

RESEARCH ARTICLE

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# Awareness and utilization of personal protective equipment among small-scale welders in Cross River State, Nigeria: a descriptive cross-sectional study

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## Abstract

**Objective:** Rapid urbanization and industrialization in the many low- and middle-income countries means that there is a growing demand for the welding industry. Previous studies in Nigeria, and other low- and middle-income countries have reported a significant discrepancy between awareness and consistent and appropriate use of personal protective equipment (PPE). This study assessed the awareness and utilization of PPE among small-scale welders in Calabar South, Cross River State, Nigeria.

**Methods:** This study was conducted in Calabar South Local Government Area using a descriptive cross-sectional design. Data collection was with an interviewer-administered semi-structured questionnaire, and an observation checklist was used to monitor the use of PPE among small-scale welders.

**Results:** One hundred and sixteen small-scale welders were surveyed with a mean age of  $34.9 \pm 9.1$  years. Almost 90% of respondents had completed at least primary education. Eighty-one respondents (69.8%) were aware of PPE. Three-quarters of respondents (61/81) knew PPE protected the user from injury. The most frequently identified type of welding PPE among the respondents aware of PPE, were safety goggles (38.3%), hand gloves (25.9%), safety boots (19.8%), and coveralls (9.9%). 83.6% had access to PPE at work. However, only 14.4% reported using PPE consistently. Observation revealed that the PPE most frequently used, sunglasses, were not the recommended welding goggles.

**Conclusion:** The low utilization of PPE calls for stricter enforcement of occupational health and safety regulations among welders in the informal sector, including implementing PPE awareness programs.

**Keywords:** Awareness, Occupational health, Personal protection, Utilization, Welders

## Plain English summary

This study conducted in Calabar South Local Government Area assessed awareness of and utilization of PPE among small-scale welders using a survey design and found that respondents in this study had good knowledge of and access to PPE. Despite having good knowledge and access, low utilization of PPE was reported among respondents in the workplace, which meant that awareness among welders in the study area did not translate into utilization. This points to the need for a system of better and stricter enforcement of work safety measures among welders and improved education on the need for consistent and proper utilization of PPE.

## Background

Globally, the welding industry comprises skilled and semi-skilled workers, numbering over 5 million who contribute to several sectors of the economy such as manufacturing, real-estate

construction, automotive repairs, and mining (1, 2).

According to the International Labour Organization, globally, there are 270 million occupational accidents and 160 million

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occupational diseases each year. These result in about 2 million deaths annually (3).

The welding occupation involves heating and fusing metals at high temperatures and is thus associated with tremendous physical and chemical hazards including heat, high noise levels, radiation, and fumes (4, 5, 6, 7). The nature of the occupational exposure from welding is dependent mainly on the welding type, materials being welded, and the consistent and appropriate use of personal protective equipment. The use of personal protective equipment such as eye goggles, boots, and overalls is known to mitigate the health hazards from occupational exposures (8).

Rapid urbanization and industrialization in many low- and middle-income countries means that there is a growing demand for the welding industry. Several studies carried out in Nigeria, and other LMICs have reported a significant discrepancy between awareness and PPE utilization (9, 10, 11, 12, 13). A previous study from Calabar, Cross River State had observed welders seldom used protective goggles during welding (6). This study aimed to assess the awareness of and utilization of personal protective equipment among small-scale welders in Calabar South, Cross River State, Nigeria.

### Methodology

This study was conducted in Calabar South Local Government Area, a semi-urban settlement in Cross River State. Calabar South LGA covers an area of 264km<sup>2</sup>. Calabar South comprises 12 wards and has a projected population of about 278,260 in 2020, assuming an annual growth rate of 2.6% from 2006 Nigeria Population and housing Census figures (14). Calabar South has one secondary facility, 27 primary health centers, and several private

health facilities. The predominant ethnic groups are the Efiks, Efuts, Quas, and Ibibios. Most occupants are civil servants, traders, subsistence farmers, and fishermen (15). A descriptive cross-sectional design was adopted for this study. As no sampling frame existed, the research team generated a sampling frame of all the small-scale welders in Calabar South by snowball sampling. All one hundred sixteen small-scale welders identified were selected for inclusion in this study.

Data collection was with an interviewer-administered semi-structured questionnaire that elicited information on sociodemographic characteristics, knowledge of the importance of PPE use, utilization of PPE, barriers to PPE utilization, and welder's perception of their occupational hazards. An interviewer-administered questionnaire was used because some respondents were expected to be without formal education. Also, an observation checklist adapted from the Occupational Safety and Health Administration (OSHA) PPE compliance audit checklist (16) was used to monitor the use of PPE among small-scale welders. Data analysis was done using the Statistical Package for Social Science (SPSS) software (Version 20). Descriptive statistics have been used to summarize and present data. Verbal consent was obtained from all respondents, and participation was voluntary. All respondents were assured of confidentiality and anonymity of data collected.

