



## Awareness Of Occupational Hazards, Use of Personal Protective Equipment and Workplace Risk Assessment Among Welders in Mechanic Village, Abakaliki, South-East Nigeria

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### Abstract

**Background:** Occupational diseases can result in sickness absence, economic loss, disability, or death of workers. Several studies have revealed that occupational health and safety practice is still low in some occupational groups despite their knowledge and the occupational health legislation. This study assessed the level of knowledge, Background: Occupational health service delivery, includes the creation of a safe and healthy work environment. The protection and promotion of workers' health; is at its infantile stages in the informal sector such as the welding industry in Nigeria. We determined the level and determinants of awareness of occupational hazards, determinants of use of personal protective equipment (PPE) and carried out a workplace risk assessment among the welders at the mechanic village in Abakaliki, Ebonyi State.

**Methodology:** We conducted a cross-sectional study among welders who work in the mechanic village, Abakaliki. A structured, pretested interviewer-administered questionnaire was used to extract information on awareness of occupational hazards, frequency of use of PPE, health-related complaints amongst others. Chi-square test and logistic regression analysis were conducted at a 5% level of significance.

**Result:** All the respondents were male with a mean age of 27.6± 10.1 years. We found a good awareness of occupational hazards in 60% of the respondents and though this was associated with being older than 30years (p=0.03), being an expert compared to apprentice (p=0.003), duration of work more than 5years (p=0.004), none of these factors, when modelled in logistic regression, were predictors of good awareness. Regular use of PPE was reported in 49.79% of respondents. Cuts, sparks, foreign bodies in the eye were the most common hazards they were aware of. Cuts were the most reported health complaint. Good awareness of hazards was associated with higher odds of sustaining cuts (adjusted odds ratio [AOR]: 3.1, 95% CI:1.46 – 6.69) and a predictor of regular use of PPE (AOR:2.6, 95%CI:1.12 – 5.88). The workplace risk assessment revealed a work environment not conducive to occupational safety and health.

**Conclusion:** A good awareness of occupational hazards was moderately high, a predictor of regular use of PPE and not protective of sustaining cuts in the suboptimal work environment.

**Keywords:** Personal Protective Equipment; Risk Assessment; Injury; Welder; Hazards.

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**How to cite this article:** Agu PA, Umeokonkwo CD, Adeke AS, Nnabu CR, Ossai EN, Azuogu BN. Awareness of occupational hazards, use of personal protective equipment and workplace risk assessment among welders in mechanic village, Abakaliki, Southeast Nigeria. Niger Med J 2021; 62; (3):113-121.

Quick Response Code:



## Introduction

Work-related accidents and illnesses cause unacceptable human suffering and economic losses worldwide (ILO). The ILO promotes a preventative safety and health culture in the workplace and is committed to improving occupational safety and health conditions in small and medium-sized enterprises and the informal economy as part of the focus of its strategies to address this important issue.

Welding is a common and hazardous industrial process and is often in the informal sector in developing countries including Nigeria. Welders are exposed to workplace hazards such as welding fumes and gases, heat, radiation, noise, flying metal chips and undesirable postures.– The resulting adverse effects of burns, arc eye, metal fume fever, musculoskeletal disorders, injuries, pulmonary and fertility symptoms–make it imperative that safety measures be employed to control these hazards. Unfortunately, occupational safety and health management systems that would ensure implementation, are poorly developed in the informal sector in Nigeria. While there has been published research among welders in Nigeria, this is limited and none in Ebonyi State at the time of the study. In Abakaliki, the capital of Ebonyi State in Southeast Nigeria, welders are usually located at mechanic workshops, the mechanic village and along the streets and there is no provision of occupational health services for them. We aimed therefore to determine the level of awareness of occupational hazards and their determinants, the reported use and determinants of use of PPEs, the health-related complaints and to carry out a workplace risk assessment among the welders within the mechanic village. The study was carried out to provide a database for intervention to prevent or control the effects of identified hazards in conjunction with the relevant stakeholders and for a comprehensive provision of occupational health services and policy advocacy for these and other groups of informal workers in the state and country.

