



AWARENESS OF OCULAR-RELATED EFFECTS OF WELDING AMONG WELDERS IN KAKAMEGA, KENYA

Walter Yegoⁱ,
Alfred Ragot

Masinde Muliro University of Science and Technology,
Department of Optometry and Vision Sciences,
P.O BOX 190, Kakamega,
Kenya

Abstract:

Purpose: To determine welders' awareness on ocular-related problems and the importance of using safety measures in workplace in Kakamega, Kenya. **Methods:** A descriptive cross-sectional design involving 100 welders from Kenya Industrial Estate in Kakamega, was conducted and semi-structured interview schedule was applied on selected participants who gave written consents to participate in a face-to-face interview. Details of the interview varied from nature and duration of engagement in welding activities, through levels of awareness of ocular effects and extent of actual use of eye protections at work. **Results:** Seventy-five percent of welders had form of injuries related to metallic foreign bodies due to welding activities. Religion was the most influential factor (61%). Majority of welders had better understand of risk related to compliance to Personal protective Eye equipment (PPEE), with male (65) and female (1) being aware and utilize the PPEE. There was association ($X^2(1, N = 100) = 48.454, p < 0.05$) between having and using PPEE There was no association ($X^2(1, N = 100) = 0.58, p > 0.05$) between welder's awareness and use of PPEE. **Conclusions:** Given the nature of welding activities among low income earners, there is a gap between the knowledge of welders regarding awareness of hazards and PPEE and the actual use of PPEE at work by the same welders.

Keywords: awareness, personal protective eye equipment, ocular effects of welding, protective filters

1. Introduction

The occupational-related injuries can lead to severe disease process that directly impacts on the economic situation of developing countries (Rushton, 2017). These injuries vary in the degree it affects individual person depending on type of occupation and the level of awareness. Despite advances in work-related technologies of promotions on prevention

ⁱ Correspondence: email wyegeo@mmust.ac.ke

of accidents at work places, there still an estimation of over one million work-related deaths, 250 million accidents and 160 cases of diseases associated with workplace activities annually resulting in absence from work (Niu, 2010). However, it is reported that over a half million lives would be saved every year if available safety practices and appropriate instructions are adhered to by workers. Work related eye injuries has been shown to be a public health concern and impetus to economic burden , that result in significant morbidity with greater effect to working age groups in developing states (Jovanovic et al., 2016).

The particular emphasis is placed on the proper use of protective garments during engineering work including welding which reduces the cases of needless injuries including ocular injuries (Abu et al., 2016a). Ocular related welding injuries are common morbidities resulting from welding such as shielded metal-arc or stick welding, gas metal-arc welding, and oxyacetylene welding (*Case Report: Burns from acetylene gas: More than skin deep*, n.d.) (Chang et al., 2015). These methods of welding produces ultraviolet, visible, and infrared radiation which can lead to serious damage to the ocular structures (Pabley & Keeney, 1981). Ocular related risks of arc welding works have been of great concern due to possibilities of flying metal chips which eventually leads to corneal ulcer and opacity if remains untreated (Fiebai & Awoyesuku, 2011).

Studies elsewhere have demonstrated significant incidence of ocular abnormalities such as pinguecula, cataract, allergic conjunctivitis, corneal opacity, and keratoconjunctivitis which have been reported from arc welding (Abu et al., 2016b; Davies et al., 2007; Fiebai & Awoyesuku, 2011; Prabhu et al., 2018). Surprisingly, simple wearing protective equipment could prevent most of such cases among employed individuals.

Injuries-related visual impairment can profoundly affect mobility and efficiency at work, of which the deleterious effect can be worse in developing countries and settings with limited economic means (Tafida et al., 2015). Further, ocular morbidity ultimately affects other aspect of the individual's personal and social life and in effect their quality of life (Dev et al., 2014).

