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The relationship between ppe use and work accidents among firefighters in Pinrang 2025

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ABSTRACT

Firefighting is a high-risk occupation that requires strict implementation of occupational safety measures, including the consistent use of personal protective equipment (PPE). Despite existing safety regulations, work accidents among firefighters remain a global concern. This study aimed to analyze the relationship between PPE use and the incidence of work accidents among firefighters at the Watang Sawitto Subdistrict Fire Station in Pinrang Regency. Using a quantitative cross-sectional design with total sampling, all 52 firefighters were included as respondents. Data were analyzed using the Chi-square test to examine the correlation between PPE use and work accidents. The results showed a significant relationship (p = 0.001), indicating that incomplete PPE use increases the likelihood of occupational accidents. This finding highlights the importance of strengthening compliance with PPE standards and institutional safety management systems to reduce occupational risks among firefighters. The study contributes scientifically by providing empirical evidence on the role of PPE adherence in preventing workplace accidents in high-risk emergency service environments, and practically by offering insights for policy development and safety interventions within Indonesia's occupational health and safety (K3) framework.

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1. Introduction

According to the World Health Organization (WHO), up to 685,000 work accidents occur every day, which means that every 8 minutes, 475 industrial workers experience a work accident. According to the World Health Organization (WHO), work-related illnesses and accidents are a violation of human rights and poor health, and their occurrence or severity is related to exposure to workers or hazardous work environments.

According to 2018 data from the International Labor Organization (ILO), 278 million workers died from work accidents and work-related illnesses. 86.3% of work-related deaths were caused by fatal accidents in the workplace, while more than 13.7% were caused by negligence in performing work.

The Social Security Administration Agency (BPJS) for Employment recorded that the average number of work accidents in Indonesia handled each year was around 130,000 cases, ranging from minor accidents to fatal accidents. There were 298,137 workplace accident cases in Indonesia in 2022, increasing to 370,747 cases in 2023, and 356,383 workplace accident cases from January to October in 2024. Based on data on workplace accidents in South Sulawesi according to the Ministry of Manpower, the number of

workplace accidents in 2010 reached 531 cases, in 2011 reached 501 cases, in 2012 increased to 912 cases, and in 2013 reached 632 cases. Meanwhile, according to the Ministry of Manpower, the number of workplace accidents in Pinrang Regency in 2022 was 22 cases, in 2023 it reached 88 cases, in 2024 it increased to 150 cases, and in 2025 (January-June) there were 71 cases. (BPJS Ketenagakerjaan).

The implementation of occupational safety and health in Indonesia is clearly regulated by Law of the Republic of Indonesia Number 1 of 1970 concerning Occupational Safety. The implementation of occupational safety and health is the responsibility of all stakeholders in accordance with their duties and authorities. Companies are required to take active, continuous, and sustainable measures in various actions and fields of work. When occupational safety levels are high, accidents involving illness, disability, and even death can be minimized, so that employees and the community around the workplace can feel safe and comfortable (Oktaviany, 2020).

There are two factors that influence workplace accidents, namely unsafe actions and unsafe conditions. Based on statistics in Indonesia, 80% of accidents are caused by unsafe actions and 20% by unsafe environments or hazardous conditions (Febriani, 2023). The use of PPE in accordance with Standard Operating Procedures (SOP) is an effort to protect workers and minimize workplace accidents. Equipment used by workers to protect themselves from physical, chemical, biological, mechanical, electrical, and other contacts that cause workplace accidents is called Personal Protective Equipment (PPE). It is clear that PPE is equipment that must be used in the workplace in accordance with the risks in the workplace to ensure the safety of employees and observers. PPE is the last line of defense for workers in the workplace (Lubis, 2022).According to Suma'mur (2009:91), a workplace accident is an unwanted event or incident that causes harm to humans, damages property, or causes losses to processes. Workplace accidents are accompanied by various material losses and suffering, ranging from mild to severe symptoms, and even death, which can harm employees and companies.