## Materials and Methods

The study took place in Abakaliki, the capital of Ebonyi State, Nigeria. The state has 13 Local Government Areas (LGAs). Abakaliki metropolis is made up of parts of Abakaliki and Ebonyi LGAs. The mechanic village along Ogoja road, Abakaliki, is the only place where a large cluster of welders exists in both LGAs.

The study population was welders (experts and apprentices) in the mechanic village in Abakaliki. All welders (experts and apprentices) who work in the mechanic village in Abakaliki, were registered with the National Automobile Technician Association (NATA) and gave informed consent were included in the study while apprentices that were less than 10 years of age were excluded. We conducted a cross-sectional study among the welders in February 2016 using a pretested interviewer-administered questionnaire to assess their knowledge, attitude, and use of PPE. A walk-through survey was also done to conduct a workplace risk assessment at the same period.

Using the formula for a single independent proportion we estimated the minimum sample size required of 190 after adjusting for finite population correction. All welders who responded during the 2-day prearranged sessions in the course of the study and met the inclusion criteria were interviewed. The population of registered welders at the time was 225.

We used a semi-structured interviewer-administered questionnaire to extract information on socio-demographic characteristics, awareness of occupational hazards, awareness, ownership and use of PPE and health-related complaints associated with their work as some of the variables. Data quality was ensured by training of the research assistants on data collection to ensure consistency in the administration of the questionnaire, field supervision and checking of the questionnaires for completeness and accuracy by the principal investigator and supervisors. The questionnaire was translated into the local language and back translated into English.

Data was entered, cleaned, and analyzed using Epi Info version 7.2 statistical software. We estimated the frequency and proportion of respondents who were aware of hazards in their workplace. Those that were aware of 3 or fewer hazards were categorized as having poor awareness while those that were able to identify 4 or more hazards were categorized as having good awareness. Regular use of PPE was taken as the response always for frequency of use of PPE. The relationship between good awareness of a hazard and socio-demographic characteristics was estimated using the chi-square. Those factors that were associated with good awareness of hazards, having injuries at the workplace and regular use of PPE at a p-value of 0.2 were modelled in logistic regression to identify predictors of good awareness, having injuries at the workplace and regular use of PPE respectively.

Ethical approval was obtained from the Research and Ethics Committee of Federal Teaching Hospital Abakaliki and permission was sought from the chairman of the National Automobile Technicians Association, Abakaliki branch. Written Informed consent was obtained from respondents.

## Results

A total of 191 welders were interviewed. All the respondents were males with a mean age of 27.6±10.1 years. The age group 21-30 years had the highest percentage of respondents (48.2%). A greater proportion were apprentices (53.9%; Table 1) Majority of the participants (60.2%) have worked for five years or less, 49.2% work with gas welding while 14% do both gas and arc welding. Cuts, Sparks, foreign body in the eyes, heat and electric shock were the most common hazards the respondents were aware of (Table 2). The awareness of PPE among the respondents was high (95.3%) and the majority of the

respondents knew about the PPE through their employers (68.5%). Goggles, hand gloves and boots were the most common PPEs they were aware of, owned and used. 49.7% of respondents fell into the category of regular use of PPE (Table 3). 90.6% of the respondents had used PPE (Table 3). A majority (71.7%) of the workers procure their PPE. All the workers believe that PPE is beneficial, important and protects the workers.

Eighty-eight percent of the respondents had reported injuries associated with welding. Cuts (85%), waist pain (69.6%) and injury to the eye (57.1%) were the most commonly reported injuries. None of the respondents had ever received any health or safety training. Patent medicine vendors serve as the main source of first aid (90.6%). Good awareness of hazards was seen in 60% of the respondents using the criteria outlined in the methods section. Being older than 30 years is significantly associated with good awareness of hazards at the workplace ( $p=0.03$ ; Table 5). Similarly, a higher proportion of experts had a good awareness of the hazards in the workplace compared to the apprentice and this difference in proportion was found to be statistically significant ( $p=0.003$ ). A higher proportion of those who had worked for more than 5 years had a good awareness of hazard compared to those that had worked for 5 years or less ( $p=0.004$ ; Table. However, when these factors were modelled in logistic regression, none of the factors significantly predicted good awareness. Though the experts and those who had worked for more than five years were twice more likely to have a good awareness of hazard the higher odds were not statistically significant (Table 6). None of the factors examined (age, marital status, level of expertise, ever used PPE, duration of work experience, good awareness of PPE), were associated with having an injury at the workplace. Good awareness of hazards was associated with regular use of PPE (aOR: 2.6; 95%CI: 1.12 – 5.88; Table 7) and having cuts (aOR: 3.1 95% CI: 1.46 – 6.69; Table 8). The workplace risk assessment (Table 9) showed that the work environment was not conducive (Figure 1, 2 & 3).

