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INFLUENCE OF OCCUPATIONAL EXPOSURE TO ULTRAVIOLET RADIATION AND FLYING PARTICLES ON EYE HEALTH AMONG WELDERS IN UMUONYEALI INDUSTRIAL MARKET, IMO STATE

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Abstract

Exposure to ultraviolet rays (UV rays) and flying particles is linked to serious eye health problems among welders because welders are constantly exposed to these risks because of their work. Increased awareness of the harm they can cause to the eyes and promoting education on the use of effective personal protective equipment (PPE) as protection against UV rays and flying particles can prevent eye problems among welders. A descriptive cross-sectional study was employed. The study population comprised 200 welders, from which a sample of 134 was determined using Slovin's formula. Data were collected using a structured questionnaire. Validity was ensured through expert review, while reliability was established using Cronbach's alpha product moment coefficient method. Quantitative data were analyzed through descriptive and inferential statistics (tables, percentages, and Chi-square at a 0.05 significance level. Findings revealed a generally high awareness level of the harmful effects of ultraviolet rays and flying particles on the eyes (71.6%, mean=3.7). None used helmets with auto-darkening lenses that offer maximum protection from ultraviolet rays, only (3.7%, mean=1.1) wore face shield that can really take care of flying particles (56.7%, mean 2.6) occasionally wore goggles due cost, comfort and availability. As a result, (15.7%, mean 1.2) had pterygium, (9.0%, mean 1.1) had pinguecula, (86.6%, mean3.1) had frequent red eyes, and (56.7%, mean 2.6) had corneal injuries from flying particles. A greater number of welders wore PPE occasionally (81.5%, mean 3.1). Chi-square revealed no significant relationship between the educational level of welders and their use of PPE ($\chi^2 =$ 5.26, tabulated value 16.9, df=9 P-value = 0.05) and no significant relationship between years of welding experience and use of ocular protection (x2 = 0.82, tabulated value = 12.6, df = 6, P-value = 0.05). There is a clear gap between awareness of ultraviolet rays and flying particles' influence on eye health and the use of personal protective equipment among welders, causing arc eye, corneal injuries, pterygium, pinguecula, and cataract. Therefore, health education by eye care experts on the use of effective PPE, its availability, affordability, and Government intervention will ensure maximum ocular protection, increased productivity, and reduced eye injury burden among welders

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Keywords: Welders, ultraviolet radiation, ocular damage, personal protective equipment (PPE). Flying particle

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Introduction

A welder is a skilled person who specializes in joining metal parts together using various welding processes. (Hero, 2022). Welders are trained and certified to perform welding operations. They use specialized equipment and techniques to fuse materials like steel, aluminum, stainless steel, and other metals (and sometimes plastics or polymers). (Cooper, 2024). Welders need good dexterity, attention to detail, technical knowledge of materials and best practices- (Hero, 2022). Welding as an occupation need high skill, expert coordination, scientific understanding of the material and welding process needed to join them and very high level of mental concentration during work. If these criteria are not met, the joints they produce will be very weak, they may expose themselves and others to physical injuries such as electrical or thermal burns or even damage the materials hence the welding work really need that welders pay attention to minute details, have sound knowledge of the materials, safety precautions and ability to handle tools effectively. Good dexterity helps welders to construct beautiful designs (Forsyth Technical Community College, 2024) Welders need to have "physical strength, flexibility and dexterity to safely perform welding techniques in all positions", ensuring effective and efficient coordination between their eyes, hands, and fingers together at same time with good control and expert precision. Good dexterity does not come by chance; it needs to be learned through steady practice. Experienced welders achieve better quality of welds and higher productivity than less experienced ones because experienced welders over time develop better motor coordination through regular consistent practice. welders' ability to change technical knowledge into quality workmanship can help welders to reduce errors, job rework and achieve good results even when they have to weld in uncomfortable positions (Tamer et al.,2024). When setting frameworks for industrial skill and occupational standards, attention to details, maximum concentration and accuracy are distinguished basic requirements for welders.

Different materials such as: stainless steel, carbon steel and aluminum, all need varied shielding gasses, specific filler material and different welding temperature controls to produce an effective and durable weld (Human Resource Development Council of Botswana, 2024) A welder can achieve good weld if he understands these technical requirements or else produce works with cracked joints that will break off under stress.

