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Predominant ocular challenges and protective eyewear compliance among welders in Port Harcourt mechanic and steel villages, Rivers State, Nigeria

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Abstract

Purpose: Welding is associated with several ocular and systemic hazards especially where adequate protective measures are not observed resulting in occupational eye challenges which constitutes an appreciable proportion of ocular morbidity, The purpose of this study was to ascertain the pattern of major ocular challenges (symptoms and signs) among welders in the Port Harcourt Mechanic and Steel Villages Rivers State, Nigeria and the level of compliance to the use of protective eye wear during work...

Methodology: The study which took place at the work sites of the participants adopted a combination of physical eye examination and a survey to find out history of previous ocular injuries and predominant symptoms experienced. A total of 103 welders sampled from two study sites located in two local government areas LGAs of Rivers State participated in the study which involved the use of a well structured interviewer-administered pre-tested and validated questionnaire to ascertain frequently experienced ocular complaints and previous work related ocular injuries, followed by detailed external examination of the eyes and surrounding structures for signs of ocular surface abnormalities resulting from welding related activities. Data generated from the study were analyzed using descriptive and inferential statistical tools of the statistical package for social sciences (SPSS) version 25. Results were presented descriptively using tables and charts while Chi Square statistics was employed to test for statistically significant association at an alpha level of 0.05 ($p< 0.05$).

Results: 88.3% of the welders involved in the study were aware that welding could cause harm to their eyes which could be prevented by the use of protective eyewear, 7.8% disagreed, while 3.9% had no idea Only 5.8% of welders complied regularly, 60.2% complied occasionally, 28.2% complied sparingly while 5.8% have never used a protective eyewear before. All (100%) of the welders who have never complied fall within the youngest age group (16 – 25 years). There was no statistically significant association between the age of welders and compliance to protective eyewear($p< 0.05$) While 22.3% of welders have no remarkable eye complaint, the

most frequent eye symptoms among welders in order of decreasing proportion were sandy sensation (30.1%), cloudy vision (22.3%), painful red eyes (18.5%), watery eyes (3.9%) and itchy eyes (2.9%). The distribution of ocular surface abnormalities in order of decreasing proportion include Pinguecula (31.1%), Pterygium (21.4%), Conjunctiva discoloration (14.6%) and Corneal opacity (3.9%). Also, there is a statistically significant association between age of welders and eye symptoms experienced and predominant ocular surface abnormalities observed.

Unique Contribution to Theory, Policy and Practices: Findings from this study can be used by government agencies, employers, vocational training institutions and other stakeholders to formulate policies and guide for welders and other artisans to inculcate better work ethics in order to enjoy the benefits of regular compliance to the appropriate protective eyewear and prevent the negative effects of poor compliance. The study findings also reemphasized the need for a well articulated health insurance policy for workers in the informal sector employment to safeguard their ocular and general health. The urgent need for a subsidy regime on the price of quality protective devices and incentives for local production of quality protective eyewear should be looked into... Lastly, welders and eye care practitioners can tap from the findings to fine-tune their policies and practices to ensure ocular safety and better management/ care for welding related eye challenges.

Keywords; *Compliance, Protective eyewear (PEW), Ocular assessment Ocular injuries, Welders.*

INTRODUCTION

Welding is an important tool for maintenance and construction in domestic and industrial set ups but could be hazardous to the eyes and other parts of the body due to the physical activities and materials involved and the potentially harm from flying metals and harmful radiation it produces. The eye is one of the most sensitive sense organs of the human body and it plays an important role in our daily life (Oriowo, 2009). A seriously impaired eye either from injury or disease may not function well in terms of seeing but one can to some extent make use of a leg or hand that has suffered from a serious injury or disease (Franck, 2006). According to Mir *et al* (2014), the eye is the third most common organ affected by injuries after the hands and feet. Globally more than 2.5 million people succumb to eye injuries and more than 500,000 blinding injuries takes place annually (Ihekaire and Oji, 2017).

Occupational injuries particularly those involving the eyes are common among workers in the welding/metal fabrication industry and could have a major impact on their general health, wellbeing and livelihood. The hazards associated with the welding process depend on a number of factors among which include; the type of welding, the materials (base metals, surface coatings, electrodes) to be welded, the welding environment (outside or in a confined space), the technique adopted and dexterity of the weld operator (Sithole, Oduntan and Oriowo, 2009) It is vital that appropriate eye protection be used for all welding operations to protect the eyes from potential injuries and prevent avoidable blindness in line with the goals and strategies of the international agency for the prevention of blindness (IAPB) and the World Health Organization.

