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Knowledge, Attitude And Safety Practices Of Workers Of Aluminium Fabrication Company In Port Harcourt, Rivers State

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ABSTRACT

Aluminium fabrication job is one of the fastest growing occupations in Nigeria, and as a result of their demand aluminium fabrication workers are faced with work related hazards. The aim of this study is to investigate the knowledge, attitude and safety practices workers of an aluminium fabrication company in Port Harcourt, Rivers State. This was a mixed method descriptive research design. A sample size of 210 was calculated using the formula for descriptive studies. A two stage sampling method was used to recruit workers into this study. A semi-structured interviewer-administered questionnaire was used. The questionnaire was validated through scrutiny and corrections by my supervisor, pre-testing of the questionnaire were carried out among aluminium workers. Data were collected and was entered into the Statistical Package for Social Science (SPSS) version 23 software as numeric codes and analysed. Ethical clearance for this study was gotten from the Ethics Committee of University of Port Harcourt while verbal consent was obtained from each participant. Confidentiality of responses was assured and purpose of the study was explained before administering the questionnaire. Data were analysed using frequencies, percentages, graphs and chi-square. The result showed that the overall very good knowledge of occupational hazards associated with aluminium fabrication among respondents was 18(9.0%), good knowledge was 93(46.5%) while poor knowledge was 89(44.5%). Overall positive attitude of workers towards occupational hazards associated with aluminium fabrication was 97(48.5%). Overall good safety practices of workers against occupational hazards associated with aluminium fabrication was 97(48.5%). Based on the findings of the study, it was concluded that a significant portion of the participants possessed a strong understanding of the risks associated with aluminium fabrication. Additionally, it was observed that an average proportion of the population held a positive outlook regarding these potential hazards.

Keywords: Environmental, medical, workplace, workers.

INTRODUCTION

Aluminium fabrication job is one of the fastest growing occupations in Nigeria, and as a result of their demand aluminium fabrication workers are faced with work related hazards. These hazards are particularly common among workers who spend much of their time in course of their work, and aluminium workers are no exception. Shaaban et al. (2016) reported that aluminium production is accompanied by emissions of dust and gases, which are potentially harmful to the workers and the local environment. Therefore, the principle method which is used in the production of aluminium

metal involves two major steps: refining (Bayer process): refining of bauxite to produce alumina (Al_2O_3). This is produced by adding caustic soda (sodium hydroxide) to the bauxite in a furnace in high pressure and at temperature from 200 to 1200 °C, the produced product is called alumina (aluminium oxide). Reduction (Hall–Heroult process): alumina (aluminum oxide) is reduced to aluminum by an electrolytic process using carbon electrodes (cathode and anode) and cryolite (aluminum sodium fluoride) as flux which is added to decrease the melting point of alumina, and hence decreasing the cost of aluminium production (Wesdock et al., 2014; Agbo, 2020).

Donoghue et al. (2014) opined that the electrolytic cell in which reduction takes place is called pot, and the building called potroom. Hence, workers at aluminium industries are exposed to various occupational hazardous factors such as fumes and gases, mineral dusts, coal tar pitch volatiles, electromagnetic fields and others. The major gaseous constituents of pot emissions are hydrogen fluoride, carbon oxides, sulfur dioxide and oxides of nitrogen. The particulates include mainly alumina and fluorides with traces of many elements as vanadium and nickel, also polycyclic aromatic hydrocarbons (Shaaban et al., 2016).

Aluminum factory workers have been shown to suffer from respiratory symptoms either chronic or work related ones as cough, phlegm, dyspnea, wheezing and chest tightness. Also it has been shown that potroom work may result in long-term lung function impairment and in an asthma-like syndrome of unknown pathogenesis. It is termed “potroom asthma” and is more common for workers engaged directly in serving pots. However, wider range of lung diseases may be caused due to aluminum production as toxic dust: chronic bronchitis, chronic obstructive pulmonary disease (COPD), alveolitis, pneumoconiosis, and oncological respiratory diseases (Mazzoli-Rocha et al., 2010; Ohioson et al., 2010).

