



KNOWLEDGE ON THE HEALTH EFFECTS OF WELDING SMOKE, USE OF PPE AMONG ELECTRIC-ARC WELDERS IN ILORIN SOUTH, NORTH CENTRAL NIGERIA

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ABSTRACT

INTRODUCTION: *Electric arc welding and oxy-fuel gas welding are the commonest welding technologies used in small scale industries in Nigeria. Electric arc welders are exposed to serious health hazards like exposure to welding smoke. Health effects of such exposure include metal fume fever, and increased risk of chronic diseases and cancers. Exposure to welding smoke can be minimized by use of PPE. The aim of the study is to determine the knowledge of welders on health implication of welding smoke and use of PPE.*

MATERIALS AND METHODS: *This cross sectional study was carried out among self-employed electric-arc welders, their journeymen and apprentices with at least six months working experience in Ilorin South Local Government Area. Simple random sampling technique was used in selecting the 285 respondents. Data was collected using pre-tested interviewer-administered semi-structured questionnaire, and analyzed using EPI-INFO version 3.5.1. P-value of less than or equal to 0.05 was considered statistically significant.*

RESULTS: *A total of 285 respondents were interviewed. Close to two third of the respondents 185 (64.9%) had poor knowledge of the health effects of welding smoke. There was a statistically significant relationship between the knowledge on health effects of welding smoke and the use of face-mask during welding operation ($p = 0.0000$). Forty three point five percent of all the respondents that used Face-mask during welding operation, reported always use of Face-mask, 34.8% used Face-mask often while 21.7% used face-mask occasionally. Of the respondents that*

used Eye-goggles during welding operation, 51.3% always used Eye-goggles, 23.1% often used Eye-goggles while 23.6% used Eye-goggles occasionally.

CONCLUSION: Knowledge of the respondents on the health effects of welding smoke is poor among the majority of the respondents and it has influence on the use of face-mask. There is need to have health education session for this category of workers.

Keywords: Knowledge, Electric-arc welders, Welding smoke, Health effects.

1. INTRODUCTION

The commonest welding technologies used in small scale industries are electric arc welding and oxy-fuel gas welding (Vimesh-Jani and Mazumumda, 2004). In Electric-arc welding, electric arc is struck between the metallic electrodes and work piece. Tiny globules of molten metal are transferred from the metal electrode to the weld joint. A holder or clamping device with an insulated handle is used to conduct the welding current to the electrode. A return circuit to the power source is made by means of a clamp to the work piece (Nicholas *et al.*, 2010). Electric-arc welding is mainly practiced on a small scale in Nigeria and this means that in many instances production occurs in residential areas where there can be serious health hazards not only to the Electric-arc Welders but also other occupants or family members.

An important hazard of electric-arc welding is the exposure of electric arc welders to welding smoke which is said to be inseparable from the welding process as the processes itself lead to the generation of smoke. Other hazards of electric arc welding include risk of electrocution, fire accident, burns, musculoskeletal problems, cut and injuries from heavy metals which are all avoidable when necessary precautionary measures are taken.

Welding smoke is a mixture of very fine particles (fumes) and gases. Welding fumes and gases comes from base materials been welded or filler material that is used, coating and paints on the metals being welded or coat covering the electrode, shielding gases supplied from cylinder, chemical reaction resulting from the action of ultraviolet light from the arc or heat, process and consumables used and contaminants in the air. Route of exposure to welding smoke is mainly through inhalation or eye contact. The amount and type of metals and gases found in welding smoke will depend on the welding process and base metal used (Zimmer and Biswas, 2001). Types of metals commonly found in the welding fumes include Aluminium, Beryllium, Cadmium oxides, Chromium, Copper, fluorides, Iron-oxide, Lead, Manganese, Molybdenum, Nickel, Vanadium, Zinc-oxide (Coggen *et al.*, 1994; OSHA, 1995; Rugger, 1995; Contrás and Chan-Young, 1997). Welding process produce gases which contain Carbon-monoxide, Fluorine, Hydrogen-fluoride, and Nitrogen-oxide (Brandshaw *et al.*, 1998).

