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Original Research Article

Awareness and practice of safety measures against occupational hazards among aluminium foundry workers in Jos, Nigeria

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ABSTRACT

Background: Founding predisposes the worker to hazards (extreme heat, dust, fumes, sharp objects), which if unchecked, can cause health problems (burns, respiratory problems, cuts). This study aimed to assess the awareness and practice of safety measures against occupational hazards among aluminium foundry workers in Jos-North LGA.
Methods: This was a descriptive, cross-sectional study, which involved 125 aluminium foundry workers in Laranto-Katako area of Jos-North LGA. An interviewer-administered questionnaire was used to collect data. Analysis of data was done using EPI-Info® version 3.5.4 statistical software package. A probability value of $p \leq 0.05$ was considered statistically significant.
Results: All 125 (100%) respondents were males with a mean age of 24.8±9.7 years and 52 (41.2%) were less than 20 years of age. The study revealed that 118 (94.4%) of them were aware of occupational hazards associated with foundries; The hazards most known were fires with 116 (92.8%) mentions, extreme heat, 85 (68.0) and sharp objects, 85 (68.0%), and with the least being, long working hours, 25 (20.0%). A majority, 118 (94.4%) were aware of hand gloves, 114 (91.2%) nose masks with overalls having the least awareness, 13 (10.4%). The most frequently used safety measures were nose masks, 73 (58.4%), then hand gloves, 57 (45.6%). A statistically significant relationship, with p value of 0.0321, was found between the level of education and the practice of safety measures.
Conclusions: The study showed that most of the foundry workers had good knowledge of the hazards, safety measures; however, there was low use of safety measures. An educational campaign on the hazards and use of safety measures, accompanied by the efforts of the government, should be instituted for the foundry workers regularly to help safeguard their health.

Keywords: Occupational hazards, Foundry workers, Awareness, Safety practice, Jos

INTRODUCTION

The workplace plays an important role in human life. It is seen as a basic approach to surviving and sustainability. People spend at least six hours daily working either in the office, factory and worksite or outside on the street, and this accounts for the need to have a healthy and productive work life.[1] Occupational health according to the International labour organisation (ILO), is aimed at the promotion and maintenance of the highest degree of physical, mental and social wellbeing of workers in all occupations. It also covers the prevention amongst workers of departures from health caused by their working conditions, the protection of workers in their employment from risk resulting from factors adverse to health and the placing and maintenance of the worker in

an occupational environment adapted to his physiological and psychological capabilities.[2-5]

Naturally, the need for safety is an intrinsically human concern; hence, safety measures need to be in place to prevent injury to workers while protecting the equipment and the environment at the same. Hazards in a workplace should be identified, documented, monitored and managed. However, hazards not eliminated entirely are subjected to control measures which minimize the effects.[2] Workplace settings vary widely in size, sector, design, location, work processes, work culture and resources. Also, workers themselves differ in terms of age, gender, training, education, cultural background, health practices and access to health care.[2] All these translate to disparities in safety. The foundry as a workplace was considered in this study and focus was on the aluminium foundry workers.

Founding involves the pouring of molten metal into the hollow inside of a heat-resistant mould which is the outside shape of the pattern of the desired metal object. The mould may contain a core to determine the dimensions of any internal cavity in the final casting. Foundry work comprises: making a pattern of the desired article, making the mould and cores and assembling the mould, melting and refining the metal, pouring the metal into the mould, cooling the metal casting, removing the mould and core from the metal casting, and removing extra metal from the finished casting.[6]