However, Sim and Benke (2003) added that epidemiological studies have implicated these exposures as causal agents for excess cancers and/or respiratory disease in the primary aluminium industry. The atmospheric concentrations of the chemical contaminants vary in potrooms and are usually dependent on the technology used in the potroom and the age of the facility. Peak exposures to fluorides and sulphur dioxide may also be a hazard as extraction hoods must be removed from time to time, resulting in potential for significant levels of emissions over short time periods.

Typically, in many of the jobs and tasks the worker can be simultaneously exposed to all of these dusts and fumes. But it depends on the stage of the smelting process and task as to the “mix” of concentrations of the various exposures. The jobs and tasks with highest potential for exposure involve anode changing, metal and bath tapping, and pot-lining, although significant exposure to dusts and fumes can also be experienced by maintenance workers and crane drivers (Shaaban et al., 2016).

Potroom aluminium workers are also exposed to physical hazards such as magnetic fields, noise, radiant energy, and the likelihood of burns from hot metal. Since the pots in most potrooms operate at currents of 12–300 kA at 5 volts, exposure to static magnetic fields may be typically between 0.1 and 10.0 milliTesla with some extra low frequency (ELF) AC magnetic fields also present. Noise in potrooms can exceed 80 dB(A) and is often loudest near the air powered (pneumatic) impact tools (electrically powered tools are often not used due to the electrical hazards in potlines) and mobile equipment. Radiant energy, as ultraviolet, visible, and infra-red radiation can exceed the ACGIH TLVs at open pots in pre-bake smelters. Since the pots run at temperatures of about 960°C, there is significant potential for heat stress and burns from hot electrolytic bath and metal to occur. Workers in potrooms in hot climates are particularly at risk of heat stress since the natural secondary ventilation may not afford sufficient cooling. Burns from contact with hot metal, bath splashes, or surfaces of pots are major hazards to workers in most jobs and tasks in the potroom (Sim & Benke, 2013).

In 1984 the International Agency for Research on Cancer concluded: “certain exposures in the aluminium fabrication are probably carcinogenic to humans” Also, working in aluminium potrooms has been associated with increased risk of lung and bladder cancer. Respiratory diseases such as potroom asthma, have been the main focus of over 50 epidemiological studies since the 1960s. The mechanism is not clear, but may involve a mix of irritancy and sensitization and asthma can continue after a worker is removed from exposure. An association between plasma fluorides and bronchial hyper-responsiveness has been shown. It has also been reported that workers in aluminium potrooms are at increased risk of mortality from chronic obstructive lung disease (COLD) (Sim & Benke, 2013; Chebotarey, 2009).

In Nigeria, there is a primary federal law ensuring physical safety on the job which was passed in 1970s. The goal of the law is to ensure that employers provide a workplace environment free of risk to employees' safety and health, such as mechanical or electrical dangers, toxic chemicals, severe heat or cold, unsanitary conditions, and dangerous equipment. The employer obligations under this law include the duty to provide a safe workplace free of serious hazards, to identify and eliminate health and safety hazards, to inform employees of hazards present on the job and institute training protocols sufficient to address them, to extend to employees protective gear and appropriate safeguards at no cost to them, and to publicly post and maintain records of worker injuries. Hence, it gives employees several important rights, including the right to make a confidential complaint that might result in an inspection of the workplace, to obtain information about the hazards of the workplace and ways to avoid harm, to obtain and review documentation of work-related illnesses and injuries at the job site, to obtain copies of tests done to measure workplace hazards. However, these are not obtainable in most aluminium companies (Agbo, 2021).

Therefore, the control of hazards in a modern aluminium company should involve the classical forms of workplace controls—that is, engineering controls, administrative or work practices, and personal protective equipment (PPE). With the potential for high exposure to fluorides, other gases, and particulates in potrooms, the principal control is by local exhaust ventilation (LEV). Söderberg potrooms may have a skirt hood or a complete hood over the cell. In pre-bake potrooms the local exhaust ventilation (LEV) removes the gases and particulates, to a distant location where wet or dry scrubbing takes place. Often, potrooms also have secondary emission controls such as natural ventilation to reduce the airborne contaminants and generally cool the potroom. In modern potrooms crane-drivers usually work in totally enclosed and air filtered cabins above the potlines. This greatly reduces exposure to any dusts and gases that were not captured by the primary ventilation system. Numerous mechanical lifting devices are used to work as remotely as possible from the hot metal and bath; these also reduce the likelihood of manual handling and posture injuries (Donoghue et al., 2014; Diaz-Carrion, 2020).

