



Factors related to work accidents in welding workshops in Paleteang District, Pinrang Regency in 2025

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ABSTRACT

Workplace accidents remain a major occupational health problem in Indonesia, particularly in the informal sector. According to the ILO, more than 2.78 million workers die each year due to accidents and occupational diseases. This study aims to analyze factors associated with workplace accidents among welding workshop workers in Paleteang District, Pinrang Regency, in 2025. This research employed a quantitative analytical method with a cross-sectional design and total sampling technique, involving 37 workers from 17 welding workshops. Data were analyzed using the Chi-Square test and Fisher's Exact Test. The results showed no significant relationship between age or occupational safety and health (OSH) training and work accidents ($p > 0.05$). However, there was a significant relationship between the use of personal protective equipment (PPE) and the incidence of work accidents ($p = 0.01$). This study contributes scientifically by highlighting the critical role of consistent PPE use in improving occupational safety practices in the informal sector, particularly among small-scale welding workshops. It is recommended that workers consistently use complete PPE and that workshop owners enhance OSH supervision and provide adequate protective equipment to reduce workplace accidents.



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1. Introduction

Workplace accidents are unexpected events that cannot be prepared for in advance, resulting in actual injuries to workers (Hinsberg & Lamanna, 2024; Lee et al., 2020; Moses, 2018). According to the World Health Organization (WHO), accidents occur as a result of a combination of various factors, including technical equipment, working conditions, and the behavior of the workers themselves (Winge et al., 2019; Zhang et al., 2020). In practice, many accidents occur due to unsafe work equipment, machines that are not equipped with adequate safety features, or technical designs that do not take operator safety into account. A noisy work environment can distract workers and prevent them from hearing danger signals, while excessive heat or poor air circulation can reduce workers' stamina and concentration (Aftab et al., 2023; Patel et al., 2022). These conditions can even trigger the accumulation of toxic gases that have the potential to cause fatal accidents. Human factors also contribute significantly, such as lack of training, low work experience, negligence, or physical fatigue that causes workers to lose their alertness (Levintow, 2021; Mburu, 2019; Pebriyani et al., n.d.). According to data from the International Labor Organization

(ILO), approximately 2.78 million workers die each year due to accidents and occupational diseases, with 86.3% of deaths caused by occupational diseases and 13.7% due to accidents. In addition, there are approximately 374 million cases of non-fatal work accidents that have a serious impact on worker productivity and income. In Indonesia alone, the number of work accidents is still quite high (Aprianto et al., 2023; Sahda Saraswati Akbar & Rianda Dirkareshza, 2024). The latest data from the Ministry of Manpower shows that in the January-March 2025 period, there were 5,632 cases of work accidents, mainly in the construction, manufacturing, and mining sectors, with fatal accidents such as falls from heights, electric shocks, and exposure to hazardous chemicals. Data from the South Sulawesi Manpower and Transmigration Office (Disnakertrans) even shows that around 80% of accidents are caused by human error, such as fatigue, negligence, and non-compliance with standard operating procedures (SOPs). From BPJS Ketenagakerjaan claims in the South Sulawesi region, thousands of accident cases have been recorded in various districts/cities, with the highest number occurring in Makassar (863 cases), followed by Palopo, Pare-pare, and other areas. This data shows that workplace accidents are still a major problem in the industrial world, and the causes are multidimensional, covering technical and environmental aspects, as well as human factors themselves (Cvetković et al., 2024; Dodoo & Al-Samarraie, 2019; Thatcher et al., 2020).

