GPH-International Journal of Applied Science
(Online ISSN 3050-9653)
Volume 09 | Issue 04 | April 2026
Published by: Global Publication House
DOI: https://doi.org/10.5281/zenodo.20257713
Available online at: www.gphjournal.org
Journal homepage: https://gphjournal.org/index.php/as/index

PERCIEVED HEALTH IMPACT OF WELDING FUMES AMONG WORKERS IN THE FABRICATION FACILITIES IN PORT HARCOURT

OSUGBA, E[1]. UGBEBOR. J[2], & EJIKEME, U[3].
[1,2 and 3;] Center for Occupational Health, Safety and Environment, Institute of Petroleum Studies, University of Port Harcourt, Rivers State, Nigeria
Lead Authors Email. emmanuelosugba@gmail.com

Abstract

This study examined the perceived health impact of welding fumes among workers in the fabrication facilities in Port Harcourt. The objectives were to; examine the prevalence of workplace-related injuries associated with welding fume exposure among welders in a fabrication facility in Port Harcourt, examines prevailing safety practices and investigate preventive actions and control measures that should be taken to reduce the effects of these fumes on welder. Using cross-sectional descriptive survey design, structured questionnaire was administered to 300 welders selected from the sampled fabrication facilities. Descriptive statistics methods such as frequencies and percentages were used for data analysis. The results revealed that 66.7% (156) of the welders in the fabrication facility reported experiencing workplace injuries associated with welding fumes such that burns (139, 59.6%) and eye injuries (117, 50%) are the most common. Respiratory issues were reported by 34.6% (80) of the welders, while cuts and lacerations affected 29.5% (69) workers. Use of Personal Protection Equipment (PPEs) (96, 41.5%), ventilation systems (159, 68, 29.1%) and regular safety training (86, 36.8%) are safety practices adopted to prevent exposure to fumes while provision of PPEs (178, 76.1%) regular health check-ups (112, 47.9%) and use of local exhaust ventilation (156, 66.7%) are most common control measures adopted by fabrication facilities to reduce the effects of welding fumes. These findings highlight the high prevalence of work-related problems linked to welding fumes and the need to enforce occupational health and safety regulations aimed at reducing welding fume exposure, as well as encouragement and enforcement of the use of PPE, ventilation systems and proper safety training to mitigate the injuries among welders in fabrication industries in Port Harcourt.

Keywords:

Health Impact, Welding Fumes, Fabrication Facilities, Port Harcourt.

1.0 Introduction

According to the World Health Organization (WHO, 2016), health is not merely the absence of disease or infirmity but a state of complete physical, mental, and social well-being. In the case of welders, a range of risk factors can threaten their health, including the specific type of welding process, the materials used, workplace safety conditions, and the duration of exposure to harmful fumes. Each of these factors can affect a welder's health in different ways, and the cumulative effects of exposure can lead to long-term health problems (Achalu, 1999).

The impact of welding fumes on health can be both short-term and long-term. Short-term effects can include irritation of the eyes, nose, and respiratory tract, leading to symptoms such as coughing, wheezing, and difficulty breathing. These immediate reactions are often a result of exposure to metallic fumes, such as zinc, magnesium, copper, and their respective oxides. Long-term exposure, on the other hand, can lead to chronic respiratory conditions, including lung cancer, gastrointestinal cancer, and chronic obstructive pulmonary disease (COPD). Welders who have been exposed to these harmful substances over time may experience significant reductions in lung function, which can increase their susceptibility to pulmonary abnormalities (Antonini *et al*., 2003)

The accumulation of ultrafine particles from welding fumes in the alveoli of the lungs has also been a subject of concern. These particles are difficult for the body to eliminate, leading to chronic respiratory issues (Antonini *et al*., 2003). In addition to respiratory diseases, welding fumes have been linked to a variety of other conditions, including fever from metal fumes, siderosis, occupational asthma, pulmonary fibrosis, and pneumonia (Doherty *et al*., 2004; El-Zein *et al*., 2005; Koh *et al*., 2015; Cosgrove & Zschiesche, 2016). In fact, welding fumes were classified as hazardous to humans by the International Agency for Research on Cancer in 2017 (Guha *et al*., 2017).

To mitigate the risks associated with welding fumes, various control measures have been introduced, such as ventilation systems and personal protective equipment like respirators. When used correctly, these measures can significantly reduce a welder's exposure to harmful fumes. However, improper training and inadequate safety protocols can lead to excessive exposure, which defeats the purpose of these protective measures (Budhathoki *et al*., 2014). Regular workplace assessments and air monitoring are essential to ensure that safety standards are met and that workers are not exposed to harmful levels of fumes. While air monitoring can be time-consuming and costly, it is a critical aspect of maintaining a safe working environment (Popovi *et al*., 2014; Yi, 2015). Given the health risks associated with welding, it is vital for employers to take proactive steps to reduce exposure to harmful fumes and gases. A comprehensive understanding of welding fume constituents, combined with appropriate safety measures, is essential to protecting the health of workers and minimizing the occurrence of workplace illnesses. Proper training, workplace assessments, and the use of effective control mechanisms can help mitigate the dangers associated with welding and improve the overall well-being of welders.

Welding is a vital industrial activity, especially in cities like Port Harcourt, Nigeria, where fabrication services are central to economic operations. However, this occupation poses severe health impact due to the release of hazardous welding fumes during metalworking processes. These fumes are complex mixtures of gases and fine particles formed by vaporizing metals and compounds at high temperatures. (Thaon *et al*., 2012). Welders are particularly vulnerable due to the frequency and duration of their exposure. Inhalation of these fumes can result in acute symptoms such as eye irritation, headaches, nausea, and metallic taste, as well as more serious long-term conditions like chronic bronchitis, occupational asthma, reduced lung function, and even lung cancer (Antonini, 2003; Susi *et al*., 2000). Beyond the lungs, toxic particles can enter the circulatory system, affect other organs and potentially lead to systemic conditions.

In Port Harcourt, the problem is compounded by the absence of structured occupational health services, limited access to personal protective equipment (PPE), and poor enforcement of safety protocols. Most welders operate in informal sectors—around automobile markets, roadside mechanic shops, and small-scale fabrication facilities—where health regulations are either unknown or poorly implemented. The result is persistent overexposure to welding fumes with minimal health protection. Compounding this concern is the widespread lack of awareness among welders regarding the health implications of their work and the proper use of safety measures. Many continue to work without respirators, proper ventilation systems, or protective clothing, thereby heightening their risk of both short- and long-term illnesses. The problem is not limited to workers alone. Secondary exposure, or "take-home contamination," affects their families when toxic residues on clothing and equipment are inadvertently transported home (Antonini, 2003).

Scientific studies show that welding fumes contain multiple toxic components, including aluminium, cadmium, chromium, manganese, iron oxide, nickel, and zinc oxide, among others, which can accumulate in the human body over time and cause irreversible organ damage (Balkhyour & Goknil, 2010). Despite advancements in welding technology and safety innovations, many Nigerian welders remain exposed without adequate health risk mitigation measures. The issue has gained global attention as a public health concern, with international agencies recommending more stringent workplace controls. In Nigeria, however, enforcement remains weak, and welders continue to face significant risks. Studies have linked welding fumes to elevated rates of respiratory illnesses, particularly in areas with high concentrations of welders and poor regulatory oversight (Bakri *et al*., 2013). Given these conditions, there is a pressing need for detailed research to examine the health impact of welding fume on workers, and the safety practices in place to check and control the health problems. Understanding these dimensions is essential to formulating effective interventions that protect worker health, ensure compliance with safety standards, and promote occupational well-being in the welding industry. Hence, the aim of the study are; to Assess the prevalence of workplace-related injuries associated with welding fume exposure among welders in a fabrication facility in Port Harcourt, Assess the safety practices available for welders in the fabrication facility in Port Harcourt and Identify the preventive actions and control measures that should be taken to reduce the effects of these fumes on welder in the fabrication facilities in Port Harcourt

2.0 Methodology

2.1 Research Design

This study adopted cross-sectional descriptive research design. The decision to adopt this methodological approach was influenced by its ability to efficiently gather and summarize data on the health effects of welding fumes on workers within a specific timeframe. The descriptive survey design, as highlighted by Orodho (2012), is a simple and effective tool for collecting data, which allows the researcher to easily access and interpret information from a diverse group of individuals. This design is especially valuable when the aim is to gather detailed insights into people's opinions, perceptions, and behaviours, especially concerning a particular phenomenon under study.