Control of hazards by work practices involve rotation of workers in various jobs and tasks and short residence times when required to work in close proximity to pots. PPE for workers in potrooms may include respiratory protection, overalls, earplugs or muffs, gloves, gaiters, safety boots, face shields, and eye protection. The respirators may be activated alumina/charcoal impregnated disposable dust masks, half-face or full-face filter respirators, or powered air purifying respirators (PAPRs), depending on the technology, tasks, and level of contaminants involved. Since the atmosphere inside potrooms is not considered immediately dangerous to life or health (IDLH), the PAPR design is popular in many potrooms. Wearing of hearing protection should be mandatory in most modern potrooms and disposable earplugs usually the most acceptable form of protection (Donoghue et al., 2014).

Medical monitoring of aluminium workers can be undertaken, but this should not be seen as an alternative for hazard reduction in the workplace. The most useful aspects of such medical monitoring would include a respiratory symptom questionnaire, spirometry or peak expiratory flow rates, and measurement of airway responsiveness. This should also provide an opportunity for monitoring information on potroom asthma, control measures, and the correct use of PPE. Therefore, for the purpose of protecting the health of workers, the determinants and measures to mitigate or prevent occupational hazards must be identified. It was based on this premise that the researcher deemed it necessary to carry out this study to investigate the knowledge, attitude and safety practices of workers of an aluminium fabrication company in Port Harcourt, Rivers State

RESEARCH MATERIALS AND METHODS

Research design

The design of the study was a mixed method descriptive research design.

Area of the Study

Port Harcourt Metropolis

Population for the Study

The population of the study consisted of workers in Aluminium Fabrication Company in Port Harcourt (Mile 3/Ikoku fabrication site)

Inclusion criteria and exclusion criteria

Inclusion criteria

1. Workers who are duly employed by the Aluminium Company
2. Workers who have worked for more than one year

Exclusion criteria

1. Workers who are on leave or absent due to ill health or other issues that may not permit them to take part in the study.
2. Workers who are on internship or any form of training

Sample size determination and Sampling Technique

Sample size determination

The sample size of 210 was calculated using the formula for descriptive studies

$$n = \frac{Z^2 P \cdot q}{d^2}$$

Sampling techniques

A two-stage sampling technique was employed for the study

Stage I: Selection of a fabrication company in Port Harcourt

A simple random sampling technique was adopted to select Mile 3/Ikoku fabrication site out of various fabrication companies in Port Harcourt for the study.

Stage II: Selection of participants

A simple random sampling technique was also adopted to select participants for the study until the desired sample size was reached.

Instrument for Data Collection

The questionnaire assessed level of knowledge, attitude and safety practices of occupational hazards associated with aluminium fabrication.

Reliability of the Instrument

The validated instrument was pre-tested on 10% of the population homogenous to the research sample in Port Harcourt. Pre-tested instrument was then subjected to a test-retest method of reliability where the researcher administered the instrument on 2 weeks interval after which the data was analysed and a reliability co-efficient of 0.78 was obtained to show that the instrument was reliable.

Methods of Data Collection

The questionnaire and guide was self-administered by the researcher with the help of three trained research assistants.

Methods of Data Analysis

Data collected was coded using statistical products for Service Solution (SPSS) and analysed using the descriptive statistics of frequency percentages (%).

Ethical consideration

Permission was sought and obtained from the management of the fabrication company. A written informed consent was obtained from the participating workers before the commencement of the study. Ethical clearance was obtained from the Research and Ethics committee of the University of Port Harcourt

RESULTS

Respondent Rate / Data Completion

A total of 210 questionnaires were distributed to metal fabrication workers, 200 questionnaires were properly filled and used for this analysis. This gave a response rate of 95%.