Globally, cataracts diminish the eyes of millions of Americans and cost billions of dollars in medical care each year (EPA, 2025). Cataract develops following several years of occupational exposure to repeated ocular traumas, intense infrared and ultraviolet radiation causing the lens protein lose its transparency and become foggy and opaque (Chisom et al., 2025). When cataract develops, the natural lens which is meant to be transparent becomes opaque making vision blurred. The condition becomes similar to when a clear glass window is exposed to dust over some years becomes less transparent and foggy, same is similar to the effects of ultraviolent radiation and frequent trauma on the lens following many years of unprotected welding experience. Occupational eye injuries are a major public health concern because of constant exposure to ultraviolet rays and flying particles. An estimated 2.5 million eye injuries happen annually worldwide, with over 500,000 of them being occupational and preventable (Ajuonuma & Tijani, 2024). Welding-related activities can lead to ocular injuries. However, all these problems can be prevented with the regular use of personal protective equipment such as – safety goggles, face shield and helmet with standard filter lenses. This work will therefore research the influence of occupational exposure to ultraviolet radiation and flying particles on eye health among welders in Umuonyeali industrial market, Imo state.

Methodology

Study Area

This study was conducted in Umuonyeali Industrial Market Imo State, South-East Geopolitical Zone of Nigeria., due to its high concentration of welding activities. It is a hub of metal fabrication where varieties welding work are done. It is located in Mbaitoli Local Government Area, Imo State, Nigeria. Specifically, it's situated along Akwakuma - Hardel junction Orji. The market operates from 7:00 AM to 6:00 PM, Monday through Saturday, and is closed on Sundays. Here, welders are constantly exposed to UV rays and flying particles. Welding can damage the eyes by absorbing radiation from the bright light produced and the radiation can reach the retina if no protection is worn. Welders who do not adequately protect themselves will dearly compromise their eye health. The study population consists of 200 welders actively working in Umuonyeali Industrial Market, Imo State.

Research Design

A descriptive survey was adopted for this study.

Study Population

The study population included two hundred (200) welders in Umuonyeali Industrial Market, Imo State.

Inclusion Criteria

Professional welders currently working in Umuonyeali Industrial Market who show willingness to participate and give consent, who are 18 years or older, with good

visual system, and who have active welding experience with regular exposure to ultraviolet rays and flying particles of one (1) year or above are included in the study.

Exclusion Criteria

Welders who work in private workshops other than Umuonyeali Industrial Market and welders who already have existing eye conditions like diabetic retinopathy or congenital ocular anomalies, or welders with less than one (1) year of welding experience.

Sample Size Determination

The sample was calculated using Slovin's formula for simple random sampling technique (n=N/(1+N×(e)2)
Slovin's formula to calculate the sample size for a population of 200 welders, given a margin of error is 5% (0.05).
Sample size calculation using Slovin's formula by Stephanie (2020)
n=N/(1+N×(e)2)
n = sample size
N= population size (200e=margin of error
Plugging in the value n=
200/ (1+200× (0.05)2)
n=200/ (1+200×0.0025)
n=200/1+0.5
n=200/1.5
n=133.33
n= 134 (Approximately)
Therefore, the sample size required for the population of 200welders with a 5%margin of error is approximately 134. (A good representation of the population).

Sampling Technique: A convenient and simple random sampling technique was used in selecting suitable research participants. Welders were selected in their business workshops and during their end-of-year meeting.

Study Instruments/ Tools

Data were collected using a structured, self-developed questionnaire. The questionnaire was used to gather information on demographics, work history, types of personal protective equipment PPE used by the welders, factors affecting regular use of PPE, and prevalent eye health problems among the welders

Validation Of the Instrument

The questionnaire content was reviewed and validated by the supervisors, other eye care givers, and other researchers to ensure the questions cover all relevant aspects, and their inputs were implemented.

Reliability of the Instrument

Cronbach's alpha was used to measure its reliability coefficient, which yielded 0.87 and was considered reliable.

Ethical clearance

Ethical standards were observed by the authors while conducting the research and preparing the manuscript.

Consent to participate Declaration:

We declare that all participants in the study gave informed consent. All the participants were informed about the purpose of the study, benefits and risks. Throughout the study, the rights of the respondents were observed.

