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Risk Factors for Occupational Injuries among Solid Mineral Miners in Ose Local Government of Ondo State, Nigeria

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ABSTRACT

Introduction: The mining industry is known to have a high incidence rate of fatal injuries hence, the knowledge of the risk factors of injury is important. The risk factors of occupational injury are important in the interplay between work and health, and the knowledge of the risk factors can be used in planning preventive measures. The study was done to determine the risk factors for occupational injuries among solid mineral miners.

Methods: This was a descriptive cross-sectional study. Consenting staff completed the pretested self-administered questionnaire. Data were analyzed using descriptive and inferential statistics and $p \leq 0.05$ was considered significant.

Results: A total of 120 workers were recruited with 109 (90.8%) males and 11 (9.2%) females leading the male to female ratio of 9.9:1. The age range was 18-48 years with a mean of 28.9 (5.8) years. More than one-third (35.0%) had a tertiary level of education. Seventy-two (60.0%) had good knowledge of the occupational injury, and it was associated with the level of education (p<0.001) and occupational injury (p<0.001). About 60.8% have had an occupational injury while inhalational injury (30.0%) was the highest type of injury. Hands (34.5%) were the most affected part of the body even though hand gloves (85.8%) were the most common personal protective equipment used. The factors associated with an occupational injury were age, length of services and job tasks. The predictor of occupational injury was the length of service.

Conclusion: The respondents had good knowledge of the occupational injury and the major risk factors of occupational injury were the length of services, job tasks and age of respondents of this study.

Key words: Knowledge, Miners, Occupational-injury, Risk factors, Workers

INTRODUCTION

Work has a positive effect on health and it also provides financial dividends to the workers with the basic life necessities.[1] This translates into healthy well-being, job satisfaction, and ultimately higher productivity. The knowledge of interactions between work and health is an important factor in understanding and practicing occupational health and safety, but the importance of safety at the workplace is often overlooked.[2] The effect of overlooking the safety at the workplace makes workers face a variety of injuries at work which is otherwise called occupational injury.

Occupational injury is defined as any personal injury, disease or death resulting from an occupational accident.[2] This injury can be physical harm like cutting of arm on a broken piece of glass, hurting the back

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while moving heavy object or electrocution at the place of work.[2] The International Labour Organization (ILO) revealed that 153 employees experience work-related accidents worldwide in every 15 seconds, with 6300 deaths annually due to occupational injuries and 2.3 million deaths due to occupational diseases.[3] A total of 374 million suffer from non-fatal occupational accidents each year and 355,000 fatal injuries annually at workplaces worldwide.[3-6] A global estimate of 4% of the Gross Domestic Product (GDP) is lost as a result of occupational injuries and diseases annually.[3,4] Similarly, more than 270 million occupational injuries result in severe socio-economic consequences for workers and society at large.[7]

Since 2001, there has been an increase in the number of cases of occupational injuries worldwide.[8] The increase in exposure to air pollution, toxic chemicals and strenuous work activities have negative implications on the health and wellbeing of employees.[9] These observed impacts cause serious health and safety problems hence, the need for inculcating a safety culture in the workplace is paramount.[10]

The mining industry has a high incidence rate of fatal injuries among all industry divisions and is considered one of the world's most dangerous occupations with severe socio-economic consequences for workers and society therefore, mine safety is a serious issue.[11] The injury to a miner often requires medical treatment as it can lead to loss of consciousness or even death. It also causes restriction of movement which leads to an inability to perform regular job duties, lost workdays, temporary assignment to other duties, transfer to a different job or even termination.[12] Despite the investment of money and resources, the incidence of injuries remained relatively unchanged and the government, companies, employees and society all agreed that it is still unacceptably high.[13]

Preventive measures to reduce the burden of these problems must be taken and an accurate assessment and understanding of the risk factors leading to injuries can be a good starting point. The information would be very useful in the planning of strategies/interventions at the workplace by mine managements to reduce occupational injuries. Therefore, the present study aimed to assess the risk factors for occupational injuries among solid minerals miners in Ose local government of Ondo state.

Methods

The study was descriptive cross-sectional conducted in Xiamen Win Stone company in Ose local government area in Ondo-State, Nigeria between 1st September 2020 and 31st November, 2020. Ethical approval with registration number FMC/OW/380/VOL.XCIV/200 was obtained from the Research and Ethics Committee of Federal Medical Centre, Owo, Ondo-State. Permission was obtained from the management of Xiamen Win Stone company to have access to the factories and workers. Respondents were informed about the aim and objectives of the research. The respondents were assured of the confidentiality of the information given and the data collected were entered and kept in a password-protected computer.