Regardless of the claim that all occupations are associated with some form of hazards, it is a well-known fact that some occupations are comparatively more hazardous or risky. The welding profession, especially in developing countries belongs to this category of hazardous occupations with a relatively high potential for the work force to suffer harm/ injury involving but not limited to the eyes. This is so because safety practices/ culture are lacking for unjustifiable reasons. This pose a major occupational health challenge as it involves the eyes, one of the most sensitive organs in the human body, playing a vital role in our day to day life. Injuries caused by metal and its products especially to the eyes can result to immediate and long-term problems to individuals involved, their dependent, relatives and society. Despite the large number persons, especially youths engaged in welding, there seem to be little or no regulation and enforcement of compliance to protective eye devices by the appropriate government agencies and relevant stakeholders.

Welding and fabrication industry in Nigeria have witnessed a tremendous influx due to the current economic situation and a craving for entrepreneurial activities for sustainability purposes. Some health threatening hazards are encountered by welders during the welding process; resulting in ocular injuries such as; conjunctival degeneration, pterygia, pingueculae, photokerato conjunctivitis, corneal foreign bodies, burns, cataract and maculopathy (Douglas and Karoye-

Egbe, 2018). Metal fabrication plays a major role in human infrastructural development by designing metallic products used for rail construction of a variety of gadgets. The welders together with some allied professionals play a major role in the fabrication of metallic products for industrial and domestic purposes to suit human needs. Similarly, a category of welders popularly referred to as Panel Beaters play a vital role in refurbishing the metallic frame (body) of dented vehicles and other automobile parts. The increasing demands for these products and services has led to a remarkable increase in the number of individuals venturing in to the welding profession with workshops mainly situated along the roadside in most cities and suburbs of Nigeria. Non industrial welders are not often seen with the requisite personal protective equipment (PPE) including the appropriate eye protection gear such as goggles, U-V filter glasses helmet, coveralls, face and neck shields, safety boots among a few. It is not uncommon to come across welders putting on sunglasses, fancy glasses or using their unprotected eyes to carry out their jobs.

To achieve a safe and healthy work environment, it is important safety systems are put in place to safeguard the welfare, well-being and safety of the worker. The challenging economic climate and high unemployment level in southern Nigeria has led to increase in self employed artisanal trades of which welding is one of the preferred due to its seemingly lucrative attraction. Due to the poor attitude of the relevant regulatory bodies, the establishment and implementation of safety practices in this sector may be primarily dependent on the proprietors of these small-scale welding sites and the knowledge and safety practices of welders themselves. The poor enforcement of safety measures can result in an upsurge of preventable occupational eye injuries among this sub group if the status quo on the situation is maintained Davies *et al* (2007).

There is paucity of documentation regarding eye injuries and the use of protective eyewear among welders in Nigeria as a whole and specifically in Rivers state. Hence, this study on the epidemiology of eye injuries among welders in Rivers state provides information on the pattern of eye injuries among and identified factors which positively or negatively influence eye injuries. It also made appropriate recommendations to improve the health and safety of welding professionals. This study also provided information on occupational health and safety practices among welders with regards to the use of protective devices and could serve as a basis for advocacy targeted at the reduction of eye injuries suffered by welders through health protection/ promotion education, occupational safety training and welfare with a view to mitigate the economic and social impact that eye injuries can cause to the nation, communities, families and individuals.

METHODOLOGY

This study was conducted between the months of February and July, 2021 at the Port Harcourt Auto Mechanic Village, Ikokwu, Port Harcourt city local government area and the Port Harcourt Steel Village Obio/Akpor local government area of Rivers State with approval from the Research

Ethics committee of the department of Public Health, Faculty of Health Sciences, School of Post Graduate Studies, Imo State University, Owerri Nigeria, in partial fulfillment of the requirements of the award of the doctor of philosophy (PhD) degree in Public Health. Permission to carry out the study was also obtained from the leadership of the local branches of the Nigerian welder's association as well as the Head/Proprietor of each welding sites involved in the study. Verbal consent was obtained from each participant after a detailed explanation of the procedures and purpose of the study. The confidentiality of all information obtained was also guaranteed by the researchers

The study involved a descriptive survey of frequently experienced ocular challenges associated with welding and direct observation of the eyes and surrounding structures for signs of injuries or degeneration/ changes from welding related activities. A pretested and validated interviewer administered questionnaire was employed to ascertain the participant's subjective complaints resulting from welding. This was followed by the use of a Pen Torch and Ophthalmoscope to examine the eye for prominent ocular signs/ changes related to welding activities.

