

## Risk assessment of welding workshops in Jos, Nigeria

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### Abstract

**Background:** Risk is the likelihood that a person may be harmed or suffers adverse health effects if exposed to a hazard and for welders, there are several hazards lying around them in their workplace. This study aimed to assess the risks in welding workshops and practice of safety measures amongst welders in Jos metropolis.

**Methodology:** This was a descriptive, cross-sectional study involving 50 workshops in Jos metropolis. An interviewer-administered questionnaire was used to collect data which was entered and analyzed using Epi-info version 3.5.4 statistical software.

**Results:** Among the hazards identified in the workshops, manual handling, noise/vibration and fumes had the highest frequencies. All the workshops were well ventilated and 49 (98.0%) were well-lit. None of the shops had fire extinguishers, first aid boxes nor did they label hazardous substances. Only 41 (82.0%) workshops provided goggles for the workers while no helmet, apron nor hearing protection was provided by any of the workshops assessed.

**Conclusion:** From this study, almost all the workshops practiced manual metal arc welding (electric) and the biggest hazards identified in the welding workshops were manual handling of welding equipment, noise, vibration and fumes. Even though there was good environmental control practices of adequate ventilation and lighting, provision of PPE was not adequate. It is recommended that continuous educational campaign on workplace hazards, adequate environmental control measures, provision and proper use of different PPE should be sustained for welders on a regular basis by the welders' association, local and state governments.

**Keywords:** Risk assessment; welding workshop; safety practices.

### 1. Introduction

Welding operation is a highly engineered process that has evolved with evolving technology. In many developing countries, welding has become one of the most important occupational groups, owing to rapid urbanization and industrialization.[1] Welding is an essential part of everyday life; from cars to high rise office buildings, airplanes to rockets, pipelines to highways, none of it would be possible without welding. This means there is a large population of people involved in welding. The International Standard Classification of Occupations (ISCO) defined welders as workers who join and cut metal parts using flame or electric arc and other sources of heat. [2]

The World Health Organization (WHO), states that there are about 250 million cases of work-related

injuries per year and one of the occupations that contributes to these work-related injuries is non-industrial welding in developing countries. [1] According to the reports from Occupational Safety and Health Administration (OSHA), the risk from fatal injuries as a result of welding alone is more than four deaths per thousand workers over a working lifetime. [3]

In Nigeria also, welding involves a large population of young people within the low socioeconomic class which puts them at a disadvantage in terms of occupational health and safety. This is because welding is usually an informally learnt occupation in most parts of the country. The informal sector contributes significantly to the economic development of the country. The operators of this sector are artisans with mainly primary education, and

sometimes no formal education at all. [4] This exposes them to various hazards associated with welding. There are varieties of welding processes but the commonest types in Nigeria are the gas welding by the use of oxyacetylene flame and the electric arc welding involving the use of electricity. [5]

Risk is the likelihood that a person may be harmed or suffers adverse health effects if exposed to a hazard. [6] For welders, there are several hazards lying around them in their workplace. Considerable work has been done to identify the hazards that are associated with welding. [7] Currently, the typical practice of health surveillance regarding welding operation is by conducting a comprehensive industrial risk assessment of the welding workplace. Repetitive industrial risk assessment needs to be done on each welding workplace for health surveillance evaluation. The greatest challenge has been to develop occupational health programmes that are feasible in developing nations like Nigeria, as well as in small and medium industries (which are the major forms in Nigeria) where resources and technical expertise may be scarce.

Inadequate ventilation is a risk factor that can expose welders to various types/ forms of hazard depending on several factors, 1) type of welding being performed, 2) material the electrode is made of, 3) type of material being welded, 4) presence of coatings on the metal, 5) voltage and current used and 6) type of ventilation.[8] Adequate ventilation is used to control overexposure to the fumes and gases generated during welding and cutting. Adequate ventilation will keep the fumes and gases from the welder's breathing zone. Overexposure to fumes containing hazardous substances may cause acute (short term) or chronic (long term) health effects. Fumes and gases may be produced at toxic levels and they can displace oxygen in the air causing asphyxiation, dizziness, illness, and even unconsciousness and death. Adequate ventilation depends on the size and shape of the workplace, number and type of operations, contents of the fume plume, position of the worker's and welder's head, and type and effectiveness of the ventilation. [9]

In Nigeria, a lot of welders set up their work place by the roadside, predisposing them to roadside accidents from cars/ trucks that have lost control or from drunken drivers. They are also prone to trips and falls as a result of equipment, cables, machines and rails that might be lying on the floor leading to accidents.[10] These are just but a few of the hazards that need to be assessed and tackled so as to reduce the dangers that are associated with welding. The aim of the study was to conduct a risk assessment among welders in Jos Metropolis and assess knowledge of safety measures among them in other to make recommendations for improving their occupational health and safety.

