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Occupational injuries among workers in a welding company within Mangaung Metropolitan Municipality

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ABSTRACT

A questionnaire survey was conducted among 37 welders and 21 fitters (exposed group) and 30 office workers (unexposed group) employed by a welding company located in the Mangaung Metropolitan Municipality. The objective was to calculate and describe the prevalence of occupational injuries among these workers and to compare the frequencies of injuries among the employees. A total of 87 injuries were reported by workers. The most common injuries sustained were burns (n=29), cuts (n=24) eye injuries inflicted by foreign objects (n=19), electric shock (n=8), arc eyes (n=4) and bone fracture (n=3). Most occurred on the hands (n=57). More workers in the exposed group sustained injuries than in the unexposed group. It is necessary to implement safety measures in order to reduce the prevalence of the injuries.

Keywords: **welders, fitters, work-related injuries, municipal workers**

INTRODUCTION

Occupational injuries result from accidents that occur during the course of work in various industries. An injury can occur anywhere on the human body due to excessive exposure to energy that exceeds physiological tolerance.[1] Occupational injuries are caused by two types of energy exposures, namely acute and chronic. Accident and injury are closely related terms and are often used synonymously although they are not synonyms.[2] Occupational injuries affect human integrity and entail high costs to the social security system of any country.[3] The economy is affected due to loss of productive hours, skilled manpower, money paid as compensation, and suffering to the injured persons and their families.[4] It is the responsibility of each country to plan, implement and control the occupational health and preventive measures, and safety policies. In South Africa, the statistics about occupational injuries are documented in the Compensation Commissioner's annual report in terms of the Compensation for Occupational Injuries and Diseases Act of 1993.[5] In 1993, a total of 242 424 occupational accidents were reported, representing an incident rate of 33.4 per 1000 workers covered by the compensation fund.[6] According to the occupational injury statistics for 1990, a high proportion of injuries were reported in Gauteng (32%), Western Cape (21%) and KwaZulu-Natal (19%). These provinces are mostly industrialised with injuries accounting for more than 70% of all reported cases of occupational injuries. More than 80% of injuries were reported in urban areas and most of the injured persons were male (> 80%).[6]

There were 217 680 occupational injuries reported for the year 2003/2004. Of these injuries, 29% occurred in the manufacturing industry, constituting the second highest prevalence in the country following the transport sector.[7] The figures for 1993 showed that the most common body parts affected by the injuries were fingers (24%), legs (15%) and trunk (12%). The major cause of permanent disability was injuries to fingers that accounted for 57% of all cases.[6] The statistics provided for 2007 by the Federated Employers' Mutual Assurance Company Limited (FEMA), showed that the dominating causes of injuries were being struck by objects (44%), falls on different levels (14%) and striking against objects (10%).[8] The main causes of death were identified as motor-vehicle accidents (47%), being struck by objects (17%), and falls on to different levels (17%); and the nature of injuries sustained was superficial wounds (3%) and penetrating wounds (30%). The most common anatomical regions affected by the injuries were hands (24%), head and neck (19%) and legs (16%).[8]

The most common processes in the welding industry are metal inert gas (MIG) and tungsten inert gas (TIG) welding processes. The TIG welding process uses a non-consumable tungsten electrode while the MIG uses a consumable wire electrode which produces an electric arc.[9] Welders wear full face and neck helmets with dark eye lenses to prevent

exposure to ultraviolet light for both MIG and TIG welding methods. Protective long sleeve shirts, leather jackets and gloves are also worn to prevent exposure to ultraviolet light. The dark eye lenses also protect the eyes against foreign bodies.

A study conducted in Nigeria (2005) indicated that 85% of welders experienced at least one injury in the preceding year.[10] In a follow-up study[11], the number of injuries reported by 61 out of 208 welders was 105. In a study conducted in India, a high prevalence of injuries was reported among welders younger than 30 years. The study showed that these young welders had a five times higher risk of developing more than 10 injuries compared to welders older than 50 years.[12]

Occupational injuries are mostly common among workers in the welding industry and have a major impact on human integrity and economic development. This study was conducted to calculate and describe the prevalence of occupational injuries and compare the injury frequencies among different workers in a welding company.

METHODS

A cross-sectional survey was conducted among workers in a heavy engineering CO_2 MIG welding company located in the Mangaung Metropolitan Municipality, Free State Province, South Africa. The study population consisted of full time permanent welders (n=37), fitters (n=21) and office workers (n=30). Welders and fitters work in two similar welding workshops and use the MIG welding method. At the time of the survey, in November 2011, there were 124 full-time employees working at the welding company. Workers were classified into exposed and unexposed groups. The exposed group comprised the welders and fitters, while the unexposed group comprised the office workers.

Permission was obtained from the management of the welding company before commencement of the study. Questionnaires were sent to all employees. The questionnaire included personal information such as age, gender, and marital and smoking status. In addition, work-related information was collected such as current position, years of employment and type of occupational injuries sustained during the last three years prior to the survey.