Ethics Declaration

The research was carried out in line with the Declaration of Helsinki adopted by the World Medical Association in October 2024 after a 30-month global consultation process (Wise, 2024). The Ethical Research Committee of the University of Port Harcourt and the Welders Association Union, Umuonyeali Industrial Market, Imo State also gave their ethical approval for this work. Reference number: **(UPH/CEREMAD/REC/MM117/127)**.

Human Ethics and Consent to Participate declaration

The Ethical Research Committee of the University of Port Harcourt and the Welders Association Union, Umuonyeali Industrial Market, Imo State gave ethical approval for this work. All participants gave their informed consent. They were assured that their data would be treated with utmost anonymity and confidentiality, and their right to withdraw from the study at any point was assured.

Method of Data Collection

A validated self-structured questionnaire was given out face-to-face to the respondent randomly in their workshops. For convenience, some were given the questionnaires at the venue of their general meeting. An eye examination with a simple pen torch was done.

Method of Data Analysis

Data collected were sorted out, checked for completeness, edited, and coded.

Descriptive Statistics: Descriptive statistics (demographic data) was presented using frequency tables, mean statistics, and percentage distribution to analyze the data.

Inferential Statistics: Chi-square was to examine the relationship between the educational level of the respondents and their use of PPE use and the relationship between the years of welding experience and use of PPE.

Decision Rule

A 4-point Likert scale was used for data collection, with the responses ranging from:

strongly agree (4 points), agree (3 points), disagree (2 points), strongly disagree (1 point).

The decision rule was based on a cut-off mean of 2.5 and above as a positive response. Therefore, any response scoring 2.5 and above was accepted as a positive result, whereas responses of 2.5 were regarded as negative responses.

For the hypothesis, when the calculated value is above the tabulated value, the null hypothesis is accepted, but when the tabulated value is above the calculated value, the null hypothesis is rejected.

Results

Table 1: Socio-Demographic Data of Respondents

Characteristics	N=134	%
Sex		
Males	134	100
Females	0	0
Age		
18-25 years	24	17.9
26-33 years	34	25.4
34-41 years	26	19.4
42 years and above	50	37.3
Educational level		
Primary education	34	25.4
Secondary education	79	58.9
Tertiary education	21	15.7
Marital status		
Single	45	33.6
Married	88	65.7
Divorced/ separated	1	0.7
Widow/ widower	0	0.0
Years of welding experience		
1-5 years	25	18.7
6-10 years	24	17.9
11-16 years	29	21.6
17 years and above	56	41.8

From Table 1, all 134 respondents (welders) are males (100%). This shows that all the welders are male. 24 (17.9%) respondents were aged 18-25 years, 34 (25.4%) respondents were aged 26-33 years, 26 (19.4%) respondents were aged 34-41 years, and 50 (37.3%) respondents were aged 42 years and above. 34(25.4%) of respondents had primary education, 79(58.9%) had secondary education where 21(15.7%) had Tertiary education. 45 (33.6%) of respondents are single, 88(65.7%) are married while only 1(0.7%) is divorced there was no widow among the respondents. 25(18.7%) welders had worked for 1-5 years, 24(17.9%) had 6-10 years' experience, 29(21.6%) had 11-16 years' experience, while 56 (41.8%) had been welders for 17 years and above.

Table 2: Awareness levels of the occurrence of ultraviolet rays and flying particles among welders in Umuonyeali Industrial Market, Imo State.

S/N	Questions	SA	A	D	SD	Total
6	Welders are exposed to UV Rays and flying particles	96 71.6%	38 28.4%	0 0	0 0	134 100%
7	Awareness of the effects of exposure to UV rays and flying particles.	96 71.6%	38 28.4%	- -	- -	134 100%
8	Wearing safety measures (PPE) will reduce the effects of UV rays and flying particles on the eyes of welders	114 85.1%	20 14.9%	-	-	134 100%
9	Frequent training and health education on protective measures will help welders understand the risks and comply	129 96.3%	5 3.7%	-	-	-

with ocular protection measures					
Grand Total	435	101	-	-	536
	81.2%	18.8%	-	-	100%

Data mean of the table =3.8

Table 3: Prevalence of eye health problems caused by ultra violet rays and flying particles among welders in Umuonyeali industrial market Imo State.