## 2. Methodology

The study was conducted in Jos metropolis, north-central Nigeria. Jos metropolis has a number of business and industrial layouts spreading from Bukuru (Jos South) to Jos North where welders usually set up their workshops for their business or are employed as staff of industries. The study population comprised welders and welding shops within the metropolis. A descriptive cross-sectional design was used for the study. A systematic sampling technique was used to select 50 welding workshops from a pool of 105 workshops within Jos metropolis, and one welder was interviewed from each of the selected workshops.

Information about each workshop was collected using an interviewer administered semi-structured questionnaire adopted from the Department of Labor's Welding Health and Safety Assessment Tool published by Welding Technical Institute of Australia. [11] The questionnaire was structured into five sections as follows: **Section A)** Socio demographic data, **B)** Before any welding occurs, **C)** General welding safety, **D)** Specific welding safety issues and **E)** General welding safety issues

Approval for the study was obtained from the Health Research Ethical Committee of Jos University Teaching Hospital, (JUTH). Permission was then sought and obtained from the heads of each workshop. Informed verbal consent was obtained from each respondent before being enrolled into the study; after being assured of confidentiality. The data collected was analyzed using Epi-info software version 3.5.4 and presented using frequency tables, percentages and charts.

## 3. Results

A total of 50 welding workshops were assessed in this study. From Table 1, 24 (48.0%) of them were less than 10 years old. Most of the welding workshops were located in Dilimi 21 (42.0%) and Building Materials 19 (38.0%) areas of the metropolis. Majority of them 34 (68.0%) employed less than six workers and working hours was 6-10 hours a day for 42 (84.0%) of them.

Table 2 shows that of the 50 shops surveyed, 47 (94%) practiced manual metal arc welding as compared to only 3 (6%) which practiced gas metal arc welding with most of them using 12mm electrodes (82%). Paint (100%) was the most used coating by the respondents in the study with metallic coating used by 26%.

Table 3 shows that among the hazards identified in the workshops, manual handling, noise/vibration and fumes have the highest frequencies of 47 (94.0%), 47 (94.0%) and 46 (92.0%) respectively while asphyxiant gases, compressed gases and fires had low frequencies of 3(6.0%), 4 (8.0%) and 5 (10.0%) respectively.

Table 4 shows all 50 (100%) workshops were well ventilated and 49 (98%) were well-lit. Two (66.7%) out of the 3 shops that do gas welding said that work usually stopped when the smell of gas was perceived. However, most 48 (98.0%) employees working nearby were not protected from arc flash during welding, and none of the shops were arranged or tidy. None of the shops had fire extinguishers, first aid boxes nor did they label hazardous substances. Only 41 (82.0%) workshops provided goggles for the workers while no helmet, apron nor hearing protection was provided by any of the workshops assessed. All the welding took place in an open area in all the workshops assessed.

Figure 1 showing the level of knowledge of workers in the workshops on occupational health and safety as good 22 (44.0%), fair 25 (50.0%) and poor 3 (6.0%) respectively.

**Table 1: General information about the workshops**

Variable	Frequency (n=50)	Percentage (%)
<b>Age of shops (years)</b>		
≤10	24	48.0
11 – 20	18	36.0
21 – 30	8	16.0
<b>Location</b>		
Dilimi	21	42.0
Building materials	19	38.0
Others*	10	20.0
<b>Number of workers</b>		
≤5	34	68.0
6 – 10	15	30.0
11 – 15	1	2.0
<b>Work hours in a day</b>		
≤5	1	2.0
6 – 10	42	84.0
11 – 15	7	14.0
<b>Work days in a week</b>		
5	6	12.0
6	42	84.0
7	2	4.0

\*Shaaka, Namua Junction, Hwolshe, Mai-Adiko, Abbatoir, Bauchi Ring Road and Tina Area.

**Table 2: Workshop welding practices**

Practices	Frequency (n = 50)	Percentage (%)
<b>Type of welding done</b>		
Electric metal arc welding	47	94.0
Gas metal arc welding	3	6.0
<b>Diameter of electrodes used</b>		
10mm	7	14.0
12mm	41	82.0
Missing	2	4.0
<b>Types of metals welded*</b>		
Stainless steel	32	42.0
Mild steel	50	100.0
Galvanized	10	20.0
Aluminum	19	38.0
<b>Type of coatings applied*</b>		
Metallic	13	26.0
Paints	50	100.0

\*Multiple responses allowed

**Table 3: Assessment of occupational hazards present in the workshops**

Hazards*	Frequency (n=50)	Percentage (%)
Noise and vibration	47	94.0
Manual handling	47	94.0
Fumes	46	92.0
Heat stress	23	46.0
Hazardous substances	20	40.0
Burns	18	36.0
Electric shock	12	24.0
Fires	5	10.0
Compressed gases	4	8.0
Asphyxiant gases	3	6.0