In this context, the use of the descriptive survey design was deemed appropriate because it facilitates the collection of data on individuals' health-related experiences, the prevalence of workplace-related injuries associated with welding fume exposure among welders in a fabrication facility in Port Harcourt, safety practices available for welders in the fabrication facility in Port Harcourt and the preventive actions and control measures that should be taken to reduce the effects of these fumes on welder in the fabrication facilities in Port Harcourt. According to Orodho and Kombo (2002), this methodology enables the researcher to summarize data from a large group and interpret it for meaningful clarification, ensuring that the findings are reflective of the population being studied. The flexibility of this design makes it ideal for a study like this, which aims to capture a snapshot of health effects in a specific occupational setting, focusing on employees exposed to welding fumes.

Additionally, the cross-sectional descriptive design was chosen due to its alignment with the study's objective, which was to explore the prevalence and impact of welding fumes on workers' health at the time of the study. This type of design allows for the simultaneous collection of data from multiple participants, providing a comprehensive overview of the health risks associated with the exposure to welding fumes. According to Fajonyomi (2003), surveys are particularly beneficial for explanatory, exploratory, and descriptive purposes, making the descriptive survey an ideal tool for this research. The approach ensures that the study's findings accurately reflect the current health challenges faced by employees working in the fabrication plant.

Moreover, this study provides an opportunity to characterize the phenomenon under investigation - welding fumes and their health effects - as it occurs in real-time, allowing the researcher to examine how these hazards manifest in the workplace and affect workers' health in a concurrent and descriptive manner. Through this methodological choice, the study captures a comprehensive understanding of the current state of occupational health in the fabrication industry, focusing on the immediate impact of welding fume exposure on workers' well-being.

2.2 Study Area

The study area, Port Harcourt, is the capital of Rivers State and is in Nigeria's Niger Delta (as shown in Figure 1). Known for its strategic importance, Port Harcourt is home to Nigeria's second-largest seaport, making it a vital hub for maritime trade and the oil and gas industry. Situated on the Bonny River, the city is approximately forty miles (64 km) away from the Atlantic Ocean, making it ideally positioned for international trade and logistics.

Port Harcourt lies within geographical coordinates of longitude 6°41'S–7°11'E and latitude 4°0'N–5°0'N. This positioning places it in the southernmost region of Nigeria, contributing to its tropical climate and rich wetlands. The city is thought to cover an area of about 1,811.6 square kilometres, providing ample space for its rapidly growing population and expanding urban and industrial activities. Despite Port Harcourt's relatively low elevation, the surface morphologies and the evolution of its drainage system are not significantly shaped by structural geological controls. Instead, they are more influenced by the tropical environment, heavy rainfall, and the riverine nature of the area. The city's growth has been shaped by its proximity to waterways, facilitating transportation, trade, and the extraction of natural resources.

As the economic and administrative centre of Rivers State, Port Harcourt is the focal point for the region's business, industrial, and political activities. The city plays a crucial role in Nigeria's oil and gas sector, housing several oil companies and refining plants. It is often referred to as the "treasure base of the nation" due to its importance in Nigeria's economy, particularly in the context of the petroleum industry. Port Harcourt's rapid growth and development have also led to significant urbanization and industrialization, contributing to both the economic vibrancy and the environmental challenges of the region. In summary, Port Harcourt's geographical and economic significance makes it an ideal focal point for the study of occupational health hazards, particularly those associated with industries such as welding, oil refining, and manufacturing. The city's centrality in Nigeria's industrial landscape underscores the relevance of understanding the health impacts on its workforce, especially in sectors with significant exposure to hazardous substances

Figure 1: Map of Port Harcourt in Rivers State showing the Study Area
(*Source*: Britannica. "Port Harcourt, Nigeria." 2025.)

2.3 Population of the Study

In this study, the target population comprised employees at the Port Harcourt fabrication facility, encompassing those directly involved in welding and metal assembly, as well as supervisory and support staff. This figure aligns with the workforce size of comparable local fabricators, for example, Daiik Engineering Limited reports 201–500 employees on LinkedIn, ensuring our sample reflects the typical scale of such industrial operations in Port Harcourt. These individuals carried out roles ranging from hands-on welding and cutting to equipment maintenance, safety supervision, and administrative functions. Their varied socio-demographic profiles, professional experience levels, and job responsibilities provided a comprehensive view of occupational exposures. By focusing on this well-defined population, the study aimed to capture the full spectrum of welding-related health risks and safety practices within a major fabrication hub in Port Harcourt's industrial landscape.

2.4 Sampling Techniques and sample size determination

In this study, respondents who matched the target population criteria within the study area were carefully selected to ensure that the findings would be relevant and representative of the larger group. These respondents, drawn from the Port Harcourt fabrication site, provided critical data to the researcher, enabling the formulation of conclusions about welding-related health risks within this industrial setting. In this study, Cochran's formula was used to calculate a base sample size n_0 that would yield a 95 % confidence level and a 5 % margin of error, assuming 75 % of workers exhibit the attribute of interest (e.g., prior fume-related symptoms):

$$n_0 = \frac{z^2 \cdot p \cdot (1-p)}{e^2}$$ (3.1)

Where, n_o = initial sample size estimate; z = z-score, p = estimated proportion of the population, q = 1 - p, and e = margin of error.\\

To ensure enough completed questionnaires for robust analysis, we added a 10 % nonresponse buffer, common practice in industrial surveys, to the 288 calculated questionnaires, bringing the total distributed to 317. In the field, we retrieved 300 usable returns, yielding a 94.6 % response rate, well above the 80 % reliability benchmark. Because our interest lay specifically in those with direct welding-fume exposure, we employed purposive sampling, selecting participants who met explicit inclusion criteria: they had to be employed at the Port Harcourt fabrication site for at least six months (to ensure sufficient exposure history), actively perform welding or allied tasks (including arc welding, gas metal arc welding, metal cutting, or fume-extraction operations), or serve as supervisory or maintenance staff who regularly enter welding zones (to capture varied exposure profiles). We excluded administrative personnel with no direct or indirect welding-area contact, short-term contractors or trainees employed for less than six months (to avoid transient exposure effects), and any individuals who declined to consent, in keeping with ethical standards. This targeted approach ensured our sample closely reflected the true welding-exposed workforce, capturing the full spectrum of occupational roles, from hands-on welders to supervisors overseeing safety practices. By distributing 300 questionnaires to these carefully screened individuals, we balanced statistical rigor with logistical feasibility, yielding a data set both large enough for meaningful generalization and focused enough to illuminate the specific health impacts of welding-fume exposure in Port Harcourt's fabrication sector.

2.5 Sources of Data

This study used primary data, Primary data were collected using structured and semi-structured questionnaires distributed to welders at a fabrication site in Port Harcourt, Nigeria. This approach allowed for the collection of specific, contextually relevant data that aligned with the research objectives. However, a pilot test of the questionnaire was not conducted, which is acknowledged as a limitation of the study. A pilot test could have helped to validate the clarity and reliability of the questions and ensured that the instrument captured the necessary data effectively. The absence of a pilot test introduces potential risks related to the comprehensibility and accuracy of responses, which should be addressed in future research.

2.6 Method and Instrument of Data Collection

In this study, a questionnaire was used as the primary data collection tool. According to Kothari (2004), a questionnaire is a structured set of questions designed to collect data from respondents. This method requires participants to answer questions on their own, and the responses are subsequently submitted back to the researcher for analysis. The questionnaire was particularly suited for this study because it allowed the researcher to collect a wide range of information from a relatively large number of respondents in an organized manner.