Table 1: Sociodemographic characteristics of the respondents

Variables	Frequency	Percentage (%)
<b>Age group (years)</b>		
11-20	44	23.0
21-30	92	48.2
31-40	34	17.8
41-50	13	6.8
>50	8	4.2
<b>Marital status</b>		
Married	63	33.0
Single	128	67.0
<b>Level of education</b>		
No formal	18	9.4
Primary	101	52.9
Secondary	69	36.1
Tertiary	3	1.6
<b>Religion</b>		
Christianity	177	92.7
Islam	12	6.3
Traditional	2	1.1
<b>Level of expertise</b>		
Apprentice	103	53.9
Expert	88	46.1

Table 2: Respondents work experience and hazard awareness.

Variable	Frequency	Per cent (%)
<b>Type of welding</b>		
Arc welding	70	36.7
Gas welding	94	49.2
Both	27	14.1
<b>Duration of work experience as a welder</b>		
<1year	22	11.5
1-5years	93	48.7
6-10years	28	14.7
11-15years	19	10.0
16-20years	8	4.2
>20years	21	11.0
<b>Hazard Awareness</b>		
Cuts	157	82.2
Sparks	142	74.4
Foreign body/injury in the eye	128	67.0
Heat	123	64.4
Electric shock	121	63.4
Noise	110	57.6
Fire and explosions	93	48.7
Dust	72	37.7
Fumes and gases	60	31.4
Falls	14	7.3

Table 3: Personal Protective Equipment (PPE) awareness, ownership, use and attitudes by the respondents.

Variable	Frequency	Per cent (%)
<b>Awareness of PPE</b>		
Yes	182	95.3
No	9	4.7
<b>Source of awareness of PPE</b>		
Customers	4	2.2
Employers	125	68.7
Fellow workers	50	27.5
Friends	2	1.1
Others	1	0.6
<b>PPEs the respondents were aware of</b>		
Goggles	180	98.9
Gloves	140	76.9
Boots	135	74.2
Aprons	95	52.2
Hand shield	81	44.5
Welding helmets	34	18.7
Fire-resistant clothing	32	17.6
Respirators	29	15.9
Earmuffs	10	5.5
Earplugs	2	1.1
<b>Ownership of PPEs</b>		
Goggles	161	88.5
Boots	43	23.6
Gloves	36	19.8
Aprons	15	8.2
Hand shield	15	8.2
Fire-resistant clothing	10	5.5
Welding helmets	4	2.2
Earmuffs	1	0.6
<b>Ever Used PPE</b>		
Yes	173	90.6
No	18	9.4
<b>PPE used</b>		
Goggles	165	95.4
Boots	39	22.5
Gloves	34	19.7
Aprons	17	9.8
Hand shield	11	6.4
Fire-resistant clothing	9	5.2
Welding helmets	3	1.7
Earplugs	1	0.6
<b>Frequency of PPE use</b>		
Always	86	49.7
Rarely	10	5.8
Sometimes	76	43.9
When forced by an employer or agency	1	0.6
<b>Reasons for working without PPE (multiple options)</b>		
When I am doing small work	50	27.5
When PPE are not available	35	19.2
When in a hurry to work fast	23	12.6
No obvious reason	9	5.0
When I am tired of using PPE	4	2.2
<b>Enforcement team</b>		
No	191	100.00

PPE=Personal Protective Equipment

Table 4: Health-related complaints associated with welding.