Sample size was calculated using the formular below:

$$Sm = \frac{(Z_\alpha)^2 \times p \times q \times N}{d^2 (N-1) + [Z_\alpha^2 \times p \times q]}$$

$$Sm = \frac{322.69}{1 + \frac{322.69-1}{164}}$$

$$Sm = \frac{322.69}{2.96}$$

$$= 109.02$$

Non- response rate of 10% is 10.9

The minimum sample size is, therefore, 109.02 +10.90= 119.92

The minimum sample size for this study is 120 respondents.

One hundred and twenty consenting staff of Xiamen Win Stone company were recruited for the study using simple random sampling. The consenting working staff filled out a pretested semi-structured questionnaire which was distributed consecutively during their break period and was filled at their convenience. The content of the questionnaire was reviewed by a community-health physician prior to administration.

The questionnaire provided information on sociodemographic characteristics (age, sex, marital status, highest level of education and average monthly income), knowledge of respondents on occupational injury (awareness of dangers associated with their work, awareness of safety measures to

prevent injuries and if available at place of work, awareness of the type of injury sustained and use of personal protective equipment) and work-related injuries sustained, availability of safety standards and protective equipment (helmet, face mask, goggle, ear muffle, hand gloves, protective apron and boots). A pilot study was done and the result was reviewed with the Community health physician before acceptance for the present study. The questionnaire filled out during the pilot study was not included in the final analysis of the study.

The data obtained from the questionnaires used for the study was analyzed using the Statistical Package for Social Sciences (SPSS) for Windows version 22. The knowledge score was computed for a 41-item question on knowledge of the occupational injury. Each item was assigned '+1' for correct knowledge and '0' for incorrect knowledge. The knowledge score was graded as good if respondents score > 13 points and poor if the score was < 13 using the mean score of knowledge as the breakoff point. The Chi-square (χ^2) was used to compare occupational injury and risk factors. Multivariate analysis was performed using binary logistic regression to evaluate risk factors (independent variables) that are associated with occupational injury (dependent variable). Odds ratio and 95% confidence interval were presented and used as measures of strength of association. Results were considered to be significant at $p \leq 0.05$.

Results

One hundred and twenty completely filled questionnaires were analyzed. There were 109 (90.8%) males and 11 (9.2%) females leading to male to female ratio of 9.9:1. The age range of the respondents was 18-48 years with a mean age of 28.9 (5.8) years. The age group 18-28 years accounted for more than half, 62 (50.8%) of the respondents. Seventy-one (59.2%) of the respondent's highest level of education was a secondary school leaving certificate. Forty-five (37.5%) of the respondents had worked between 13 to 24 months while 20 (16.7%) had about five years length of service. The range of length of service was 1-60 months and the mean length of service was 22.8 (5.1) months. The sociodemographic characteristics of the respondents are shown in table 1.

The majority (96.7%) were aware of the dangers associated with their work while they stated that fire accident (32.5%) was the least danger known. Eye irritation (78.3%), cuts and abrasion (73.3%), body pain (83.3%), exposure to high pitch noise (80.0%) and hand/foot injury (80.0%) were the major occupational injuries. The majority (95.8%), were aware of the safety measures set by their employer while hand gloves (85.8%) and protective boots (72.5%) were the personal protective equipment mostly aware of (table 2).

Seventy-two (60.0%) of the respondents had good knowledge on the occupational injury. This is shown in figure 1. The mean level of knowledge of the respondents on the occupational injury was 13.4 (5.9). There was a statistically significant association between the level of knowledge and level of education (p = 0.001).

A total of 73 (60.8%) of the respondents have had various forms of occupational injury while 47 (39.2%) have not had any form of injury. Inhalational injury (29.8%) was the highest injury sustained, while frictional burn (1.0%) was the least injury. The hand, 36 (34.5%) was the most affected location of the body followed by the upper respiratory tract, 31 (29.5%). The head and neck (1.0%) were the least affected part of the body (table 3). Hand gloves, 103 (85.8%), were commonly used personal protective equipment followed by both dust masks and protective boots, 87 (72.5%) each. The least used personal protective equipment was a helmet and ear muffle, 41 (34.2%) each. While 54 (45.0%) used protective goggle and 61 (50.8%) used protective apron.

Age of the respondents (p= 0.008), length of services (p= 0.010), job task (p= 0.047) and level of knowledge (p=0.000) were the factors that had a statistically significant association with occupational injury. There were more injuries among the younger age group 57 (78.1%), workers with less working experience 49 (67.1%) and respondents with poor knowledge 53 (72.6%). The injuries in males 67 (91.8%) was far above the females though gender (p= 0.654) had no significant association with occupational injury. Similarly, the injury was more among less-educated respondents 48 (65.8%) with no statistical significance (p= 0.829). The level of knowledge (95% CI = 1.545-7.756; p = 0.003), and the length of service (95% CI = 0.669-3.022; p = 0.048) were the predictors of occupation injury. (Table 4).

