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ORIGINAL ARTICLE

Application of William Fine Method for Occupational Risk Assessment in a Selected Welding Workshop

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ABSTRACT

Background: Welding workshops play a vital role in various industrial sectors and are associated with multiple hazards that can lead to occupational injuries and health issues. In many small-scale welding workshops, safety measures are often insufficient, increasing the likelihood of preventable accidents. This study focuses on assessing the risks present in a welding workshop using the William Fine risk assessment method to identify and prioritize potential hazards, as well as to propose and evaluate appropriate control measures.

Methods: The William Fine method was applied to evaluate risks based on their probability, exposure, and potential consequences. Data were collected through direct observations, interviews with workers, and analysis of workshop conditions. Risks were categorized and scored to determine their severity and prioritize mitigation measures.

Results: Our findings reveal that about 41% of the hazards were in the high category. Entanglement of workers' hands/clothes, awkward posture, grindstone breakage, metal fume, and falling work pieces were in the high-risk category. The highest and lowest number of risks were related to the tasks of welding operation and connecting the electrode, respectively.

Conclusion: This study underscores the importance of risk assessment in welding workshops to mitigate occupational hazards. Applying the William Fine method provided a clear framework for identifying and addressing risks to enhance safety in small-scale welding operations. The findings emphasize the need for regulatory compliance, worker education, and investment in safety infrastructure to reduce accidents and promote a safer working environment. Furthermore, ergonomic principles and load-carrying techniques are crucial for mitigating risks in these workshops.

KEYWORDS: *Risk Assessment; Risk Identification; Hazard; Welding Workshop; Welder*

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INTRODUCTION

Occupational accidents are a significant threat to the health and safety of workers worldwide. Occupational accidents in the workplace are also considered a major challenge for countries [1, 2]. The results of a study in Iran showed that 207,604 workers suffered occupational accidents during the years 2007-2016. The mortality rate from occupational accidents during these 10 years was 0.4–0.6%. Occupational accidents can have various life, health, social, and economic consequences for the workplace, workers, and their families. Therefore, paying attention to occupational accidents and related factors in industrial environments is of particular importance [1, 3].

Small industrial workshops play a pivotal role in the global economy, contributing to employment and production across various sectors. Despite their importance, these workshops often operate with limited resources, making them more susceptible to safety oversights. Ensuring the safety of such environments is not only a moral obligation but also a practical necessity to prevent disruptions, financial losses, and harm to workers. The unique challenges faced by small workshops, including inadequate safety infrastructure and training, underscore the importance of implementing effective risk management practices [4, 5].

Hazard identification and risk assessment are foundational elements of occupational safety. These processes enable the systematic evaluation of potential risks, allowing for the implementation of targeted preventive measures. Effective risk assessment not only mitigates the likelihood of accidents but also ensures compliance with safety regulations and standards. In high-risk environments like welding workshops, where hazards such as chemical exposure, mechanical injuries, and fire risks are prevalent, a thorough risk assessment is indispensable for safeguarding workers' health and safety [6].

The William Fine method is a widely recognized risk assessment tool that evaluates risks based on their likelihood, exposure, and potential consequences. This method is particularly advantageous for its simplicity, adaptability, and ability to prioritize risks, making it suitable for small industrial workshops with limited resources [7, 8]. Another notable feature of the William Fine method is its integration of economic analysis into safety evaluations, offering a clear justification for the expenses related to risk mitigation. This approach enhances decision-making by aligning safety investments with financial reasoning [9]. Welding workshops, especially small-scale operations, are critical yet hazardous environments. The nature of welding work involves exposure to temperatures, toxic fumes, and flammable materials, which can lead to severe accidents if not properly managed [10]. Statistics reveal that welding-related accidents account for a significant proportion of occupational injuries, including burns, respiratory issues, and even fatalities. In a study in among welders, all participants reported experiencing more than two injuries, with 44% sustaining more than ten injuries. Abrasions were universal among the welders, while over three-quarters of them suffered from lacerations, foreign bodies in the eye, flash burns, and contusions [11]. Given the high-risk nature of welding activities, ensuring the safety of these workshops is paramount. This study focuses on a small welding workshop as a case study, highlighting the unique challenges and risks associated with this sector.