The output from aluminium foundries yieldtools and equipment that are used commonly in households ranging from pots to colander to “kaskon masa” (a pan used in frying/making masa). The processes by which they carry out their activities predispose them to certain hazards and health problems.[7,8] These include: mechanical hazards; stepping on, colliding or hitting an object; injuries and cuts caused by sharp objects, broken glass, knives and other sharp tools; eye injury, as a result of flying aluminium splinters, physical hazards; exposure to very high noise levels; exposure to, and/or contact with electric current; exposure/contact with extreme temperature (heat); hand and arm vibrations influencing various body organs and systems, chemical hazards: cough as a result of dust, lung problems due to fumes, difficulty in breathing resulting from working in confined places lacking oxygen or having reduced oxygen content, or due to exposure to various other chemicals, ergonomic hazards; back pains and other musculoskeletal problems caused by over-exertion, inconvenient work position (including working in a bent posture), psychosocial factors; relevant to the type or place of workplace, such as human relations, work organization, being exposed to violence or crime at the workplace, shift work and similar problems.[9]

Preventive measures for these hazards include: use personal protection equipment (work gloves, safety goggles, welding masks, ear-plugs, safety-screen that protects against ricochets and sparks), disuse of defective portable power tools or those with improper isolation, work clothes should be fitted to the climatic conditions of the workplace (such as proper clothing), elimination of injuries resulting from hand-arm vibrations requires adoption of the relevant medical, technical and administrative procedures. In severe cases, an occupational psychologist can be consulted to improve worker’s psychosocial wellbeing.[10] Challenges in providing these safety measures include: lack of cooperation between governments, employers and workers' organizations, in the improvement of occupational safety and health, lack of knowledge among workers of their right to ownership and use of protective equipment, ignorance among workers to the use of safety equipment citing discomfort as reason for no use, poverty among workers leading to inability to acquire protective equipment, lack of knowledge among workers of presence of hazards.[11,12]

According to the ILO estimates, every year over 2.3 million women and men die at work from an occupational injury or disease. Over 350,000 deaths are due to fatal accidents and almost 2 million deaths are due to fatal work-related diseases. Estimates show that work-related diseases represent the main cause of death at work, killing almost six times more workers than occupational accidents. This should highlight the need for a new paradigm of prevention: one that also focuses on work-related diseases, not only on occupational injuries.

The ILO has estimated the great economic burden of not investing in Occupational Safety and Health (OSH) so as to prevent occupational accidents and diseases. The total costs amount to approximately four per cent of the world’s GDP per year (roughly 2.8 trillion US dollars). Further to the economic constraints, the human costs are unacceptable; a global society has a moral obligation to reduce the human and economic costs.[13] A study conducted in 2009 among welders in Kaduna Metropolis (North-West Nigeria) found that 85.3% of the subjects had experienced one or more work-related accidents and occupational hazards. The most common injuries sustained were cuts or injuries to hands or fingers (38.0%), back or waist pain (19%), arc eye injuries due to foreign bodies in the eye (17.0%), burns (14.0%), hearing impairment (7.0%), fractures (4.0%) and amputation (1.0%).[14] Aluminium foundry workers need to be assessed for knowledge on the hazards associated with their work environment because curative health care services place a larger burden, both financially and physiologically on the workers compared to promotive and preventive health care services. When health issues arise as a result of these workplace hazards, there is decreased productivity on the job.

Current study was aimed to assess the awareness of occupational hazards, compliance with safety standards, identify factors affecting use of safety measures and determine the prevalence of health problems amongst

aluminium foundry workers in Jos-North LGA in other to add to the pool of knowledge, and to make recommendations for improving their occupational health.

METHODS

Study area

The study was carried out in Jos North, Plateau state, Nigeria. It lies at latitude 9°55'42.6''N and longitude 8°53'31.6''E. Jos is the administrative capital of Plateau State. Jos North has a population of 572,700 based on the 2016 Population projection.[15] Aluminium foundry work has played a vital role in the development of individuals and communities in Jos. It helps to engage the youths especially those unable to attain formal education and also helps them to earn a living. Most aluminium foundry workshops are located in Laranto, Katako area of Jos North, with other workshops sparsely distributed in Dilimi-Rikkos area. They have a union, aluminium pot-makers association of Nigeria, Plateau state chapter, registered under the state ministry of mines and steel development, with an estimate of one hundred and forty-six workers.