Table 1: Sociodemographic Distribution of the Respondents

Variables	Numbers (%)
Age Range (years)	
18-28	62 (51.7)
29-38	46 (38.3)
39-48	12 (10.0)
Marital Status	
Single	72 (60.0)
Married	46 (38.3)
Separated	2 (1.7)
Educational Qualification	
None	3 (2.5)
Primary	4 (3.3)
Secondary	71 (59.2)
Tertiary	42 (35.0)
Monthly income (Naira)	
20,000- 30,000	47 (39.2)
30,001-70,000	73 (60.8)
Length of Service (months)	
1-12	26 (21.6)
13-24	45 (37.5)
25-48	29 (24.2)
49-60	20 (16.7)
TOTAL	**120 (100)**

Table 3: Occupational Injuries among Respondents

*Variables	Numbers (%)
Types of injury	
Inhalational injury	31 (29.8)
Abrasions	27 (26.0)
Cut	26 (25.0)
Eye irritational injury	8 (7.7)
Fall	7 (6.7)
Crush injury	4 (3.8)
Frictional Burns	1 (1.0)
Total	**104 (100.0)**
Location of injury	
Hand	36 (34.5)
Upper respiratory tract	31 (29.8)
Leg	27 (26.0)
Eye	9 (8.7)
Head and Neck	1 (1.0)
Total	**104 (100.0)**

*Multiple responses

Table 2: Knowledge of respondents about Occupational injury

*Variables	No of respondents (%)
On types of occupational injury	
Awareness of dangers associated with work process in work place	116 (96.7)
Electric shock	67 (55.8)
Fall from height	72 (60.0)
Eye irritation	94 (78.3)
Slip trip and falling from untidy work area	84 (70.0)
Cuts and abrasions	88 (73.3)
Body pain from repetitive tasks	100 (83.3)
Exposure to high pitch noise	96 (80.0)
Stuck by falling objects	78 (65.0)
Hand and foot injury	96 (80.0)
Crush injury from machine	84 (70.0)
Heat exhaustion	70 (58.3)
Physical exhaustion	76 (63.3)
Breathing difficulty	61 (50.8)
Fire accidents	39 (32.5)
On safety measures of occupational injury	
Awareness of safety measures to prevent occupational injuries	112 (93.3)
Awareness of safety measures set by the employer	115 (95.8)
Use of helmet	41 (34.2)
Use of dust mask	87 (72.5)
Use of protective goggle	54 (45.0)
Use of ear muffle	41 (34.2)
Wearing of protective apron	61 (50.8)
Wearing of protective boots	87 (72.5)
Wearing of hand gloves	103 (85.8)
Awareness of the enforcement on the use of the safety measures	97 (80.8)
Awareness of penalty for not adhering to the safety measures	99 (82.5)

*Multiple responses

Table 4: Factors Associated with Occupational Injury

Variables	Have had occupational injury n (%)		p-value	Odds Ratio	95% Confidence-Interval Lower limit Upper limit
	Yes	No			
Age (years)					
18-34	57 (55.9)	45 (44.1)	0.008	0.174	0.020 - 1.544
35-48	16 (88.9)	2 (11.1)		1.000	
Monthly income (Naira)					
20,000-30,000	28 (59.6)	19 (40.4)	0.821		
30,001-70,000	45 (61.6)	28 (38.4)			
Gender					
Male	67 (61.5)	42 (38.5)	0.654		
Female	6 (54.5)	5 (45.5)			
Educational qualification					
Pre-tertiary	48 (61.5)	30 (38.5)			
Tertiary	25 (59.5)	17 (40.5)			
Length of service (months)					
1-24	49 (69.0)	22 (31.0)	0.010	1.422	0.669 - 3.022
25-60	24 (49.0)	25 (51.0)		1.000	
Knowledge					
Yes	20 (41.7)	28 (58.3)	0.000	3.905	1.545 - 7.756
No	53 (73.6)	19 (26.4)		1.000	

Discussion

The study was conducted to determine the risk factors for occupational injuries among solid mineral miners in Ose local government, Ondo state. The majority of the respondents in the present study were male which is in concordance with what was reported in other studies.[14-20] The male dominance could be due to the physically exerting nature of the mining work.

The present study revealed that the majority of the respondents had good knowledge of occupational injury encountered in the workplace. This was similar to what was reported in a study in Ghana.[14] This is probably due to good dissemination of information about occupational injury and its prevention by the employer in order to reduce absenteeism of employees due to occupational injury and also to probably prevent litigations.