For small scale welding sites hosting three welders or less, all subjects who consented to partake in the study were included while for workshops having more than four welders, participants were selected through a balloting process .The subjects were issued study numbers after sampling and a detailed ocular history of each subject was extracted.. This was followed by external examination of the eyes and surrounding structures for the presence of ocular anomalies related to welding. The most prominent objective finding was noted for each participant on the External Examination sheet attached to the questionnaire.

Reliability and Validity of Test Procedure

The questionnaire employed for this study was pre-tested using the test-retest procedure. 20 copies of the instrument were administered on 20 welders (10 each from the mechanic and steel villages). The instrument was re-administered 2 weeks later to the same subjects and the results of both exercises were correlated using the Pearson Moment Correlation and a reliability coefficient of 0.75 was obtained. The Ophthalmoscope employed examination of the eyes was of international standard approved for eye care practitioners by the World Council of Optometry (WCO) and the Optometrist and Dispensing Opticians Registration Board of Nigeria (ODORBN)

Data Analysis

Data collected from the study was entered into the Microsoft Excel spreadsheet (Version 2010) for inspection of variables and then exported to the Statistical Package for Social Sciences (SPSS) Version 25 software for descriptive and inferential analysis. Results were presented descriptively using tables and charts while Chi Square statistics was employed to test for statistically significant association at an alpha level of 0.05 ($p< 0.05$).

RESULTS

The study involved 103 welders comprising of 50 (48.5%) electric (arc) and 53 (51.5%) gas welders. Their age ranged from 17 – 64 years with a mean age of 29.75± 9.03 (SD), with the 26 – 35 years age group constituting the largest proportion with 43.7 % (n = 45) followed by the 15 – 25 years group with 36.9% (n =38) while the 56 – 65 years group constitute the least proportion with just 1% (n = 1) as shown in table 1below; The participants comprised of 101(98.1%) males and 2 (1.9%) females as shown in figure 1, with the females belonging to the youngest age group (16 – 25 years) as shown in table 1.

Table1: Age and gender distribution of participants

Age group	Gender of participants		Total
	Male	Female	
15 – 25 years	36 (35.0)	2 (1.9%)	38 (36.9%)
26 – 35 years	45 (43.7%)	0	45 (43.7%)
36 - 45 years	14 (13.6%)	0	14 (13.6%)
46 – 55 years	5 (4.9$)	0	5 (4.9$)
56 – 65 years	1 (1.0%)	0	1 (1.0%)
Total	101 ((98.!%)	2 (1.9%)	103 (100%)

