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Injuries and Usage of Personal Protective Equipment among Welders in Brikama, The Gambia

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Abstract

Globally, injuries have not been recognized as a public health concern. Welding has been identified as a high-risk profession according to the ranking of occupations-based injuries. Adherence to safety measures and practice among welders are potential ways of preventing occupational injuries. The study aimed to describe welding-related injuries and utilization of safety measures among welders in Brikama. The study is a descriptive cross–sectional study. A structured and semi-structured questionnaire was administered as well as direct observation and interview. The study population consisted of 271 welders within Brikama, in The Gambia. Data was analysed using the Statistical Package for Social Sciences (SPSS 20.0).The descriptive statistics was used to summarize the data. Analytical statistic test was used to test for association using the chi-square at 95% significant level. Multivariable regression analysis was done to examine the predictors of welding-related injuries. The prevalence of occupational injuries was found to be 91.1%. Only 57.6% of the study participants were found to have always used personal protective equipment (PPE) with goggles (94.8%) as the most protective device utilized; 97.8% of the respondents reported that the welding profession is hazardous. Educational status and type of training on-the-job among respondents were found to be statistically associated (p=0.032, 0.042) with those who suffered from welding-related injuries. Occupational injuries are preventable during welding. The training type, level of experience and attitude during work can significantly reduce injuries.

Les blessures et l'utilisation d'équipements de protection individuelle parmi les sondeurs a Brikama en Gambie

Abstrait

Les blessures sont un problème de sante publique mondiale. Ce sondage a étéidentifiée comme une profession a haut risqué selon le classement des blessures en fonction des professions. Respecter des mesures de sécurité et des pratiques chez les sondeurs sont des moyens d'éviter les lésions professionnelles. Le but de cet étudeétait de décrire les blessures liées au sondage et l'utilisation des mesures de se protéger chez les sondeurs de Brikama. Il s'agissait d'une étude transversale descriptive utilisant un

questionnaire structure et semi-structure qui était administre par l'intervieweur et une liste de contrôle d'observation. La population étudiée était composée de 271 sondeurs à Brikama, en Gambie. Les données ont été analyséeà l'aide du progiciel statistique pour les sciences sociales. (SPSS20,0). Le statistique descriptif a été utilisé pour résumer les données. Un test statistique analytique a été utilisé pour tester l'association en utiliser le chi carréeà un niveau significatif de 95%. Une analyse de régressionmultivariée a été effectuée pour examiner des prédicteurs des blessures liées au sondage .Leprévalence des lésions professionnels était de 91, 1%.Seulement 57,6% des participants à l'étude ont toujours utilisés un équipement de protection individuelle avec des lunettes (94,8%)comme le protecteur , le plus utilise. 97,8% des répondants ont déclaréque la profession de sondeur est dangereuse. On a constaté que le niveau de scolarité et le type de formation, étaientstatistiquement associes ((p=0,032,0,042) a ceux qui souffraient des blessures liées au sondage. Les blessures professionnelles peuvent êtreévitées. Pendant le sondage, c'est établi que le type de formation, le niveau d'expérience et l'attitud au travail peuvent réduireconsidérablement les blessures.

Introduction

Injuries among welders are a growing concern. The welding technology is needed in almost all kinds of metallic construction work commonly practiced in the Gambia (Popovi *et al*., 2014). It encompasses numerous metal-joining processes such as electric arc welding, resistance welding, oxy-fuel gas welding, solid-state welding, high energy density welding, as well as brazing and soldering (Antonini, 2014). The electric arc welding is the most common in The Gambia.

Welders are an important occupational group especially in developing countries with rapid urbanization and industrialization. This makes it a labour-oriented market and there is the need to adopt automation in welding activities (Bhumika *et al*., 2014, Health and Safety Executive, 2017). According to Gebrezgiabher *et al* (2019), it is estimated that more than one million workers are presently employed as welders worldwide with more than three million performing welding intermittently as part of their work duties.

According to Bhumika *et al.* (2014), the World Health Organization stated that 250 million cases of work-related injuries are registered per year globally. Non-industrial welding in developing countries contributes to these occupationally-related injuries.

Welders in the non-industrial sector are involved in automobile and real-estate sector welding. This sector is usually involved in welding of mufflers or automobiles' repairs following accidents or crashes (Shaikh and Shaikh, 2005). The process involves lying underneath the vehicle for welding or repair. It also involves cutting and joining of metal parts with the help of flame, electric arc or other sources of heat. Welders are mostly injured by flying sparks and particles of hot metals, ultraviolet radiation and metal fumes (Yu and Hui, 2004). Most of the injuries are preventable during welding if proper safety measures are practiced (Ajayi *et al*., 2011).