S/N	Questions	Never	Once	Occasionally	Very often	Total
10	Have you experienced eye irritation after your welding work?	8 5.9%	10 7.5%	78 58.2%	38 28.4%	134 100%
11	Have you suffered ocular pain and redness after your welding work?	8 5.9%	10 7.5%	84 62.7%	32 23.9%	134 100%
12	Have you had difficulty looking at light after welding work due to the Arc light (UV rays)	8 5.9%	10 7.5%	84 62.7%	32 23.9%	134 100%
13	Have flying particles entered your eyes in the course of your welding work	9 6.7%	43 32.1%	64 47.8%	18 13.4%	134 100
	Grand Total	33 62%	73 13.6%	310 57.8%	120 22.4%	546 100%

Data mean of table =3.0

From the Table 2, 96 (71.6%) of welders strongly agree that welders are exposed to ultraviolet rays and flying particles, while 38(28.4%) agree

From Table 3, a total number of 8 (5.9%) of welders never experience eye irritation after their weltering work 10 (7.5%) experienced irritation once, 78 (58.2%). Occasionally had eye irritation whereas 38(28.4%) of welders had eye irritation very often as a result of weltering activities 8(5.9%), never had ocular pain and redness 10 (7.5%) once had ocular pain and redness 84 (62.7%) welders occasionally suffered ocular pain and redness whereas 32(23.9%) had pain and redness very often. 8(5.9%) never experienced difficulty looking at light (photophobia). 10 (7.5%) once experienced photophobia; 84 (62.7%) occasionally experienced photophobia, whereas 32(23.9%) very often had photophobia. 9(6.7%) of the welders never had flying particles entering their eyes. 43(32.1%) once had flying particles entering their eyes. 64(47.8%) occasionally had eye irritation, whereas 38(28.4%) of welders had eye irritation very often as a result of welding activities. 8(5.9%) never had ocular pain and redness 10(7.5%) once had ocular pain and redness. 84(62.7%) welders occasionally suffered ocular pain and redness whereas 32(23.9%) had pain and redness very often. 8(5.9%) never experienced difficulty looking at light (Photophobia). 10(7.5%) once had ocular pain and redness. 84 (62.7%) welders occasionally suffered ocular pain and redness, whereas 32(23.9%) had pain and redness very often. 8(5.9% never experienced difficulty looking at light (photophobia). 10 (7.7%) once experienced photophobia 84(62.7%) occasionally experienced photophobia whereas 32(23.9%) very often has photophobia. 9(6.7%) of the welders never had flying particles entering their eyes. 43(32.1%) once had flying particles entering their eyes. 64(47.8%) occasionally experienced flying particles entering their eyes, whereas 18(13.4%) had flying particles entering their eyes very often in the course of their welding work.

Table 4: Available personal protective equipment (PPE) measures against ultraviolet rays and flying particles.

S/N	Questions	SD	D	A	SA	Total
14	Do you wear personal equipment (PPE) during your weltering work?	-	-	114 81.5	20 14.9%	134 100%
15	Welding Googles/Sun glasses	-	-	112 83.6%	22 16.4%	134 100%
16	Face shield	129 96.3%	-	5 3.7%	-	134 100%
17	Welding Helmet with auto-darkening glasses	134 100%	-	-	-	134 100%
	Grand Total	263 49.1%	- -	231 43.1%	42 7.8%	536 100%

The mean of the table = 2.1

Table 5: Factors influencing the use of various types of personnel protective equipment (PPE) among welders in Umuonyeali industrial market, Imo State.

S/N	Questions	Number of respondents	Percentage
18	They are very experienced	14	10.5%
19	They are not available	20	14.9%
20	They make vision dark	70	52.2%
21	They are hearing and uncomfortable	30	22.4%
	Total	**134**	**100%**

From the above 4, 114(81.5%) of the welders occasionally wear PPE, while only 20 (14.9%) wear PPE very often. 112 (83.6%) occasionally wear welding googles/sunglasses, while 22(16.4%) wear googles/sunglasses very often. Only 5(3.7%) occasionally wear a face shield, whereas 129 (96.3%) never wear a face shield. 134(100%) of the respondents never wear a welding helmet with auto-darkening glasses.