The questionnaire used in this study comprised both structured and semi-structured questions. The structured questions provided predefined options for the respondents, making it easier to quantify and analyse the data. Meanwhile, the semi-structured questions allowed the respondents to offer more detailed responses, enabling the researcher to capture more nuanced information that was not confined to a set of predefined options. By combining both types of questions, the questionnaire was able to strike a balance between standardization and the flexibility needed to explore specific aspects of the study in more depth. The design of the questionnaire was directly informed by the research questions and the objectives of the study.

The first section of the questionnaire gathered demographic information about the respondents, such as their age, gender, years of experience in welding, and educational background. This allowed for a better understanding of the profile of the welders and to identify any demographic factors that could influence their exposure to welding fumes and other occupational hazards. The subsequent sections of the questionnaire focused on the specific issues related to the health risks of welding, such as welding techniques used, types of hazards encountered, and the use of personal protective equipment (PPE). These sections were designed to gather detailed information about the welders' daily work practices and their perceptions of the risks associated with their work environment. The questions were crafted in a way that encouraged the respondents to provide honest and relevant responses, which were crucial for achieving the objectives of the study. To collect the data, a total of 300 copies of the questionnaire were administered to welders working at the fabrication factory in Port Harcourt, Nigeria.

The copies of the questionnaire were hand delivered to ensure that they were handed directly to the intended respondents. This allowed for a better explanation of the purpose of the study and answer any questions the welders might have had about the process. Once the respondents completed the questionnaire, a scheduled pickup time to collect the responses was arranged. This ensured that the data collection process was efficient and that all respondents had the opportunity to complete the questionnaire at their convenience. In addition to the physical collection of the completed questionnaires, some respondents chose to email in a scanned copy of their responses. This method was particularly useful for those who had limited access to the study area or preferred a digital format. This flexibility in submission methods helped ensure a higher response rate and allowed for gathering of data from a broader group of welders, even if they were not physically present at the fabrication factory during the data collection period. Overall, the use of a questionnaire in this study allowed for systematic gathering of relevant data from many respondents in a structured yet flexible manner. This method proved effective in addressing the research questions and provided valuable insights into the health risks faced by welders in the Port Harcourt fabrication factory

2.7 Method of Data Analysis

In this study, quantitative analysis was conducted using a combination of frequencies, percentages, and means to examine the data collected from the completed questionnaire. The data analysis process began with coding the responses from each questionnaire. Coding involves assigning numerical values to the answers provided by the participants, allowing for efficient processing and analysis of the data. Once the data was coded, descriptive statistics were applied to generate frequencies and percentages. Descriptive statistics are valuable tools for summarizing large amounts of data and providing an overview of the trends and patterns. The frequencies represent how often certain responses or categories appeared in the dataset, while the percentages show the proportion of respondents who selected answers relative to the total number of respondents. This helped in identifying the distribution of responses to specific questions related to the health effects of welding fumes and other factors explored in the study.

The study utilized tables and charts to present the results in a clear and organized manner. These visual tools made it easier to interpret the data and identify patterns. For example, bar charts and pie charts were used to illustrate the distribution of responses, making complex data more accessible and helping to highlight key findings. The analysis was carried out using the Statistical Package for Social Sciences (SPSS) specifically to answer research question 2, 3, 4 and 5 which involves descriptive analysis that includes percentages and frequencies and for the development of bar and pie charts for clear data presentation. The use of SPSS ensured that the data analysis was both efficient and reliable, providing accurate results that were crucial for addressing the study's research questions.

In summary, the study employed robust quantitative analysis techniques using descriptive statistics, data coding, and visual representations to process the information gathered from the questionnaires. By setting clear criteria for data inclusion and employing SPSS for analysis, we were able to produce reliable, comprehensible results that shed light on the health risks and safety concerns experienced by welders in the Port Harcourt fabrication industry.

3.0 Results and Discussions

3.1 Sociodemographic Characteristics of Respondents

Table 1 showed the summary of the sociodemographic characteristic of the study respondents in the power sectors. On age distribution of welder in Port Harcourt., the results showed that majority of the welders 95 (40.60%) were between age 26-35, followed by welders who are between age 18 to 25 who are 55 (23.50%) while the least are welders of over 40 years old who are just 40 covering (17.09%). This result on age distribution shows that most of the welders in Port Harcourt are young adults. The distribution of the welders based on their gender revealed that all the welders 234 (100%) were males and there are no female welders in the study areas. This results on distribution of welders in the study area based on their gender revealed that the welding is a male dominated profession. On educational qualification, the results revealed that majority of sampled welders have O-level certificate 167, (71.37%), followed by people without any form of formal educations 51, (21.80%) and while the least are people with first degree. 16 (6.83%). This result showed that most of the welders are not highly learned. On years of experience, the results revealed that majority of the welders have 6 to 10 years of experience in welding operation 95 (40.60%) followed by welders who have 0 to 5 years of experience 55, (23.50%) and those with under 11 to 15 years of experience 51, (21.80%) while the least are welders who have 0ver 15 years of experience. 33, (14.10%). The results suggest that most of the sampled welders in welding work have substantial number of years of working experience in the welding work. Lastly, marital status, the results revealed that most of the welders are married 179, (76.50%), 47 (20.09%) welders are single while only 8 (3.41%) welders were divorced

Table 1 Summary of sociodemographic characteristic of the respondents in the Nigerian Power Sector

Socio Demographics	Range	Frequency (n=234)	Percentage (%)
	18 – 25	55	23.50
Age	26 – 35	95	40.60
	36- 45	44	18.81
	above 45	40	17.09

Gender	Male	234	100
	Female	0	0.00
Educational Qualification	First Degree	16	6.83
	O-level	167	71.37
	None	51	21.80
	0-5	55	23.50
Years of Experience	6-10	95	40.60
	11-15	51	21.80
	Above 15	33	14.10
	Married	179	76.50
Marital Status	Single	47	20.09
	Divorced	8	3.41

3.2 The prevalence of workplace-related injuries associated with welding fume exposure among welders in a fabrication facility in Port Harcourt

The first objective of the study was centered on investigating the Prevalence of workplace-related injuries associated with welding fume exposure among welders in a fabrication facility in Port Harcourt. Three question items were posed to obtain the response of the sampled welders in Port Harcourts on the prevalence of workplace-related injuries associated with welding fume exposure among welders in a fabrication facility in Port Harcourt. The question items are related to experience of injuries linked to welding fumes, types of injuries associated with welding fumes and level of occurrence or frequencies of injuries linked to welding fumes.

Figures 2, 3 and 4 show the descriptive analysis results on the response of the study respondents with regards to the three question items posed on prevalence of workplace-related injuries associated with welding fume exposure among welders in a fabrication facility in Port Harcourt. It was found that 66.7% of the welders in the fabrication facility reported experiencing workplace injuries associated with welding fumes, with burns (59.6%) and eye injuries (50%) being the most common. Respiratory issues were reported by 34.6% of the welders, while cuts and lacerations affected 29.5%. The frequency of these injuries varied, with a significant number of respondents experiencing injuries rarely (41.7%) or occasionally (28.8%). The high prevalence of work-related injuries associated with exposure to welding fumes among welder could be attributed to poor knowledge of safety practices among the welder and unavailable or not using proper PPEs.