The Gambia is one of the West African countries where occupational health is neglected. Welders are exposed to injuries or disabilities by flying sparks and particles of hot metals, ultraviolet radiation and metal fumes (Kumar and Dharanipriya, 2014). Globally, 271 million people are affected with work-related injuries and two million die as a result of these injuries yearly (WHO, 2003). The available studies on industrial injuries in Africa indicated work-related injuries with greater frequency and severity. Occupational accidents in Sub-Saharan Africa were more than 54, 000 fatal work-related incidents and approximately 42 million work-related incidents which led to at least three days absence from work (Hämäläinen *et al*., 2006).

In Nigerian factories, the injury rate was 22 per 1000 exposed workers per year (Ezenwa , 2001).

According to Kumar and Dharanipriya (2014), welders are exposed to injuries such as lacerations, abrasions, flash burns and foreign bodies in the eye.

The International Labour Organization (ILO) estimated that 2.3 million work-related deaths occur every year, 250 million incidents, 160 million occupation-related diseases worldwide (ILO, 2007). In The Gambia, the economically active population is 400,000 and fatal accidents were estimated at 87 % and 21.7% fatality rate (Hämäläinen *et al*., 2006). Welding accounts for 250 million cases of occupational health-related injuries and it has been identified as a high-risk occupation with a serious public health problem (Ajayi *et al*., 2011). Occupational injuries are under-reported yearly worldwide (Shaikh, 2001).

According to the World Health Organization (WHO, 2013), an estimated 250 million work-related injuries occur per year globally. Studies have shown that all participants had more than two injuries and 44% had more than ten injuries among welders (Kumar and Dharanipriya, 2014).

A study conducted in Northern Nigeria indicated hands and finger injuries as the most common injuries sustained by welders (Sabitu *et al*., 2009). Another study carried out at 31 local workshops and one industrial centre surrounding Palakkad Town, indicated arc eye injuries as the most prevalent health injuries (90%) complaint among welders, followed by burns (88%), skin problems (69%), tiredness, sleepiness and muscular weakness (45%), hearing impairment (35%) and respiratory ailments (22%); (Biji *et al*., 2013). A similar study conducted in South India in 2014 found the prevalence of occupational injury to be 80% among welders (Kumar and Dharanipriya, 2014). Injuries caused by flying sparks and particles of hot metals, ultraviolet radiation, and metal fumes seriously threaten welders' health (Kumar and Dharanipriya, 2014). Welders found their job to be dangerous and were being exposed to at least one hazardous substance at their workplace. The majority of them complained of eye symptoms (Chauhan *et al*., 2014). In Pakistan, foreign bodies in the eyes are the most common type of injuries sustained by workers (Shaikh and Shaikh, 2005). Holm *et al* (2012), revealed that musculoskeletal problems, such as back injuries, shoulder pain, tendonitis, reduced muscle strength, carpal tunnel syndrome, white finger, and knee joint diseases are the other health problems. Also, according to Bhumika *et al* (2014), physical and accidental risks like burns, cuts, lacerations, and fall injuries are also common. Amani *et al* (2017) in their study on the evaluation of occupational injuries among welders in Northwest Iran revealed that 92% of welders suffered eye problems while 86% of them actually used their protective glasses. Forty-four percent suffered from hearing loss, and 88% had musculoskeletal problems particularly in the knees, neck and back. Around 36% did not use respiratory masks for preventing inhalation of the fumes. Ghimire *et al* (2018) in their study on "Work- Related Injury among Welders Working in Metal Workshops of Dharan Municipality, Nepal" reported that in the past 12 months, 21.1% of the welders suffered from work-related injuries.

Injuries among welders can be prevented by proper use of personal protective equipment (PPE) (Ajayi *et al*., 2011).Welders using PPE were those who were aware of them. The gap is being aware of PPE and the use of PPE at work (Budhathoki *et al*., 2014). In developing countries, welding is done in small-scale industries with very low usage of PPE (Fiebai & Awoyesuku, 2011).