### Results

A total of 116 small-scale male welders participated in the study. The mean age of welders was  $34.9 \pm 9.1$  years. Almost 90% of respondents had completed at least primary education. Slightly over half (50.8%) of the welders had been in employment as welders for 6-10 years (See Table 1).

**Table 1: Sociodemographic characteristics of respondents (n = 116) Calabar South, Nigeria, 2019**

Variables	Frequency	Percentage
Age (in years)		
18-25	23	19.8
26-33	27	23.4
34-41	34	29.3
42-49	29	25.0
50 & above	3	2.5
Total	116	100
Religion		
Christianity	112	96.5
Traditional Religion	1	0.9
No religion	3	2.6
Total	116	100

Educational attainment		
No formal	12	10.3
Primary	28	24.1
Secondary	57	49.1
Tertiary	19	16.4
Total	116	100
Marital Status		
Single	41	35.3
Married	68	58.6
Divorced/Separated	4	3.5
Widowed	3	2.6
Total	116	100
Duration in employment		
Less than a year	12	10.3
1-5	41	35.3
6-10	59	50.8
11 years +	4	3.5
Total	116	100

#### *Awareness of Personal Protective Equipment (PPE)*

Eighty-one respondents (69.8%) were aware of PPE. Among welders who were aware of PPE, the primary sources of information were television (48.2%) and radio (33%).

Three-quarters of respondents (61/81) who were aware of PPE, stated they protected the

user from injury. The most frequently identified type of welding PPE among the respondents were safety goggles (38.3%), hand gloves (25.9%), safety boots (19.8%), and coveralls (9.9%) as shown in Table 2. About 15% (12) did not think PPEs were necessary.

**Table 2: Welders' awareness of PPE (n = 116) Calabar South, Nigeria, 2019**

Variables	Frequency	Percentage
Awareness of PPE		
Yes	81	69.8
No	35	30.2
Total	116	100
Source of information on PPE		
Television	39	48.2
Radio	33	40.7
Posters/Handbill	9	11.1
Total	81	100
Definition of PPE		
Protective clothing to protect the user from injury	61	75.3
Clothing that causes discomfort or heat	17	21.0
To protect the user from skin diseases	1	1.2
To protect the user from the splash of blood	2	2.5
Total	81	100
Is PPE necessary?		
Yes	69	85.2
No	12	14.8
Total	81	100
Welding PPE identified by respondents		
Safety goggles	31	38.3
Hand gloves	21	25.9
Safety boots	16	19.8
Coverall	8	9.9
Face mask	4	4.9
Respirator	1	1.2
Total	81	100

### *Utilization of Personal Protective Equipment (PPE)*

The majority of the respondents, 97(83.6%), had PPE for use during work hours. The most frequently used PPE among the welders was safety goggles 76(65.5%), as shown in Table 3. Seventy-nine (68.1%) welders reported utilization of at least one PPE. For some welders, these were used along with hand gloves, coveralls. Consistent use of PPE was

low, with only 14.4% (14/97) reporting that they used PPEs always. A considerable proportion of respondents, 63.9% reportedly used PPEs most of the time (Table 3). Only 7.7% (7/97) had received training on the use of PPE and safety in the workplace. The majority of the respondents 101 (87.1%) were willing to be trained on the use of PPE and safety in the workplace.

**Table 3: Welders' utilization of PPE (n = 116) Calabar South, Nigeria, 2019**

Variables	Frequency	Percentage
Had access to PPE at work		
Yes	97	83.6
No	19	16.4
Total	116	100
*Utilization of PPE		
Hand gloves	44	37.9
Coverall	41	35.3
Safety boots	31	26.7
Safety goggles	76	65.5
Frequency of PPE use		
Always	14	14.4
Most times	62	63.9
Sometimes	9	9.3
Rarely	12	12.4
Total	97	100
Training on the use of PPE & safety at the workplace		
Yes	9	7.7
No	107	92.3
Total	116	100
Willing to be trained on the use of PPE		
Yes	101	87.1
No	15	12.9
Total	116	100

\*Multiple responses

The main reasons for the non-utilization of PPE were discomfort associated with use (41.4%) and lack of funds to buy PPE (39.6%). Of the remaining respondents, 19% (22) stated their PPEs were either worn out or damaged.

### *Observation of PPE use among welders*

The observational checklist consisted of a list of PPEs that the researcher used to observe the utilization of PPE among welders. From Table 4, the majority of the welders 64 (55.2%) used

sunshades instead of the recommended safety goggles, 39 (33.6%) welders out of 116 used hand gloves, 22 (19%) welders out of 116 used safety boots, 13 (11.2%) welders out of 116 used coverall. In contrast, none of the welders used a face mask, respirator, or earmuffs. The observation revealed that the welders in Calabar south utilized PPE but incorrectly in some cases. This is due to the lack of training on PPE use and its importance.