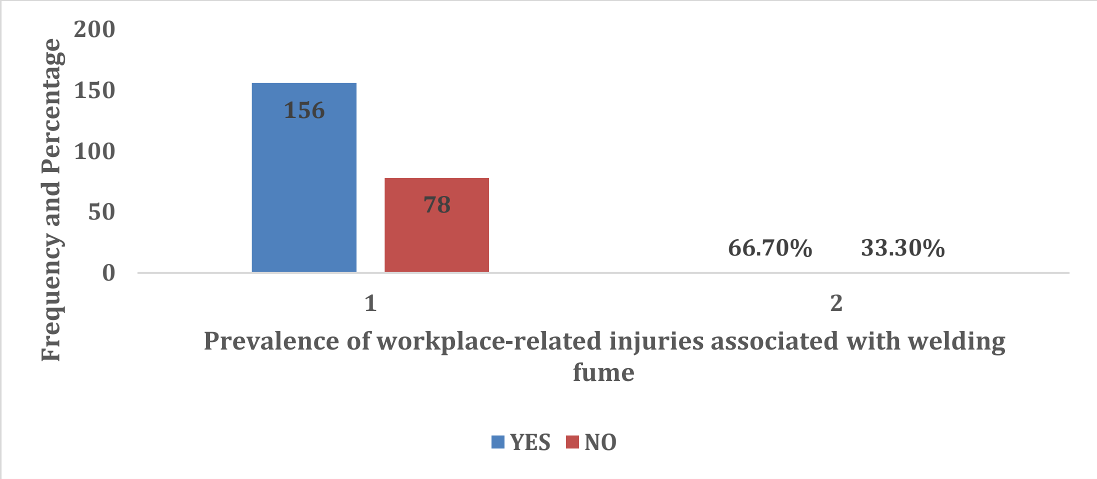

Figure 2 Responses on welder who experience injuries associated with exposure to welding fumes

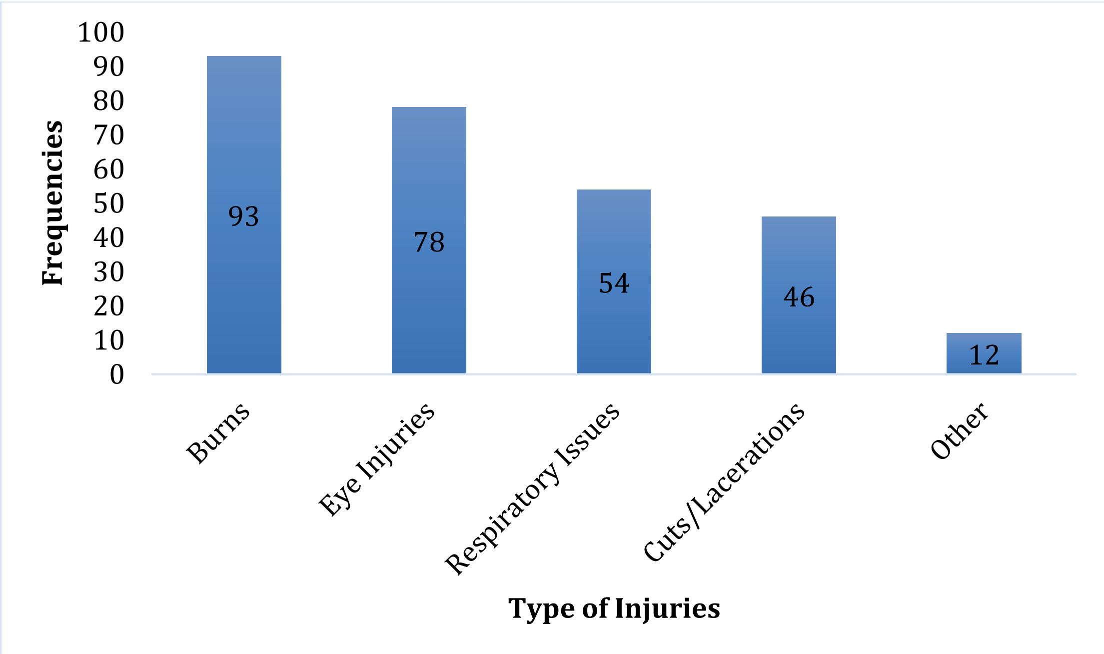

Figure 3. Types of Injuries among welders who experienced injuries associated with exposure to welding fumes

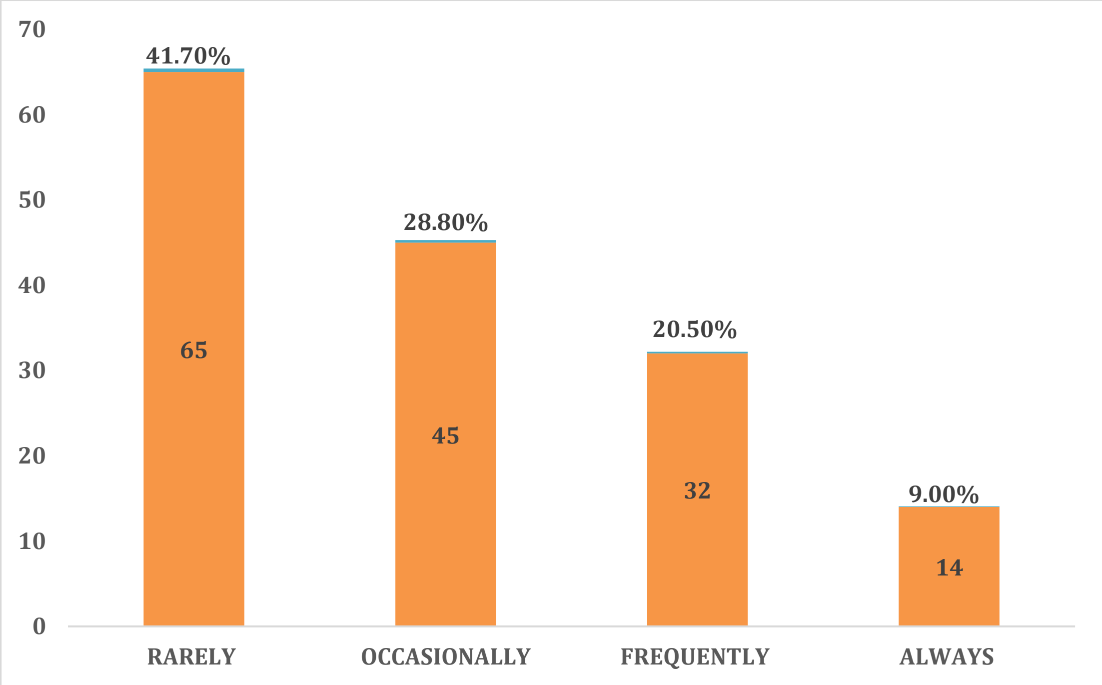

Figure 4. Frequencies of injuries occurrence among the sampled welders in Port Harcourt

The finding reported in the current study aligns with findings from other studies that highlight the possible work-related injuries common during welding operations. According to a study by Work Safe BC (2017), welders are at high risk of burns, eye injuries, and respiratory problems due to exposure to high temperatures, ultraviolet radiation, and toxic fumes. Burns are particularly common due to the direct exposure to hot metal and sparks, while eye injuries often result from inadequate protection against arc flashes (American Welding Society, 2020). Respiratory problems reported in this study among welders have also been documented in several studies. Meo and Al-Drees (2005) reported that welders exposed to metal fumes are at an increased risk of developing chronic respiratory issues, including bronchitis and decreased lung function. They also reported a significant association between long-term exposure to welding fumes and chronic respiratory conditions like bronchitis and reduced lung function. The recurring nature of these injuries highlights the urgent need for stronger preventive strategies and consistent use of protective equipment These findings are consistent with the 34.6% of welders in this study who reported respiratory issues. These findings also align with the report of Work Safe BC (2017) who stated that welders are among the occupations most vulnerable to physical injuries due to direct contact with hot metal, arc radiation, and fume exposure. The American Welding Society (2020) also emphasized the high prevalence of eye injuries and burns, often resulting from insufficient protective measures such as poorly maintained PPE.