The safety of small welding workshops is a pressing issue that demands immediate attention. This research aims to contribute to the field of occupational safety by applying the William Fine method to assess and mitigate risks in a welding workshop. By identifying key hazards, this study seeks to enhance workplace safety, reduce accident rates, and promote a culture of safety in small industrial settings. The findings of this research will not only benefit the specific workshop under study but also provide a framework for improving safety in similar environments globally.

MATERIALS AND METHODS

The present study was conducted in welding ward of a selected industry in Iran. In this study, the risk assessment of welding processes was done by the Job Safety Analysis (JSA) and William Fine method. At first, the work process of welders was observed and investigated. Then, the job of making iron parts such as ladders, etc., which was the most common job of welders, was selected. After determining the tasks of the work operation, the risks in each task were identified by the methods of observation, and interview. Also, the safety and health risks of the welding were identified in the relevant ward, so that the risk identification was carried out by the team, which included one person as a supervisor, an experienced worker and an occupational health and safety expert.

In order to assess risks using the William Fine method, it is necessary to extract the effect intensity rating, risk probability rating, and contact rating of each activity and its aspects according to the Tables related to the mentioned method. In this method, the risk score is calculated based on the effect intensity rating Tables, occurrence probability rating, and contact rate rating, and by calculating their product (Tables 1-3) [12, 13].

In this regard, a scientific and approved method is needed to decide on the necessity and justification of risk elimination costs, as well as the need to implement risk control programs as soon as possible. One of the common methods that is approved by safety experts to achieve the above goal is the William Fine technique, which is based on risk calculation and assessment.

This technique helps managers to prioritize risk and incident control programs and determine urgency and control planning in order to speed up the achievement of specific goals in a completely transparent manner.

A risk score, R, is computed from $R = P \times C \times E$

P is the probability value,

C is the consequence rating value

E is the exposure value

After calculating risk score according to the pattern presented in the risk level ranking table, the risk level ranking was done in the William Fine method (Table 4). In this ranking, risk is classified into three categories: high (H), middle (M), and low (L). For high-

Table 1. Probability, P (likelihood that accident sequence will follow to completion) Complete accident sequence

Rate	Classification
10	Is the most likely and expected result if the hazardous event takes place
6	Is quite possible, not unusual, has an even 50–50 chance
3	Would be an unusual sequence or coincidence
0.5	Has never happened after many n years of exposure, but is conceivably possible
0.1	Practically impossible sequence (has never happened)

Table 2. Consequences, C (most probable result of potential accident)

Rate	Classification of the accident
100	Catastrophe; Numerous fatalities; Major disruption of activities
50	Multiple fatalities
25	Fatality
15	Extremely serious injury (i.e., amputation, permanent disability
5	Disabling injury
1	Minor injury or damage

Table 3. Exposure, E (frequency of occurrence of the hazard event) Hazard event occurs

Rate	Classification
10	Continuously (or many times daily)
6	Frequently (about once daily)
3	Occasionally (once per week to once per month)
2	Unusually (once per month to once per year)
1	Rarely (it has been known to occur)
0.5	Remotely possible (not known to have occurred)

Table 4. Risk level ranking in William Fine method

Score	Action	Risk Level
200 <	Immediate correction required; activity should be discontinued until hazard is reduced	High (H)
90–199	Urgent; requires attention as soon as possible	Middle (M)
< 89	Hazard should be eliminated without delay, but situation is not an emergency	Low (L)

level risks, immediate corrective action is required to control the risk or requires the unit under investigation to cease operations. For middle-level risks, the situation is urgent or requires immediate action. For low-level hazards, the potential hazardous agent is monitored and controlled [12]. This rating determines the effective corrective actions that should be taken in the risk management phase.