Objective 4. Identify the factors influencing the use of protective measures against ultraviolet rays and flying particles among welders in Umuonyeali industrial market, Imo State.

From Table 5 above, 14(10.5%) welders said that other types of PPE are expensive, 20 (14.9%) said they are not available, and 70(52.2%) said they are very uncomfortable to wear.

From Table 6 below, 8(5.9%) of the welders never had red eyes (arc eyes). 10(7.5%) had red eyes once. 82(61.2%) had red eyes occasionally. 34(25.4%) had red eyes very often. 14(10.5%) never had cornea injury, 44(32.8) had cornea injury once 58(43.3%) occasionally had cornea injuries whereas 18(13.4) had cornea injuries very often.

21(15.7%) developed pterygium, 12 (9.05) had pinguecula, while only 2(1.5%) had cataract.

Table 6: The influence of occupational exposure to ultraviolet radiation and flying particles on the eye health among welders in Umuonyeali industrial market, Imo State.

S/N	Questions	Never	Once	Occasionally	Very Often	Total/%
22	Have you had red eyes (red eyes) after your welding work?	8 5.9%	10 7.5%	82 61.2%	34 25.4%	134 100%
23	Cornea injury from flying metal particles	14 10.5%	44 32.8%	58 43.8%	18 13.4%	134 100%
24	Pterygium	113 84.3	21 15.7%	-	-	134 100%
25	Pinguecula	122	12	-	-	134

		91.0%	9.0%			100%
26	Cataract	132	2			134
		98.5%	1.5%			100%
	Grand Total	389	89	140	52	670
		58.0%	13.3%	20.9%	7.8%	100%

Data mean = 1.8

Table 7: Hypothesis I between Education level and compliance

Educational level	Never	Once	Occasionally	Very often	Total/ %
Primary education	-	-	28	6	34 25.4
Secondary education	-	-	69	10	79 58.9
Tertiary education	-	-	17	4	21 15.7
	-	-	114	20	134 (100%)

TEST OF HYPOTHESIS

Hypothesis one: There is no significant relationship between the educational level of welders and their use of personal protective equipment (PPE).

Expected Frequency (F) = $\frac{Colum\ Total}{Grand\ Tota} x \frac{Roll\ Total}{1}$

Cell (1) = $\frac{0\ x\ 34}{134} = 0$

Cell (2) = $\frac{0\ x\ 79}{134} = 0$

Cell (3) = $\frac{0\ x\ 21}{134} = 0$

Cell (4) == $\frac{0\ x\ 34}{134}$

Cell (5) = $\frac{0\ x\ 79}{134} = 0$

Cell (6) = $\frac{0\ x\ 21}{134} = 0$

Cell (7) = $\frac{114\ x\ 34}{134} = 28.9$

Cell (8) = $\frac{114\ x\ 79}{134} = 67.2$

Cell (9) = $\frac{114\ x\ 21}{134} = 17.9$

Cell (10) = $\frac{20\ x\ 34}{134} = 5.1$

Cell (11) = $\frac{20\ x\ 79}{134} = 11.8$

Cell (12) = $\frac{20\ x\ 21}{134} = 3.1$

$X^2 = 0.82$

$$For\ degree\ of\ freedom = (C-1)(R-1)$$

$$For\ degree\ of\ freedom = (C-1)(R-1)$$
$$= (4-1)(3-1)$$
$$= (3)(2)$$
$$= 3 \times 2$$
$$df = 6$$
$$Significant\ level\ \alpha = 0.05$$

The chi-square tabulated value is 12.6 at df of 6 and significance level p-value 0.05.
Calculated chi-square value = 0.82.
Tabulated value = 12.6.

	0	$\in$	$0-\in$	$(0-\in)^2$	$\frac{(0-\in)^2}{\in}$
$\in 1$	0	0	0	0	0
$\in 2$	0	0	0	0	0
$\in 3$	0	0	0	0	0
$\in 4$	0	0	0	0	0
$\in 5$	0	0	0	0	0
$\in 6$	0	0	0	0	0
$\in 7$	28	28.9	-0.9	0.81	0.03
$\in 8$	69	67.2	1.8	3.24	0.05
$\in 9$	17	17.9	-0.9	0.81	0.05
$\in 10$	6	5.1	0.9	0.81	0.16
$\in 11$	10	22.8	-1.8	3.24	0.27
$\in 12$	4	3.1	0.9	0.81	0.26
					0.82

The calculated chi square value of 12.6 is less than the tabulated chi square of 0.82. Therefor the null hypothesis is accepted: there is no significant relationship between the educational level of welders and their use of PPE.