Legally, workplace accidents are regulated by various national regulations (Curington, 1986; Indrayana et al., 2020). Law No. 1 of 1997 concerning Manpower defines a workplace accident as an unexpected and unintended event that disrupts activities and causes human and material losses. Meanwhile, Minister of Manpower Regulation No. 03/MEN/1998 emphasizes that a workplace accident is an unexpected event that results in fatalities or property damage. This definition broadens the scope of accidents to include not only those that occur at the workplace but also those that occur while traveling to or from work. The causes of accidents are diverse, ranging from the condition of machinery and the work environment, production processes, to work methods and worker behavior. According to Widjaja and Abdullah (2021), accidents can occur due to dangerous actions motivated by limited knowledge, skills, or even the physical condition of workers, such as physical disabilities, fatigue, or lack of concentration. Age is also an important factor. Suma'mur's theory (1996) states that human physical capacity, including vision and reaction speed, begins to decline after the age of 30, thereby increasing the risk of serious accidents. Recent studies show that the younger age group (18–25 years old) has a higher risk of accidents because they often ignore safety procedures and are less consistent in using personal protective equipment (PPE). Conversely, older workers are more cautious but are prone to long-term occupational diseases, such as musculoskeletal disorders and hearing impairment. Research by BPJS Ketenagakerjaan (2022) confirms that although the tendency for work accidents decreases with age, the risk of occupational diseases increases. Therefore, age must be taken into account in human resource management, both to reduce the potential for accidents and to anticipate long-term health impacts. These age-related differences require specific and adaptive occupational safety strategies tailored to worker profiles, so that occupational safety and health (OSH) policies can be implemented more effectively.

In addition to accidents, occupational diseases are also an important concern in the context of worker safety (Badri et al., 2018; Magalhães et al., 2022). The WHO and ILO define OWD as health disorders that arise from exposure to risk factors in the workplace over a certain period of time. These risk factors can be physical, such as noise and vibration; chemical, such as exposure to heavy metals and toxic substances; biological, such as exposure to viruses and bacteria; or psychosocial, such as stress due to excessive workloads. Global data shows that more than 2 million deaths per year are caused by OWD, a number that is much higher than deaths due to work accidents. The most common types of diseases are lung diseases caused by dust exposure (silicosis, asbestosis), hearing disorders due to noise, contact dermatitis, musculoskeletal disorders, and cardiovascular diseases triggered by work stress. A report by BPJS Ketenagakerjaan (2023) shows that work-related illnesses have a significant impact, not only on individual workers but also on companies and the national health system. Therefore, prevention is vital. Steps that need to be taken include providing adequate PPE, regular monitoring of the work environment, periodic health checks, and implementing a work safety culture based on worker awareness.

Unfortunately, the level of compliance with PPE use remains an issue in many sectors, particularly in welding workshops or small industries. According to Herlina and Marlin (2022), although workers' knowledge of PPE is quite good, non-compliance still occurs due to factors such as comfort, availability, and the perception that PPE hinders productivity. In fact, the independent use of PPE without supervision from superiors is a reflection of professionalism and a good safety culture. International organizations such as the ILO and OSHA emphasize the importance of individual awareness in the use of PPE as part of a comprehensive worker protection system. Thus, OSH is not only a medical issue, but also a managerial issue, a company policy issue, and a government regulation issue that requires the synergy of various parties.

Certain working conditions, such as those found in the welding industry, provide a clear picture of the potential risks of accidents and occupational diseases. Welding is the process of joining metals by melting the parts to be joined, usually using high heat energy, so that a strong metallurgical bond is formed after cooling. According to Deutsche Industrie Normen (DIN) standards, welding can cause various hazards, ranging from electric shocks, burns, eye irritation due to exposure to ultraviolet and infrared rays, to respiratory disorders due to smoke and toxic gases. Research by Akbar et al. (2021) shows that welding workers who are exposed to UV and infrared rays in the long term are at risk of damage to the lens of the eye, characterized by pain, itching, and temporary visual impairment. In addition, the risk of workplace accidents in welding workshops is also quite high, such as hands being burned by hot iron, being cut by materials, or being hit by welding sparks, most of which are caused by negligence or non-compliance in using PPE. A preliminary survey in Paleteang District, Pinrang Regency, in 2025 of 37 respondents from 17 welding workshops showed that work accidents still occur frequently, although most are not reported because they are considered minor and do not reduce productivity. This shows a weak culture of incident reporting and a lack of awareness that even minor accidents can accumulate into serious problems. Field observations also found many potential hazards in welding workshops that had not been adequately addressed. Comfort was the main reason workers were reluctant to use PPE, for example, gloves that were considered hard and restricted movement. This phenomenon confirms that in addition to providing PPE, companies also need to pay attention to ergonomics and comfort so that workers are more compliant. Occupational safety in the welding industry is not only related to physical risks, but also includes long-term health aspects due to exposure to hazardous work environments. Thus, strict supervision, the provision of standard PPE, and regular training are urgent needs to reduce the number of accidents and occupational diseases in this sector.