\*Multiple responses allowed

**Table 4: Safety measures practiced among welding workshops**

Safety measures	Frequency (n= 50)	Percentage (%)
<b>Work area</b>		
Work areas well-ventilated	50	100.0
Work areas well-lit	49	98.0
Work stops if there is smell of gas	2	4.0
Employees working nearby protected from arc flash	2	4.0
Work areas well-arranged	0	0.0
Work areas tidy	0	0.0
Signs reading danger, no smoking etc.	0	0.0
First Aid available at all times	0	0.0
Hazardous materials well-labelled	0	0.0
Fire extinguishers	0	0.0
<b>Basic safety equipment provided by the employer</b>		
Goggles	41	82.0
Facemask	11	22.0
Overalls	2	4.0
Gloves	2	4.0
Apron	0	0.0
Helmet	0	0.0
Hearing protection	0	0.0
<b>Welding area</b>		
Open area outside	50	100.0

\*gas welding is not carried out in these shops



**Figure 1: Pie chart showing the general knowledge of workers in the workshops on health and safety practices**

#### 4. Discussion

This study was carried out to assess welding workshops within Jos metropolis for occupational hazards, risks and safety practices. The health risks associated with welding gases and fumes are often determined by the length of time one is exposed to them, type of welding engaged in, the work environment and the protection employed. [13] The results obtained from this study revealed that 48% of the workshops were less than 10 years old. Hence, many of them may not have documented records of health effects, if any, of occupational exposure to welding hazards. Of the 50 shops surveyed in the study, majority had less than 6 workers, and only one shop employed more than 10 workers. This corroborates previous information about welding in Nigeria being a predominantly informal occupation. Almost all the workshops practiced manual metal arc welding (electric) as compared to only 6.0% who practiced gas metal arc welding, this is contrasted by a study conducted in Benin City, Nigeria among welders to determine their occupational health problems, which revealed that 67.9% of the welders worked with oxyacetylene flame (gas welding) whereas 32.1% were electric welders.[12]

Among the hazards identified in the workshops in the course of this study, manual handling, noise/vibration and fumes had the highest frequencies while asphyxiant gases, compressed gases and fires were less commonly mentioned. This is similar to the hazards pointed out by the Welding hazards AFSCME factsheet as some of the major hazards found in the welding workshop, which included fumes, asphyxiant gases, compressed gases, electric shocks etc. [9] Among the shops that performed gas welding, only two (66.7%) said that work stops when the smell of gas was perceived, and that most employees working nearby were not protected from arc flash. Not stopping work when the smell of gas was perceived means that there is a lack of adequate safety culture in the workshops and this could predispose the workshop to fire outbreaks and uncontrolled inhalation of toxic fumes which could lead to both acute and chronic health effects such as metal fume fever and lung cancer.[13]

Regarding occupational safety practices, almost all of the work areas were well lit and all of the workshops were well ventilated, and this is commendable. However, none of the shops were well arranged or tidy. None of the shops had fire extinguishers, first aid boxes nor did they label hazardous substances properly. This is a wrong practice, as fire extinguishers should be made available at every workshop to control potential fire outbreaks. Only about 92% of the workshops provided goggles for the workers while no helmet, apron nor hearing protection was provided by any of the workshops assessed. This is also dangerous for the workers' health and is grossly negligent on the part of the employers/owners of the workshops. It is

however, commendable that almost all of the workers used at least one kind of PPE during work.

The study revealed a fair level of awareness of health hazards associated with the welding vocation among the respondents. About half of the respondents had a fair knowledge about health problems associated with welding. This is a positive finding and it could be due to the long working experience of majority of the respondents. However, a similar study carried out in Coastal South India on awareness of occupational hazards and utilization of safety measures among welders revealed a much higher level of awareness of 83.3%.[15]

#### 5. Conclusion

From this study, almost all the workshops practiced manual metal arc welding (electric) and the biggest hazards identified in the welding workshops were manual handling of welding equipment, noise, vibration and fumes. Even though there was good environmental control practices of adequate ventilation and lighting, provision of PPE was not adequate. It is recommended that continuous educational campaign on workplace hazards, adequate environmental control measures, provision and proper use of different PPE should be sustained for welders on a regular basis by the welders' association, local and state governments. Safety devices should be made readily available and accessible through sale at subsidized rates to welders by local and state governments. Local and state governments should institute a program that could give financial rewards to welders who maintain a work related accident free record yearly.

#### Declarations

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**Conflict of interest:** None declared

**Ethical approval:** Approval for the study was obtained from the Health Research Ethical Committee of Jos University Teaching Hospital, (JUTH), Jos.

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