Hypothesis Two: There is no significant relationship between welders' years of experience in the Umuonyeali industrial market, Imo State, and their use of PPE (Personal protective equipment).

Expected Frequency (F) = $\frac{Colum\ Total}{Grand\ Tota} x \frac{Roll\ Total}{1}$

Cell (1) = $\frac{0\ x\ 25}{134} = 0$

Cell (2) = $\frac{0\ x\ 24}{134} = 0$

Cell (3) = $\frac{0\ x\ 29}{134} = 0$

Cell (4) = $\frac{0\ x\ 56}{134} = 0$

Cell (5) = $\frac{0\ x\ 25}{134} = 0$

Cell (6) = $\frac{0\ x\ 24}{134} = 0$

Cell (7) = $\frac{114\ x\ 29}{134} = 0$

Cell (8) = $\frac{114\ x\ 56}{134} = 0$

Cell (9) = $\frac{114\ x\ 25}{134} = 21.3$

Cell (10) = $\frac{114\ x24}{134} = 20.4$

Cell (11) = $\frac{114\ x\ 29}{134} = 24.7$

Cell (12) = $\frac{114\ x\ 56}{134} = 47.6$

Cell (13) = $\frac{20\ x\ 25}{134} = 3.7$

Cell (14) = $\frac{20\ x\ 24}{134} = 3.6$

Cell (15) = $\frac{20\ x\ 29}{134} = 4.3$

Cell (16) = $\frac{20x\ 56}{134} = 8.4$

X^2 =5.26

	0	∈	0−∈	$(0-\in)^2$	$\frac{(0-\in)^2}{\in}$
∈ 1	0	0	0	0	0
∈ 2	0	0	0	0	0
∈ 3	0	0	0	0	0
∈ 4	0	0	0	0	0
∈ 5	0	0	0	0	0
∈ 6	0	0	0	0	0
∈ 7	0	0	0	0	0
∈ 8	0	0	0	0	0
∈ 9	20	21.3	-2.4	1.69	0.08
∈ 10	18	20.4	-0.7	5.76	0.28
∈ 11	24	24.7	-1.8	0.49	0.02
∈ 12	52	47.6	4.4	19.36	0.41
E13	5	3.7	1.3	1.69	0.46

Degree of freedom = (C-1) (R-1)

= (Column total-1) (Roll total-1)

= (4-1) (4-1)

= (3) (3)

= 3 x 3

d f = 9

Significant level α = 0.05

The chi-square value was calculated at d of 9 and significance level p-value at 0.05

Tabulated value = 16.9

Calculated ^{X2} = 5.26

The calculated chi-square value of 5.26 is less than the tabulated value of 16.9. Therefore, the null hypothesis is accepted because there is no significant relationship between the educational level of welders and their use of PPE.

From the data analysis, the results of the study include:

1. All the welders in Umuonyeali Industrial Market, Imo State are males, majority had secondary school education, aged 42 years and above, married, and has had 17 years and above welding experience.
2. There is no significant relationship between the educational level of the welders and their wear of PPE.
3. There is no significant relationship between the years of experience of welders and their use of PPE.
4. There is high awareness level of ultraviolet rays and flying particles, but their compliance with effective ocular protection is low, as a result, many have been exposed to the influence of ultraviolet rays and flying particles, such as red eyes, ocular injuries, photophobia, pterygium, pinguecula.

The findings reveal that 83.6% of the welders rely on only on welding goggles and sun glasses instead of helmet with auto-darkening lenses and face shield.

Discussion

Demographic Data

The study conducted on the influence of ultraviolet rays on the eye health of welders in Umuonyeali industrial market, Imo State, showed that all the welders are males. The greater number of welders are 42 years and above (37.3%). The greater number of the welders had secondary education only (58.9%). Almost all the welders are married (65.7%). The majority of the welders have been on the job for 17 years or more (41.8%).