A cross-sectional study of welders in Kaduna Metropolis in Northern Nigeria stated that out of 330 welders, 113(34.2%) used one or more types of protective devices with eye goggles (60.9%), hand gloves (50.3%) and boots (34.5%). They are the most frequently used safety devices among workers. Regular use of safety devices, shorter working hours and increasing experience are good protective measures of occupational accidents (Sabitu *et al*., 2009).

A study in eastern Nepal mentioned that, out of 272 participants, 90.7% were aware of at least one hazard of welding and a similar proportion of welders were aware of at least one PPE. 47.7% used one or more types of PPE during work (Budhathoki *et al*., 2014).Ghimire *et al* (2018) also reported that more than 95% welders used at least one personal protective equipment.

Despite the awareness of one or more occupational health hazards, the use of full protective devices by the subjects was generally low (10%) (Biji *et al*., 2013). Health promotion measures at the workplace is an important step towards providing a healthier workplace for this particular set of working group especially in developing countries where such measures are not commonly well-considered (Budhathoki *et al*., 2014).

Budhathoki *et al* (2016) reported a wide range of problems among welders in Nepal including arc-related problems, metal fume fever-related problems, asthma-related symptoms, hearing problems, musculoskeletal problems and injuries among welders in Northwest Iran.

Most of the injuries if not all are preventable during welding. An increase in the awareness and education of welders on the use of PPE is very important for the protection of injuries and saving of lives. A similar study revealed that the level of awareness of occupational hazards does not match the utilization of protective measures against the hazards (Sabitu *et al*., 2009). Awareness of occupational hazards and utilization of safety measures is low among welders in coastal South India, which highlights the importance of strengthening safety regulatory services towards this group of workers (Kumar *et al*., 2013). The common personal protective equipment used among welders were faced shield (90%), helmet (77%), hand gloves (77%) and boots (29%) (Biji *et a*l., 2013). None of the welders reported the use of any form of ear or respiratory protection (Biji *et al*., 2013). The level of awareness of occupational hazards and the work-related health problems among welders is not commensurate with the use of safety and protective devices against the hazards (Biji *et al*., 2013). A study by Tadesse *et al* (2016) on awareness of occupational hazards and associated factors among welders in Lideta Sub-City, Addis Ababa, Ethiopia revealed that 86.5 % of surveyed workers were aware of occupational hazards.

According to a study carried out in Kaduna, the awareness of welders on hazards has been positively influenced by educational attainment, age, nature of training and work experience (Sabitu *et al*., 2009). The majority of welders aged from 20 to 40 years and who had 1 to 10 years of education were more aware of hazards' safety measures (Kumar *et al*., 2013). Educational level, age group and the utilization of safety measures were significantly associated with awareness of hazards (Kumar *et al*., 2013). A study in Europe found that welding and smoking are associated with an increased risk of chronic bronchitis (Holm *et al*., 2012).

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 leads to the generation of smoke. Electric arc welding includes the risk of electrocution, fire accident, burns, musculoskeletal problems, cuts and injuries from heavy metals which are all avoidable when necessary precautionary measures are taken during welding (Ajayi *et al*., 2011). Promotion of health and safety depends on the control of occupational health hazards, the prevention of diseases and the protection of workers, which affects work productivity and human resource security (Jessy, 2015).

At personal levels, numerous strategies could be used to avoid or reduce contact to welding hazards. The main objective of using PPE is to avoid occupational hazards. In Public Health, the promotion of occupational safety is the best for the reduction of risks and hazards' exposures at work (Jessy, 2015).

A study conducted on "Hazard Perception and Occupational Injuries among Welders and Lathe Machine Operators of Rawalpindi and Islamabad" revealed that 39 (18.7%) and 63 (30.3%) welders reported sustaining injuries in the past three months and one year, respectively (Shaikh, 2001). A similar study conducted in Taiwan revealed that, 67.2% of all injured subjects were employed by small enterprises with less than 10 workers or were self-employed workers (Chen *et al*., 2009). In addition, 76.3% of those injured had more than 5 years of work experience. Pre-employment safety training was rare among these workers, with 84.1% stating they have never received any job safety training before employment.

Although the welding-related injuries are a major public health problem among welders, Gambia has no published literature on welding-

related injuries and safety measures. This study will provide first-hand data that will serve as a springboard for policymakers in consideration of welding-related injuries in the Gambia.