In the stage of proposing corrective measures, according to the importance of risks, control plans, and corrective measures were first prepared for high-level risks (H) to reach an abnormal or normal level. In the following, control programs were prepared for risks with middle level (M), to be changed to low level (L) by applying control methods and continuous monitoring. The amount of acceptable costs was calculated from the following formula and using Tables 5 and 6 [12, 14].

$J = R / CF \times DC$

J = the Justifiable cost
R = the Risk score
CF = the cost factor and
DC = the degree of the correction value.
CF and DC values were adapted from Tables 5 and 6.
In this formula, if the amount of $J>10$, the control cost is justified, but if the amount of $J<10$, the control costs are not justified.

RESULTS

This study investigated the job of making iron parts such as ladders for industry use. The job was divided into five steps, and each step was examined. The results of this investigation are presented in Table 7.

According to Table 1, entanglement of workers hand/clothes, awkward posture, grindstone breakage, metal fume, and falling work pieces were in high risk category. In the present study, the risks were classified based on the William Fine method. The results of the classification of the identified risks are presented in Figure 1. The control measures for the risks classified as high were evaluated in terms of their justifiability according to the William Fine method, and the results are presented in Table 8.

As shown in Figure 1, about 41% of the hazards are in the high category. Executive management has recommended it according to the standard of planning and action in a logical framework. Figure 2 shows the number of risks in each task.

As shown in Figure 2, the highest and lowest percentage of risks are related to the tasks of welding operation (35%) and connecting the electrode (6%), respectively. Also, the risk of awkward posture and ergonomic risk factors has been identified in most steps. Therefore, it seems necessary to implement the necessary measures in this regard.

Table 5. Cost factor, CF (estimated dollar cost of proposed corrective action)

Value	Classification
10	>$50,000
6	$25,000–50,000
4	$10,000–25,000
3	$1,000–10,000
2	$100–1,000
1	$25–100
0.5	Under $25

Table 6. Degree of correction, DC (degree to which hazard will be reduced)

Value	Classification
1	Hazard positively eliminated 100%
2	Hazard reduced at least 75%
3	Hazard reduced by 50%–75%
4	Hazard reduced by W-50%
6	Slight effect on hazard (<25%)

Table 7. Risk assessment in the selected welding workshop

Number	Step	Hazard	Effect of damage	P	C	E	RPN	Risk level	Control measures
1	Profile cutting	Clogging worker's hand/clothes	Amputation, injury	6	15	10	900	High	Clamps, Guards, Training, PPE, Housekeeping
		Scrap iron projectiles	Eyes or skin damage	6	1	10	60	Low	Shields, Goggles,
		Electrocution	Death, burn	0.5	5	10	25	Low	Inspection, Grounding, Residual Current Device (RCD), Training
		Awkward posture	Musculoskeletal disorders	6	5	10	300	High	Ergonomic table, Lifting aids, Training
		Noise	Auditory and non-auditory effects	6	1	10	60	Low	Hearing protection,
2	Transporting metal parts	Falling workpiece	Injury, fracture, dislocation of limbs	6	5	10	300	High	Carts, Clamps, Safe handling Training
		Awkward posture, Carrying loads,	Musculoskeletal disorders	6	5	10	300	High	Carts, Lifting devices, Training
3	Connecting of electrode	Electrocution	Death, injury, burn	3	5	6	90	Middle	RCD, Maintenance, Training
4	Welding operation	UV exposure	Eyes damage	3	5	10	150	Middle	Welding curtain, auto-dark mask,
		Weld spatter	Eye damage	5	2	10	100	Middle	Shields, Face protection,
		Noise	Auditory and non-auditory effects	0.5	1	10	5	Low	Hearing protection, Maintenance
		Awkward posture, repetitive tasks	Musculoskeletal disorders	6	5	10	300	High	Ergonomic design, Job rotation
		Fume	Metal fume fever, lung diseases	6	5	10	300	High	Local exhaust Ventilation, PPE, Training
		Heat	Heat stroke	0.5	1	10	5	Low	Ventilation, Hydration,
5	Grinding	Throwing scrap iron	Eyes and skin damage	6	1	10	60	Low	Shields, Goggles, cleaning
		Electrocution	Death, burn, injury	0.5	5	10	25	Low	Inspections, RCD, Training
		Grindstone breakage	Injury, Eyes damage	6	5	10	300	High	Guard, Inspection, PPE