Firefighters and other rescue workers are high-risk occupations because they face various traumatic events. Electrical short circuits, high temperatures, fire, working at heights, explosions, backdrafts and lightning, burning buildings, sharp objects, and physical confrontations with residents are greater risks experienced by firefighters when traveling and at the scene of a fire (Nuramida et al., 2020). According to research results (Nurmaida W, 2020), 53 firefighters in the city of Palu have experienced work accidents with mild, moderate, and severe severity due to a lack of knowledge in the use of PPE. All 11 standard personal protective equipment are available at the Palu City Fire Department, but the number is still insufficient. The more employees have good knowledge, attitudes, and procedures, the less likely they are to face high occupational accident risks. On the other hand, the less knowledge, attitudes, and actions employees have, the greater the risks they face in the workplace.

Based on preliminary data, the fire department in Pinrang Regency is under the auspices of the Pinrang Regency Civil Service Police Unit (POL PP). According to data from the Pinrang Regency fire department, in 2022 there were 98 cases of fire and 1 case (1.9%) of minor work accidents. in 2023 there were 278 fire cases and 2 cases (3.8%) of minor work accidents, and in 2024 there were 84 fire cases and 1 case (1.9%) of severe work accidents. Work accidents experienced by firefighters at the Pinrang Regency city post unit included cuts on the forehead, exposure to zinc, broken bones, punctures from sharp objects, wasp stings, and exposure to falling zinc debris while extinguishing fires. In such situations, officers are often assigned to extinguish fires, so the frequency of exposure to danger is even higher.

Based on an interview with one of the firefighters in Pinrang Regency on March 22, 2025, firefighters play an important role in responding to fire hazards that occur in Pinrang Regency. Firefighting operations in Pinrang Regency are carried out by 52 personnel from the Watang Sawitto Subdistrict City Post Unit in Pinrang Regency. When there is a report of a fire, only a few people use personal protective equipment at the scene. The four people who use PPE are those who work as Nossel/firefighters who spray directly or come into direct contact with the burning object. The officers did not wear fire fighting suits or heat-resistant clothing because they were damaged, the available PPE was limited, and the quality of the PPE was also unsafe, which could cause work accidents.

Based on the description and background above, firefighters can be categorized as one of the groups of workers who are at risk of experiencing work accidents and occupational diseases because their

daily activities are in a fairly dangerous area. Therefore, the researcher is interested in conducting research with the title Relationship Between the Use of Complete Personal Protective Equipment (PPE) and Work Accidents Among Firefighters at the Pinrang Regency Fire Station.

2. Methods

This type of research uses an analytical observational approach with a cross-sectional design. This design was chosen because it provides an overview of the relationship between independent and dependent variables at a specific point in time. The independent variable in this study is the use of personal protective equipment (PPE), while the dependent variable is the incidence of work accidents among firefighters. With this design, researchers can assess the extent to which the use of PPE is related to the risk of work accidents experienced by respondents. The cross-sectional approach is also relevant because the study was only conducted in a specific period of time, making it practical, efficient, and in line with the study's objective of assessing the relationship without direct intervention. In addition, the analytical observational method allows researchers to analyze behavior patterns and risk factors naturally, so that the results can reflect the real conditions in the field.

This study was conducted at the Watang Sawitto Subdistrict City Post Unit, Pinrang Regency, which is one of the main operational locations of the Fire Department in the area. This location was chosen because it has a relatively adequate number of personnel and a fairly high level of occupational risk, which is in line with the objectives of the study. The study was conducted from July 2 to 8, 2025. This timing was chosen considering the availability of respondents and compatibility with the fire department's operational schedule so that the data collection process would not interfere with their work activities. All research activities, from instrument preparation and data collection to validation, were carried out within that time frame. Thus, this study is expected to accurately and representatively describe the use of PPE and work accidents during the study period.

The population in this study was all firefighters serving at the Watang Sawitto District Fire Station in Pinrang Regency in 2025, totaling 52 people. This number was obtained based on official data from the Fire Department for the last three years. The sampling technique used was total sampling, so that all members of the population were included in the research sample. The inclusion criteria included firefighters who were on duty at the Watang Sawitto Subdistrict City Post Unit and were willing to be respondents by giving their consent. Meanwhile, the exclusion criteria were officers who did not serve in the unit and who refused to participate in the study. Total sampling was chosen to avoid selection bias and to ensure that the data obtained covered the entire population. Thus, the results of the study are expected to be more valid, generalizable to all officers in the unit, and provide a comprehensive picture of the relationship between the use of PPE and work accidents.