Materials and Methods

Study Sites and Population

This study is descriptive cross-sectional. The study was carried out among welders working in workshops in Brikama. The study area consists of 24 wards with a population of 77, 770 while the regional population is 699,704 (Census, 2013). Brikama is a nodal settlement in the West Coast Region of the Gambia and approximately 27km from the capital city (Banjul). It is the administrative head of West Coast Region where all regional administrative offices are found.

However, Brikama serves as a commercial centre for the surrounding settlements. The majority of inhabitants of Brikama are farmers or businessmen and petty traders. The informal sector is also important to economy of Brikama and this includes activities such as carpentry, fitter, timber processing and welding.

Inclusion Criteria

Welders who were 18 years and above with five years or more work experience, working in welding workshops in Brikama were included in the study.

Exclusion Criteria

Welders who were less than 18 years of age with less than five years of work experience were excluded from the study.

Sampling Procedures

Multistage sampling method was used to select 271 consented respondents for the study. The study focused on people engaged in welding in the study area. Firstly, a list of 165 registered workshops was obtained from the local government area council Brikama (BAC). The serial number of each workshop from the list was written on a piece of paper which was rolled, put in a plastic bag and mixed thoroughly based on wards. An individual was called to pick out 3 workshops randomly one at a time for each ward. Simple random system was used to select 3 workshops in each of the 24 wards of Brikama. Secondly, census was conducted in each workshop ground to recruit welders who were 18 years and above with 5 years or more work experience. The census was conducted due to the fact that welding workshops in Brikama have a minimum of 2 and a maximum of 5 employees. A total of 72 workshops were selected within 24 Wards in Brikama, outof which 271 respondents were proportionally recruited for the study.

Sample Size

The sample size for the study was calculated using the following formulae:

$(N = Z^2_* p_*(1-p)/ C^2)$.

Where,

N= sample size

z = standard normal deviation at 95% confidence level [1.96]

P = prevalence of the population based on previous studies is 80% [0.8] (Kumar and Dharanipriya, 2014).

c = standard error in decimal [0.05]. The calculation produced a sample size of 246.

A none response rate of 10% which is 10/100 x 246 = 25

The calculated sample size plus 10% none response rate is equal to 271. Therefore, the actual sample size for the study was 271 respondents.

Data Collection Instruments

Two instruments were used for data collection.

i. Questionnaire: Data were collected by using a structured and semi-structured interviewer-administered questionnaire. The questions were read out to the respondents and explanations were provided whenever necessary. The interview was conducted in Mandinka, Wollof, and Fula being the major languages spoken by most of the respondents in the study site. The questionnaire was divided into four sections namely;

demographic data, welding-related injury, safety measures adopted by welders and perceptions of the occupational hazard.

ii. **Observation Checklist:** This was used to obtain information such as environmental hazards and work conditions that may adversely affect health and increase one's chances of injury.

Reliability and Validity of Instruments

The questionnaire was translated into English, Mandinka, Wollof, Fula and was translated back into English. The tool was pretested among welders in Kanifing Municipality(KMC) that has similar characteristics to the study site. Corrections and revisions suggested during the pre-test were integrated into the tools.

Cronbach alpha at 0.80 was used as a reference point to maintain the power of the study. The researcher was directly involved in data collection, cross-checking, data processing, and data analysis.

Independent Variable

These include socio-demographic variables such as age, sex, length of services, etc.

Dependent Variable

Injuries such as cuts on the hands, body trunk, burns on the hands, body trunk, feet etc. Metal fume fever such as flu-like symptoms, body chills and fever, general body weakness, sweet metallic taste in the mouth etc.

Data Management and Analysis

The completed copies of the questionnaire were checked on-the-spot for completeness. Information collected was examined as regards the research objectives. After data collection, copies of the questionnaire were securely stored and only the research team had access to them.

Data were analysed using the Statistical Package for Social Sciences (SPSS) version 20. Descriptive statistics was used to summarize the data. Analytical statistic test was used to test for association using the chi-square at 95% significant level. Multivariable regression analysis was done to examine the predictors of welding-related injuries.

Results

Socio-demographic Information of the Respondents

Table 1 shows the socio-demographic characteristics of the respondents. A total of 271 welders were included in the study. The results of 271 participants are presented under various domains as frequency and percentage. 270 of the participants were males with only 1 female. The mean age of the participants was 26.78 years (SD 8.96).

The minimum age was 18 while the maximum age was 42 years. Regarding respondent's educational status, 109 (40.2%) did not have any formal education, 81 (29.9%) had a primary school education, 71 (26.2.%) had secondary education and only 10(3.7%) had tertiary education.