Data were captured using Microsoft Excel 2007 and analysed using SAS Version 9.2. The Chi square test was used to test the differences between the exposed and unexposed workers in terms of the injury frequencies. The statistical significance level used was 95%. Frequencies and percentages were calculated.

The study was approved by the Ethics Committee of the University of the Free State (reference number 170/2011).

RESULTS

Questionnaires were sent to all 124 employees and only 88 responded, giving a response rate of 71%. Of the 88 participants that responded, 58 were from the exposed group and 30 were from the unexposed group. The demographic information of the participants is shown in Table 1. The majority of participants were males (90% of the exposed group and 70% of the unexposed group). Most of the participants were aged 30-39 years, with a median age of 34 years. A high proportion was married (39% of the exposed group and 63% of the unexposed group).

Work-related information of the participants is shown in Table 2. Forty-two percent and 24% of participants were welders and fitters, respectively; 34% were office workers. Most of the participants had worked for 1-10 years (67% of the exposed group and 60% of the unexposed group).

A comparison of the injury types in the exposed and unexposed groups is shown in Table 3. Seventy-eight percent of injuries were reported by the exposed group; twenty-two percent were reported by the unexposed group. The percentages of burn injuries in the exposed and unexposed groups were 35% and 5%, respectively ($p < 0.05$). Seventeen percent of injuries caused by foreign bodies in the eyes were reported by the exposed group while the unexposed group reported only two such injuries ($p < 0.05$). Six percent and 21% of injuries related to electric shock were reported by the exposed and unexposed groups respectively.

The results in Table 4 show the distribution of injury frequencies by body location. Sixty-six percent of injuries were inflicted on the upper limbs and hands among the exposed group while 63% similar injuries were reported by the unexposed group. Thirty percent of injuries to the eyes were reported by the exposed group and 10% by the unexposed group. Most of the injuries occurred among workers younger than 40 years (Table 5).

DISCUSSION

The majority of the injuries were reported by the exposed workers. Due to a small number of workers employed at the welding company and withdrawal of other participants, the sample size was limited. Welders and fitters are exposed to hazardous situations in the workplace that increase their chances of sustaining injuries. During welding, a high pressure or heat is applied in order to melt part of a large metal. Burns are more likely to occur among workers exposed to welding because of the amount of heat and pressure used in the process. The majority of participants in the exposed group sustained burns. Exposure to infrared radiation, also created by electric arc from welding, may heat the surface of the skin and underlying tissues, resulting in scarring thermal burns. In addition, exposure to ultraviolet radiation created by electric arc in the welding process can cause burns and damage the eyes resulting in arc eyes. Welding sparks can cause eye injuries if protective equipment (face shield and safety glasses) are not worn during welding process or if workers use defective protective equipment.

The eye injuries reported in the present study may be due to poorly maintained protective equipment, lack of knowledge

about the safe use of the protective equipment and/or an insufficient supply of protective equipment. The eye injuries may occur as a result of hammering associated with welding and flying metal chips. A study conducted in Port Harcourt, Nigeria, showed that flying metal chips were the main source of eye injuries among welders, accounting for 68.2% of all eye injuries while arc rays accounted for 31.85% of all injuries.[13] A 2005 study by Lombardi et al.[14] showed that subjects sustained burns (22%) and foreign objects injuries in the eyes (72%). The prevalence of burns in the present study was higher (33.3%) than that reported in the previous study[14] while the prevalence of foreign objects injuries in the eyes was lower (21.8%). The study also indicated that workers who were non-welders often walked past the welding area, increasing their chances of sustaining flash burns to their eyes.[14] A fourfold increased risk of eye injuries among workers who were exposed to welding was reported in a study conducted in Hong Kong, China.[15]

Fall from heights (e.g. ladder, scaffold or fixed platforms) and contact with falling objects account for the prevalence of bone fractures and cuts reported by the participants. Welders and fitters lift objects and climb ladders and scaffolds during work, increasing their chances of falling and being struck by objects. The study[16] conducted in the cement industry by Iqbal et al. in 2010, indicated that workers sustained injuries by lifting objects (12%), falling (8%) and being struck by objects (11%).

The present study shows that the majority of injuries were sustained to the hands and fingers (67.8%). The reported injuries in the previous study[16] occurred on the arm (26.5%), finger (14%), and shoulder (7.8%). These findings differ from those reported in the present study.

Electric shock is common among workers who are exposed to welding, and might occur when a worker accidentally touches the welding electrode with bare hands. Workers might also get shocked when accidentally touching electric cables which are not insulated or when they come into contact with faulty electrical equipment. In the present study, electric shock injuries were common among the unexposed group. This could be due to a large number of faulty electrical appliances which they use frequently and also due to the fact that they do not wear insulating gloves to protect against electric shock. Lack of safety training about electricity may also contribute to the number of injuries reported by the unexposed group. The absence of occupational safety training, limited use of personal protective devices and prolonged hours of work were identified as the major contributing factors to the occurrence of injuries in a previous study.[17]

A study conducted in Mangalore city, Karnataka, showed that injuries were most common among younger age group workers and those without training.[18] It appeared as if some of the injuries reported in the present study might have been due to the use of equipment by untrained persons and non-compliance with safety regulations. Some of the injuries might be influenced by age and working experience of workers. Risky behaviour is influenced by age and working experience increases with age. The incidence of non-fatal accidents reported in the European Union (EU) was high among the youngest workers.[19]

CONCLUSION

Injuries among workers in the welding industry pose a major challenge and are a major health concern. This study provides valuable data. The incidence rate of occupational injuries in the welding industry needs immediate action. Implementation of occupational and safety programmes, provision of personal protective equipment and compliance with safety regulations are the principal remedial measures to prevent occupational injuries.