**Table 4: Observation of PPE use among welders (n = 116) Calabar South, Nigeria, 2019**

Types Of PPE	Utilization rate	Remarks
Hand Gloves	39/116 (33.6%)	All the hand gloves used were the recommended type. However, 9 (23.1%) were worn out.
Face Mask	0/116	All the respondents had no face mask for use.

Cover All	13/116 (11.2%)	Only 13 welders used their coverall. Others claimed to have.
Respirators	0/116	None of the respondents had a respirator.
Safety Boots	22/116 (19%)	All 22 welders had appropriate safety boots.
Safety Goggles	64/116 (55.2%)	All the 64 welders had sunshades which are not the recommended type of safety goggles.
Earmuffs	0/116	None of the welders used earmuffs.

## Discussion

This study aimed to assess the awareness and utilization of personal protective equipment among small-scale welders in Calabar, Cross River State, Nigeria. In this study, 54.3% of the respondents had more than five years' experience. Other studies in Nigeria (17) have shown 74.8% of welders with more than a decade of experience.

Welders surveyed in this study had good knowledge of PPE and safety goggles were the most frequently reported PPE used by them. This finding is similar to other studies (2, 11, 12) conducted in Nigeria that found safety goggles to be the most frequently used PPE. Safety goggles, hand gloves, and safety boots were the main PPE utilized by study respondents based on self-report or observation of welders. The consistent use of PPE was low among respondents despite 84% reporting they had access to PPE in the workplace. Awareness among welders in the study area did not translate into consistent use. This is similar to findings from similar studies that found low utilization of personal protective eye devices (18) and the utilization of at least one type of PPE (9). However, a study in Nepal (19) reported a utilization rate of at least one PPE to be 95.5% among welders in metal workshops much higher than the 68.1% observed in this study.

The findings of the study showed that the barriers to the use of PPE in the study area are discomfort and lack of funds to buy PPE. Lombardi and colleagues (20) found that among workers in the United States of America, inadequate financing and difficulties in obtaining them were barriers to the utilization of PPE.

Only about 8% of the respondents had received training on the use of PPE and safety at the workplace. A study from South India (21) found only about 19.1% of welders had received institutional training. This underscores the need for safety regulatory services to be extended to this occupational group.

Welding is associated with various physical and chemical hazards when welders do not continuously utilize appropriate PPE. The consistent use of recommended PPE to minimize these hazards should be a priority. Thirty percent of welders interviewed in this

study were not aware of PPEs, and only 14.4% consistently used PPE during welding. From observation, the sunglasses being used by welders in the study area were not the recommended welding goggles, thus exposing their eyes to harmful ultraviolet radiation. This finding is similar to a study from Nepal (9) and another from Pakistan (20).

Most welders in the study area had never received training on the use of PPE and workplace safety. There is a significant know-do gap between the knowledge of welders regarding awareness of PPE and the consistent use of PPE at work by the welders. Appropriate interventions need to be designed to address this gap, especially as most welders expressed willingness to be trained. Occupational Health and Safety need to be promoted by the Nigeria Labor Congress and the national welder's union.

Limitations of this study include the risk of social desirability bias and self-reports. However, to mitigate this risk, observation of PPE utilization was undertaken at the worksites of all welders sampled.

## Conclusion

The low utilization of PPE calls for stricter enforcement of occupational health and safety regulations among welders in the informal sector, including implementing PPE awareness programs. This is particularly important as most respondents expressed their willingness to be trained on occupational health and safety.

The Federal Ministry of Labour and Employment in Nigeria should also enforce operating guidelines and a safe working environment for welders employed in the small-scale, informal sector. Interventions to improve welders' awareness and utilization of PPE should focus on providing safety training, enforcement of worksite safety regulations, and knowledge of occupational hazards. Also, further studies should investigate the use of other workplace safety measures such as the use of engineering and administrative controls, regulation, and enforcement.

## List of abbreviations

PPE: Personal Protective Equipment



## Declarations

### *Ethics approval and consent to participate*

Ethical approval to conduct this study was obtained from the Research Ethics Committee of Department of Public Health, University of Calabar, Calabar on 21 June 2019 and reference number UC/CMS/PUH/ETH/1940. Verbal consent was obtained from all participants before data collection.

### *Consent for publication*

The authors hereby give consent for the publication of our work under the creative commons CC Attribution-Non-commercial 4.0 license.

### *Availability of data and materials*

The data and materials associated with this research will be made available by the corresponding author upon reasonable request.

### *Competing interests*

The authors have no competing interests.

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### *Authors' contributions*

EEB and EUE—conceptualized and designed the study. EEB wrote the first draft of the manuscript. EUE—was responsible for data collection and EEB- supervised data collection. All authors read and approved the final manuscript.

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