Variable	Frequency	Per cent (%)
<b>Injuries associated with welding</b>		
Yes	168	88.0
No	23	12.0
<b>Nature of injury</b>		
Cuts	143	85.1
Waist/back pain	117	69.6
Foreign body/ Injury to the eye	96	57.1
Electric shock	76	45.2
Burns	54	32.1
Impaired vision	18	10.7
Injury from falls	3	1.8
Fractures	1	0.6

Table 5: Factors associated with good awareness of the hazard in the workplace.

Variable	Good awareness	Poor Awareness	Chi-Squared	p-value
<b>Age</b>				
≤30 years	102 (75.0)	34 (25.0)	4.697	0.030
>30 years	49 (89.1)	6 (10.9)		
<b>Marital Status</b>				
Married	54 (87.1)	8 (12.9)	3.583	0.058
Not currently married	97 (75.2)	32 (24.8)		
<b>Education</b>				
Primary education or less	92 (77.3)	27 (22.7)	0.582	0.446
Secondary education or more	59 (81.9)	13 (18.6)		
<b>Level of Expertise</b>				
Apprentice	73 (70.9)	30 (29.1)	9.043	0.003
Expert	78 (88.6)	10 (11.4)		
<b>Duration of work experience</b>				
≤5 years	83 (72.2)	32 (27.8)	8.272	0.004
>5 years	68 (89.5)	8 (10.5)		

Table 6: Logistic regression of the factors associated with good awareness of hazard in the workplace.

Variable	AOR	95% CI	p-value
<b>Age</b>			
≤30 years	1		
>30 years	1.2	0.21 – 7.14	0.818
<b>Marital Status</b>			
Married	1		
Not currently married	1.6	0.34 – 7.15	0.562
<b>Level of Expertise</b>			
Apprentice	1		
Expert	2.2	0.59 – 8.39	0.238
<b>Duration of work experience</b>			
≤5 years	1		
>5 years	2.0	0.36 – 10.84	0.427

Table 7: Factors associated with regular use of PPE among the welders.

Variable	Regular use of PPE		p-value*	aOR (95%CI)
	Yes	No		
<b>Age</b>				
≤30 years	54 (45.4)	65 (54.6)	0.091	1
>30 years	32 (59.3)	22 (40.7)		
<b>Marital Status</b>				
Married	33 (55.9)	26 (44.1)	0.239	
Not currently married	53 (46.5)	61 (53.5)		
<b>Level of Expertise</b>				
Apprentice	42 (47.2)	47 (52.8)	0.495	
Expert	44 (52.4)	40 (47.6)		
<b>Level of education</b>				
Primary or less	54 (48.7)	57 (51.3)	0.798	
Secondary or more	32 (51.6)	30 (48.4)		
<b>Duration of work experience</b>				
≤5 years	46 (45.1)	56 (54.9)	0.146	1
>5 years	40 (56.3)	31 (43.7)		
<b>Awareness of Hazard</b>				
Good awareness	76 (54.3)	64 (45.7)	0.013	2.6 (1.12 – 5.88)
Poor awareness	10 (30.3)	23 (69.7)		

\*p-value of Chi-square statistics

Table 8: Factors associated with cuts.

Variable	Cut		p-value*	aOR (95%CI)
	Yes	No		
<b>Age</b>				
≤ 30 years	100 (73.5)	36 (26.5)	0.502	
>30 years	43 (78.2)	12 (21.8)		
<b>Marital Status</b>				
Married	51 (82.3)	11 (17.7)	0.103	1
Not currently married	92 (71.3)	37 (28.7)		0.6 (0.22 – 1.57)
<b>Level of Expertise</b>				
Apprentice	73 (70.9)	30 (29.1)	0.168	1
Expert	70 (79.6)	18 (20.4)		0.9 (0.38 – 2.31)
<b>Level of education</b>				
Primary or less	90 (75.6)	29 (24.4)	0.755	
Secondary or more	53 (73.6)	19 (26.4)		
<b>Duration of work experience</b>				
≤ 5 years	84 (73.0)	31 (27.0)	0.474	
>5 years	59 (77.6)	17 (22.4)		
<b>Awareness of Hazard</b>				
Good awareness	121 (80.1)	30 (19.8)	0.001	3.1 (1.46 – 6.69)
Poor awareness	22 (55.0)	18 (45.0)		1