The latest data shows that the number of workplace accidents in Indonesia continues to increase. As of April 2025, there were 47,300 cases, up about 12% compared to the same period last year. In the first quarter alone, there was a 9.4% increase with a total of 5,632 cases. This surge shows that even though various regulations have been put in place, implementation in the field still faces major challenges. The ILO report even ranks Indonesia as the country with the second-highest number of workplace accidents in the world, with 65,474 cases recorded, including 1,451 deaths, 5,326 permanent disabilities, and nearly 59,000 cases of recovery without disability. To date, official data on the provinces with the highest number of work-related illnesses in 2025 has not been published, but previous trends show that provinces with high industrial concentration, such as West Java, East Java, and Central Java, have the highest incidence rates. The main factors contributing to these high rates are industrial density and low compliance with the implementation of the Occupational Health and Safety Management System (SMK3). Meanwhile, the demographic aspects of workers also play an important role. The productive age group of 15–64 years, as categorized by the ILO and BPS, has different characteristics in terms of the risk of accidents and occupational diseases. Young workers (15–30 years) are in prime physical condition but are prone to making impulsive decisions, while middle-aged workers (31–64 years) are more stable but are prone to physiological decline as they approach old age. This condition is reinforced by a NIOSH (2021) report which states that workers aged 55 and above are more prone to injuries due to decreased muscle strength, reaction speed, and endurance. Thus, employment policies that take age into account are very relevant amid the trend of an aging workforce and increasing retirement age. Comprehensive prevention efforts, ranging from workplace safety education, provision of comfortable PPE, regular training, to

monitoring compliance with SOPs, need to be strengthened. Only in this way can Indonesia reduce the number of work-related accidents and illnesses, while simultaneously increasing productivity and the long-term well-being of the workforce.

Despite the extensive research conducted on occupational safety and health, there remains a significant research gap regarding the specific conditions and safety behaviors of workers in small-scale welding workshops, particularly in the informal sector such as those in Pinrang Regency. Most previous studies have focused on large-scale industries or formal manufacturing settings, where occupational safety management systems are more structured and regularly monitored. In contrast, welding workshops in Pinrang operate with limited supervision, minimal safety infrastructure, and varying levels of worker awareness regarding PPE use. This creates a unique context where occupational accident risks are high but often underreported or neglected. Therefore, this study is crucial to provide empirical evidence on the relationship between worker characteristics (such as age and OSH training), the use of personal protective equipment (PPE), and the incidence of workplace accidents in welding workshops. The objective of this study is to identify the factors associated with workplace accidents among welding workshop workers in Paleteang District, Pinrang Regency, in order to contribute to the improvement of occupational safety strategies and the development of evidence-based preventive measures within Indonesia's informal sector.

2. Methods

This research method uses a quantitative analytical approach with a cross-sectional design, which is a study that examines the relationship between risk factors (independent variables) and outcome factors (dependent variables) through observation or measurement of variables simultaneously at one point in time (Salmarianty et al., 2021). This study was conducted in welding workshops located in Paleteang District, Pinrang Regency, from July 10 to July 23, 2025.