The need to increase welders' awareness on proper and consistent use of personal protective eye equipment (PPEE) cannot be overemphasized (I. Ajayi et al., 2011). Studies abound on welders utilization of PPEE at work (Abraham et al., 2015; I. A. Ajayi et al., 2011; Budhathoki et al., 2014a; Ganesh Kumar et al., 2013; Sabitu et al., 2009). However, there still remain limited documentation on welder's awareness of ocular-related problems associated with welding and consequence of poor adherence to safety eye measures while engaged at work. In light of these, the need aroused for a study aimed at bridging the knowledge gap in welders' awareness in Kenya. In this study, we investigated welders' awareness of ocular-related problems and proper use of PPEEs in Kakamega, Kenya. This study provides baseline data for developing targeted health education tool and policy formulation on eye health safety among welders and for the purpose of occupational health planning.

2. Materials and Methods

A descriptive cross-sectional study was conducted among welders working in the Kenya Industrial Estate (KIE) of Kakamega town, regardless of their work experience and type of welding techniques participation. Kakamega town is the largest town and headquarter of Kakamega County, which is in the western region of Kenya and with a population of over 1.6 million (GoK, 2015).

Selection criteria was mainly based on engagement on day-to-day basis in welding works, either as an experience or apprenticed welder, and either engaged in arc or oxyacetylene welding. Ethical approval to conduct this study was received from the Institutional Ethics Review Committee of MMUST, while permission to conduct this study was granted by the management of KIE following due clarification on the purpose and benefits of the research. The study adhered to tenets of Helsinki Declaration.

A pre-validated, semi-structured, questionnaire adopted from Budhathoki et al. (2014a) was piloted and used as a tool to collect data from the selected participants. The questionnaire was slightly adjusted to suite the local context of the study, after which it was pretested, to further validate the tool, on a selected group of welders not working within the KIE setting. Relevant corrections in line with the objective of this study and following expert input, was made on the questionnaire before confirmation to be fit for use to collect data relating to awareness of ocular-related hazards of welding activities, awareness of PPEE as well as its use. The questionnaire was constructed in two sections; A and B. while section A addressed relevant socio-demographic issues, section B consisted of semi-structured questions in line with object of the study. The questionnaire was explained to welders in local dialect by research assistants during data collection.

All clinical assessment and data collection involved in this study was conducted at the participants place of work (KIE) by an optometrists and involved the use of a transilluminator (Keeler®) to examine all physical external structures of the welders' eyes for presence of any ocular abnormally. Vision function assessment include distant visual acuity measurement at 4 meters using log MAR tumbling E charts was used. Visual acuity (in LogMar of the better eye was categorized as between 0.1 to -0.2 as normal, 0.2 to 0.5 as near normal and 0.6 to 1.7 as reduced vision (Ricci et al., 1998).

Other details of data collection procedure (interview) included the welders being first asked to list the hazards of welding they were aware. Next, were questions relating to on specific ocular hazards the participants either have experienced or are aware of, which include: light/radiation, welding fumes, sharp metals, electric current, heat, noise, sparks, vibration and their work environment. Yes/No responses were elicited. In line with awareness and use of PPE, the participants were asked closed Yes/No question relating to awareness and use of the following protective equipment; helmet/face shield, protective gloves, welding goggles/eye shield, respirators/masks, study footwear, apron, earmuffs. The section also included open question to enable the participants list other protective equipment they were either aware of or use while engaged in the welding works.

Data collected were categorized according to gender, age, welding experience, education level, awareness of hazards, safety measures, actual use of safety measures and finding of vision function assessment and ocular examination conducted.

All data were entered into the statistical software IBM –SPSS-Statistics-version 25 and analysed using relevant descriptive statistics and presented in frequencies, mean and percentages. Association and risk of awareness ocular-related hazards with possession/use of PPEE were also analysed at 95% CI, using Chi-square contingency test. All results were presented in tables.

3. Results

A total of 100 welders (99 male and 1 female) who gave consent were examined and interviewed, all welders gave a positive response resulting to 100% response rate. Their mean age was 41.18 ± 11.68 years. The modal age was 34 years and the range were 46 years. The mean duration of employment was 15.53 ± 9.21 years with the minimum having stayed there for 1 year and the maximum of 40 years. Most welders (77%) were Christians followed by Muslim (19) and other forms of religions (4) respectively. Majority of welders went up to secondary (41) and primary education (39%), while few went up to tertiary (12) and 8 had informal education.