\*p-value of Chi-square statistics

Table 9: Result of the workplace risk assessment

Hazard	Who might be harmed and how	What is already being done	Further action needed	Action by who
Direct contact with used engine oil which is drained onto the ground	All workers, visitors  Dermatitis, increased risk of skin cancer, soil contamination		Use of PPE- gloves, overalls, boots  Worker training on hazardous substances & need for use of PPEs  Management training  Regular hand hygiene  Drain the oil into a waterproof  Periodic medical examinations	National Automobile Technicians Association management  Workers  Ministry of Commerce and Industry
Inhalation of fumes and gases plus fire explosions from the gases	All workers, visitors  Eye irritation; respiratory problems such as cough, wheezing, increased risk of lung cancer; burns, death	Use of PPE- facemask, goggles	Use of PPEs facemask, goggles, helmet powered respirator with a visor  Worker training on hazard and control  Management training  Use of local exhaust ventilation  Shift work	Workers  National Automobile Technicians Association management  Employers  Ministry of Commerce and Industry

			Provision of fire extinguishers & training workers to use  Periodic medical examination	
UV radiation IR radiation Visible light	At-risk- Workers  Effect- Arc eye, cataract, pterygia, pinguecula, band-shaped keratopathy, skin burns, increased risk of skin cancer	Use of PPEs goggles	Use of PPEs-goggles, helmets, visors, lead shields  Worker training on radiation exposure  Need for PPE use  Shift work  Radiation monitors at the arc welding power-supply areas  Use of personal dosimeters  Regular checking & maintenance of the welding machines  Periodic medical examinations  Management training	Workers  National Automobile Technicians Association management  Ministry of Commerce and Industry
Flying metal chips, fragments, stone and sand	At-risk- workers, visitors  Effect-Foreign body in the eye, ocular injuries	Use of PPEs= goggles and visors	Use of PPEs- goggles, helmets, visors	Workers  National Automobile Technicians Association management  Employers  Ministry of Commerce and Industry
Noise from welding and generators	At-risk- workers, visitors  Effect-Temporary deafness, permanent deafness, fatigue, headache, loss of concentration, accident		Use of PPEs-earmuffs, earplugs, noise guards for machines  Training of workers on their use	Workers  National Automobile Technicians Association management  Employers  Ministry of Commerce and Industry
Obstructions to passageways with tools, gas cylinders, metal and wooden scraps, vehicles, wires	At-risk- workers, visitors  Effect-Slips, trips, falls which can lead to sprains injuries, fractures		Creation of safe clear passageways with designated areas for welding  The orderly arrangement of tools and scraps in use	Workers  National Automobile Technicians Association management  Employers

			Disposal of useless scraps and abandoned vehicles	Ministry of Commerce and Industry
Electrical equipment, e.g. exposed wires	At-risk- workers, visitors  Effect- Burns, electric shock, death, destruction of property	Use of boots and gloves made of rubber	Fire-resistant clothing  Functional fire extinguishers  Train workers in fire drills  Boots and gloves made of rubber  Insulation of electric wires and earthing	Workers  National Automobile Technicians Association management  Employers  Ministry of Commerce and Industry
Sharps tools on walls and floors plus unguarded parts of used machinery for cutting metal	At-risk- workers, visitors  Effect- Cuts	Use of safety boots	Placement of sharp tools on shelves  Provision of safety boots and thick protective gloves for workers  Educate workers on their use  Training of workers on the proper use of these machines  Regular inspection of these machines and repair/replace when faulty	Workers  National Automobile Technicians Association management  Employers  Ministry of Commerce and Industry
			Cutting machines should be placed away	
Hot metal	At-risk- workers, visitors  Effect- Thermal burns	Use of gloves	Use of PPE-gloves, overalls, boots  Worker training	Workers  National Automobile Technicians Association management  Employers  Ministry of Commerce and Industry



**Picture 1:** Apprentice learning without protective equipment



**Picture 2:** Welder working without protective goggle



**Picture 3:** Workplace environment

**Discussion**

A good awareness of occupational hazards, their effects, and the understanding of the need to and willingness, therefore, to comply with safety measures instituted, on the part of the worker; combined with government and management's commitment to the provision of these measures including health and safety training of workers and provision of occupational health services, would make the welding occupation less hazardous for the workers.