3. Results and Discussion

1. Respondent Characteristics

Table 1.
Respondent Characteristics

Characteristics	Category	n	(%)
Education	Elementary School	0	0,0
	Junior High School	1	1,9
	High School/Vocational School	43	82,7
	Bachelor's Degree	8	15,4
Gender	Male	52	100,0
	Female	0	0,0
Age	21–35 Years Old	25	48,1
	36–50 Years Old	27	51,9
Total Respondents		52	100,0

Based on Table 1, the characteristics of the research respondents show that the majority of firefighters have a high school/vocational school education, totaling 43 people (82.7%), while the lowest

level of education is junior high school, with only 1 person (1.9%). In terms of gender, all 52 respondents (100%) are male, with no female respondents. In terms of age, the respondents were divided into two groups, namely 21-35 years old, totaling 25 people (48.1%), and 36-50 years old, totaling 27 people (51.9%). These results show that most of the firefighters at the Watang Sawitto Subdistrict Fire Station are of productive age and have a high school education or higher, with a predominance of males, which is in line with the physical demands of the job.

b. Variable Characteristics

1) Personal Protective Equipment

Table 2.
Distribution of Respondents Based on Personal Protective Equipment at the Fire Department Unit in Watang Sawitto District, Pinrang Regency, in 2025

No	Personal Protective Equipment	n	(%)
1	Complete	24	46,2
2	Incomplete	28	53,8
	Total	52	100,0

Based on Table 2 above, it shows that out of 52 respondents, 24 respondents (46.2%) used complete personal protective equipment and 28 respondents (53.8%) used incomplete personal protective equipment at the Fire Department Unit in Watang Sawitto District, Pinrang Regency.

2) Work Accidents

Table 3.
Distribution of Respondents Involved in Work Accidents at the Fire Department Unit in Watang Sawitto District, Pinrang Regency, in 2025

No	Work Accident	n	(%)
1	Experienced	36	69,2
2	Not Experienced	16	30,8
	Total	52	100,0

Based on Table 3 above, it shows that out of 52 respondents, 36 respondents (69.0%) experienced work accidents and 16 respondents (30.8%) did not experience work accidents at the Fire Department Unit in Watang Sawitto District, Pinrang Regency.

c. Bivariate Analysis

Table 4.
Cross-Tabulation of Respondents Based on the Relationship Between Personal Protective Equipment and Work Accidents Among Firefighters at the City Fire Station in Watang Sawitto District, Pinrang Regency, in 2025

No	APD	Work Accident				Total		P
		Not Experienced		Experienced				
		n	%	n	%	n	%	
	Complete	2	0,3	2	1,7	4	00	,001
	Incomplete	4	0,0	4	0,0	8	00	
	Total	6	0,8	6	9,2	2	00	

Table 4 shows that of the 24 respondents who used complete personal protective equipment, 2 respondents (8.3%) did not experience a work accident and 22 respondents (91.7%) experienced a work accident. Meanwhile, of the 28 respondents who used incomplete personal protective equipment, 14 respondents (50.0%) did not experience a work accident and 14 respondents (50%) experienced a work accident.

Discussion

Based on the results of the analysis conducted on firefighters based on their education, it was found that out of 52 respondents, 1 respondent (1.9%) had a junior high school education, 43 respondents

(82.7%) had a high school/vocational school education, and 8 respondents (15.4%) had a high school education. The gender distribution showed that all 52 respondents (100.0%) were male. The age distribution shows that of the 52 respondents, 25 respondents (48.1%) were firefighters aged 21-35 years, while 27 respondents (51.9%) were aged 36-50 years.

Based on these results, it can be concluded that the relationship between education and work accidents according to the human error theory is the main cause of work accidents. Low education can increase the potential for errors and make it difficult to understand technical instructions or SOPs. The higher the level of education, the better the ability to understand work risks and the use of PPE to reduce the risk of work accidents. All respondents in this study were male (100%). This shows that the profession of firefighter at the Watang Sawitto sub-district fire station in Pinrang Regency is still dominated by men, in line with the characteristics of the job, which requires physical strength and courage. Meanwhile, according to Individual Difference Theory, this theory states that individual characteristics such as age, experience, and physical ability affect the risk of workplace accidents. Younger people (less experienced) tend to be more careless and less aware of risks, while older people may be more experienced, but their physical abilities such as vision, hearing, and reflexes may decline.