Study type and period

This was a descriptive cross-sectional study of aluminium foundry workers who had been working in the industry for at least three months and who consented to participate in the study. Using a prevalence rate of 80.9% (proportion of aluminium workers with knowledge of occupational hazard in a previous study), an absolute standard error of 0.05 and a standard normal deviate of 1.96, a minimum sample size of 261 was calculated using the formula for cross sectional study and correction for finite population was done to arrive at 94.[16,17] The study was conducted between September and November 2019.

Selection criteria of the respondents

Purposive sampling technique was used to select the area for the study, where all eligible foundry workers available were interviewed for the study.

Procedure

Informed verbal consent was obtained from each respondent before being enrolled into the study; after being assured of confidentiality and anonymity without any loss of benefits or penalty. A semi-structured interviewer-administered questionnaire was used for data collection and it was divided into sections; socio-demographic data, knowledge of safety measures, practice of safety measures, factors affecting knowledge and practice of safety measures and prevalence of health problems.

Responses to the questions on the section for knowledge and practice were scored and then graded. For every correct answer the respondent gets a score of one and for every wrong or blank the respondent gets a zero. A total of 32 was obtainable for knowledge. It was graded as poor (0-10), fair (11-20), good knowledge (21-32). Practice had a total obtainable score of 15 and it was graded into good and poor practice based on the median score of three. Written informed consent was sought and obtained before administration of the questionnaire, and each participant was assured of the confidentiality of the information provided. They were given the freedom to decline participation in the study with no loss of benefit or penalty.

Statistical analysis

The data collected was analyzed using EPI-Info® version 3.5.4 statistical software package. Quantitative data was presented using mean, standard deviation and frequency tables, while qualitative data was presented using frequency tables, percentages and charts. Tests of statistically significant relationships were carried out using Chi-square test. A probability value of ≤0.05 was considered statistically significant.

RESULTS

A total of 125 respondents participated in this study. The age range of respondents was between 9 and 50 years with a mean age of 24.8±9.7 years and the highest proportion of respondents, 52 (41.6%) were aged 9-20 years. All the respondents were males 125 (100%). A larger proportion were single, 79 (63.2%) and over half of them had secondary education, 71 (56.8%) while only 11 (8.8%) had no education at all. Their daily wage ranged ₦100-₦9000, with their mean income at ₦1799.2±₦1423.2. Work spanned for 3-12 hours, with 24 (19.2%) working for over 8 hours. Most of them 80 (64.0%) had apprenticeship training for 3 years and less and 27 (21.6%) of them had over 15 years of experience (Table 1).

The study revealed that 118 (94.4%) of them were aware of the hazards associated with their work, 122 (97.6%) were aware of the health problems. The table also shows that only 107 (85.6%) knew what safety at workplace was. The hazards most known to the respondents were fires with 116 (92.8%) mentions, extreme heat, 85 (68.0) and sharp objects, 85 (68.0%), with the least being, long working hours, 25 (20.0%). The most known health problems were burns with 120 (96.0%) mentions and cuts, 110 (88.0%) with psychological problems, 2 (1.6%), the least known health problem. A majority of the respondents, 118 (94.4%) were aware of hand gloves, 114 (91.2%) aware of nose masks with overalls having the least awareness, 13 (10.4%). Thirty-two (25.6%) respondents had good knowledge about hazards, health problems and safety measures associated with foundry work, whereas 83 (66.4%) had fair knowledge and 10

(8.0%) had poor knowledge of hazards, health problems and safety measures (Table 2).

From the bar chart, it revealed that the most used safety measure were nose-masks,73 (58.4%) and hand gloves, 57 (45.6%), however, goggles, pre-employment and periodic medical examination (PE & PME) recording the lowest use, 2 (1.6%). There was no use of overalls. From the pie-chart, only 14 (11.2%) of the respondents always used any safety measures with 39 (31.2%) never making use of any safety measures. Sixty-one (48.8%) respondents had good practice of safety measures against hazards associated with foundry work, whereas 64 (51.2%) had poor practice of safety measures (Table 3).