Health risk and effects of Welding fumes and gases are determined by length of time of exposure, work environment, protective measures used. Alberta health and safety legislation specifies exposure limits for the substances present in welding gases and fumes. Occupational exposure limit represent only minimum standards. The law in Alberta requires that employers keep exposure levels to harmful substances as low as reasonably practical (Work Safe Alberta, 2008).

Health effects of exposure to welding smoke are numerous because the fumes contain so many different substances that are known to be harmful. The individual components of the welding

smoke can affect any part of the body including the central nervous system, heart, kidneys and the lungs. Exposure to welding smoke may have short and long term health effects. Short term effects include metal fume fever as a result of exposure to metal fumes such as Zinc, Magnesium, Copper and Copper oxide. Metal fume fever consist of flu-like symptoms with alternating chills and high fever that last for few days. Other short term effects are irritation of the eyes, nose, chest and respiratory tract causing cough, wheezing, breathlessness, bronchitis, pulmonary edema, pneumonitis and gastrointestinal effects such as nausea, loss of appetite, vomiting, cramps and slow digestion. Long term health effects include increase risk of lung cancer, cancer of the larynx and urinary tract, varieties of chronic respiratory problems such as bronchitis, asthma, pneumonia, emphysema, pneumoconiosis, decrease lung capacity, silicosis and siderosis. A study in Northern Europe found that occupational exposure to welding fumes and smoking are associated with increased risk of chronic bronchitis (Holm et al., 2012). Another study also reported an increasing lung cancer risk for longer duration of exposure to welding fumes (Andrea et al., 2012). Other long term effects include heart and skin diseases, hearing loss, chronic gastritis, gastroduodenities, ulcer of the stomach and small-intestine, kidney damage and damage to the reproductive system leading to reduction in sperm count and fecundity (Mortensen, 1998). Repeated exposure to certain element in welding fumes like chromium vi for a very long time could lead to DNA damage (Sellapa et al., 2011). Heat stress or heat stroke, arc eye injuries, sunburn and musculoskeletal problems such as back injuries, shoulder pain, tendonitis, reduced muscle strength, carpal tunnel syndrome, white finger and knee joint diseases are other health problems. Recent studies even suggest that exposure to fumes containing manganese during welding may be a risk factor for the aetiology of Parkinson's disease among the career welders (Chandra et al., 1981; Mergler et al., 1994; Racette et al., 2001). India reported a 44% prevalence of respiratory morbidity among welders resulting from their exposure to welding fumes (Vimesh-Jani and Mazumumda, 2004). Another survey done in Nigeria by Isah and Okojie, reported prevalence of 96.4% work related health complaints among welders and 43% of the welders have suffered from metal fume fever (2006).

Methods that are effective in controlling welders' exposure to welding smoke, depending on the feasibility of the implementation include process enclosure, local exhaust ventilation, general dilution ventilation and use of Personal protective equipment. During electric welding processes operators must use safety goggles, hand-gloves, welding helmets, face-mask or respirator and safety boots. Welders and other workers in similar occupation particularly in developing countries lack knowledge of occupational health hazards and were unlikely to take protective measures against the hazards. A study done in Nigeria reported average of 35.9% of welders used personal protective equipment when carrying out welding operation. Having good knowledge on the health implications of exposure to welding fumes will influence the adoption or practices of occupational safety among the welders. The information obtained will be very useful when carrying out occupational and safety education for this category of workers and the study will go a long way in improving the lot of electric arc welders. The aim of the study is to determine the knowledge of welders on health implication of welding smoke and practices of occupational safety among the electric-arc welders.