The majority, 255(94.1%) of the respondents acquired training through apprenticeship and 16 (5.9%) had attended training school. 48.0% of respondents spent 9-10 hours a day at work and 54.6% spent 11-12 hours. A total of 182 (67.2%) had 5 to 10 years work experience and 89 (32.8%) had above 10 years work experience in welding with a mean of 10.83 years (SD 8.25%).

Table 1: Socio-demographic characteristics of respondents (n=271)

Variables	Frequency (n)	Percent (%)
Age of respondents in years		
18 – 22	117	43.2
23 – 27	61	22.5
28 & above	93	34.3
Mean (SD) : 26.78 (8.96)		
Sex of respondent		
Male	270	99.6
Female	1	0.4
Educational status		
Never attended school	109	40.2
Primary	81	29.9
Secondary	71	26.2
Tertiary	10	3.7
Mode of acquiring training		
Apprenticeship	255	94.1
Training school	16	5.9
Number of working hours		
<5hrs	10	3.7
5-6hrs	30	11.1
7-8hrs	31	11.4
9-10hrs	52	48.0
11-12hrs	148	54.6
Experience in the welding field		
5 to 10 years	128	67.2
11 years and above	89	32.8
Mean (SD) : 10.83 (8.25)		

Prevalence of Occupational-Related Injuries among Respondents

As shown in Table 2, the prevalence of occupational injuries was 91.1 %. It was observed that 118(67.8%) respondents had watery eyes, 112 (64.4%) had irritated and itchy eyes and 109 (62.6%) had particulates entering the eyes. Cuts experienced on body parts during work were on hands/arms, 127(83.6%), body trunk, 20 (13.2%) and feet, 71 (46.7%). Burns experienced on body parts were on hand/arms, 149 (89.2%), body trunk, 19 (11.4%) and feet, 59(35.3%). Metal fume fever experienced were flu-like symptoms 100 (58.6%), body chills and fever 55 (31.2%), general body weakness 118(67.0%), sweet metallic taste in the mouth 33(18.8%) and those who stayed away from work due to injuries were found to be 165 (60.9%).

Table 2: Prevalence of occupational-related injuries according to body parts among respondents

Variables	Frequency (n)	Percent (%)
Welding-related injuries sustained		
Yes	247	91.1
No	24	8.9
Eye symptoms *		
Running eyes	118	67.8
Irritated, red & itchy eyes	112	64.4
Flying particles entering your eyes	109	62.6
Cuts *		
Hands/Arms	127	83.6
Body trunk	20	13.2
Feet	71	46.7
Burns *		
Hands/Arms	149	89.2
Body trunk	19	11.4
Feet	59	35.3
Metal fume fever *		
Flu-like symptoms	100	56.8
Body chills and fever	55	31.2
General body weakness	118	67
Sweet metallic taste in the mouth	33	18.8
Staying away from work due to injuries		
Yes	165	60.9
No	106	39.1

Personal Protective Equipment (PPE) Utilized by Participants Figure 1 indicates that 96% of the respondents wore at least one type of the PPE and 4% did not wear any during welding. Table 3 indicates that the types of PPE worn by welders during work were goggles 253(94.8%), rubber-soled, steel toe capped, safety shoes 158(59.2%), Insulated gloves 89 (33.3%), work suit/coverall, leather apron 32(12.0%), welding helmet 30 (11.2%), respirators/face masks 21(7.9%), hand shield 15(5.6%), ear muffs/earplugs 10 (3.7%).

156(57.6%) of the welders always used PPE and 115(42.4%) wore it occasionally during work. Reasons for not wearing PPE were 169(62.4%) not available, 69 (25.5%) discomfort, 16(5.9%) affect communication during work, 9(3.3%) not knowing its importance and 8(3.0%) affects vision during welding.