Table 1: Socio-demographic and occupational data of the respondents.

Variables (n=125)	N	(%)
Age (years)		
≤20	52	41.6
21-30	46	36.8
31-40	18	14.4
41-50	6	4.8
>50	3	2.4
Mean=24.8±9.7, Range=9-70		
Gender		
Male	125	100.0
Female	0	0.0
Marital status		
Single	79	63.2
Married	46	36.8
Level of education		
None	11	8.8
Primary	33	26.4
Secondary	71	56.8
Tertiary	10	8.0
Religion		
Christianity	4	3.2
Islam	121	96.8
Daily income		
≤₦1500	74	59.2
>₦1500	51	40.8
Hours worked per day		
≤8	101	80.8
>8	24	19.2
Duration of apprenticeship training (years)		
≤3	80	64.0
>3	69	40.8
Health and safety training		
Yes	26	20.8
No	99	79.2
Work experience (years)		
≤15	98	78.4
>15	27	21.6

Table 2: Knowledge of hazards and health problems.

Variables (n=125)	N	(%)
Awareness of hazards		
Yes	118	94.4
No	7	5.6
Hazards mentioned*		
Fires	116	92.8
Extreme heat	85	68.0
Sharp objects	85	68.0
Dust	78	62.4
Fumes	74	59.2
Chemicals	45	36.0
Manual lifting	38	30.4
Poor ventilation	33	26.4
Inconvenient work position	32	25.6
Noise	29	23.2
Long working hours	25	20.0
Awareness of health problems		
Yes	122	97.6
No	3	2.4
Health problems mentioned*		
Burns	120	96.0
Cuts	110	88.0
Respiratory problems	47	37.6
Body pains	44	35.2
Eye problems	38	30.4
Gas poisoning	23	18.4
Skin diseases	21	16.8
Psychological problems	2	1.6
Awareness of workplace safety practice		
Yes	107	85.6
No	18	14.4
PPE mentioned*		
Hand gloves	118	94.4
Nose masks	114	91.2
Safety boots	70	56.0
Goggles	18	14.4
Earplugs	14	11.2
Overalls	13	10.4
Knowledge score		
Poor	10	8.0
Fair	83	66.4
Good	32	25.6

*Multiple responses allowed

Table 3: Practice grading of respondents.

Grade (n=125)	N	(%)
Poor	64	51.2
Good	61	48.8

There was a statistically significant relationship between level of education and practice of safety among the aluminium foundry workers (Table 4). The study revealed that among the 125 aluminium foundry workers

who participated in the survey, burns was the most prevalent of health problems in the past month, with 83 (66.4%) mentions, followed by cuts, 33 (26.4%) with no record of eye problems among the respondents (Table 5).

There was no statistically significant relationship practice of safety measures and presence of health problems among the aluminium foundry workers (Table 6).

Table 4: Relationship between socio-demographic/occupational data of respondents and practice of safety.