2. METHODOLOGY

Ilorin South Local Government Area is one of the three local government areas in Ilorin metropolis with headquarter at Fufu. The local government area has a total population of 290,259. It is made up of twelve wards. The predominant ethnic group is Yoruba. The 2 major religions are Islam and Christianity. For the electric-arc welders Ilorin South is divided into five zones namely Gaa-akanbi, Fate, Tanke, Kulende and Offa-garage. The study population was self employed electric-arc welders, their journeymen and apprentices in all the registered workshops in Ilorin South. Cross sectional study was carried out among the welders, their journeymen and apprentices in the month of January 2012. Letter of introduction was obtained from the ethical committee of the University of Ilorin Teaching Hospital to the chairman of the union in Ilorin South L.G.A. The instrument of data collection was interviewer administered semi-structured questionnaire. The questionnaires were filled and completed by the researcher and two trained research assistants based on the various responses from the respondents. Sample size of 285 respondents used for the study was arrived at using Fischer's formula. Simple Random Sampling technique was used in selecting 100 registered workshops out of the 305 registered workshops in Ilorin South LGA.

The total number of respondents (Welders, journeymen and apprentices of more than six months experience obtained from the 100 randomly selected workshops were 320). Simple Random Sampling by balloting was used to select the required sample size of 285 respondents from the 320 respondents. Apprentices with less than 6 months working experience were excluded from the study. Pre-test of the questionnaire was done in Offa, Kwara state which is about 45 kilometres from Ilorin. The completed questionnaires were collected and collated by the researcher and the research assistants. The questionnaires were sorted and coded and all completed ones were checked for errors and completeness. Data were entered using EPI-INFO version 3.5.1 software package before the analysis of the data. Data were presented in form of charts, frequency distribution tables and cross tabulation of variables. Scoring system was used for assessing the knowledge of the respondents on the effects of welding smoke on health by awarding marks based on their response to question 14 of the questionnaire which determines the knowledge of the respondents on the effects of welding smoke on health. The maximum score obtainable was eleven (11) representing eleven different options supplied by the researcher on the possible effects of welding smoke on health. Each of the options was given a score of one. Any of the respondents that mentioned between zero to three of the options available was classified as having poor knowledge, respondent that mentioned between four to six of the options available was classified as having fair knowledge while respondent that mentioned between seven to eleven of the options available was classified as having good knowledge. For questions on the used pattern of eye-goggles and Face-mask during the welding session, Always= Use of personal protective for greater than 80% of the welding session, Often= Use of personal protective equipment for between 50-80% of the welding session while occasional= Use of personal protective equipment for less than 50% of the welding session.

3. RESULTS

A total of 285 respondents were interviewed on the month of January 2012. SIX (2.1%) had tertiary education, 136 (47.7%) had secondary education while 126 (44.2%) had primary education, as shown in Table 1. Almost all the respondents 284 (99.6%) had apprenticeship training. Close to two third of the respondents 185 (64.9%) had poor knowledge of the health effects of welding smoke, as shown in Table 2. There was a statistically significant relationship between the knowledge on health effects of welding smoke and the use of face-mask during welding operation ($p= 0.0000$) but knowledge on the health effects of welding smoke and the use of eye-goggles was not statistically significant ($p= 0.4558$) as shown in Table 3. Among the 23 respondents that used Face-mask during welding operation, 43.5% of them reported always use of Face-mask, 34.8% used Face-mask often while 21.7% used occasionally as shown in figure 1. Of the 273 respondents that used Eye-goggle during welding operation, 51.3% reported always used Eye-goggle, 23.1% often used Eye-goggles while 23.6% used Eye-goggle occasionally as shown in figure 2.

4. DISCUSSION

Majority of the respondents had poor knowledge on the health effects of welding smoke. This is probably due to the fact that most of the respondents received their training through apprenticeship and thereby rely on their masters for information on the job especially knowledge of the hazards associated with arc welding of which the masters too probably have insufficient knowledge. Apprentices, Journeymen and their masters inclusive had no formal training for the vocation and hence might not have had the opportunities to learn about the health hazards associated with their occupation as well as possible precautions to be taken in the practice of their vocation. This finding is contrast to what was obtained in a related study done in Northern Nigeria and Benin city in Nigeria that majority of welders were aware that their job were hazardous to their health despite the fact that most of the respondents interviewed received their training through apprenticeship (Isah and Okojie, 2006; Sabitu *et al.*, 2009). But the extent of understanding or knowledge of health hazards of welding was not assessed in the study. Poor knowledge of imminent dangers of welding will lead to poor utilization of safety gadgets by the welders even when they possess such.