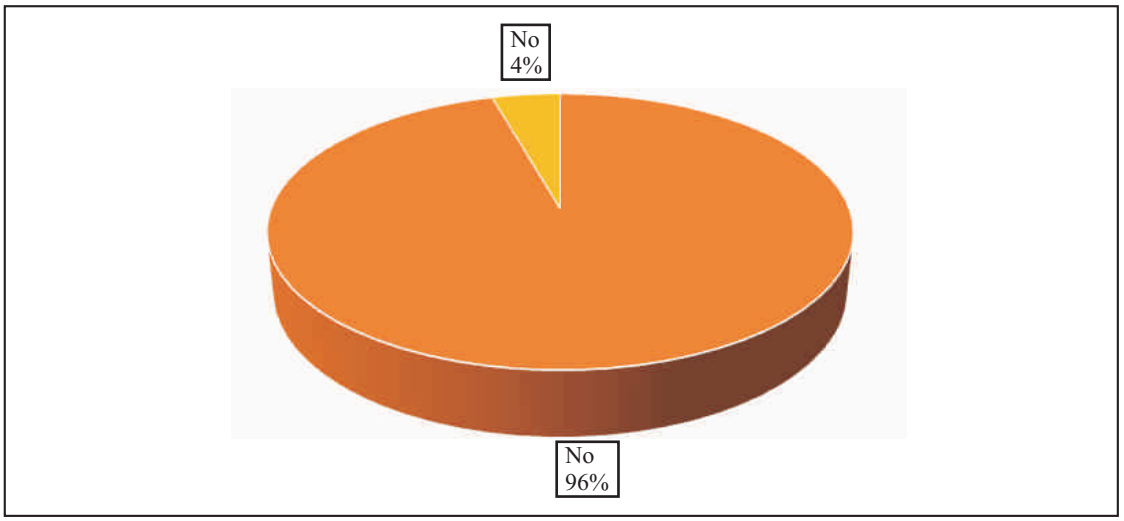

Figure 1: PPE use (at least one type) by welders during work

Table 3: Safety measures adopted by welders

Variables	Frequency (n)	Percent (%)
PPE used during work*		
Goggles	253	94.8
Rubber-soled, steel toe cap, safety shoes	158	59.2
Insulated gloves	89	33.3
Work suit/Coverall, Leather apron	32	12.0
Welding helmet	30	11.2
Respirators/face masks	21	7.9
Hand shield	15	5.6
Earmuffs	10	3.7
Always use PPEs	156	57.6
Occasionally use PPEs	115	42.4
Reasons for not wearing PPE		
Not available	169	62.4
Discomfort	69	25.5
Affect communication during work	16	5.9
Not knowing its importance	9	3.3
Affects vision during work	8	3.0

Perception of Welders towards Occupational Hazards

In Table 4, 265(97.8%) respondents reported that the welding profession is hazardous and the causes of injuries/harm were identified as: 267(99.3%) sharp edges/metals, 260(96.7%) failing objects, 259(96.3%) flying sparks/particles, 257(95.5%) electricity, 245(91.1%) heat, fire or explosion, 237 (88.1%) bright light, 237(88.1%) noise, 233(86.6%) welding fumes and gases.

Table 4: Perception of respondents towards occupational hazards

Variables	Frequency (n)	Percent (%)
Perception if welding is hazardous		
Yes	265	97.8
No	6	2.2
Causes of injuries/harm*		
Sharp edges/metals	267	99.3
Failing objects	260	96.7
Flying sparks/particles	259	96.3
Electricity	257	95.5
Heat, fire or explosion	245	91.1
Bright light	237	88.1
Noise	237	88.1
Welding fumes and gases	233	86.6

Risk Associated with Welding Injuries and Illnesses

Concerning the workplace environment, it was observed that 84.7% of the workshops were extremely hot, 2.8% were slippery, and 95.8% were noisy and 54.2% vibrating. However, 98.6% of the workshops were well lit, 95.8% well ventilated, 45.8% well-arranged and 37.5% were clean.

It was also observed that 98.6% of workshops did not label hazardous materials, 1.4% had fire extinguishers while 6.9% had first aid boxes and none had safety data.

Cross Tabulation of Educational Status and Training Types

Table 6 summarizes the analysis of the educational status and training type as a factor influencing welding-related injuries among welders.

Majority of welders who suffered from welding-related injuries were found to have never attended school (96.3%) and followed by those with primary education (90.1%). However, those with tertiary education (20.0%) had the highest score of not sustaining welding-related injuries which were followed by those with secondary education (13.6%). These differences were statistically significant (p=0.032) as indicated.

Training types of the respondents were also found to be statistically associated with those who suffered from welding-related injuries as reported (p=0.042).