A similar finding to the all-male gender of the welders in this study has been reported in studies among welders in other parts of the country and attributed possibly to the hazardous nature of the job. The largest number of the respondents were in the 21-30 year age group (48%), similar to the findings of Isah and Okogie in Benin (40.3%) but contrasting with the study in Kaduna and East Nepal where the 30- 39 year age group had the highest percentage of respondents (44.5%). The Ebonyi State program of free primary and secondary education for close to 20 years may account for the percentage of those who had primary education (52%) in this study is more than twice the national average figure for men in the National Demographic Health Survey 2018. Studies in Benin, Ilorin and Kaduna though have secondary education as the highest level attained for the highest percentage of the welders studied. The South-East zone where Ebonyi State belongs has earned a reputation for sending off children to learn apprenticeship for a marketable skill at an early age as can be seen by the lowest age group in this study (11-20 years) having as much as 23% of respondents and apprentices making up 53.9% of the respondents. Health systems research to understand the sociocultural contextual factors at play beyond the economic factors may help in addressing the issue of formal school education for children.



Even though older age, higher level of expertise and duration of work experience of 5 or more years were significantly associated with good awareness of hazards (recognition of four or more hazards) as is to be expected and has been reported elsewhere, none of these factors was a predictor of good awareness. Cuts were the most commonly identified hazard among the respondents (82.2%) and the commonest health-related complaint experienced (85.1%). A good awareness of hazards was significantly associated with not having cuts and predicted outcomes in the logistic regression. Good awareness was also a predictor of regular use of PPE emphasizes its importance in keeping the workers safe and healthy. None of the workers had formal health and safety training and the majority of their awareness of PPE (and therefore possibly hazards) was from their employers. Only 86 respondents (45%) used PPE regularly. Studies in South-eastern Nigeria and Southwestern Nigeria have reported low levels of use of welding goggles. It is expected that an increase in good awareness of hazards would improve the regular use of PPE and reduce the number of people experiencing cuts. However, some of the reasons given for working without PPE such as when the work is perceived as being small or speed is of the essence implies that effort is needed not only to increase awareness of the multiple hazards through formal health and safety training but explore further the reasons why they are not being used even when they are aware of its importance through qualitative studies and behavioural change communication interventions.

Goggles being the commonest PPE the workers were aware of was also reported in Benin, Ilorin, Ile-Ife and Kaduna. This can be attributed to the fact that various studies in Nigeria, some as far back as three decades ago, have reported eye disorders in welders and in recognition of the risk the UV radiation from the welding process poses to the eyes, health education and awareness campaigns as was recommended by some and even their distribution is expected to have been carried out across the country.

For almost all the respondents, the point of first aid treatment is patent medicine vendors as was also reported in a study on healthcare-seeking behaviour conducted among all the groups of artisans at the same study site. Provision of occupational health services is therefore needed.

From the results of the workplace risk assessment, the work environment of the welders is not in optimum condition, and it is necessary that a stakeholder meeting of management, workers and the overseeing government ministry be convened and the results of this study disseminated. Engineering controls, the establishment of a safety committee, drafting of an organizational policy, training of workers and health surveillance are some actions needed to keep their workplace health and safety compliant.

## Conclusion

This study found a good awareness of occupational hazards in close to two-thirds of the welders, with cuts, sparks and foreign bodies in the eyes being the most frequently mentioned, while regular use of PPE was reportedly practised by only half of the welders. The work environment was not in optimal condition. A good awareness of occupational hazards was the only predictor of regular use of PPE, in addition to being associated with risk of sustaining the commonest reported health complaint and injury, cuts. Given its importance, therefore, coupled with the high level of reported injuries, the departments in the relevant ministries charged with the overseeing of activities of the welders in the study area in conjunction with experts from the academia, should ensure that interventions that increase the awareness of occupational hazards and implement control measures including behavioural change communication programs to improve the regular use of PPE are carried out as part of the provision of occupational health services to safeguard their health and safety. This should be extended to other occupational groups in the study area.

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