Table 8. The justification of control measure for high-level risks identified according to the William Fine method

Step	Hazard	RPN	Control measures	CF	DC	Justifiability
Profile cutting	Entanglement of worker's hand/clothes	900	Clamps, guards, training, PPE, housekeeping	3	2	Yes
Profile cutting	Awkward posture	300	Ergonomic table, lifting aids, training	3	3	Yes
Transporting metal parts	Falling workpieces	300	Carts, clamps, safe handling training	2	3	Yes
Transporting metal parts	Awkward posture, Carrying loads	300	Carts, lifting devices, training	3	3	Yes
Welding operation	Awkward posture, repetitive tasks	300	Ergonomic design, job rotation	3	3	Yes
Welding operation	Fume	300	Local exhaust ventilation, PPE, training	3	3	Yes
Grinding	Grindstone breakage	300	Guard, inspection, PPE	2	3	Yes

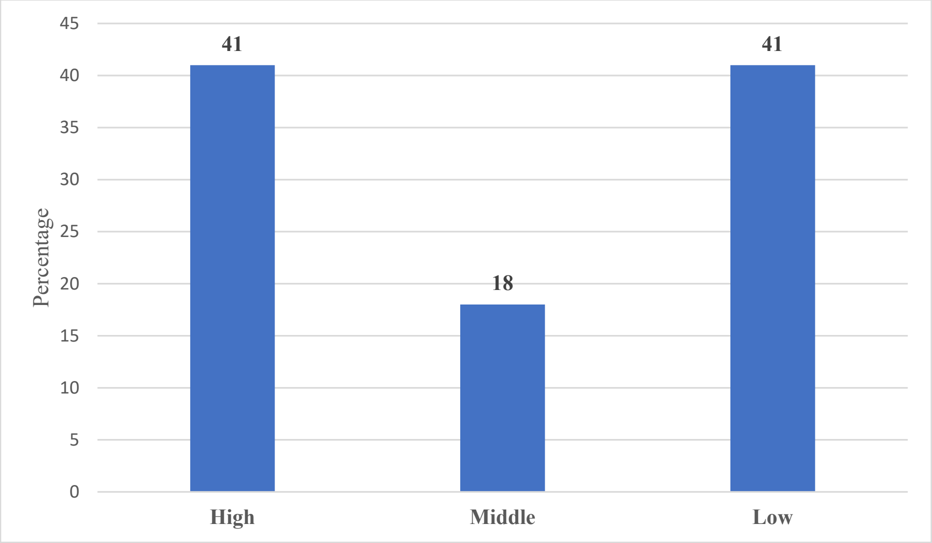

Figure 1. Classification of risks

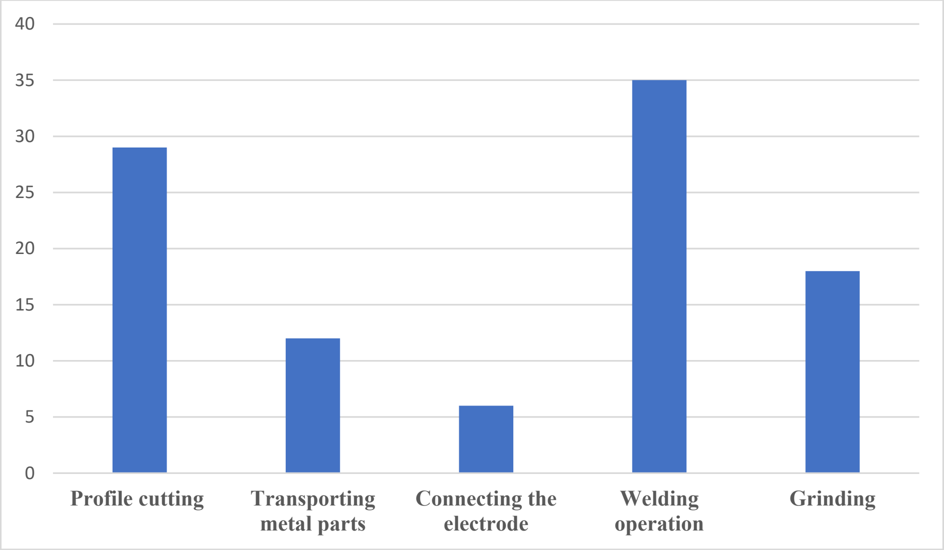

Figure 2. Percentage of hazards identified at each stage

DISCUSSION

Welding safety is essential to protect workers from immediate and long-term hazards, ensure compliance with regulations, and maintain productivity. By understanding the risks and implementing proper safety measures, employers and welders can create a safer work environment and reduce the likelihood of accidents and health issues. Prioritizing safety not only saves lives but also enhances the overall quality and efficiency of welding operations [15]. This result underscores the urgent need for heightened awareness and the implementation of risk assessment practices across all levels of welding operations.

The William Fine risk assessment method is an organized and systematic method for identifying and evaluating potential hazards and estimating the level of risk, in order to manage the risk and reduce it to an acceptable level. In this method, attention to the severity of the impact and the probability of encountering the hazard is mandatory [16]. The William Fine Risk Assessment Method is a valuable tool for welding risk assessment due to its quantitative, systematic, and customizable approach. It enables organizations to prioritize hazards effectively, implement targeted control measures, and foster a safer work environment. By using this method, welding operations can reduce the likelihood of accidents, protect workers' health, and ensure compliance with safety regulations. This method has been used in various studies in industries. In the study by Gholami et al., all risks of a plastics industry were assessed using this method [17].