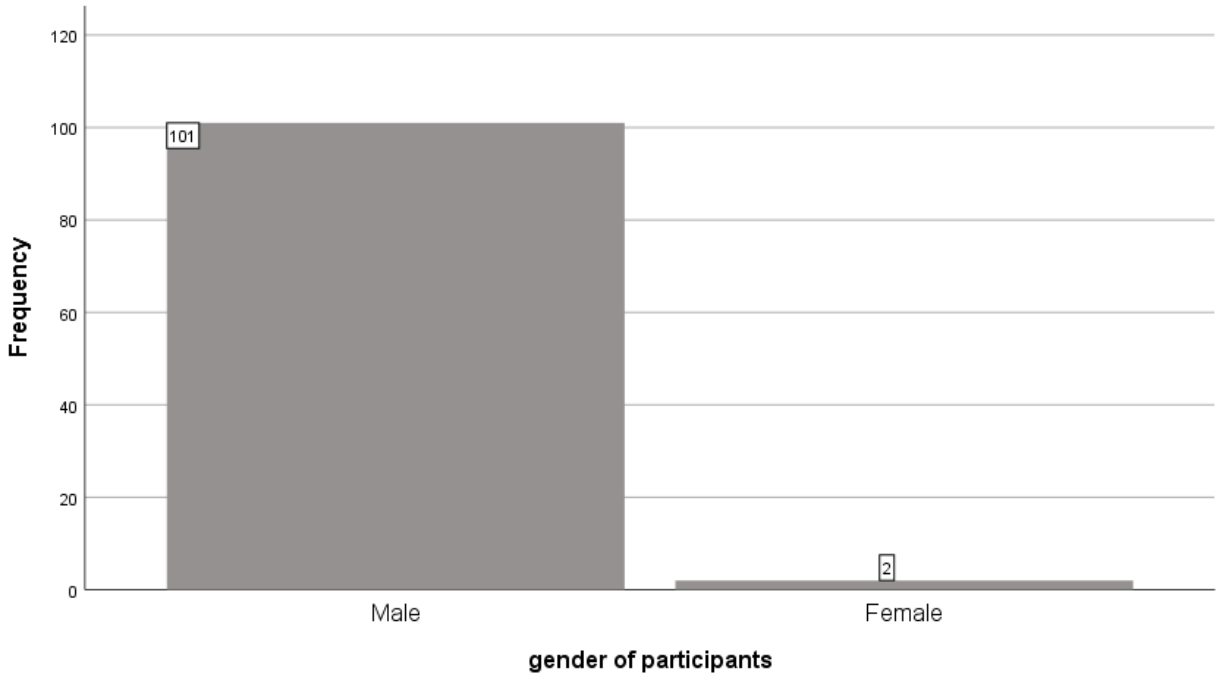

Figure 1: ***Gender distribution of welders***

Level of Compliance to the Use of Protective Eyewear

The level of awareness of the hazardous nature of welding (Response to the question "do you think that welding can cause harm to your eyes") revealed that 88.3% (n = 91) responded "Yes", 7.8% (n = 8) responded "No" while 3.9% (n = 4) had no idea as shown in figure 2

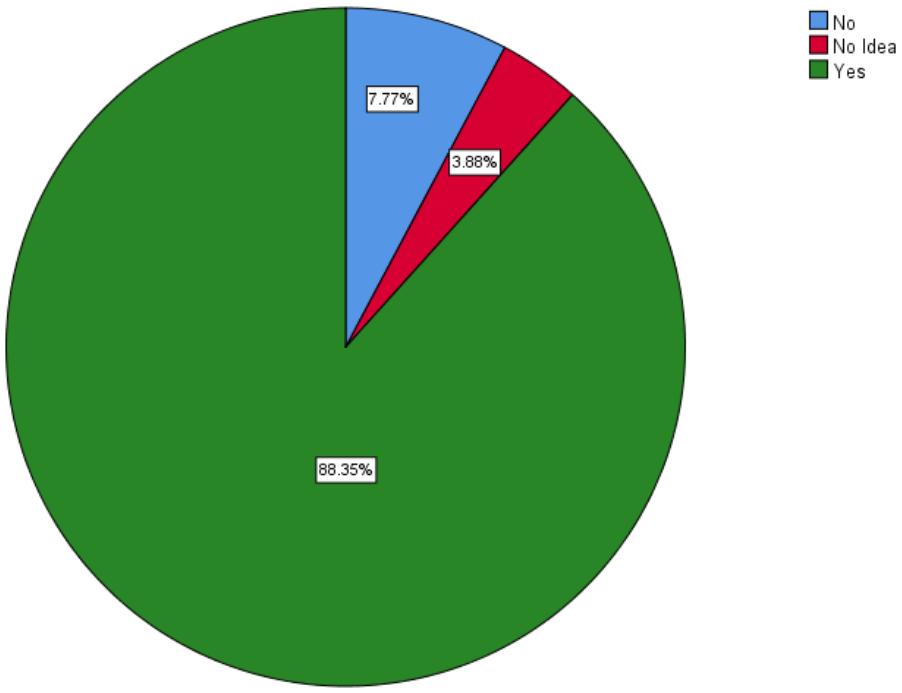

Figure 2*: Knowledge of the hazardous nature of welding and benefit of protective eyewear.*

(Response to the question "do you know if welding can cause harm to the eyes which can be prevented by protective eyewear)

Compliance to Protective Eyewear

Assessment on the level of compliance to protective eyewear revealed that only 5.8% (n -6) complied always, 60.2% (n=62) complied occasionally, 28.2% (n=29) complied sparingly while 5.8% (n=6) have never used a protective eyewear before. All (100%) of the welders who have never complied fall within the youngest age group (16 – 25 years) with fewer years of work experience as shown in table 2a. However, Chi Square test for association between age of welders and level of compliance revealed that there is no statistically significant association between the age of welders and compliance to protective eyewear ($p< 0.05$) as shown in table 2b.

Table 2a. Proportionate levels of compliance to the to use of safety eyewear among different age group

	Level of compliance to the use of protective eyewear				
Age groups	Never	Sparingly	Occasionally	Always	Total
15 – 25 years	6 (5.8%)	10 (9.7%)	21 (20.4%)	1 (1.0%)	38(36.9%)
26 – 35 years	0	12 (11.7%)	30 (29.1 %)	3 (2.9%)	45(43.7%)
36 – 45 years	0	6 (5.8%)	6 (5.8%)	2 (1.9&)	14(13.6%)
46 – 55 years	0	1 (1.0%)	4 (3.9%)	0	5(4.9$)
56 – 65 years	0	0	1 (1.0%)	0	1(1.0%)
Total	6 (5.82%)	29 (28.2%)	62 (60.2%)	6 (5.8%)	103(100.0%)