Similar outcome was reported in a 2016 study by Simiyu and Cholo in the Kamukunji informal sector of Nairobi, Kenya, it was found that approximately 92% of welders had suffered some form of injury while working, with cuts being the most common type of injury, affecting 74.8% of the workers (Simiyu & Cholo, 2017). These injuries, though sometimes minor, can lead to more severe consequences if not treated properly. In addition to cuts, welders are also at risk of more serious injuries, such as burns, eye damage from the intense light produced by welding, and long-term respiratory issues from inhaling metal fumes.

3.3 Safety practices available to welders in the fabrication facility in Port Harcourt

In this study, four question items were presented to obtain the response of the sampled welders in Port Harcourts on the safety practices available for welder in the fabrication facility in Port Harcourt. The question Items include frequency of usage of Personal Protection Equipment (PPE), the PPE equipment that is commonly used, frequency of usage of ventilation systems, in the facility and frequency of safety training regarding welding fumes.

Figure 5, 6, 7 and 8 show the descriptive analysis results on the response of the sampled welders with regards to the four question items presented on safety practices available for welder in the fabrication facility in Port Harcourt, and the results revealed that 97 (41.5%) of the welders reported to always use their PPE as safety practice against exposure to welding fumes, 78 (33.3%) often used their PPE as safety practice, 41 (17.5%) sometimes uses their PPEs, 12 (5.1%) rarely uses their PPEs while only 6 (2.6%) never uses their PPEs as safety practices measures to against exposure to welding fumes. The results on the type of PPE commonly available and used by welders as safety practices against exposure to welding fumes revealed that welding helmet (201, 85.90%) and Gloves (178, 76.10%) are two most common PPE available and used by welders in fabrication facilities in Port Harcourt followed Protective Clothing: (167, 71.40%) and Safety Goggle (156, 66.70%) while Ear Protection (112, 47.90%) and other safety gadgets are the least PPE available and used by welders in fabrication facilities in Port Harcourt. The results on availability and use of ventilation systems in fabrication facilities in Port Harcourt revealed that majority of the fabrication facilities often (89, 38.0%) and always (68, 29.1%) have ventilation system available and in use while only few fabrication facilities rarely (23 9.8%) and never (9, 3.8%) have their ventilation system available and in use. Results on regularity of safety training regarding welding fumes among welder in fabrication facilities in Port Harcourt revealed that majority of the sampled welders agreed that theire is regular safety training on welding fumes among welder in fabrication facilities in Port Harcourt (97, 41.5%), 86 (36.8%) workers reported that they occasionally have safety traning on welding fumes, 34 (14.5%) reported that safety training on welding fumes are rare while 17 (7.3%) reported that they have never undergone any safety training on welding fumes.

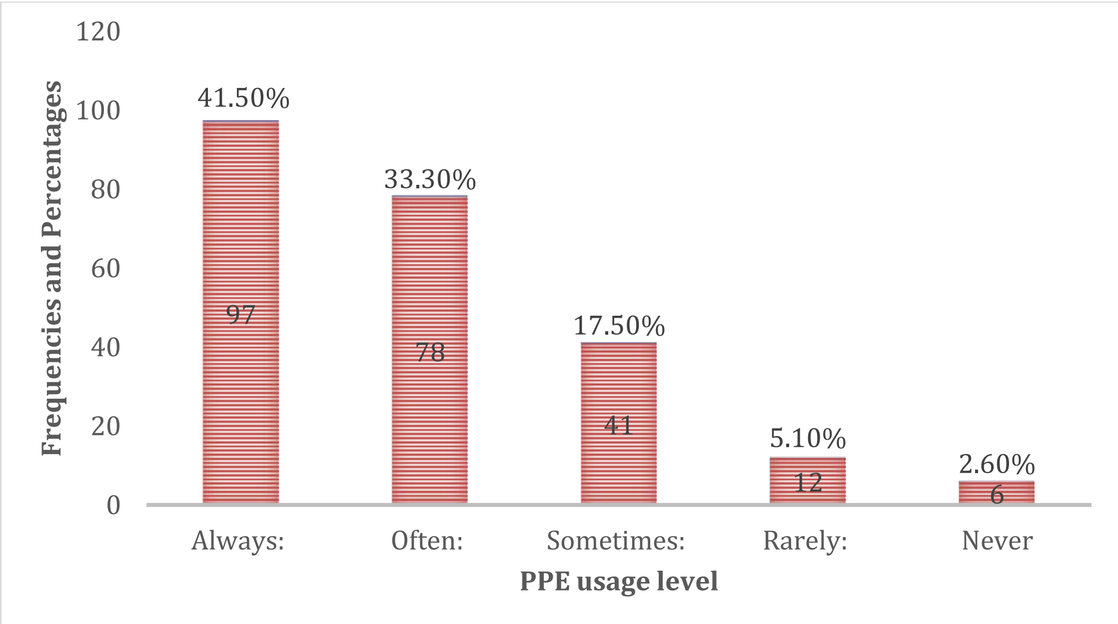

Figure 5. Frequency of usage of Personal Protection Equipment (PPE) as safety practices against exposure to welding fumes

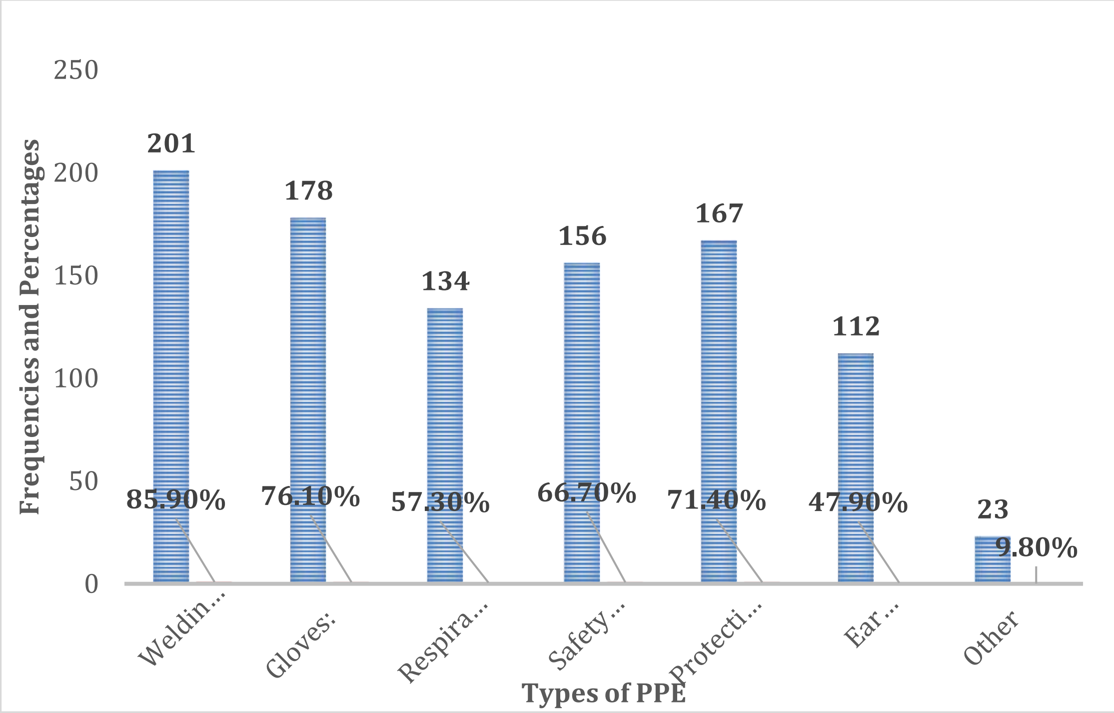

Figure 6. Type of PPE commonly available and used by welders as safety practices against exposure to welding fumes.