Table 1: Socio-demographic characteristics of the respondents

Variable	Frequency (n=200)	Percentage
Age (Years)		
16yrs - 25 yrs	26	13.0
26yrs - 35yrs	55	27.5
36yrs - 45yrs	84	42.0
46yrs – Above	35	17.5
Mean Age	33 ±5.70	
Gender		
Male	185	92.5
Female	15	7.5
Education		
Non formal Education	32	16.0
Primary Education	78	39.0
Secondary Education	40	20.0
Tertiary Education	50	25.0
Training		
Yes	145	72.5
No	55	27.5
Years of working experience		
1-5 years	67	33.5
6-10 years	74	37.0
11 > years	59	29.5

Table 1 shows the socio-demographic data of respondents. The result showed that 26(13.0%) were aged 16-25 years, 55(27.5%) were aged 26-35, 84(42.0%) were aged 36-45 years and 35(17.5%) were aged 46 years and above. The result also showed that 185(92.5%) of the respondents were males and 15(7.5%) were females. For education, 32(16.0%) of the respondents had no formal education, 78(39.0%) had primary education, 40(20.0%) had secondary education and 50(25.0%) had tertiary education. The result showed that only 145(72.5%) of the respondents had training. For years of working experience, 67(33.5%) had worked for 0-5 years, 74(37.0%) 6-10 years and 59(29.5%) 11 years and above.

Table 2: Knowledge of occupational hazards associated with aluminium fabrication among respondents

Variables	Frequency	Percentages
Knowledge of occupational hazards associated with aluminium fabrication		
Very Good (8-10)	18	9.0
Good (4-7)	93	46.5
Poor (<3)	89	44.5
Total	200	100.0

In measuring the overall knowledge of occupational hazards associated with aluminium fabrication among respondents, ten (10) different questions were asked on varying knowledge of occupational hazards associated with aluminium fabrication among respondents and scored, based on a true and false methodology. They were all positive and negative questions and those that answered true to correct knowledge of occupational hazards associated with aluminium fabrication among respondents were scored 1 and those that answered otherwise, 0. The scores were summed for all participants. Participants with very good knowledge of occupational hazards associated with aluminium fabrication among respondents were scored 8-10, good knowledge of occupational hazards associated with aluminium fabrication among respondents were scored 4-7 and those with poor knowledge were scored ≤ 3 as shown in table 4.3. Overall very good knowledge of occupational hazards associated with aluminium fabrication among respondents was 18(9.0%), good knowledge was 93(46.5%) while poor knowledge was 89(44.5%).

Table 2: Attitude of workers towards occupational hazards

Variables	Frequency	Percentages
Attitude of workers towards occupational hazards		
Positive >3	97	48.5
Negative <2	103	51.5
Total	200	100.0

In measuring the overall attitude of workers towards occupational hazards associated with aluminium fabrication, five (5) different questions were asked on varying attitude of workers towards occupational hazards associated with aluminium fabrication and scored, based on a likert scale method. They were all positive questions and those that answered true to correct attitude of workers towards occupational hazards associated with aluminium fabrication were scored 1 and those that answered otherwise, 0. The scores were summed for all participants. Participants with positive attitude of workers towards occupational hazards associated with aluminium fabrication were scored >3 and those with negative attitude were scored ≤ 2 as shown in table 4.4. Overall positive attitude of workers towards occupational hazards associated with aluminium fabrication was 97(48.5%) while negative attitude was 103(51.5%).

Table 3: Safety practices of workers against occupational hazards associated with aluminium fabrication

Variables	Frequency	Percentages
Safety practices of workers against occupational hazards associated with aluminium fabrication		
Good >6	97	48.5
Poor <5	103	51.5
Total	200	100.0

In measuring the overall safety practices of workers against occupational hazards associated with aluminium fabrication, ten (10) different questions were asked on varying safety practices of workers against occupational hazards associated with aluminium fabrication and scored, based on a true and false methodology. They were all positive and negative questions and those that answered true to correct safety practices of workers against occupational hazards associated with aluminium

fabrication were scored 1 and those that answered otherwise, 0. The scores were summed for all participants. Participants with good safety practices of workers against occupational hazards associated with aluminium fabrication were scored 6-10, and those with poor safety practices of workers against occupational hazards associated with aluminium fabrication were scored ≤ 5 as shown in table 4.4. Overall good safety practices of workers against occupational hazards associated with aluminium fabrication was 97(48.5%) while poor safety practices of workers against occupational hazards associated with aluminium fabrication was 103(51.5%).