The population in this study was all workers in the welding workshop industry in Paleteang District, with a total of 37 people from 17 welding workshops. The sampling technique used total sampling, so that the entire population was used as the research sample. Thus, the number of research samples was 37 welding workshop workers who were willing to be respondents. The inclusion criteria were set as welding workers who did not have disabilities and welding workers who expressed their willingness to participate in the study.

The research instruments used were structured questionnaires and observation sheets to collect data related to risk factors and occupational accidents among welding workshop workers. The questionnaires were compiled based on the indicators of the variables being studied, while the observation sheets were used to record working conditions directly in the field. Before use, the research instruments were tested for validity and reliability to ensure the quality of the data obtained.

Data analysis was performed in two stages, namely univariate analysis and bivariate analysis. Univariate analysis was used to describe the frequency distribution of each research variable. Next, bivariate analysis was performed to determine the relationship between the independent variables (risk factors) and the dependent variables (work accident incidents) using the Chi-Square test with a significance level of 95% ($\alpha = 0.05$). The results of the analysis were then interpreted to answer the research objectives.

3. Results and Discussion

This study was conducted from July 10 to July 23, 2025, in Paleteang Subdistrict, Pinrang Regency. This study is quantitative in nature. The purpose of this study is to determine the factors related to workplace accidents in welding workshops in Paleteang Subdistrict, Pinrang Regency, in 2025.

The population used in this study was welding workers in Paleteang District. There were 37 workers from 17 welding workshops in the welding industry. The sample used was all workers in welding workshops in Paleteang District, namely 37 respondents. Primary data was collected through questionnaires given to respondents. The collected data was then processed, starting from the editing, coding, processing, cleaning, and analysis stages using the SPSS program. The results of the data

processing were presented in the form of a frequency distribution of respondent characteristics and an overview of the variables studied.

The number of workers in welding workshops ranged from 1 to 8 workers. These welding workshops are owned by people living in Paleteang District. The welding workshops in Peleteang District are as follows:

Table 1.
Number of welding workshops in Paleteang subdistrict

No	Welding Workshop Name	Address	Workers
1	Bengkel las Teteaji	Jl. Patimura	1
2	Bengkel las bubut Kawan	Jl. Paimura	2
3	Bengkel Las bubut Mutiara	Jl. Patimura	2
4	Bengkel Las Taufiq 02	Jl. Cempaka	4
5	Las HM 257	Jl. Veteran	1
6	Bengkel Las Citra	Jl. Teuku Umar	2
7	Bengkel Las Rudi	Jl. Pole Baramuli	1
8	Sinar Terbit	Jl. Teuku Umar	2
9	Us. Putra	Jl. Ahmad yani	8
10	Las Bubuk Maspul	Paleteang 2	1
11	Cahaya Madina	Jl. Ambo Dondi	1
12	Bengkel Basrih	Sulili	2
13	Mawan Bubuk	Jl. A. johan	1
14	Bengkel Las Tunas Baru	Jl.G Lompo Battang	3
15	Khusnul	Paleteang	2
16	Cv. Bukit Mas	Jl. Seroja	2
17	Alif NFY	Jl. Tedong Borneo	2

Primary Data Sources

1. Respondent Characteristics

a. Respondent Distribution

Table 2.
Distribution of Respondents in Welding Workshops in Paleteang District, Pinrang Regency, in 2025

No	Variable	n	%
1	Age 15–30 years old	15	40,5
2	Age 31–64 years old	22	59,5
3	Junior high school education	3	8,1
4	Senior high school/vocational high school education	34	91,9
5	Length of employment (Long)	30	81,1
6	Length of Employment (New)	7	18,9
7	Workplace Accident (Yes)	30	81,1
8	Workplace Accident (No)	7	18,9
9	Use of PPE (Yes)	11	29,7
10	Use of PPE (No)	26	70,3
11	At-Risk Age	15	40,5
12	Non-At-Risk Age	22	59,5
13	K3 Training (Yes)	25	67,6
14	K3 Training (No)	12	32,4
Total		37	100