Table 2b: Chi-Square Test for association between level of compliance and age group

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	16.363[a]	12	.175
Likelihood Ratio	18.229	12	.109
N of Valid Cases	103		

Statistical significance is considered at an alpha level of 0.05 ($p < 0.05$)

Relationship between Years of Welding Experience and Level of Compliance

The level of compliance to protective eyewear with reference to years of work experience shows slight variation among the different groups of welders as shown in table 3a, however, Chi Square test for statistically significant association between both variables revealed that there is no statistically significant association between the years of work experience and the level of compliance to eye PPE at a 0.05 level of significance ($p < 0.05$) as shown in table 3b

Table 3a: Level of compliance in relation to years of work experience

Work Experience	Level of compliance to the use of orotective eyewear				Total
	Never	Sparingly	Occasionally	Always	
1 – 5 years	5 (4.8%)	8 (7.8%)	16 (115.5%)	2 (1.9%)	31 (30.1%)
6 – 10 years	1 (1.0%)	9 (8.7%)	22 (21.4%)	2 (1.9%)	34 (33.0%)
11 – 15 years	0 (0.0%)	4 (3.9%)	13 (12.6%)	1 (1.0%)	18 (17.5%)
16 – 20 years	0 (0.0%)	3 (2.9%)	0 (0.0%)	1 (1.0%)	4 (3.9%)
Above 20 years	0 (0.0%)	5 (4.9%)	11 (10.7%)	0 (1.0%)	16 (15.5%)
Total	6 (5.8%)	29 (28.2)	62(60.2%)	6 (5.8%)	103 (100%)

Table 3b: Chi-Square Test of association between years of work experience and level of compliance to protective eyewear

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	18.850[a]	12	.092
Likelihood Ratio	20.526	12	.058
N of Valid Cases	103		

(Statistical significance considered at $p < 0.05$)

Relationship between type of Welding and Level of Compliance to use of Protective Eyewear

Table 4a: Compliance levels amongst the different types of welders

Type of welding	Level of compliance to the use of orotective eyewear				Total
	Never	Sparingly	Occasionally	Always	
Gas welding	4 (3.9%)	21 (20.4%)	25 (24.3%)	3(2.9%)	53 (51.5%)
Electric welding	2 (1.9%)	8 (7.8%)	37 (35.9%)	3 (2.9%)	50 (48.5%)
Total	6 (5.8%)	29 (28.2%)	62 (60.2%)	6 (5.8%)	103 (100%)

Table 4b: Chi-Square Test for association between type of welding and level of compliance to protective eyewear

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.737[a]	3	.033
Likelihood Ratio	8.970	3	.030
N of Valid Cases	103		

Statistical significance considered at $p < 0.05$

Table 4a above shows the proportionate levels of compliance to the use of protective eyewear amongst gas and electric welders while table 4b which shows the Chi Square test of association between the type of welding practice and compliance to protective eyewear revealed that there is a statistically significant association between the type of welding practice and compliance to protective eyewear at the 0.05 level of significance ($p<0.05$).

Relationship between Level of Formal Education and Frequency of Compliance to the Use of Protective Eyewear

Table 5a below shows the level of frequency of compliance to the use of protective eyewear in relation to the level of format education attained by the welders while table 5b shows the Chi Square test of association between both variables which revealed that there is a statically

significant association between the level of formal education attained and the level of compliance to the use of protective eyewear at the 0.05 level of significance ($p < 0.05$)

Table 5a: Level of formal education and compliance to the use of protective eyewear

Level of formal education	Level of compliance to the use of protective eyewear				Total
	Never	Sparingly	Occasionally	Always	
No formal education	0 (0.0%)	7 (6.8%)	4 (3.9%)	1 (1.0%)	12 (17.5%)
Primary school	1 (1.0%)	8 (7.8%)	20 (19.4%)	1 (1.0%)	25 (24.3%)
Secondary	5 (4.9%)	18 (17.5%)	33 (32.0%)	2 (1.9%)	58 (56.3%)
Post secondary	0 (0.0%)	1 (1.9%)	5 (4.9%)	2 (1.9%)	8 (7.8%)
Total	6 (5.8%)	29 (28.2%)	62 (60.2%)	6 (5.8%)	103 (100%)

Table 5b: Chi-Square Test for association between level of education and compliance to protective eyewear

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	18.216[a]	9	.033
Likelihood Ratio	17.131	9	.047
N of Valid Cases	103		

Statistical significance is considered at 95% confidence interval ($p < 0.05$)

Major Work-related Eye Symptoms Experienced by Welders

Statistics of the most frequent eye symptom relative to welding work revealed that While 23(22.3%) had no remarkable eye symptom, the most predominant eye symptom experienced by welders in order of decreasing proportion were sandy sensation with 31 (30.1%), cloudy vision, 23 (22.3%), painful red eyes, 19 (18.5%), watery eyes, 4 (3.9%) and itchy eyes 3(2.9%) as shown in table 6a. Chi Square test of association between age and most frequent eye symptoms

experienced and revealed that there is a statistically significant relationship between the age of welders and eye symptoms experienced ($p< 0.05$) as shown in table 6b.