DISCUSSION

The findings of the current study revealed that a substantial proportion, of aluminium fabrication workers exhibited a commendable knowledge of occupational hazards. This observation resonates with the outcomes of various previous studies conducted in similar occupational settings. Studies such as those conducted by Kumar et al. (2012), Sabitu et al. (2009), Tadesse et al. (2016), Budhathoki et al. (2014), and Beyene et al. (2019) similarly reported relatively high levels of awareness ranging from 50% to 90% among welders or workers in comparable roles. However, the reported awareness levels displayed a degree of variation across studies. For instance, the study conducted by Hassan et al. (2017) identified a lower hazard awareness of 54.3% among Pakistani welders, deviating from the higher percentages observed in other investigations. The specific reasons for this variability across different research inquiries remain ambiguous, but potential explanations have been postulated. Kumar et al. (2012) suggested that these discrepancies in awareness levels could potentially stem from variations in the educational backgrounds of the workers and the availability or efficacy of hazard training programs.

The notably higher level of awareness observed in the current study implies the existence of pre-existing knowledge among aluminium fabrication workers, potentially acquired through informal, on-the-job training methods. This suggests that these workers might have gained considerable insight into occupational hazards through experiential learning or workplace exposure, contributing to their heightened awareness levels demonstrated in the study. The disparity in findings across studies underscores the complexity of factors influencing hazard awareness among workers in the metal fabrication sector. These factors could range from variations in educational access, the effectiveness of training initiatives, and the nature of on-the-job learning experiences, ultimately impacting the differing levels of hazard awareness observed in distinct studies. This recognition emphasizes the necessity for a nuanced approach to occupational safety training, considering the diverse backgrounds and learning environments of workers in the metal fabrication industry.

The current investigation revealed that less than half of aluminium workers demonstrated a positive attitude toward occupational health and safety. This finding stands in contrast to prior studies conducted by Budhathoki et al. (2014) and Nalugya et al. (2022), both of which identified a negative attitude and a considerable gap between hazard knowledge and safety practices among the majority of welders surveyed. Conversely, the current study's observation aligns with the conclusions drawn by Bentum et al. (2020), who highlighted a positive attitude among Ghanaian woodworkers, despite the observed low utilization of Personal Protective Equipment (PPE). The contrasting outcomes regarding attitudes toward safety practices among metal workers pose an intriguing contrast in the research landscape. While the reasons for these differing attitudes remain elusive, several factors might contribute to these disparities. Variances in workplace safety cultures and the accessibility of Personal Protective Equipment across distinct settings could significantly influence the attitudes of workers toward occupational health and safety. Factors such as differing training protocols, workplace policies, or even cultural norms within these industries could potentially account for these discrepancies.

Given the discrepancies in attitude findings across various studies, there is a pressing need for further investigation to delve into the predictors and determinants of hazardous attitudes among metal workers. Understanding the underlying factors influencing the attitudes of these workers toward safety practices could yield critical insights into designing targeted interventions and tailored strategies. Future studies could explore various aspects, including the influence of training programs, the role of workplace safety policies, the impact of cultural differences, and the availability and accessibility of safety equipment within these settings. Exploring the complex interplay of these

factors and their effects on shaping attitudes toward occupational health and safety among metal workers can pave the way for more nuanced and effective interventions. By identifying the drivers of these differing attitudes, future research endeavors can contribute to the development of comprehensive and context-specific approaches aimed at fostering a positive safety culture and improving adherence to safety protocols among metal workers in diverse occupational settings.

The findings of this investigation revealed a concerning trend among aluminium workers, with few demonstrating commendable safety practices. This quota aligns with and reinforces the outcomes of previous studies that have consistently reported suboptimal Personal Protective Equipment (PPE) use within the range of 10-50% among aluminium workers (Beyene et al., 2019; Nalugya et al., 2022; Esu et al., 2021). These results underscore a persistent challenge in the workplace safety domain. Similar to the observations made by Osagiede et al. (2020), this study noted an overarching issue of inadequate safety practices despite a reasonable level of awareness regarding occupational hazards. This consistent discrepancy between knowledge and implementation, often referred to as the knowledge-practice gap, has been emphasized in previous studies, notably by Budhathoki et al. (2014).