Based on the respondent distribution table above, it can be seen that of the 37 respondents, the majority were aged 31–64 years, namely 22 people (59.5%), while those aged 15–30 years were 15 people (40.5%). In terms of highest level of education, most respondents had a high school/vocational school education, totaling 34 people (91.9%), while only 3 people (8.1%) had a junior high school education. In terms of length of employment, 30 respondents (81.1%) had been working for a long time, while 7

respondents (18.9%) had just started working. Regarding work accident experience, 30 respondents (81.1%) had experienced a work accident, while only 7 respondents (18.9%) had never experienced a work accident. In terms of personal protective equipment (PPE) use, 26 respondents (70.3%) did not use PPE, while only 11 respondents (29.7%) used PPE. Based on the risk age category, 15 people (40.5%) were included in the risk group, while 22 people (59.5%) were not at risk. Furthermore, in terms of OSH training, most respondents, namely 25 people (67.6%), had participated in training, while 12 people (32.4%) had never participated in OSH training. These results show that the majority of workers are of productive age, have a secondary education, long work experience, and a tendency not to use PPE even though some have participated in OSH training.

B. Discussion

1. Relationship between Respondent Characteristics and Work Accidents

Age is the age of an individual since birth, where according to the WHO and BPS Indonesia, productive age is in the range of 15–64 years, which is considered to be a group that is physically and mentally active in the workforce and has the capacity to contribute to economic and social activities. Despite being in optimal physical condition, young people are considered to lack experience, emotional control, and training, making them more vulnerable to workplace accidents. Based on the results of univariate analysis, of the 37 respondents who were welding workshop workers, 15 people (40.5%) were in the 15–30 age group and 22 people (59.5%) were in the 31–64 age group.

The level of education plays an important role in workers' ability to understand work instructions, safety procedures, and occupational risks, where workers with low education tend to have difficulty following SOPs and K3 training, making them more prone to errors (Kristiawan & Rijal, 2021). Based on the research findings, the majority of respondents had a high school/vocational school education, totaling 34 people (91.9%), while only 3 people (8.1%) had a junior high school education. In addition, length of service is also an important indicator of experience and understanding of safety procedures (Ramli, 2021), where workers with less than 1 year of service tend to be at higher risk of accidents because they are not yet familiar with the environment and SOPs, while workers with more than 1 year of service are more experienced but still at risk of negligence due to routine (Suma'mur, 2021). The results of the study show that most respondents, namely 30 people (81.1%), have been working in welding workshops for a long time, while 7 people (18.9%) are classified as new employees.

2. Relationship between age and workplace accidents

Based on the results of the study, age is one of the factors that influence the occurrence of workplace accidents, as stated by the Indonesian Ministry of Manpower (1998) and reinforced by several theories. In this study, age was divided into two categories, namely at risk (15–30 years) and not at risk (31–64 years). Of the 37 respondents, 15 people (40.5%) were in the high-risk category, with 11 people (73.3%) having experienced a work accident. This is because young workers tend to be hasty, careless, rushed, and irresponsible even though they are still physically fit. Meanwhile, of the 22 respondents in the non-risk category, 19 people (86.4%) had experienced a work accident, which was caused by a decline in physical functions such as vision, hearing, reaction, and muscle strength with age. The results of Fisher's Exact Test showed a p-value of 2.83 ($p > 0.05$), which means that there is no significant relationship between age and workplace accidents in welding workshops in Paleteang District.

This finding is in line with the research by Mulyad et al. (2022), Huda et al. (2021), Irkas et al. (2021), and Arifandi (2021), which stated that there was no relationship between age and work accidents. However, several other studies, such as Mahfud Anwar and Sugiharto (2018), found that work accidents were more common among workers aged ≥ 30 years due to a decline in bodily functions after the age of 30, with physiological capacity decreasing by about 1% each year. Thus, work accidents can be experienced by both young and old workers, where young workers are vulnerable due to carelessness and lack of experience, while older workers are more vulnerable due to declining physical condition. Therefore, it is recommended that young workers avoid rushing while working, while older workers need to pay more attention to their physical condition and maintain vigilance to avoid work accidents.