Table 6a Distribution of major eye symptom/ complaint among welders

Most frequent eye symptom	Age group of participants (years)					Total
	16 – 25	26 – 35	36 – 45	46 – 55	56 – 65	
None	12(11.7%)	8(7.8%)	2(1.9%)	1(1.0%)	0(0.0%)	23(22.3%)
Cloudy vision	7(6.8%)	10(9.7%)	4(3.9%)	2(1.9%)	0(0/0%)	23(22.3)
Painful red eyes	5(4.9%)	10(9.7%)	2(1.9%)	2(1.9%)	0(0.9%)	19(18.5%)
Sandy sensation	11(10.7)	15(14.6%)	5(4.9%)	0(0.0%)	0(0.9%)	31(30.1%)
Itchy eyes	1(1.0%)	2(1.9%)	0(0.0%)	0(0.0%)	0(0.0%)	3(2.9%)
Watery eyes	2(1.9%)	0(0.0%)	1(1.0%)	0(0.0%)	1(1.0%)	4(3.9%)
Total	38(27.2%)	45(43.7%)	14(13.6%)	5(4.9%)	1(1.0%)	103(100.0%)

Table 6b: Chi-Square Test for association between major eye complaint and ageof welders

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	35.821[a]	20	.016
Likelihood Ratio	20.931	20	.401
N of Valid Cases	103		

Statistical significance considered at $p< 0.05$

Predominant Work-related Ocular Surface Abnormalities among Welders

The pattern of prominent ocular surface abnormalities associated with

welding revealed that while 29.1% (n= 30) welders have no obvious ocular surface abnormality (NAD), the distribution of ocular surface abnormalities in order of decreasing frequency were

Pinguecula, 32 (31.1%), Pterygium, 22 (21.4%), Conjunctiva discoloration, 15 (14.6%) and Corneal opacity, 4 (3.9%) as shown in table 7a. Inferentially, Chi Square test of association between both variables revealed that there is a statistically significant association between the age of welders and ocular surface abnormality. ($p < 0.05$)

Table 7a: Predominant ocular surface abnormality among welders

Major ocular abnormality	Age group of participants (years)					Total
	16 – 25	26 – 35	36 – 45	46 – 55	56 – 65	
NAD	19(18.5%)	10(9.7%)	1(1.0%)	0(0.0%)	0(0.0%)	30(29.1%)
Conjunctiva discoloration	7(6.8%)	5(4.9%)	3(2.9%)	0(0.0%)	0(0.0%)	15914.6%)
Pinguecula	9(8.7%)	20(19.4%)	1(1.0%)	2(1.9%)	0(0.0%)	32(31.1%)
Pterygium	2(1.9%)	8(7.8%)	8(7.8%)	3(2.9%)	1(1.0%)	22(21.4%)
Corneal opacity	1(1.0%)	2(1.9%)	1(1.0%)	0(0.0%)	0(0.0%)	4(3.9%)
Total	38(36.9%)	45(43.7%)	14(13.6%)	5(4.9%)	1(1.0%)	103(100.0%)

Table 7b: Chi-Square Test of association between most obvious ocular surface abnormality and age

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	39.321[a]	16	.001
Likelihood Ratio	40.193	16	.001
N of Valid Cases	103		

Statistical significance is considered at 95% confidence interval ($p < 0.05$)

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Relationship between type of Welding and Predominant Eye Complaint and Prominent Ocular Surface Abnormality

Table 8a and 9a below shows a fair distribution of predominant eye symptom and obvious ocular surface abnormalities among gas and electric welders. Inferential statistics (Chi Square) revealed that there is no statistically significant relationship between the type of welding and predominant eye symptom experienced or prominent ocular surface abnormality observed at the 95% confidence interval ($p< 0.05\%$) as shown in table 8b and 9b above