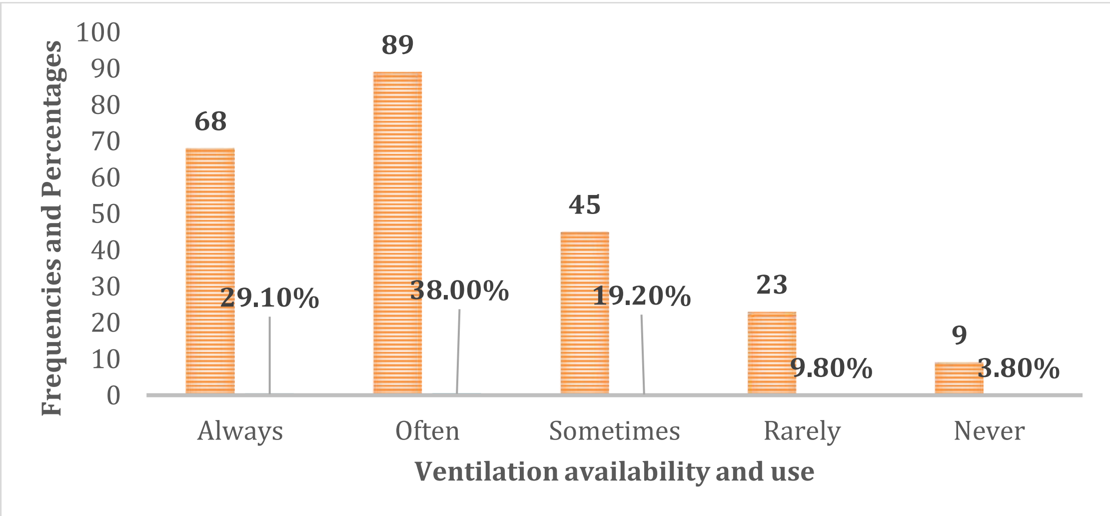

Figure 7. Availability and use of ventilation systems in fabrication facilities in Port Harcourt

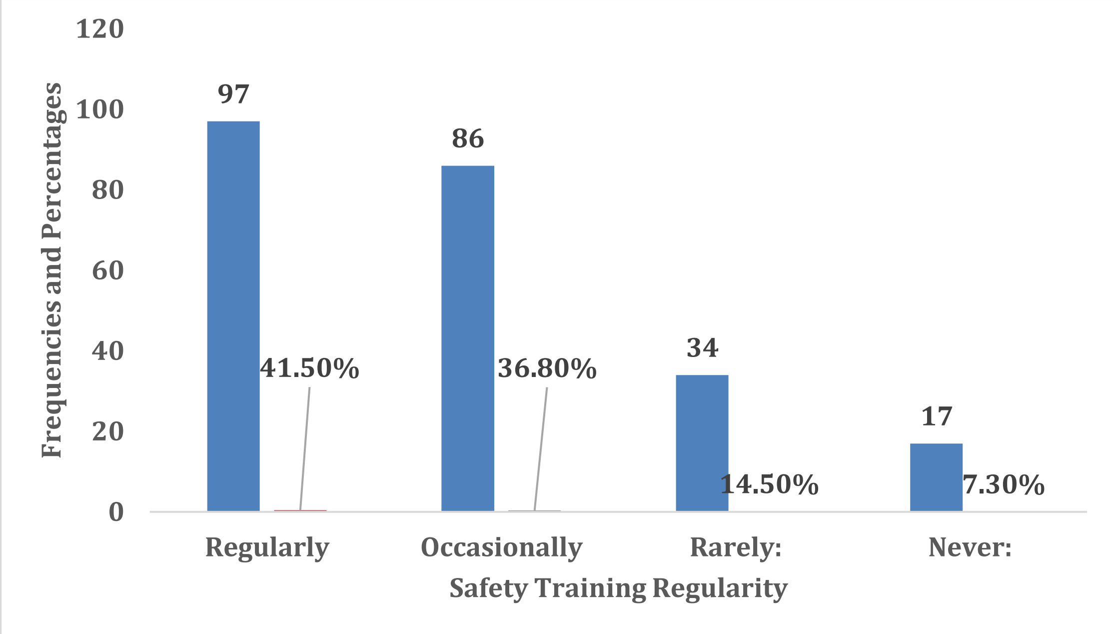

Figure 8. Regularity of safety training regarding welding fumes among welder in fabrication facilities in Port Harcourt

The widespread use of helmets and gloves reported in this study is consistent with recommendations from safety guidelines, such as those provided by the Occupational Safety and Health Administration (OSHA), which emphasize the importance of PPE in protecting welders from burns, eye injuries, and inhalation of toxic fumes (OSHA, 2020). However, the lower usage rates of ventilation systems (29.1%) is concerning because ventilation systems are critical in controlling fume circulation and other contaminants in the workplace, yet their low level of usage increase welders' exposure to harmful fumes. This finding is supported by a study conducted by Flynn and Susi (2009), which highlighted that inadequate ventilation is a significant factor contributing to respiratory health problems among welders. The gap in regular safety training (reported by only 41.5% of respondents) is also a critical issue. According to a study by Susi et al (2000), ongoing safety training is essential in reinforcing the importance of using PPE and adhering to safety protocols. Without regular training, welders may become complacent or unaware of the latest safety standards, increasing the risk of accidents and health issues.

Contrary report was reported in study by Simiyu and Cholo (2017) who found that around 41% of welders were unwilling to use personal protective equipment (PPE), despite the clear risks they face from exposure to hazardous welding fumes, UV radiation, and other dangers. This reluctance to adopt safety measures, combined with the lack of education and awareness about the potential health effects, underscores the need for more comprehensive training and regulation in the informal sector.

3.4 Preventive actions and control measures that should be taken to reduce the effects of welding fumes on welders in the Fabrication Facility in Port Harcourt

The last objective of the study is based on identifying preventive actions and control measures that should be taken to reduce the effects of welding fumes on welders in the Fabrication Facility in Port Harcourt. Three question items were presented to ascertain the opinion of the sampled welders in Port Harcourts on the preventive actions and control measures that should be taken to reduce the effects of welding fumes on welders in the Fabrication Facility in Port Harcourt. The question items include questions on current control measures used by fabrication facilities to reduce the effects of welding fumes among welders, the perceived effectiveness of the control measures adopted by the fabrication facilities in reducing the effects of welding fumes among welders and suggestion of welder on addition control measure that could be adopted to reduce the effects of welding fumes on the welders.

Figures 9, 10 and 11 show the descriptive analysis results on the response of the sampled welders with regards to the three question items presented on the preventive control measures that should be adopted to reduce the effects of welding fumes on welders in the fabrication facility in Port Harcourt. The study identified several control measures in place, including local exhaust ventilation (66.7%) and the provision of PPE (76.1%). However, only 23.1% of respondents found these measures to be very effective, and a significant number (24.8%) rated them as somewhat effective. The respondents suggested additional measures, such as increased availability and enforcement of PPE (38.0%), more frequent safety training (28.6%), and improved ventilation systems (23.9%). The use of local exhaust ventilation is a widely recommended control measure to reduce welders' exposure to hazardous fumes.