Most of the respondents in the study used eye goggles. High awareness of eye goggles as a form of protection against hazards might be a possible reason for the reported high use eye goggles among the respondents. High frequency of occurrence of ocular injuries among the welders might also be a reason for high use of Eye-goggles. This finding is comparatively higher than what was obtained from similar studies done by Sabitu *et al.* (2009) in Northern Nigeria where 60.9% of the respondents interviewed reported the use of eye-goggles and by Isah and Okojie (2006) in Benin city Nigeria where 35.9% of welders interviewed reported the use of eye-goggles. Frequent use of eye-goggles will reduce the incidence of ocular injuries among the welders.

Only 51.3% of the respondents that reported the use of Eye-goggle in this study used it always (Use of Eye-goggle for more than 80% of the welding session). Possible explanation for this finding is that some arc welders may find it not convenient using eye-goggles all the time and some are ignorant of hazards associated with irregular use of eye-goggles. This finding is comparable to

the study done by Omolase in Owo South western part of Nigeria which reported the use of eye-goggles by all the welders interviewed but majority (51.3%) said they used it occasionally while very few(17.5%) used it always. Infrequent used of Eye-goggles by the welders expose them to eye hazards (Omolase and Mahmood, 2007).

The use of face-mask was reportedly low in this study due to the following possible reasons: Poor knowledge of hazards associated with the non or irregular use of face-mask among the respondents, low awareness of these equipment as a form of occupational safety among the respondents, poor economic condition of the country that could affect the availability and affordability of personal protective equipment by the welders and lastly because of the kind of training they received as almost all of the respondents were trained through hands on apprenticeship. They did not have the opportunity of being trained in a formal welding school. This finding is similar to the result obtained from another study where poor use of face-masks (23%) was also reported (Sabitu *et al.*, 2009). The use of face mask reduced the inhalation of welding fumes that may result in the development of cancer, respiratory problem and even infertility in males.

Knowledge of the welders on the health hazards of welding smoke was statistically related to the use of Face-mask during welding operation in this study. Poor knowledge of health hazards of welding influenced negatively use of Face-mask by the welders. This finding is in tandem with the general believed that welders and other workers in similar occupation particularly in developing countries lack knowledge of occupational health hazards and were unlikely to take protective measures against the hazards (Hendkind and Friedman, 1976). A South-Africa study reported that majority of welders did not take adequate precaution to protect their eyes due to lack of knowledge on the adverse effects of welding (Norm and Frank, 1991).

Knowledge of the welders on the health hazards of welding smoke was not statistically related to the use of Eye-goggle during welding operation in this study. Eye problems been the most common work related health complaints among the welders as elucidated in another study in Nigeria possibly explained why there was no statistically significant relationship between knowledge and the use of Eye-goggles. Almost all the welders must have experience one or more Eye symptoms during welding operation making them to use Eye-goggles to protect their eyes.

Knowledge on the health effects of welding smoke was generally poor among the majority of the respondents and it has negative influence on the utilization of face-mask. There is need to have a health education session for this category of workers on the health effects of their workplace hazards. Government should adopt a policy that will make it compulsory for welders to use appropriate personal protective equipment during welding operation.

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Table-1. Distribution of Respondents by Level of Education and Training.

| | Frequency | Percentage (%) |
|------------------------|-----------|----------------|
| Level Education | | |
| None | 17 | 6.0 |
| Primary | 126 | 44.2 |
| Secondary | 136 | 47.7 |
| Tertiary | 6 | 2.1 |
| Training | | |
| Apprenticeship | 284 | 99.6 |
| Technical school | 1 | 0.4 |

Table-2. Knowledge on the Health Effect of Welding Smoke.

| Effect of welding smoke | Frequency | Percent (%) |
|-------------------------|-----------|-------------|
| Poor knowledge | 185 | 64.9 |
| Fair Knowledge | 84 | 29.5 |
| Good knowledge | 16 | 5.6 |
| Total | 285 | 100.0 |