3. The Relationship Between Personal Protective Equipment and Workplace Accidents

The use of Personal Protective Equipment (PPE) plays an important role in preventing and reducing the severity of workplace accidents, although it cannot completely guarantee that workers will be free from risk. The results of the study show that most welding workshop workers in Paleteang District are still not compliant in using PPE, citing reasons such as discomfort, hindrance to movement, lack of availability, and the assumption that PPE is only important in large industries. Bivariate analysis shows that workers who do not use PPE tend to experience more workplace accidents than those who do, although improper use of PPE also carries the risk of causing accidents. Statistical tests show a significant relationship between PPE use and workplace accidents, supported by Tarwaka's theory and previous studies stating that PPE compliance can reduce accident risks, though not eliminate them entirely.

However, the high number of workplace accidents in welding workshops is still caused by workers' disregard for safety, low awareness of risks, and a lack of supervision and provision of appropriate PPE by workshop owners. Common obstacles include heat, stuffiness, weight, and the perception that PPE is not important. This study confirms that the use of PPE is very beneficial in reducing the impact of accidents, so workshop owners need to provide complete and standard-compliant PPE, while workers are required to wear it consistently to protect themselves and minimize the risk of workplace accidents.

4. The Relationship Between K3 Training and Work Accidents

Occupational Safety and Health (OSH) training is an important effort to equip workers with knowledge, skills, and safe work attitudes to prevent accidents. The results of the study show that respondents who have never attended OSH training have higher rates of workplace accidents than those who have attended training. However, even though most respondents had attended training, the number of workplace accidents remained high, indicating that training alone is not enough without direct application, compliance with procedures, and awareness of workplace safety. This is in line with several previous studies that emphasize that training must be accompanied by a disciplined work culture, the provision of complete PPE, and management supervision to achieve effectiveness.

Based on the statistical test results, the p-value was greater than 0.05, which means that there is no significant relationship between K3 training and workplace accidents in welding workshops in Paleteang District. This finding contradicts the theory that training should improve worker safety, but supports other studies that highlight the low implementation of K3 even though training has been provided. Thus, work accidents can happen to anyone, whether they have undergone training or not, due to other dominant factors such as careless behavior, lack of supervision, and a weak safety culture. Therefore, K3 training needs to be followed up with practical implementation in the field, strict monitoring, and efforts to build a safety-oriented work culture.

4. Conclusion

Based on the results of research conducted on welding workshop workers in Paleteang District, Pinrang Regency, it can be concluded that the majority of respondents are in the productive age group (31–64 years), have a high school or vocational school education background, and have long work experience. However, most workers still do not use personal protective equipment (PPE) while working, and a high number of workplace accidents (81.1%) were recorded among the respondents. The results of the analysis show that there is no significant relationship between age and workplace accidents, which indicates that both younger and older workers have the potential to experience accidents due to different factors — younger workers tend to be careless and inexperienced, while older workers experience a decline in physical ability. Similarly, no significant relationship was found between OSH (Occupational Safety and Health) training and workplace accidents, suggesting that the existence of training alone is not sufficient to reduce accident rates without consistent implementation, supervision, and safety awareness. However, the study found that the use of personal protective equipment (PPE) has a significant relationship with the occurrence of workplace accidents. Workers who do not use PPE are more likely to

experience accidents than those who use it properly. This indicates that compliance with PPE use plays an important role in reducing the risk and impact of workplace accidents, even though it does not completely eliminate the danger. In conclusion, workplace accidents among welding workers in Paleteang District are influenced more by behavioral and compliance factors rather than demographic characteristics. Therefore, it is recommended that workshop owners ensure the availability and supervision of proper PPE use, strengthen the implementation of OSH principles through regular practical training, and foster a strong safety culture among workers to minimize the occurrence of workplace accidents.

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