Table 8a: Type of welding and predominant ocular surface complaint

Most frequent eye complaint	Type of welding		Total
	Gas welding	Electric welding	
None	13(12.6%)	10(9.7%)	23(22.3%)
Cloudy vision	14(13.6%)	9(8.7%)	23(22.3%)
Painful red eyes	9(8.7%)	10(9.7%)	19(18.8)
Sandy sensation	12(11.7%)	19(9.7%0	31(30.1%)
Itchy eyes	1(1.0%)	2(1.9%)	3(2.9%)
Watery eyes	4(3.9%)	0(0.0%)	4(3.9%)
Total	53(51.5%)	50(48,5%)	103(100.0%)

Table 8b: Chi Square test of association between type of Welding Versus Predominant Eye Complaint and Prominent Ocular Surface Abnormality

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.364[a]	5	.195
Likelihood Ratio	8.933	5	.112
N of Valid Cases	103		

Statistical significance is considered at p< 0.05)

Table 9a: Type of welding and prominent ocular surface abnormality

Prominent ocular surface abnormality	Type of welding		Total
	Gas	Electric	
NAD	18(17.5%)	12(11.7%)	30(29.1%)
Conjunctiva discoloration	4(3,9%)	11(10.7%)	15(14.6%)
Pinguecula	14(13.6%)	18(17.5%)	32(31.1%)
Pterygium	14(13.6%)	8(7.8%)	22(21.4%)
Cornea opacity	3(2.9%)	1(1.0%)	4(3.9%)
Total	53(51.5%)	50(48.5%)	103(100.0%

Table 9b: Chi Square test of association between type of welding and prominent ocular surface abnormality

	Value	Df	Asymptotic Significance nce (2-sided)
Pearson Chi-Square	7.522[a]	4	.111
Likelihood Ratio	7.723	4	.102
N of Valid Cases	103		

a. 2 cells (20.0%) have expected count less than 5. The minimum expected count is 1.94.

DISCUSSION

The largest age group involved in the study was the 26-35 years age group which constituted 38.8%, followed by the 16 – 25 years group. This differ slightly from a similar study on the impact of welding on the vision of welders in France by Boissin *et al* (2002) in which the 36-45 years age group was the largest, constituting 40.2% of the participants as shown in table 1. The

female welders involved in this study constituted only 1.9% (n= 2) of the respondents as against the males with 98.1% (n= 101) as shown in figure 1. This slightly differ from findings from an earlier study by Davies *et al* (2007) conducted in Calabar, Nigeria where all the participants (welders) were males. However, both findings affirm the view that welding is a male dominated profession in where the major players are the youthful population who possesses the strength for the energy demanding physical activities involved. A key observation from this study was that the female welders were within the youngest age group (16-25years) as shown in table 1. This suggests that young ladies are gradually venturing into this unarguably male dominated profession (welding).

88.3% of the welders involved in the study were aware that welding could cause harm to their eyes which could be prevented by the use of protective eyewear, 7.8% disagrees, while 3.9% had no idea as shown in figure 2. The level of awareness from this study is slightly lower when compared to that from a similar study carried out by Ajayi *et al* (2011) on the awareness and utilization of protective eye devices among welders in a South Western Nigerian community where 90.6% of the participants were aware of the benefits of the use of protective eye wear but higher than findings from a similar study by Sithole, Oduntan and Oriowo (2009) among welders in the Limpopo province of South Africa where 72% of respondent knew that welding can cause damage to their eyes if precautionary measures are not taken. However, regardless of the seemingly high level of awareness of the hazardous nature of welding, there is need for awareness campaign and safety education among welders

Assessment on the level of compliance to protective eyewear revealed that only 5.8% complied regularly, 60.2% complied occasionally, 28.2% complied sparingly (once in a while) while 5.8% have never used a protective eyewear before as shown in table 2a. All (100%) of the welders who have never complied fall within the youngest age group (16 – 25 years) with fewer years of work experience. It was observed that majority (60.2%) of the welders complied occasionally which is contrary to findings from a study on the awareness and use of safety devices and pattern of eye injury among Quary workers in Sabon-Gari local government area of Kano state Northern Nigeria by Sufiyan and Ogunleye (2012)where 71.6% of the participants used protective eye wear regularly. Also, a similar study by Sithole, Oduntan and Oriowo (2009) on eye protection practices among welders in the Limpopo province of South Africa reported that 89% of welders put on protective eyewear during welding. This difference in compliance level could be attributed to differences in study techniques, geographical location, training, attitude of welders and enforcement of safety practices by relevant authorities. The zero -compliant group observed in this study were presumably welders who have not suffered any previous eye injury or exposed to long period of welding due to their short exposure time to the hazardous agents associated with welding. However, Chi Square test for association between age of welders and level of compliance shows no statistically significant association ($p< 0.05$) as shown in table 2b. Similarly, the level of compliance with reference to the years of work experience showed no

defined pattern except the zero compliant group which fall within the least experience group with 1 – 5 years work experience as shown in table 3a. Inferential statistics (Chi square) also revealed that there is no statistically significant relationship between level of compliance and years of work experience ($p< 0.05$) as shown in table 3b