3.1 Prevalence of ocular-related problems among all welders in KIE

The most affected age-group was middle age between 25 to 45 years (36 welders) with most welders experiencing some forms of corneal foreign bodies. The only female had no welding related ocular injuries while majority of male counterparts (75%) had form of ocular injuries such as metallic foreign bodies related to welding. Religion was influential factor as religious people (61%) had form of ocular related injuries because of welding activity. Welders who had experience between 8 to 24 years form of injuries (59 welders suffered mostly from foreign bodies particles) as opposed to counterparts. Most primary and secondary school drop-out had more injuries resulting to over half of the total welders as shown in table 1.1

Table 1.1: Social demographic factors and prevalence of ocular-related problem

	Injuries	Common injury	No injuries	Total(n)
Age(Years)				
16-25	8(12.3%)	FB	3(8.6%)	11(11.0%)
26-35	18(27.7%)	FB	6(17.1%)	24(24.0%)
36-45	18(27.7%)	FB	10(28.6%)	28(28.0%)
46-55	16(24.6%)	FB	10(28.6%)	26(26.0%)
56-65	5(7.7%)	N	6(17.1%)	11(11.0%)
Gender				
Male	71(95.4%)	FB	28(96.6%)	99(99.0%)
Female	0(0.0%)	N	1(1.0%)	1(1.0%)
Religion				
Christian	46(70.8%)	FB	31(88.6%)	77(77.0%)

Muslim	15(23.1%)	FB	4(11.4%)	19(19.0%)
Others	4(6.2%)	CA	0(0.0%)	4(4.0%)
Work duration				
8 and below	19(29.2%)	FB	4(11.4%)	23(23.0%)
9-16	21(32.3%)	FB	12(34.3%)	33(33.0%)
17-24	19(29.2%)	FB	10(28.6%)	29(29.0%)
25-32	4(6.2%)	N	4(11.4%)	8(8.0%)
33-40	2(3.1%)	N	5(14.3%)	7(7.0%)
Educational level				
Informal / Apprenticeship	6(9.2%)	T, FB	2(5.7%)	8(8.0%)
Primary	26(40.0%)	FB	13(37.1%)	39(39.0%)
Secondary	27(41.5%)	FB	14(40.0%)	41(41.0%)
Tertiary level	6(9.2%)	FB	6(17.1%)	12(12.0%)

Note: Corneal FB-Foreign body; Metallic particles-MP; Corneal abrasion-CA; Trauma-T; None-N

3.2 Welders' understanding of ocular-related problems associated with their work

Majority of welders had better understand of risks associated with welding activities. This was mostly between 26 to 45 years. While most male welders (65) had good knowledge as compared to the only female. Most Christians (53) had better knowledge of welding related ocular risks as compared to Muslims and other religions. Welders with experience of 8 to 25 years had better knowledge (49) of welding related ocular problems than those who had more years of experience (12). Education was related to awareness as most secondary and primary school drop-out (58) were much aware than tertiary and apprentice counterparts (13) as shown in table 1.2.

Table 1.2: Level of awareness of ocular related injuries related to welding

	Had Knowledge	No knowledge	Total(n)
Age(Years)			
16-25	7(9.9%)	4(13.8%)	11(11.0%)
26-35	14(19.7%)	10(34.5%)	24(24.0%)
36-45	22(31.0%)	6(20.7%)	28(28.0%)
46-55	19(26.8%)	7(24.1%)	26(26.0%)
56-65	9(12.7%)	2(6.9%)	11(11.0%)
Gender			
Male	65(100.0%)	34(93.1%)	99(99.0%)
Female	0(0.0%)	1(1.0%)	1(1.0%)
Religion			
Christian	53(74.6%)	24(82.8%)	77(77.0%)
Muslim	15(21.1%)	4(13.8%)	19(19.0%)
Others	3(4.2%)	1(3.4%)	4(4.0%)
Work duration			
8 and below	18(25.4%)	5(17.2%)	23(23.0%)
9-16	21(29.6%)	12(41.4%)	33(33.0%)
17-24	20(28.2%)	9(31.0%)	29(29.0%)
25-32	6(8.5%)	2(6.9%)	8(8.0%)
33-40	6(8.5%)	1(3.4%)	7(7.0%)
Educational level			
Informal / Apprenticeship	4(5.6%)	4(13.8%)	8(8.0%)