However, in contrast to the findings of Awosan et al. (2017), who reported near-universal compliance with PPE use, the current study pointed out substantial non-compliance issues. These non-compliance trends could potentially be attributed to a lack of stringent regulatory enforcement and the unavailability of essential PPE, as highlighted in earlier research by Budhathoki et al. (2014). Such inadequacies in enforcement and availability might serve as significant barriers to the adoption of proper safety practices among metal workers. The evidence points to an urgent and pressing need for interventions to address these persistent and prevalent gaps in workplace safety practices. The study's results, along with the consistent findings in prior research, highlight the critical necessity for comprehensive and immediate interventions. These interventions should focus on enhancing regulatory frameworks, ensuring the availability and accessibility of necessary PPE, and implementing robust enforcement strategies to bridge the knowledge-practice gap and uplift safety compliance among metal workers. The identified gaps between knowledge and practice call for a holistic approach involving regulatory bodies, industry stakeholders, and policymakers to implement and enforce stringent safety protocols, offer adequate training, and ensure the availability of appropriate protective equipment. The urgency in addressing these issues is paramount to safeguarding the well-being and safety of workers in the metal fabrication industry.

CONCLUSION

The study's findings suggest that a significant portion of the participants possessed a strong understanding of the risks associated with aluminium fabrication. Additionally, it was observed that an average proportion of the population held a positive outlook regarding these potential hazards. While aluminium workers exhibited a high level of knowledge regarding occupational risks and work-related health issues, this knowledge did not really translate into a corresponding adherence to appropriate safety measures and the use of protective equipment.

RECOMMENDATION

Based on the findings in this study, and to improve safety practices among workers which will in turn reduce the rate of occupational injuries, the following are recommended;

To the Government

The Government should, through its relevant agencies, mount more intensive enlightenment campaigns through public talks, seminars, conferences and workshops to create more awareness of different occupational hazards found in fabrication sectors and the need for strict safety compliance amongst workers. This will in turn reduce the burden and prevalence of occupational injuries amongst workers.

To Aluminium Fabrication Workers

The aluminium fabrication workers should ensure that they practice the knowledge gained through workshops on safety (this can be done through due diligence throughout every part of fabrication process/ensuring that they meet every safety standard before and after fabrication) in other to work safely in the work environment as good practice makes perfect.

To Institutions

Institutions should as a matter of fact carry out urgent research aimed at developing appropriate workplace interventions. By echoing previous research's calls for action, it underscores the necessity of comprehensive research to inform targeted strategies that promote health and safety among metal fabrication workers in Nigeria and similar low-resource settings.