Practice of safety measures (n=125)					
Variables	**Poor N (%)**	**Good N (%)**	**Total N (%)**	x^2	**P value**
Age (years)					
≤20	23 (44.2)	29 (55.8)	52 (41.6)	3.9704	0.4100
21-30	25 (54.3)	21 (45.7)	46 (36.8)		
31-40	9 (50.0)	9 (50.0)	18 (14.4)		
41-50	5 (83.3)	1 (16.7)	6 (4.8)		
>50	2 (66.7)	1 (33.3)	3 (2.4)		
Marital status					
Single	30 (65.2)	16 (34.8)	46 (36.8)	0.0167	0.0090
Married	34 (43.0)	45 (57.0)	79 (63.2)		
Level of education					
None	10 (90.9)	1 (9.1)	11 (8.8)	8.7956	0.0321
Primary	13 (39.4)	20 (60.6)	33 (26.4)		
Secondary	36 (50.7)	35 (49.3)	71 (56.8)		
Tertiary	5 (50.0)	5 (50.5)	10 (8.0)		
Daily income					
≤₦1500	40 (54.1)	34 (45.9)	74 (59.2)	0.4419	0.2248
>₦1500	24 (47.1)	27 (52.9)	51 (40.8)		
Hours worked per day (hours)					
≤8	51 (50.5)	50 (49.5)	101 (80.8)	0.7463	0.3769
>8	13 (54.2)	11 (45.8)	24 (19.2)		
Duration of apprenticeship training (years)					
≤3	45 (56.3)	35 (43.8)	80 (64.0)	0.1321	0.0692
>3	19 (42.2)	26 (57.8)	45 (36.0)		
Health and safety training					
Yes	10 (38.5)	16 (61.5)	26 (20.8)	0.1443	0.0767
No	54 (54.5)	45 (45.5)	99 (79.2)		
Work experience (years)					
≤15	49 (50.0)	49 (50.0)	98 (78.4)	0.6091	0.3092
>15	15 (55.6)	12 (44.4)	27 (21.6)		
Job satisfaction					
Yes	62(51.2)	59 (48.8)	121 (96.8)	0.6458	0.4819
No	2 (50.0)	2 (50.0)	4 (3.2)		
Incentives/punishments					
Yes	3 (42.9)	4 (57.1)	7 (5.6)	0.9479	0.3368
No	61 (51.7)	57 (48.3)	118 (94.4)		

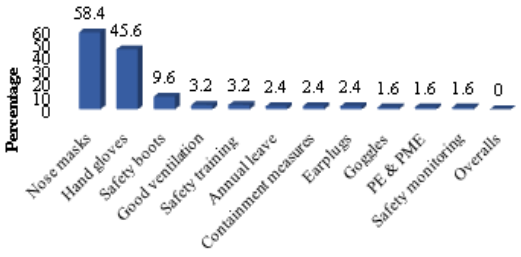

Figure 1: A bar chart showing the percentage use of safety measures by the respondents

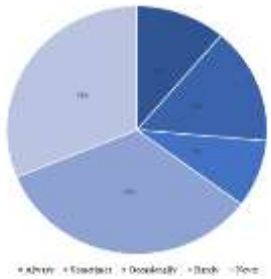

Figure 2: A pie-chart showing the frequency of use of safety measures.

Table 5: Prevalence of health problems among foundry workers.

Health problems*(n=125)	N	(%)
Burns	83	66.4
Cuts	33	26.4
Body pains	19	15.2
Respiratory problems	6	4.8
Skin rashes	3	2.4
Others	1	0.8
Eye problems	0	0.0

*Multiple responses allowed

Table 6: Relationship between practice of safety measures and presence of health problems.

Health problems					
Practice grade	**Yes**	**No**	**Total**	x^2	**P value**
Poor	46 (71.9)	18 (28.1)	64 (51.2)	0.1158	0.0615
Good	51 (83.6)	10 (16.4)	61 (48.8)		

DISCUSSION

Current study was carried out to assess the knowledge and practice of safety measures against occupational hazards among aluminium foundry workers in Jos North. In this study, it was found that almost half of the workers were below the age of 20 years and in fact, most of them were less than 18 years of age. This translates to child labour in a hazardous environment (working in a foundry) and such may deter the growth and development of these children. A separate study exploring hazardous work among children would be useful in evaluating the effect founding could have on their growth and development.

All the respondents in this study were males, perhaps reflecting differential gender roles in this part of the country. Males tend to select themselves into more hazardous jobs. Another study of workers in an aluminium industry to determine the level of awareness to hazards and the use of preventive and protective measures in Lagos, unlike ours, found some of the respondents being females and this may be because there is less emphasis on gender in that region, thus allowing females to work in foundries.[16] In this study, over half of the respondents had secondary level of education and only a few of the respondents had no formal education, this is similar to the study carried out in Kaduna Metropolis which revealed that more than half of the respondents had secondary education, while only a handful had no education at all.[14] This may be because both cities are located in north-central Nigeria and have similar socio-economic characteristics.