The results indicated that 41% of the identified hazards were classified as high-risk. This high proportion can be attributed to the inherent characteristics of welding activities, which involve simultaneous exposure to multiple hazards such as high temperatures, electric arcs, toxic fumes, and heavy equipment. Additionally, small-scale welding workshops often lack adequate safety controls and protective measures, which further elevates the risk levels. Similar findings have been reported in previous studies, highlighting the persistent safety challenges in such environments [18]. Moreover, a significant number of hazards were identified during the profile cutting and welding operations. These stages are inherently more hazardous due to factors such as high-speed cutting tools, flying metal particles, intense heat, exposure to ultraviolet radiation, and the generation of toxic welding fumes. Inadequate ventilation further contributes to the increased risk levels in these operations [10].

Our results indicate that the most significant risk for welders is awkward posture, which received a probability score of 6 (indicating repetitive exposure) across all tasks, which suggests that ergonomic risk factors are prevalent in welding activities. A study by Poorang et al. was conducted to investigate the ergonomics of welding workstations. The results of their study showed that improper posture during welding activities can cause serious injuries to various parts of the body, especially the spine [19]. A study by Rahimian et al. was conducted to evaluation of exposure to risk factors of musculoskeletal disorders in welders. The results of their study showed that the prevalence of musculoskeletal symptoms was highest in the back, trunk, and arm areas. Also, 64.6 percent of cases had high and very high risk levels [20]. The high prevalence of musculoskeletal disorders in welders is mainly due to poor posture, repetitive movements, use of vibrating tools, and long working hours. Due to the nature of their job, these people are often forced to work in difficult environments, with high temperatures and improperly designed workplaces, which put significant pressure on the spine, shoulders, and joints. In addition, the lack of awareness of ergonomic principles and correct welding techniques exacerbates these problems. Implementing training programs, improving the ergonomic design of tools and the workplace, and conducting periodic medical examinations can greatly help reduce these disorders.