Figure-1. Used pattern of Face Mask

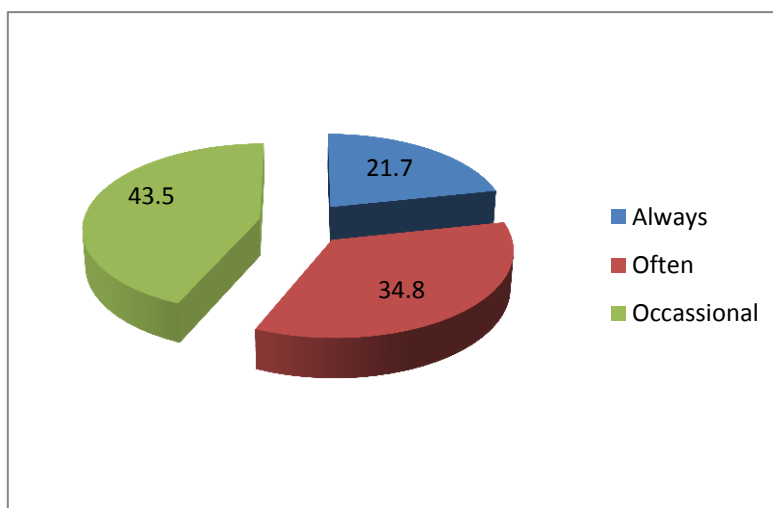


Figure-2. Used pattern of Eye - Goggle

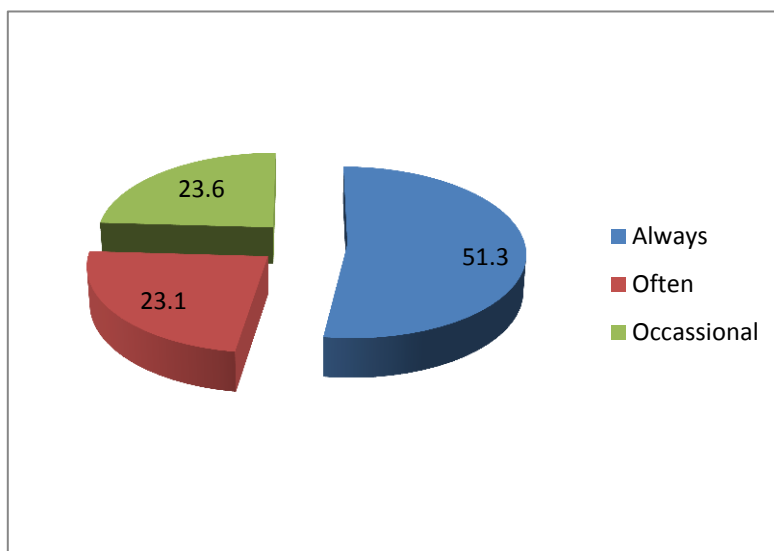


Table-3. Knowledge score and the use of Eye-Goggle/Face-mask.

| Knowledge Score | Face Mask | | Total(%) | Eye - Goggle | | Total(%) |
|-----------------|---|-------------|------------|--|-------------|------------|
| | Used(%) | Not Used(%) | | Used(%) | Not Used(%) | |
| Poor Knowledge | 7(3.7) | 183(96.3) | 190(100.0) | 184(96.8) | 6(3.2) | 190(100.0) |
| Fair knowledge | 10(12.5) | 70(87.5) | 80(100.0) | 75(93.8) | 5(6.2) | 80(100.0) |
| Good Knowledge | 6(40.0) | 9(60.0) | 15(100.0) | 14(93.3) | 1(6.7) | 15(100.0) |
| Total | 23(8.1) | 262(91.9) | 285(100.0) | 273(95.8) | 12(4.2) | 285(100.0) |
| | $\chi^2 = 54.09, p - \text{value} = 0.0000$ | | | $\chi^2 = 1.57, p - \text{value} = 0.4558$ | | |