REFERENCES

- Agbo, S. O., Tijani, K. N., Ogaugwu, C. E., Ajayi, O. A., Oyewumi, J. O., Raji, M. F., & Nebo, U. C. (2021). Toxicity of Workplace Aluminum Particles: Insights from Earthworm (*Eisenia fetida*) Tests in Soil Mixtures. *Journal of Applied Sciences and Environmental Management*, 25(4), 683-687.
- Awosan, K. J., Makusidi, M. A., Ibrahim, M. T. O., Suleiman, A., Magaji, T. G., & Mbatifuh, F. G. (2017). Knowledge and safety practices related to exposure to physical and chemical hazards among welders in Sokoto, Nigeria. *Asian Journal of Medicine and Health*, 9(1), 1-11.
- Bentum, L., Brobbey, L. K., Adjei, R. O., & Osei-Tutu, P. (2022). Awareness of occupational hazards, and attitudes and practices towards the use of personal protective equipment among informal woodworkers: the case of the Sokoban Wood Village in Ghana. *International Journal of Occupational Safety and Ergonomics*, 28(3), 1690-1698.
- Beyene Gebrezgiabher, B., Tetemke, D., & Yetum, T. (2019). Awareness of Occupational Hazards and Utilization of Safety Measures among Welders in Aksum and Adwa Towns, Tigray Region, Ethiopia, 2013. *Journal of environmental and public health*, 2019, 4174085. <https://doi.org/10.1155/2019/4174085>
- Budhathoki, S. S., Singh, S. B., Niraula, S. R., & Pokharel, P. K. (2016). Morbidity patterns among the welders of eastern Nepal: a cross-sectional study. *Annals of occupational and environmental medicine*, 28, 62. <https://doi.org/10.1186/s40557-016-0151-y>.
- Díaz-Carrión, R., Navajas-Romero, V., & Casas-Rosal, J. C. (2020). Comparing working conditions and job satisfaction in hospitality workers across Europe. *International Journal of Hospitality Management*, 90, 102631.
- Donoghue, A. M., Frisch, N., & Olney, D. (2014). Bauxite mining and alumina refining: process description and occupational health risks. *Journal of occupational and environmental medicine*, 56(5 Suppl), S12.
- Esu, E., & Ekanem, U. (2021). Awareness and utilization of personal protective equipment among small-scale welders in Cross River state, Nigeria: a descriptive cross-sectional study: awareness and utilization of PPE among welders. *Babcock University Medical Journal*, 4(1), 1-7.
- Hassan, S. M., Nasir, U., Anwar, K., & Talib, U. (2017). An assessment of the level of awareness and reported complaints regarding occupational health hazards and the utilization of personal protective equipments among the welders of Lahore, Pakistan. *International journal of occupational and environmental health*, 23(2), 98–109. <https://doi.org/10.1080/10773525.2018.1426259>
- Kumar, S. G., & Dharanipriya, A. (2014). Prevalence and pattern of occupational injuries at workplace among welders in coastal south India. *Indian journal of occupational and environmental medicine*, 18(3), 135–139. <https://doi.org/10.4103/0019-5278.146911>
- Kumar, S. G., Dharanipriya, A., & Kar, S. S. (2013). Awareness of occupational injuries and utilization of safety measures among welders in coastal South India. *The international journal of occupational and environmental medicine*, 4(4), 172–177.
- Mazzoli-Rocha, F., Dos Santos, A. N., Fernandes, S., Ferreira Normando, V. M., Malm, O., Nascimento Saldiva, P. H., ... & Zin, W. A. (2010). Pulmonary function and histological impairment in mice after acute exposure to aluminum dust. *Inhalation toxicology*, 22(10), 861-867.
- Nalugya, A., Kiguli, J., Wafula, S. T., Nuwematsiko, R., Mugambe, R. K., Oputan, P., Tigaiza, A., Isunju, J. B., & Ssekamatte, T. (2022). Knowledge, attitude and practices related to the use of personal protective equipment among welders in small-scale metal workshops in Nansana

- Municipality, Wakiso District, Uganda. *Health psychology and behavioral medicine*, 10(1), 731–747. <https://doi.org/10.1080/21642850.2022.2106987>.
- Ohio, C. G., Berg, P., Bryngelsson, I. L., Elihn, K., Ngo, Y., Westberg, H., & Sjögren, B. (2010). Inflammatory markers and exposure to occupational air pollutants. *Inhalation toxicology*, 22(13), 1083-1090.
- Osagiede, E. F., Ilokor, O. K., Ehimen, F. A., Airefetalor, I. A., Otaigbe, O. I., & Abah, S. O. (2020). Assessment of Awareness of Occupational Health Problems, and the Practices of Safety Measures among Welders in a Semi-Urban Town in South-South Nigeria. *Western Journal of Medical and Biomedical Sciences*, 1(2), 139-149.
- Sabitu, K., Iliyasu, Z., & Dauda, M. M. (2009). Awareness of occupational hazards and utilization of safety measures among welders in Kaduna metropolis, northern Nigeria. *Annals of African medicine*, 8(1), 46–51. <https://doi.org/10.4103/1596-3519.55764>.
- Shaaban, L. H., Zayet, H. H., Aboufaddan, H. H., & Elghazally, S. A. (2016). Respiratory hazards: clinical and functional assessment in aluminum industry workers. *Egyptian Journal of Chest Diseases and Tuberculosis*, 65(2), 537-543.
- Sim, M., & Benke, G. (2003). World at work: hazards and controls in aluminium potrooms. *Occupational and Environmental Medicine*, 60(12), 989-992.
- Tadesse, S., Bezabih, K., Destaw, B., & Assefa, Y. (2016). Awareness of occupational hazards and associated factors among welders in Lideta Sub-City, Addis Ababa, Ethiopia. *Journal of occupational medicine and toxicology (London, England)*, 11, 15. <https://doi.org/10.1186/s12995-016-0105-x>.
- Wesdock, J. C., & Arnold, I. M. (2014). Occupational and environmental health in the aluminum industry: key points for health practitioners. *Journal of occupational and environmental medicine*, 56(5 Suppl), S5.