Another high-risk hazard during welding operations is related to exposure to fumes. Welders are continuously exposed to fumes generated during welding processes, which consist of a mixture of metal particles, oxides, and toxic gases. These fumes may contain hazardous elements such as hexavalent chromium, nickel, manganese, and lead, inhalation of which is associated with respiratory diseases, neurological disorders, and an increased risk of cancer. The intensity of exposure depends on the welding method, materials used, workplace ventilation, and duration of work. Studies have shown that fume concentrations in poorly ventilated work environments can significantly exceed occupational exposure limits. Therefore, risk assessment of welding fume exposure and implementation of control measures such as local exhaust ventilation, personal protective equipment, and worker training are essential. Addressing this hazard plays a crucial role in improving the occupational safety and health of welders [21, 22].

This study offers valuable insights for policymakers and efforts to enhance safety and health in welding workshops. The risk assessment was conducted based on team discussions, interviews, and historical conditions, acknowledging potential differences in opinions across various workshops. Further research using alternative risk assessment approaches would be beneficial. It is also necessary to mention the limitations of the study. One key limitation is its focus on job-specific risks without accounting for hazards from surrounding factors. Additionally, the absence of a comprehensive hazard list may lead to the omission of critical risks. Addressing these limitations can involve actions such as compiling a detailed hazard list from existing documents, identifying unusual activities in the vicinity, adopting integrated risk assessment methods, and adhering to the hierarchy of controls to strengthen safety practices. Despite rigorous efforts to identify hazards systematically, there remains a possibility that some hazards were not detected. This is mainly due to the dynamic and complex nature of welding workshop environments, where certain risks may emerge intermittently or be less observable during the assessment period. Expanding the assessment duration and utilizing additional hazard identification techniques in future studies may help address this limitation.

CONCLUSION

This study identified several key occupational hazards for welders using the William Fine risk assessment method. Among the most significant risks were awkward postures causing musculoskeletal disorders and continuous exposure to toxic welding fumes. Additionally, mechanical safety hazards such as falling objects and the risk of clothing entanglement were recognized as important concerns that can lead to severe injuries if not properly controlled. These mechanical risks are often exacerbated by inadequate workplace organization and lack of appropriate safety measures. The findings emphasize the necessity for comprehensive safety programs that address ergonomic improvements, effective ventilation systems, and strict control of mechanical hazards through proper housekeeping, securing workpieces, and using appropriate personal protective equipment. Worker training on hazard recognition and safe work practices is crucial to minimizing these risks. Future studies should broaden risk assessment scopes to include environmental and contextual factors to further enhance the effectiveness of safety interventions in welding operations. Overall, addressing both ergonomic and mechanical hazards is essential for reducing injury rates and promoting a safer working environment for welders.

Conflict of Interest
The authors declare no conflict of interest.

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Author's Contributions
Study Conception or Design: M Jafari Nodoushan, S Kamali
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Data Analysis or Interpretation: M Jafari Nodoushan, S Kamali
Manuscript Drafting: M Jafari Nodoushan, S Kamali
Critical Manuscript Revision: M Jafari Nodoushan, S Kamali
All authors have approved the final manuscript and are responsible for all aspects of the work..

AI Statement
The authors confirm that no AI tools or services were used during the preparation of this work.