Table 5: Checklist on risk of welding injuries and illnesses

Variable	Yes		No	
	Freq.	%	Freq.	%
Extreme Heat	61	84.7	11	15.3
Slippery Surface	2	2.8	70	97.2
Noisy Workshop	69	95	3	4.2
Vibration	39	54.2	33	45.8
Well-lit workshop	71	98.6	1	1.4
Well Ventilated	69	95.8	3	4.2
Well-arranged workshop	33	45.8	39	54.2
Tidiness	27	37.5	45	62.5
Hazardous Materials labeled	1	1.4	71	98.6
Availability of safety data	0	0	72	100
Availability of fire extinguisher	1	1.4	71	98.6
Availability of First Aid box	5	6.9	67	93.1

Table 6: Cross tabulation of educational status and training types among welders

Variable	Prevalence of injuries sustained			
	Yes (%)	No n (%)	statistic test	p-value
Educational level				
Never attended school	105(96.3)	4(3.7)	†	0.032*
primary	74(90.1)	7(9.9)		
Secondary	60(86.4)	11(13.6)		
Tertiary	8(80.0)	2(20.0)		
Training types				
Apprenticeship	235(92.2)	20(7.8)	†	0.042*
training school	12(75.0)	4(25.0)		

=Statistical significance at P<0.05
†=Fishers exact

Discussion

Welders are exposed to many factors that put them at risk of occupational injuries and illnesses. A total of 271 welders were recruited for this study. 270 were males with only 1 female. The mean age of the participants was 26.78 years (SD 8.96). The minimum age was 18 years and the maximum age was 42 years.

The prevalence of occupational injuries among welders was 91.1%. This is in line with a study conducted at 31 local workshops and 1 industrial centre surrounding Palakkad Town, which stated the prevalence of injuries to be 90% among workers (Biji *et al*., 2013).

The major body part involved was the arm/hand and it was mostly a burn injury accounting for 89.7% of all the injuries sustained. This is similar to a study conducted in Northern Nigeria which indicated hands and finger injuries as the most common injury type sustained by welders (Sabitu *et al*., 2009).

Also, 57.6% of the study participants were found to have always used personnel protective equipment (PPE) with goggles (94.8%) as the most protective device utilized. 97.8% of the respondents in this study reported that the welding profession is hazardous while 99.3% reported sharp edges being the major cause of injuries during work. This study also revealed that the awareness level does not tally with the utilization of PPE among welders. A similar study also revealed that the level of awareness of occupational hazards and the work-related health problems among the welders is not always commensurate with the use of safety and protective devices against such hazards (Biji *et al*., 2013).

The majority of welders who suffered most of the injuries were found to have never attended school (96.3%). There was a significant relationship between educational status of the respondents and the prevalence of injury (P=0.03), hence those that were not educated had more injuries than the others. This agrees with the study by Kumar and Dharanipyriya (2014) where all respondents were illiterates. Kumar *et al* (2013) also indicated education level was significantly associated with awareness of hazards in univariate analysis ($p<0.05$).

Training types of the respondents were also found to be statistically associated with those who suffered from welding-related injuries as reported (p=0.042). This is in line with the findings by Ghimire *et al* (2018) that more injuries were seen among welders with no form of training. Kumar *et al* (2010) also reported that more injuries are found among those without training.

The study also revealed that educational status and training type are factors that influenced work-related injuries among welders. This is also very similar to a study in Kaduna, in which the

awareness of welders on hazards were positively influenced by educational level, age, type of training and work experience (Sabitu *et al*., 2009).

The training type of the respondents were found to be statistically associated (p = 0.042) with those who suffered from welding-related injuries as reported. This also corroborates the study in Kaduna, in which training type was found to have a positive influence on occupational injury (Sabitu *et al*., 2009). Kumar *et al* (2013) found that only 20% of respondents had institutional training. Professional training of welders could very well decrease injuries and increase safety among welders in the course of the work.

Conclusion

From the findings of this study, the prevalence of occupational injury was 91.1%. The level of awareness of occupational hazards does not tally with the utilization of safety measures. Occupational injuries are preventable during welding. Strategies for strengthening institutional training, promotion of safety advocacy and enforcement of workplace safety regulation can significantly reduce injuries at workplace.

Recommendations

1. Government should enforce the use of personal protective equipment among welders and other auto-mechanics in the informal sector.
2. Due to the poor health seeking behaviour of welders, policies that address the health need of welders should be ensured including the implementation of periodic medical examination and issuing of certificates.
3. There should be welding associations that would prioritize interventions to reduce injuries among welders since they suffer more injuries in various forms.
4. Employers/workshop owners should ensure availability of required number of personal protective equipment for their employees and apprentices as well as ensure their effective use.

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