Awareness level of ultraviolet rays and flying particles

The study conducted on the influence of ultraviolet rays on the eye health of welders in Umuonyeali industrial market, Imo state, showed that all the welders are males. All (134,100%) are aware that ultraviolet rays and flying particles exist and can cause negative influence on eye health, and that PPE can prevent them. Yet only 14.9% used PPE regularly. This agrees with the study by

∈ 14	6	3.6	2.4	5.76	1.6
∈ 15	5	4.3	0.7	0.49	0.11
∈ 16	4	8.4	-4.4	19.36	2.30

Adeniyi and Isah, which revealed that welders have a high awareness level of their occupational danger, but this does not influence their use of protective equipment. 441(98%) out of 450 welders studied were aware that exposure to bright light, electricity, and flying sparks/particles are potential sources of injuries in their workplaces. However, the usage of PPE was lower than those for awareness430 (97.5%), and the most used PPE was safety goggles 430 (97.5%), while none (0%) used helmet. 315(78%) reported eye problems as a result of welding. This agrees with another study on welders in Port Harcourt, Nigeria, by Oboh & Ofagbor, (2019) where out of 103 welders sampled, 88.3% had awareness

of ocular effects if unprotected, yet only 5.8% of welders complied regularly, 60.2% occasionally, whereas 5.8% never used PPE. Therefore, earnest efforts by the government and eye health workers are needed to bridge the gap between awareness and actual compliance with ocular protection.

Prevalence of eye health problems caused by occupational exposure to ultraviolet radiation and flying particles

From the study. Many of the welders experienced eye irritation frequently, red eyes, injury from flying particles, and photophobia. This study agrees with Syahrir & Israr in their study on 63 welders across 14 welding shops in Samate subdistrict, South Opus, Indonesia in 2025. 75%

of welders had photokeratitis with symptoms – eye pain, tearing, blurred vision, and sensitivity to light- and were less productive; 87% of those without photokeratitis were very productive. Continuous exposure to UV rays and flying particles can impair vision and reduce productivity. Also, in a study by Chukwuocha & Nwoke (2020) in Nekede, Imo State, Nigeria, on 260 welders. 30.7% had foreign body injury, 20.3% conjunctivitis,13,4% pterygium, 12,6% arch injury, 10,0% cataract, 3.3% uveitis, and corneal abrasion 1.3%.

All these occurred because eye protection among the welders was inadequate; hence, an eye protection educational campaign for welders should form part of the Nigerian Government's workplace safety program.

Utilized personal protective equipment (PPE) against ultraviolet rays and flying particles

Face shields and welding helmets with auto-darkening lenses offer better protection to the eyes and face, yet almost all the welders used goggle/sun glasses, which they remove intermittently to have a clearer view, especially when they are filing metal pieces. Thakali and Shrestha (2024) carried out a study in Hetauda, Nepal, on 111 welders to investigate ocular trauma among them. They found that >62% experienced occupational eye injuries, especially from metal chips and sparks, because many welders relied on only sunglasses rather than certified PPE, increasing the risk of ocular damage.

In support, Fritschi & Driscoll (2024) conducted a cross-sectional 0n-line survey in Australia on 634 welders (411 do welding, 36 supervise welders, while 130 supervise and weld). Ocular UV ray exposure occurred in 16.8% of welders and 33.1% of supervisors with lower PPE use. Therefore, mandatory, certified eye protection and integrating occupational health education is critical in preventing eye injuries.

Factors influencing the use of various types of personal protective equipment (PPE)

The results from the study showed that despite a high awareness level of ultraviolet rays and the negative effect it can cause to the eyes, a greater number surprisingly do not wear PPE regularly. Even when they do, they wear only goggles/sun glasses, which are not highly protective. Their reasons were: high cost of PPE, non-availability, dark lenses, and discomfort.

This agrees with a similar study by Getenet & Henock (2023) on 420 welders in small-scale industries in Hosanna town, Southern Ethiopia. Only 43.6% wore PPE. Poor monthly income was their reason for non-compliance. Also, Ajayi & Adeoye (2021) in their study on 405 welders in Ile Ife south-western Nigerian community, 186(45.9%) had PPE but only 39(9.6%) used it always because of discomfort and poor visibility. However, in another study by Mridula & Roopa (2017) in South India, among 60 welders, 95% had awareness, but only 45% actually used PPE regularly because of poor enforcement and a belief that they were involved in a low-risk task.