In the present study, the job task was a physical risk factor for occupational injuries which is majorly seen among those that cut or polish stone. The cutting and polishing of stones require use of machine/equipment. The machine-related risk factor for occupational injury was similarly reported in studies done in Ghana, China, France, and Zimbabwe.[14,19,22,23] The use of poorly maintained machines can cause accidents thereby leading to occupational injuries.[24] It could also be due to the manual operation of the machines as workers who use the manual machines were more likely to sustain occupational injuries. On the contrary, a study in Zambia reported falls from height as the commonest risk factor of occupational injuries among miners. While there is no uniformity among the studies in identifying a single major risk factor of occupational injury, there are however a single factor attributed to human error.

In the present study, the occupational injury was seen in the majority who failed to use personal protective measures despite the majority being aware of the safety measures made available at the workplace. This was also reported in a study in India where an increase in occupational injury was noticed among those that failed to observe proper safety practices.[26] This is not unexpected since the protective device meant to reduce workers' vulnerability to injury has been ignored.

More males were injured than females in the present study. This was in concordance with studies done in Ghana, Kenya, Nigeria, China, and France.[14-19,22] The increased risk of occupational injury among males was probably due to the different jobs specifications males and females perform within the workplace. In the mining industry, males are engaged in more exerting

and injury-prone tasks than females and thus are at higher risk of occupational injury.

The older age group was less injured at the workplace than the younger age group in this present study. This is probably because the older age group was given less injury-prone jobs due to their lower physical work capacity, and decreased aerobic and musculoskeletal capacity. It could also be that the older age group was more experienced and familiar with the work environment so they developed a compensatory ability to reduce difficulties and avoid occupational injury.[27] Similarly, the younger age group may have less work experience and engage in risk-taking behaviors.[27] The findings in the present study were similar to studies in Kenya, Nigeria, and China.[15-19] The study in France reported a contrasting view, where occupational injury was commoner among the older age group.[22] The difference in the studies was the involvement of all working industries which was dominated by the older age group in the study done in France while the present study involved the mining industry alone.

In the present study, the frequency of injury decreased with the increasing length of service. This was similarly reported in studies done in Nigeria and USA.[18,27] This is because the longer the length of service the more the experience gained and familiarity with the work environment such that a compensatory ability to prevent occupational injury were developed.

Occupational injury was more common among those with a low level of education in the present study. This is similar to studies from Kenya and Nigeria.[16,17] This finding was probably because a higher level of education ought to increase the knowledge-seeking behavior of an individual and increase the use of safety measures. The information behavior of educated respondents could be influenced by their positive attitudes towards what others feel about their actions.[17] It could also be due to the allocation of less injurious work to the educated personnel while the injury-prone and tedious work are given to the less educated ones. A study in China showed that education had no significant effect on occupational injury.[19] The difference in the studies could be due to the participant socio-demographic differences.

The major occupational injuries sustained by the respondents in the present study were inhalational and machine-related (abrasion and cut). The studies done in Ghana, Kenya, Zimbabwe and Nigeria[14,16,18,23,28] reported inhalational injury as the major injury sustained. The increased inhalational injury could be due to the improper and infrequent use of dust masks. The machine-related occupational injuries could be due to the machine being designed with inadequate safety precautions and mostly manually operated. Therefore, workers who use the manually operated machine are likely to sustain occupational injury. It is therefore very vital to note that the dangerous nature of the mining environment makes it important for workers to be alert and comply with safety measures.

The majority of workers in this present study were aware of the safety measures made available to them but few made use of the complete personal protective measures. The hand gloves were the most common personal protective equipment used, this was probably because it was readily available, easy to use and does not interfere with the daily work activities. The ear muffle was the least used personal protective equipment and the reason for this could be that their eardrum could have adjusted to the noise produced in the company (partial deafness), it could also be that the ear muffle interferes with their communication with one another while at work thereby discouraging its use.

The present study demonstrated knowledge, age of respondents and length of service as risk factors of occupational injury. This was similar to a study done in the USA where the length of service and age of participants as risk factors of occupational injury.[27] On the contrary, Ghana, Kenya, China and France[14-16,19,22] reported gender as a risk factor for occupational injury. Similar studies from Kenya and Nigeria reported level of education is a risk factor for occupational injury.[16,17] The differences in the risk factors of occupational injury could be the variation in the socio-demographic factors of the studies. The present study also revealed the length of service and level of knowledge of occupational injury as predictors of occupational injury which were similarly reported in other studies in Ghana, Kenya and the USA.[14,15,27]

The limitations of the study were the likely underestimation of the rate of injury by the respondents who might tend to selectively capture the more severe injuries because of the recall bias and the more severely injured miners might have left the company and engaged in less hazardous jobs or have disabilities that may prevent them from working and thereby leading to underestimation of the injury burden.

In conclusion, the majority of the solid mineral miners showed good knowledge of occupational injury and preventive measures set up by the employer. Efforts should be made to ensure compliance with the preventive measures to reduce the incidence of occupational injury. There should be an emphasis on the use of dusk masks since inhalational injury is the most common injury sustained. Education concerning occupational injury should be a continuum.

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