Primary	28(39.4%)	11(37.9%)	39(39.0%)
Secondary	30(42.3%)	11(37.9%)	41(41.0%)
Tertiary Level	9(12.7%)	3(10.3%)	12(12.0%)

Majority (60 welders) of young and middle-aged welders did use PPEE during welding activities. About 93 male and 1 female welder used PPEE during welding activity as compared to negligible number that did not use PPEE. Most Christians and Muslims (90 welders) used PPEE during welding activities. The more experienced welders were, the less the use of PPEE with 17 to 28 years being most PPEE users. There was no difference between secondary and primary drop out (38) in use of PPEE with negligible number of higher education drop out using not using PPEE (3 at secondary and none in tertiary) as shown in table 1.3.

Table 1.3: The use of PPEE among welders

	Used PPEE	Did not use PPEE	Total(n)
Age (Years)			
16-25	11(11.7%)	0(0.0%)	11(11.0%)
26-35	23(24.5%)	1(16.7%)	24(24.0%)
36-45	26(27.7%)	2(33.3%)	28(28.0%)
46-55	24(25.5%)	2(33.3%)	26(26.0%)
56-65	10(10.6%)	1(16.7%)	11(11.0%)
Gender			
Male	93(98.9%)	6(100.0%)	99(99.0%)
Female	1(1.1%)	0(0.0%)	1(1.0%)
Religion			
Christian	72(76.6%)	5(83.3%)	77(77.0%)
Muslim	18(19.1%)	1(16.7%)	19(19.0%)
Others	4(4.3%)	0(0.0%)	4(4.0%)
Work duration			
8 and below	23(24.5%)	0(0.0%)	23(23.0%)
9-16	31(33.0%)	2(33.3%)	33(33.0%)
17-24	28(29.8%)	1(16.7%)	29(29.0%)
25-32	6(6.4%)	2(33.3%)	8(8.0%)
33-40	6(6.4%)	1(16.7%)	7(7.0%)
Educational level			
Informal / Apprenticeship	6(6.4%)	2(33.3%)	8(8.0%)
Primary	38(40.4%)	1(16.7%)	39(39.0%)
Secondary	38(40.4%)	3(50.0%)	41(41.0%)
Tertiary Level	12(12.8%)	0(0.0%)	12(12.0%)

There was a moderately significant association, $X^2(1, N = 100) = 48.45, p < .05$. The contrary was true with association between knowledge of welding related abnormalities and use of PPEE among welders as there was no association ($X^2(1, N = 100) = 0.58, p < .05$) as shown in table 1.4 below.

Table 1.4: Association between having PPEE, Knowledge and its use

	Chi-square Value	Significance (2-sided)
Having PPEE and use of PPEE and	48.45	.000
Knowledge of ocular related problems and use of PPEE	.058	.809

4. Discussion

Ocular injuries due to welding activities are devastating as well as disabling especially in developing countries (reference), Kenya being no exception. The injuries occur often during the actual welding process and are attributed to cause unilateral monocular blindness (Rushton, 2017). The study found that middle aged welders (25 to 36 years) are mostly affected. This trend is alarming as developing nations such as Kenya consist of young generations population that drives the economy and could be disabled with the rising trend of ocular injuries (reference).

This trend is in agreement with studies in India (Joseph et al., 2017); Pakistan, (Hassan, et al 2017); Nigeria (Eze, et al 2015) and Ghana (Abu et al, 2016b). The reason could be due to the fact that these welders are the driving force to the technical economies of developing countries.