REFERENCES

1. Gallego V, Sánchez A, Martón I, Martorell S. Analysis of occupational accidents in Spain using shrinkage regression methods. Saf Sci. 2021;133:105000.
2. Halvani G, Soleimani A, Sadri Esfahani A, Akhavan A, Mortazavi M, Jafari Nodoushan M. Investigation of the Relationship between Biorhythms and Occupational Accidents Severity in a Chemical Industry, 2009-2022. Occup Med Q J. 2023;15(2):20-8.
3. Izadi N, Aminian O, Esmaeili B. Occupational accidents in Iran: risk factors and long term trend (2007-2016). J Res Health Sci. 2019;19(2):e00448.
4. Jahangiri M, Rostamabadi A, Malekzadeh G, Sadi AF, Hamzavi G, Rasooli J, et al. Occupational Safety and Health Measures in Micro-scale Enterprises (MSEs) in Shiraz, Iran. J Occup Health. 2016;58(2):201-8.
5. Hasle P, Limborg HJ. A review of the literature on preventive occupational health and safety activities in small enterprises. Ind Health. 2006;44(1):6-12.
6. Rout B, Sikdar B. Hazard identification, risk assessment, and control measures as an effective tool of occupational health assessment of hazardous process in an iron ore pelletizing industry. Indian J Occup Environ Med. 2017;21(2):56-76.
7. Halvani G, Ehrampoush MH, Ghaneian MT, Dehghani A, Arani MH. Applying job hazard analysis and William Fine methods on risks identification and assessment of jobs in hot rolling steel, Iran. J Mazandaran Univ Med Sci. 2017;26(145):293-303.
8. Zahed MA, Seidi F, Salehi S, Pardakhti A. Simultaneous assessment of health, safety, and environmental risks using William Fine and FMEA methods based on OHSAS 18001:2007 standard in the Alborz tunnel, Iran. Geomech Tunn. 2023;16(1):103-13.
9. Moloudpourfard B, Zarandi MT, Pouyakian M. Updating the "Cost Factor" in the William Fine Risk Assessment Method following Economic Power: A Case Study of Selected Production Industries in Iran. Heliyon. 2025;11(4):e42356.
10. Murugan SS, Sathiya P. Analysis of welding hazards from an occupational safety perspective. Vietnam J Sci Technol Eng. 2024;66(3):63-74.
11. Kumar SG, Dharanipriya A. Prevalence and pattern of occupational injuries at workplace among welders in coastal south India. Indian J Occup Environ Med. 2014;18(3):135-9.
12. Kakaei H, Poornajaf A, Safarpour F, Rezaei H. Risk Assessment Using William Fine Method at Ilam Gas Refinery in 2012. J Ilam Univ Med Sci. 2018;25(6):150-9.
13. Jafari NR, Kakaei Z, Rezaei H, Khodarahmi F, Kakaei HA, Hajian N. Risk assessment of Ilam gas refinery based on William Fine method in 2012. Iran Occup Health. 2014;11(3):72-81.
14. Kouhnavard B, Najimi MR, Aghanasab M, Bolghanabadi S. Identification and assessment of occupational hazards in a foam company applying William Fine method, 2012. J Health Saf Work. 2015;5(2):75-84.
15. Wanjari MB, Wankhede P. Occupational hazards associated with welding work that influence health status of welders. Int J Curr Res Rev. 2020;12(23):51-5.
16. Ehrampoush M, Halvani G, Ghaneian M, Dehghani A, Shafie M, Hesami Arani M. Equipment's environmental risks identification and assessment in the hot-rolling Kavir steel industry using What if and William Fine methods. Occup Med Q J. 2017;9(1):84-95.
17. Gholami S, Halvani G, Radpour J, Khalifeh Y. Risks and impacts of non-flammable solvent replacement on risk assessment code using William Fine's method in a plastic factory. Occup Med Q J. 2016;8(2):1-11.
18. Safety analysis of welding process in Tehran oil refinery and the effectiveness of the control methods. J Health Saf Work. 2012;1(2):3-10.
19. Poorang H, Sadeghinaeini H, Ghousi R. Diagnosis and ergonomic design of oxy gas welding workstation by RULA method: case study of welding workshops. Occup Med. 2019;11(3):1-12.
20. Tayefe Rahimian J, Choobineh A, Dehghan N, Tayefe Rahimian R, Kolahi H, Abbasi M, Abbaszadeh M. Ergonomic evaluation of exposure to musculoskeletal disorders risk factors in welders. Iran J Ergon. 2014;1(3):18-26.
21. Dueck ME, Rafiee A, Mino J, Nair SG, Kamravaei S, Pei L, Quémerais B. Welding fume exposure and health risk assessment in a cohort of apprentice welders. Ann Work Expo Health. 2021;65(7):775-88.
22. Pourhassan B, Beigzadeh Z, Nasirzadeh N, Karimi A. Application of multiple occupational health risk assessment models for metal fumes in welding process. Biol Trace Elem Res. 2024;202(3):811-23.