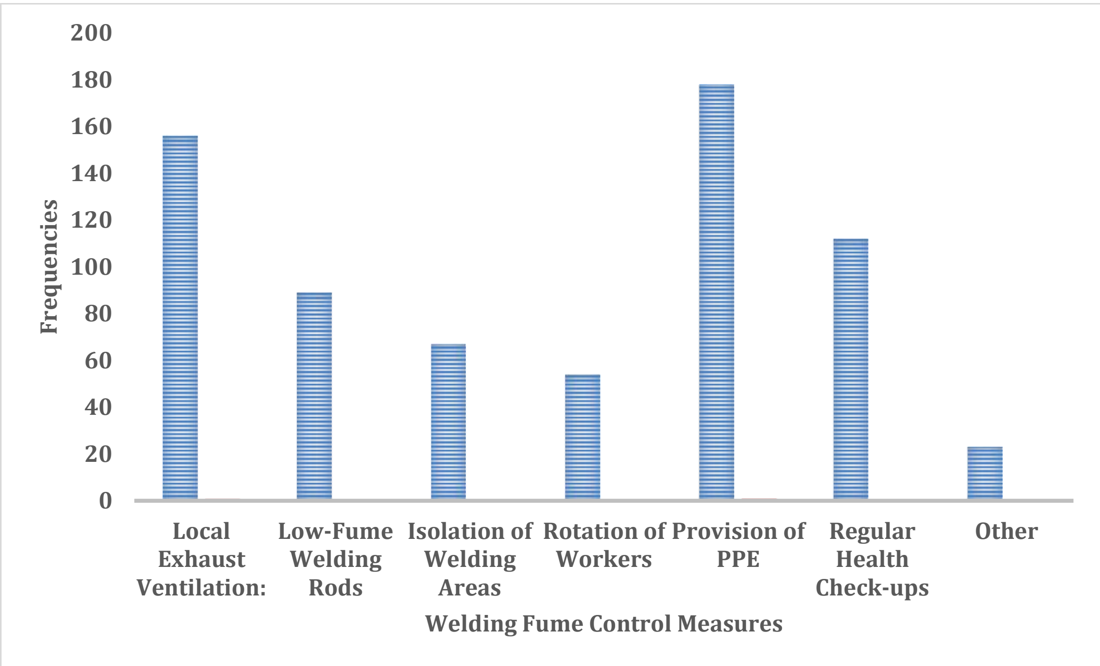

Figure 9. Current control measures used by fabrication facilities to reduce the effects of welding fumes on welders

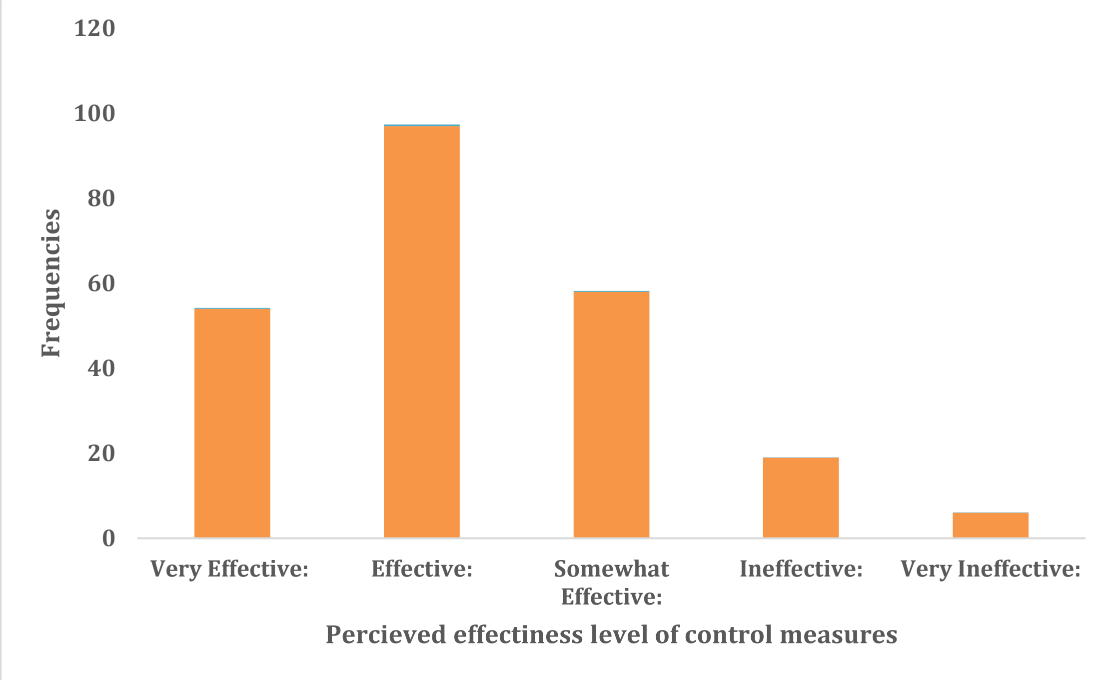

Figure 10 Perceived effectiveness of the control measures adopted by the fabrication facilities in reducing the effects of welding fumes on welders.

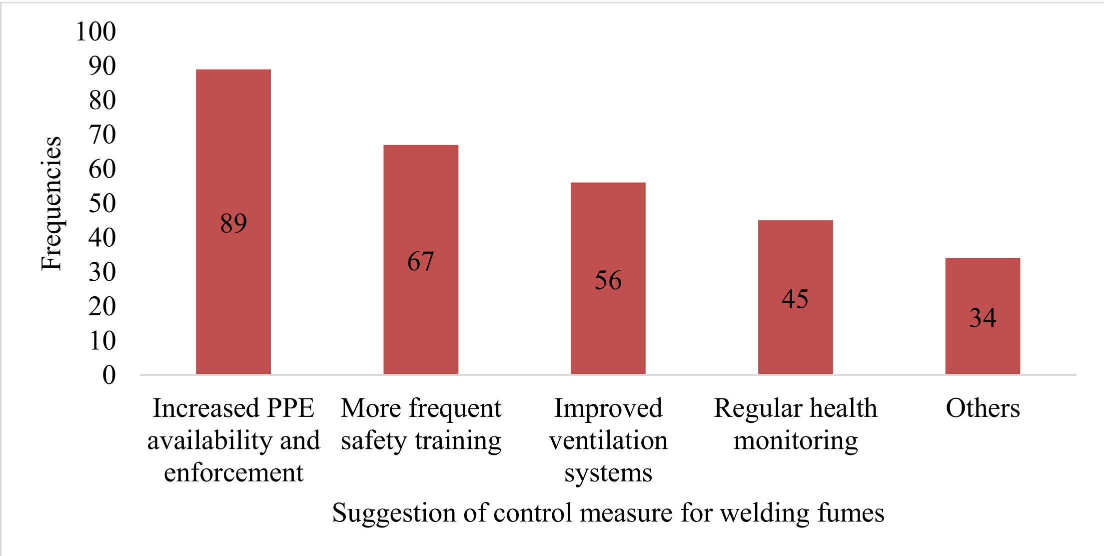

Figure 11. Suggestion of welder on addition control measure that could be adopted to reduce the effects of welding fumes on the welders in Port Harcourt.

These finding implied that local exhaust ventilation and the provision of PPE are the most common preventive actions and control measures that should be taken to reduce the effects of welding fumes on welders in the fabrication facility in Port Harcourt and these prevention action and control measures somewhat ineffective. Thus, the welders suggested that increased availability and enforcement of PPE, more frequent safety training and improved ventilation systems should be adopted as addition measure to prevent effect of welding fumes. The finding aligned with the work Tandon *et al*. (2002) who reported that effective ventilation systems can significantly reduce the concentration of welding fumes and other contaminants in workplace, thereby protecting workers from respiratory illnesses. Also, Flynn and Susi, (2009) reported that perception of effectiveness is crucial, because workers are more likely to adhere to safety measures if they believe them to be effective

The study's findings that many welders feel that current control measures are only somewhat effective is supported by report of Susi et al., (2000) who pointed out that mere presence of safety measures is not sufficient; these measures must be adequately maintained, enforced, and supplemented with regular training. The suggestion for increased PPE availability and enforcement reflects concerns highlighted in other studies that identify non-compliance with PPE usage as a major barrier to worker safety (OSHA, 2020). Moreover, the recommendation for more frequent safety training underscores the importance of continuous education in fostering a safety culture. Studies have shown that regular safety training can lead to better compliance with safety practices and a reduction in workplace injuries (Quinn *et al*., 2005).

The findings from this study have several critical implications for workplace safety management in the fabrication facility and similar environments; one, the high prevalence of workplace injuries despite significant awareness of the risks indicates that current safety measures are inadequate. This necessitates an immediate review of existing safety protocols. Enhancing safety measures could involve: ensuring that all welders have access to appropriate PPE and enforcing strict usage policies. Regular checks and penalties for non-compliance might be necessary to ensure adherence. Given that only a minority of welders consistently use ventilation systems, there may be a need to upgrade or install more efficient local exhaust ventilation systems. These systems should be easy to use and should not impede the welding process, as this could discourage their use. Workstations should be designed to minimize exposure to hazardous fumes and prevent injuries. This might involve reconfiguring the layout to reduce the risk of burns and other injuries.