The study revealed high awareness of hazards and health problems associated with aluminium foundry work. Almost all of them were aware of the hazards associated with the occupation, and almost all were aware of some of the associated health problems. The study in Lagos also found that majority of the respondents were aware of the hazards exposed to in their workplace.[16] A similar study on welders to assess the awareness of occupational hazards and utilization of PPE in Jos Metropolis found more than half of its respondents with high awareness of health problems.[17]

Our study revealed that hazards most known to the respondents were fires, extreme heat and sharp objects. Most known health problems were burns and cuts with psychological problems being the least known health problems. The study in Jos Metropolis found that among the hazards identified in the workshops, manual lifting, noise/vibration and fumes had the highest frequencies with asphyxiant gases having the lowest frequency. The health problems mentioned included eye problems, backache, burns, with cancer being the least mentioned.[18]

Current study revealed that majority of the respondents knew safety practice at the workplace. Concerning personal protective equipment, nearly all respondents mentioned hand gloves and nose masks, however, only a few respondents mentioned overalls. In contrast, the study in Jos Metropolis had almost all respondents mentioning goggles, a majority mentioning facemasks with half of the respondents mentioning earplugs.[18] Current study revealed that practice of safety measures among respondents was generally low, however, respondents with any form of education had better practice of safety measures compared to those with no form of education even though there was no statistically significant relationship between the level of education and practice of safety measures. Over half of the respondents used nose masks, about half used hand gloves and a few used safety boots. The poor use of safety boots was attributed to continuous burning of the foot in instances where molten aluminium got into the boots. This could have been circumvented by the use of overalls. Poor use of overalls was because of the extreme heat in the foundry. This could be controlled by partial enclosures of the furnaces and by redesigning of some the processes to reduce the amount of heat in the foundries. Similarly, the study in Kaduna Metropolis found that over a third of respondents used one or more types of protective measure with about two-thirds using eye goggles, half using hand gloves and a few using boots.[14]

Current study showed that there was statistically significant relationship between level of education and practice of safety measures. The poor economic condition in the country may have played a major role in the availability and affordability of these all-important protective measures which may have translated to the poor use of safety despite high awareness of hazards and health problems. In contrast, the study in Lagos found

that males were more likely to regularly use protective devices compared to females. However, there was no statistically significant association between age, educational level and hazard awareness in the study.[12]

From this study, more than three-quarters of the respondents had experienced one or more work-related health problems in the past one month. The most common problems were burns, cuts, with few mentions of body pains. This is not surprising considering that not up to half of the respondents practiced any form of safety. A similar study done to assess the prevalence of respiratory symptoms and occupational asthma in foundry workers in Samsun, Turkey showed the most common respiratory problems being phlegm, cough, breathlessness, chest tightness and wheezing.[19] Another study in Kaduna Metropolis documented that majority of the study group had experienced one or more health problems with over a third of them experiencing cuts/injuries to the hand and fingers and amputation, however, was the least recorded problem.[10]

Limitations

Limitation of the present study is the fact that it is a cross-sectional study, and long-term follow up of the health of the foundry workers are not studied. It is also difficult to establish a temporal relationship between exposure to hazards and the health problems mentioned by the respondents.

CONCLUSION

From this study, it was discovered that most of the respondents were aware of hazards encountered in their occupation as well as associated health problems. The study however revealed the practice of safety measures as poor. Majority of the respondents had experienced at least one work-related health problem especially burns and cuts.

Recommendations

It is recommended that there is need for proper education for this economically viable group on workplace hazards, safety measures and the proper use of protective equipment in order to safeguard their health. Regulations on use of safety measures (containment, personal protective equipment etc.) should be laid down by the federal ministry of labour and employment as well as the state ministry of health, to improve the practice of safety. A stronger pot-makers' association is needed, with collaboration of an occupational health consultant, to make a proper presentation to the appropriate level of government. The ministries of labour and health should collaborate to provide an occupational health service for this group of workers through the informal sector segment of the National health insurance scheme.

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