S., Doyle, E.J., & Velilla, A. (2020). Epidemiology of compensable work-related ocular injuries and illnesses: Incidence and risk factors. *Journal of Occupational Environmental Medicine*, 42, 575–581
- Iyiade, A.A., & Omotoye, O.J. (2019). Pattern of eye diseases among welders in a Nigeria community. *African Health Science*, 12(2), 210–216.
- Kumar, S.G., & Dharanipriya, A. (2014). Prevalence and pattern of occupational injuries at workplace among welders in coastal South India. *Indian journal of occupational and environmental medicine*, 18(3):135.
- Lombardi, D. A., Pannala, R., Sorock, G. S., Wellman, H., Courtney, T. K., Verma, S., & Smith, G. S. (2005). Welding related occupational eye injuries: a narrative analysis. *Injury Prevention*, 11, 174–179. <https://doi.org/10.1136/ip.2004.007088>.
- Mir, M. D., Jehan, A., Qadri, S. S., Wani, R. M., Bashir, H., & Shafi, T. (2014). An Epidemiological Study On Prevalence And Pattern Of Ocular Injuries In Kashmir Valley – A Conflict Zone. *International Journal of Medical Science and Public Health*, 3(3), 3–6. <https://doi.org/10.5455/ijmsph.2014.160220141>
- Nartey A., Tchiakpe M. P., Kobia-Acquah E., Ankamah-Lomotey S. & Ankrah B. A. (2017). Eye injuries among heavy Industry workers in Tema Metropolis, Ghana. *International Journal of Development Research*, 7, (10), 108 - 114.
- Oboh, R.A., Onwukwe, N.A. & Nwafor, S.U. (2019). Awareness and compliance with protective eye wear among Welders in Obio/ Akpor LGA, Rivers State Nigeria. *International Journal of Medical science & Applied Bioscience*, 4(3), 48 - 59
- Okuga, M., Mayega, R., & Bazeyo W. (2019). Small-scale industrial Welders in Jinja municipality, Uganda. *African Newsletter*; 22(2):35.
- Omoti, A., Edema, O., & Aigbotsua, P. (2019). Non-traumatic ocular findings in industrial technical workers in Delta state, Nigeria. *Middle East African journal of ophthalmology*. 16(1), 20 - 25.
- Pabley, S., & Keeney, H. (2015). Welding processes, ocular hazards and new protective devices. *Indian Journal of Ophthalmology*; 32(5), 347.
- Prabhu, M., Rokhade, R., Chandra, K. R. P., & Kakhandaki, A. (2017). A study of awareness and use of personal protective eyewear among welders in a tier 2 city in South India. *Indian Journal of Clinical and Experimental Ophthalmology*, 3(3), 356 - 360. <https://doi.org/10.18231/2395-1451.2017.0087>
- Reesal, M.R., Dufresne, R.M., & Suggett, D. (2014). Welders eye injuries. *Journal of Occupational Medicine*; 31, 103 - 106.
- Shaikh, M.A. (2008). Hazard perception and occupational injuries among welders and Laithe machine operators of rawalpindh and Islamabad. *Journal of Pakistan Medical Association*, 12(41), 187 - 188
- Sithole, H.L., Oduntan, O.A. & Oriowo, M.O. (2009). Eye protection practices and symptoms among Welders in the Limpopo province of South Africa. *African Vision and Eye Health Journal*, 68(3), 130 - 136.
- Wong, T.Y., Lincoln, A., & Tielsch, J.M. (2012). The epidemiology of ocular injuries in a major US Automobile corporation. *Eye*; 12, 70 –74.