The prevalence of ocular problems among welders in our study was three quarter of the total participants indicating the need for intervention. This could be because they either did not use PPEE previously or they used defective protective devices. Similar prevalence was reported in a study by Mridula et al (85%), and Joseph et al (76.8%) (Joseph et al., 2017; Mridula et al., 2017).

More than three quarter of welders (60) reported to have encountered foreign body, this concurs with other studies by Mridula et (2017) at which found almost half of the cases of injuries being foreign body related. This could be attributed to the fact that welders work with metals and in the process of beating them into desired shape, metal chips can enter the unprotected eye. However, the only female was devoid of injuries which could be attributed to compliance by the female gender compared to male counterparts, although this may not be conclusive since female was only one and it will be bias to generalize with an individual case. Our study reported higher percentage compared to the study by Lormbadi et al (2009a) (31.9%). It was also noted that religion had influence on previous ocular injuries. This could be due to strong beliefs that are against the use of protective devices during welding activity as reported by study by Mridula et al (2017). The increased number of ocular injuries increased with duration of work experience while reduces with educational level. This could be due to welders tending to care less about the use of PPEE owing complacency.

There was a good understanding among welders (36 welders), on the risk associated with welding activities especially with age and those with higher work experience also had remarkable understanding of the risk associated with welding. The findings agree with Indian study which found over 62% awareness. The reason could be increased exposure to informal safety education related to welding activities. Most

secondary school level welders were aware (fifty-eight) which emphasizes the importance of basic education before proceeding to welding activities.

This study found out that the prevalence of utilization of PPE was high (94.9%) while small number (5.1%) did not use personal protective equipment. This was higher compared to the findings of the study in Nepal that found average prevalence (47.7% (Budhathoki et al., 2014a) and Nigerian study which found the use of PPEs among welders much lower (35.9%) (Isah and Okojie 2006). Sabitu et al (2009) also found the use of PPEs to be lower than present study (34.2%). Mridula et al (2017) found the same results with education accounting to fifty five percent of awareness. In this study, we found that over half (60%) of welders did use PPEE during their welding activities despite previous ocular injuries. This was further encouraged by the fact that the female was conversant with protective devices during welding. The findings were contrary to the study by Abu and colleagues that reported low level usage of PPEE(27.5%)(Abu et al., 2016). However, education did not contribute much to the usage of PPEE while work experience dictated the low usage and it was reported that experienced welders did not need the PPEE. Moreover a study by Eze et al. (2015) indicated that a negligible percentage (0.02) used PPEE in their activities as a regular routine during work (Eze et al., 2015). This raises the need to educate welders regardless of education, religion and experience on risk of not using PPEE during welding.

The study found association between having PPEE and use PPEE. This shows that despite the level of usage of the PPEE being low it may be due to non-availability of the PPEE, since those who had PPEE were using them. This was a clear as those who had one or more PPEE used them in the welding process. This study emphasis is in line with the study by Lombardi et al (2009b) which suggest that welders needed to be encouraged to use PPEE in their welding activities .In contrast to a study in Nepal (Budhathoki et al., 2014) which stated that welders who were aware used PPEE, our study indicated that despite awareness some welders were not using PPEE. In south India, it was also noted that there was low usage of PPEE among welders which emphasized the need to strengthen education towards welders.

However, there was no relationship between awareness and use of PPEE in our study. This suggest the need for regulatory measure towards enforcing the use of PPEE which was similarly suggested by other studies.(Abu et al., 2016b; Eze et al., 2015; Hassan et al., 2017; Joseph et al., 2017)

5. Conclusion

The use of recommended PPE always minimizes exposure to these problems it is also important to note that level of experience, training and attitude while working plays a major role in reducing the ocular problems and injuries.

This study provides only a glance at the actual problems and risks involved in this profession. There is a gap between the knowledge of welders regarding awareness of hazards and PPE and the actual use of PPE at work by the same welders. This gap needs to be further explored, so that appropriate interventions can be planned to address it.

With a high level of awareness present in this group, an intervention to increase the use of PPE is needed.

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Conflict of Interest

No conflict of interest.

Financial Disclosure

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