RECOMMENDATIONS

It is recommended that preventive measures to reduce occupational injuries should be developed and implemented in the workplace. Effective knowledge and technology about occupational risks should be enhanced and communicated to all workers to enable them to apply safety measures necessary to prevent occupational injuries. Workers should be well- informed about the possible injury risks associated with their work. Information about preventive strategies should be provided to enable workers to make timely and informed risk management decisions. A variety of factors that contribute to workplace injury risk, including hazardous environmental conditions, economic issues, social and workplace organisational factors should be identified, quantified and prioritised. These factors should be taken into consideration during the development and implementation of preventive measures to reduce occupational injuries.

Every employer should make provision for the maintenance of machinery and equipment. Employees should be trained about the working procedures to enable them to perform their duties safely. Employees who are exposed to extremely hazardous working conditions should be provided with protective equipment such as face masks, helmets, safety boots and hand gloves to protect them from sustaining injuries.

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CONFLICT OF INTEREST

The author declares no conflicts of interest.

LESSONS LEARNED

1. Workers younger than 40 years have a high risk of sustaining injuries and need to undergo safety training regularly
2. Injuries to the hands and upper limbs are common and require special attention to manage and prevent them
3. Welders and fitters should always use personnel protective equipment while on duty
4. Supervisors should ensure that personnel protective equipment is in good working condition

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Table 1. Demographic characteristics of participants

Variables	Exposed group n = 58		Unexposed group n = 30		p value*
	n	%	n	%	
Age (years)					
20-29	18	31.0	4	13.3	0.069
30-39	27	46.5	13	43.3	0.773
40-49	9	15.5	6	20.0	0.596
50-59	4	6.9	6	20.0	0.066
60-65	0	0	1	3.3	0.162
Gender					
Male	52	90	21	70	0.020
Female	6	10	9	30	0.020
Marital status					
Single	29	50.0	6	20	0.006
Married	23	39.6	19	63.3	0.035
Divorced	3	5.2	5	16.7	0.075
Living together	3	5.2	0	0	0.205
Smoking status					
Smokers	17	29.3	8	26.7	0.794
Non-smokers	41	70.7	22	73.3	0.794

*Chi square test

Table 2. Work experience and job categories of participants (N=88)

Variables	Exposed group n = 58		Unexposed group n = 30		p value*
	n	%	n	%	
Working experience (years)					
1-2	10	17.3	7	23.3	0.493
3-10	39	67.2	18	60.0	0.500
11-20	4	6.9	2	6.7	0.968
21-30	4	6.9	2	6.7	0.968
31-40	1	1.7	1	3.3	0.631
Job category					
Welders	37	42			
Fitters	21	24			
Office workers			30	34	

*Chi square test

Table 3. Types of occupational injuries (N=88)

Type of injury	Exposed group n = 58		Unexposed group n = 30		p value*
	n	%	n	%	
Cuts	18	26.4	6	31.5	0.270
Burns	24	35.3	5	26.0	0.019
Foreign objects in the eyes	17	25.0	2	10.5	0.014
Arc eyes	4	5.9	0	0	0.140
Electric shock	4	5.9	4	21.5	0.319
Bone fractures	1	1.5	2	10.5	0.225
Total	68		19		

*Chi square test

Table 4. Injury frequency by body location (N=88)

Body location	Exposed group n = 58		Unexposed group n = 30		p value*
	n	%	n	%	
Upper limbs and hands	45	66.2	12	63.2	0.806
Bones	0	0	5	26.3	0.030
Eyes	21	30.9	2	10.5	0.075
Head	2	2.9	0	0	0.449
Total	68		19		

*Chi square test

Table 5. Distribution of injuries vs age groups among employees (N=88)

Age group (years)	Injuries (n = 87) Exposed group n = 58		Unexposed group n = 30		p value*
	n	%	n	%	
20-29	19	27.9	4	21.1	0.547
30-39	32	47.1	8	42.1	0.702
40-49	10	14.7	4	21.0	0.505
50-59	6	8.8	3	15.8	0.378
60-65	1	1.5	0	0	0.595
Total	68		19		

*Chi square test

Photo courtesy of Goitsemang Keretetse

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1. ". . . the majority of injuries were sustained to the hands and fingers . . ."

2. "Electric shock is common among workers who are exposed to welding . . ."

3. "Some of the injuries might be influenced by age and working experience of workers."