The gap between knowledge and practice suggests that ongoing safety education is essential. The study implies that safety training should not be a one-time event but rather a continuous process Regular Safety Training Session should be conducted frequently, with updates on the latest safety standards, potential risks, and the proper use of PPE and ventilation systems. Interactive and practical training sessions could be more effective in changing behaviours. Safety practices should be integrated into daily work routines through reminders, toolbox talks, and on-the-job training. Safety should become a core part of the workplace culture, rather than something that is only considered during formal training sessions.

The findings suggest that safety might not be fully embedded in the workplace culture. To address this, management must demonstrate a strong commitment to safety by prioritizing it in decision-making, investing in safety infrastructure, and leading by example. Visible leadership in safety can significantly influence worker behaviours. Regular safety audits and the establishment of feedback mechanisms where workers can report safety concerns without fear of reprisal could improve compliance. This participatory approach can help identify and address safety issues more effectively. Implementing regular health monitoring programs can help in early detection of health issues related to welding fumes. These programs should be part of a broader occupational health strategy that includes preventive care and wellness programs. The study's findings could inform policy at both the organizational and regulatory levels. Regulators may need to review and update safety standards specific to welding, ensuring that they reflect the latest research on health risks and mitigation strategies. This could involve stricter regulations on PPE use and ventilation requirements. The findings could also prompt industry-wide safety initiatives, where best practices are shared across facilities to improve overall safety standards. Collaboration between industry players could lead to the development of more effective safety technologies and training programs.

The findings of this study underscore the significant health risks that welders face due to exposure to welding fumes and the importance of robust safety practices. While there is a high level of awareness of these risks, the persistent prevalence of workplace injuries and inconsistent use of safety measures highlight critical gaps in current practices. Addressing these gaps through enhanced safety measures, continuous education, stronger safety culture, and policy reforms can lead to a safer working environment for welders. Ultimately, the success of these efforts will depend on the commitment of both management and workers to prioritize safety as a core value in the workplace. By taking these steps, the fabrication facility in Port Harcourt, and similar environments, can better protect workers and reduce the health impacts associated with welding fumes.

4.0 Conclusions

This study set out to investigate the perceived health impacts of welding fumes on workers in a fabrication facility in Port Harcourt. Based on the analyzed data, the following conclusions are drawn in relation to objectives: one, A substantial number of welders suffers from work-related injuries associated with exposure to welding fumes which include burns, eye injuries, and respiratory distress, two, adoption of safety practices among the welders is low especially as regards to consistent use of PPEs and proper ventilation protocols, lastly, most of the welders rated the effectiveness of existing preventive measures as moderate and specific complaints included limited PPE availability, inconsistent enforcement of safety rules, and infrequent health screenings or risk audits

References

Achalu, E. (1999). Nigeria's environmental problems and current legislative control. *The Action Plan, Nigerian School Health Journal, 1*(1&2), 112-134201

American Welding Society. (2020). Welding safety guide. Retrieved from https://www.aws.org/standards/page/welding-safety-guide

Antonini, J. M., Taylor, M. D., Zimmer, A. T., & Roberts, J. R. (2004). Pulmonary responses to welding fumes: role of metal constituents. *Journal of Toxicology and Environmental Health, Part A*, *67*(3), 233-249. https://doi.org/10.1080/15287390490275191

Bakri, S., Hariri, A., Ismail, M., Abdullah, S., & Kassim, I. (2018). Evaluation of respiratory symptoms, spirometric lung patterns, and metal fume concentrations among welders in indoor air-conditioned buildings in Malaysia. *International Journal of Integrated Engineering, 10*(5), 109-121.

Balkhyour, M., & Goknil, K. (2010). Total fume and metal concentrations during welding in selected factories in Jeddah, Saudi Arabia. *International Journal of Environmental Research and Public Health, 7*(7), 2978-2987. https://doi.org/10.3390/ijerph7072978

Budhathoki, S. S., Singh, S. B., Sagtani, R. A., Niraula, S. R., & Pokharel, P. K. (2014). Awareness of occupational hazards and use of safety measures among welders: a cross-sectional study from eastern Nepal. *BMJ open*, *4*(6), e004646. https://doi.org/10.1136/bmjopen-2013-004646

Cosgrove, M., & Zschiesche, W. (2016). Are welding of steels and pulmonary fibrosis. *Weld World*, 60, 191–199.

Doherty, M. J., Healy, M., & Richardson, S. G. (2004). Total body iron overload in welder's siderosis. *Occupational and Environmental Medicine*, 61, 82–85. https://doi.org/10.1136/oem.61.1.82

El-Zein, M., Infante-Rivard, C., & Malo, J. (2005). Is metal fume fever a determinant of welding-related respiratory symptoms and/or increased bronchial responsiveness? A longitudinal study. *Occupational and Environmental Medicine*, 62, 688–694. https://doi.org/10.1136/oem.2004.017854

Fajonyomi, A. A. (2003). Overview of the research process. In A. A. Fajonyomi & M. G. Fajonyomi (Eds.), *Research process in education and social sciences* (pp. 1–15). Goldy O. Publishing Co.

Flynn, M. R., & Susi, P. (2009). Manganese, iron, and total particulate exposures to welders. *Journal of Occupational and Environmental Hygiene*, 7(2), 115–126. https://doi.org/10.1080/15459620902777513

Guha, N., Loomis, D., & Guyton, K. (2017). Carcinogenicity of welding molybdenum trioxide, and indium tin oxide. *Lancet Oncology*, 18, 581–582. https://doi.org/10.1016/S1470-2045(17)30256-X

Kothari, C. K. (2004). *Research methodology: Methods & techniques* (2nd ed.). New Age International.

Meo, S. A., & Al-Drees, A. M. (2005). Lung function among welders working in Jeddah, Saudi Arabia. *Pakistan Journal of Physiology*, 1(1-2), 44–47.

Occupational Safety and Health Administration (OSHA). (2020). Controlling hazardous fume and gases during welding. *U.S. Department of Labor*. DSG FS-3647 03/2013

Orodho, J. A. (2012). *Techniques of writing research proposals and reports in education and social sciences*. Maseno/Nairobi: Kanezja HP Enterprises.

Orodho, J. A., & Kombo, D. K. (2002). *Research methods*. Kenyatta University, Institute of Open Learning.

Popović, O., Prokić-Cvetković, R., & Burzić, M. (2014). Fume and gas emission during arc welding hazards and recommendations. *Renewable and Sustainable Energy Reviews*, 37, 509–516. https://doi.org/10.1016/j.rser.2014.05.045

Simiyu, S. W., & Cholo, W. (2017). Dynamics of occupational injuries among metal workers in Kamukunji Jua Kali Market, Nairobi, Kenya. *International Journal of Academic Research and Development*, 1(12), 1–7. https://doi.org/10.21276/ijard.2017.1.12.1

Susi, P., Goldberg, M., Barnes, P., & Stafford, E. (2000). The use of a task-based exposure assessment model (T-BEAM) for assessment of metal fume exposures during welding and thermal cutting. *Applied Occupational and Environmental Hygiene*, 15(1), 26–38. https://doi.org/10.1080/104732200301827

Thaon, I., Demange, V., Herin, F., Touranchet, A., & Paris, C. (2012). Increased lung function decline in blue-collar workers exposed to welding fumes. *Chest*, 142(1), 192–199. https://doi.org/10.1378/chest.11-0647

World Health Organization (WHO). (2016). Constitution of the World Health Organization. *WHO Chronicle*, 1, 1–11.

Yi, J. H. (2015). Welding-fume-induced transmission loss in tapered optical fibers. *Journal of the Korean Physical Society*, 67(5), 832–846. https://doi.org/10.3938/jkps.67.832.