Therefore, health education and awareness campaigns about the importance and benefits of utilizing protective eye devices and reinforcement of their regular use are highly recommended.

Influence of occupational exposure to ultraviolet radiation and flying particles on the eye health of welders

The study found that welders are highly affected by ultraviolet rays and flying particles. They suffer frequent red eye (arc eyes, 61.2%); many have had corneal injuries from flying metal particles (43.8%), many have developed pterygium (15.7%) and pinguecula (9.0%), but there were very few cases of cataract (1.5%). There is a risk of developing Pterygium and Pinguecula among welders.

Also, in experimental research in 2024 by Lawal & Oladipo in Ogbomosho on 15 male albino Rats grouped in cages ABC with five Rats in each cage. Group A was

a control group. Group B was exposed to an imported welding machine, while Group C was exposed to UV rays from a locally constructed welding machine for four hours at a distance of 25 cm for 7 days consecutively. The rat eyes were removed and preserved in formalin for histology examination. The ocular tissues from Rat B and C showed significant damage, which included hemorrhages and oedema, indicating severe ocular damage. A similar study in Port Harcourt, Rivers State, Nigeria, by Oboh (2022) found that welders frequently exposed to UV rays and flying particles experience eye irritation, redness, and blurred vision. Among the 103 welders, 83% had awareness, but only 5.8% regularly used PPE. As a result, 31.1% had pinguecula, 21.4 % had pterygium, and 3.9% while 3.9% had corneal opacity. Also, Suherin et al. (2022) reported I,790 cases of eye injuries among welders and metal workers, with approximately 1,390 cases attributed to exposure to welding sparks. Oboh & Ofagbr (2022) and Lawal & Oladipo (2024) further strengthen

Overall consistency the evidence that welding – related eye injuries are a global health problem. There is a need, therefore, for health insurance for welders and a subsidy provision on the price of quality PPE for welders so as to achieve effective ocular protection, to reduce ocular morbidities, and increase productivity.

Hypothesis 1

The calculated chi-square value of 12.6 is less than the tabulated chi-square of 0.82. Therefore, the null hypothesis is accepted: there is no significant relationship between the educational level of welders and their use of PPE. This agrees with a study in Abakaliki. Nigeria, which found that educational level had no statistically significant effect on the use of protective eyewear among welders; compliance was generally low regardless of whether welders were educated or not. (Ifeanyi et al., 2022).

Hypothesis 2

The calculated chi-square value of 5.26 is less than the tabulated value of 16.9. Therefore, the null hypothesis is accepted because there is no significant relationship between the educational level of welders and their use of PPE. This was in harmony with the findings by Ugwu et al. (2022) in Abakaliki, where they looked at the years of experience of welders on the job and their frequency of compliance with the use of protective eyewear when on duty. Their data statistically (X^2=8.949, p>347) revealed that years of experience on the job had no influence on welders' compliance to the use of protective eyewear while on duty in Abakaliki metropolis.

Irrespective of the years of experience of the welders, factors like cost, visibility, comfortability and non-availability were their common reasons for non-use of PPE.

Conclusion

This study examined the influence of occupational exposure to ultraviolet rays and flying particles on eye health among welders in Umuonyeali industrial market Imo State. The study revealed that occupational exposure to UV rays and flying particles poses a great risk on the eye health of welders Carrying out welding work without adequate ocular protection will expose the eyes to problems like pains, photophobia, Redness (are eye), photokeratitis, blurred vision, pterygium, pinguecula and even cataract. Welders have adequate awareness of existing risks and the need for compliance with ocular protection but never wear PPE constantly, reasons being that it was either dark, expensive, scarce or uncomfortable to wear. There is a need for eye care givers to reach out to welders periodically via campaigns and media. The government should also establish a task force to monitor, enforce, and encourage compliance with ocular protection among welders. Implementing these measures will not only protect welders' eye health but also enhance productivity and overall quality of life.

Confidentiality and Privacy

Anonymity was maintained throughout the work. No names or phone numbers of the respondents were recorded.

Conflict of Interest

The author declared no conflict of interest regarding this work, authorship, or publication.

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