The study also observed that only 2.9% of both gas and electric welders complied regularly to eye PPE, 24.3% of gas and 35.9% of electric welders complied occasionally, 20.4% of gas and 7.8% of electric welders complied sparingly while 3.9% of gas and 1.9% of electric welders have never used protective eyewear during work as shown in table 4a. This suggests that electric welders had a slightly better compliance to the use of protective eyewear compared to gas welders. Inferential statistics (Chi Square) also revealed that there is a statistically significant association between type of welding and compliance to protective eyewear ($p<0.05$) as shown in table 4b.

Compliance level in relation to level of formal educational attainment showed no defined pattern, though 80% of welders who reported that they have never used protective eyewear during welding had secondary school education, with the remaining 20% attaining primary school education as shown in table 5a. Inferential statistics revealed that there is a statistically significant association between the level of formal educational attainment and compliance to protective eyewear ($p< 0.05$).

The study also revealed that while 22.3% of welders have no remarkable eye symptoms, the most frequent symptomatic eye complaint among welders in order of decreasing proportion were sandy sensation (30.1%), cloudy vision (22.3%), painful red eyes (18.5%), watery eyes (3.9%) and itchy eyes (2.9%) as shown in table 6a. These symptoms were distributed among the different cadres of welders as confirmed by Chi Square test of association between age and most frequent eye symptoms experienced which revealed that there is a statistically significant association between age of welders and eye symptoms experienced ($p< 0.05$) as shown in table 6b. The symptomatic eye complaints reported by welders could be attributed to work related exposures, prolong work duration and poor/ non compliance to safety/ preventive measures. The study also observed that while 29.1% of welders had no remarkable ocular surface abnormality, the distribution of ocular surface abnormalities in order of decreasing proportion include Pinguecula (31.1%), Pterygium (21.4%), Conjunctiva discoloration (14.6%) and Corneal opacity (3.9%) as shown in table 7a. The occurrence of ocular changes associated with welding showed no defined pattern among welders of different ages, years of work experience and welding type, However, inferential statistics (Chi Square) revealed that there is a statistically significant association between age of welders and ocular surface abnormalities as shown in table 7b. These ocular complaints and surface abnormalities among welders are indications of poor work conditions, hazardous environment, carefree attitude and practice which once again re-emphasize the need for enlightenment among this sub group on the need for safety work ethics. It was also observed that gas welders tend to have slightly higher frequency of reported

ocular abnormalities with the exception of painful red eyes which has a higher frequency among electric arc welders as shown in table 8a. However, inferential statistics (Chi square) revealed that there is no statistically significant association between the type of welding practiced and the occurrence of ocular surface abnormalities and eye symptoms ($p< 0.05$) as shown in figure 8b and 9b.

CONCLUSION

Despite the relatively high level of awareness among welders of the hazardous nature of welding and the benefits of protective eyewear, the level of compliance to protective eye devices is relatively poor (about 6%) as over 60% of welders employ the use of protective eyewear occasionally. Compliance to protective eyewear among welders is not significantly associated with age, years of work experience and level of formal education attained. However, there is a statistically significant association between level of compliance and the type of welding with the electric (arc) welders having a slightly better compliance level compared to gas welders.

The most remarkable work-related ocular symptom among welders is gritty (sandy) sensation, followed by blurry vision while the most predominant ocular sign is Pinguella, closely followed by Pterygium. Also, while there is a statistically significant association between the age of welders and the ocular signs and symptoms experienced, there is no statistically significant association between type of welding and ocular signs and symptoms associated with welding.

RECOMMENDATIONS

There should be periodic education of welders and other artisans on the benefits of regular compliance to the use of the appropriate protective devices and the negative effects of poor compliance. This should be followed by strict enforcement and monitoring of compliance to protective device and meting out of sanctions for poor compliance as well as rewards for regular compliance. Government and other stakeholders should as a priority formulate and implement worker friendly health insurance schemes for persons engaged in relatively hazardous jobs. There is also need for stakeholders, government, Non-governmental and faith based organizations to subsidize the price of protective devices as much as possible in order to make them affordable to artisans. Similarly, government agencies (such as the Nigerian Bank of industry) should formulate policies to promote local production of quality protective devices in order to make them readily available to welders and other artisans exposed daily to occupational hazards.

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CONFLICT OF INTEREST

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

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