Based on Tables 5 and 6, it shows that of the 24 respondents who used complete personal protective equipment, 2 respondents (8.3%) did not experience a work accident and 22 respondents (91.7%) experienced a work accident. Meanwhile, of the 28 respondents who used incomplete personal protective equipment, 14 respondents (50.0%) did not experience a work accident and 14 respondents (50%) experienced a work accident.

Based on the results of the bivariate analysis of the relationship between the use of personal protective equipment and work accidents at the Fire Department Unit of Watang Sawitto District, Pinrang Regency, using the chi-square test, a p-value of 0.001 ($p<0.05$) was obtained. Based on this p-value, there is a relationship between the use of personal protective equipment and work accidents, which is in accordance with the hypothesis that has been made.

The results of this study show a logical and theoretical relationship, as the use of complete PPE plays an important role in protecting workers from potential hazards in the workplace. When officers use PPE completely and in accordance with standards, the risk of exposure to heat, sharp objects, or hazardous substances is reduced. Therefore, the higher the compliance in using PPE, the lower the possibility of workplace accidents.

In the context of firefighting, the provision of PPE that complies with operational standards and work safety protocols is the main responsibility of the relevant agencies. However, the results of the observation show that officers use complete personal protective equipment but do not comply with SOPs, resulting in work accidents such as being pierced by nails because the boots worn are not safe or do not meet standards. while other officers did not use complete PPE because not all firefighters had PPE, with another reason being that PPE was not provided by the office, so the PPE used was makeshift.

Although the use of complete Personal Protective Equipment (PPE) has become a mandatory procedure for firefighters, the reality in the field shows that work accidents can still occur if the PPE used does not comply with applicable national or international standards. This study found cases where officers had used complete PPE—consisting of protective helmets, fire-resistant clothing, gloves, boots, and masks—but still experienced work accidents such as minor to moderate burns, minor pain, and injuries from falls.

One of the main contributing factors is the incompatibility of the quality and technical specifications of PPE with the standards set by authorities such as the NFPA (National Fire Protection Association) or SNI (Indonesian National Standards). For example, the fire-resistant clothing used by officers is not made of materials that can withstand extreme temperatures above 800°C, so it does not provide maximum protection in the event of a flashover or sudden heat explosion inside a burning building. Similarly, some of the boots used do not meet heat resistance and anti-slip standards, which increases the risk of slipping or being hit by sharp objects at the scene.

In addition, there are problems with the maintenance and routine checking of PPE. Some personal protective equipment, although physically complete, has experienced a decline in function due

to long-term use or improper storage. For example, SCBA that is not tested for suitability on a regular basis has the potential to leak or not provide sufficient oxygen supply, thereby endangering officers when they are in a smoke-filled environment.

Another factor is the lack of training on the proper use of PPE. Some officers still use PPE without paying attention to the correct way to wear it, such as helmets that are not fastened properly or gloves that are the wrong size, which actually reduces the effectiveness of the PPE's protection.

Thus, even though PPE has been fully implemented administratively, if it does not meet quality standards, is not properly maintained, or is not used according to procedures, the risk of workplace accidents remains high. This shows that the availability of complete PPE must be balanced with standard-compliant quality, regular maintenance, and proper training for all firefighting personnel. Therefore, it is important to implement SNI ISO 11999 as a reference in ensuring the quality, flexibility, and safety of PPE for firefighters (National Standardization Agency, 2022). The quality of PPE materials and design has been proven to play an important role in increasing its effectiveness.

The use of personal protective equipment (PPE) is closely related to safe work behavior, especially when workers face potential hazards during the work process. Even seemingly minor risks, such as not wearing a helmet, gloves, mask, or protective shoes, can have an impact on work safety. The use of PPE also plays an important role in preventing health problems, such as respiratory problems, visual impairment, and exposure to hazardous substances (Januardhana et al., 2024). The availability of adequate work facilities and their optimal utilization contribute positively to improving employee performance. Complete and high-quality facilities, such as appropriate equipment, a conducive work environment, and the right technological support, can boost efficiency and productivity. Conversely, limited facilities can hinder the smooth running of work activities (Masripah & Rahmi, 2025).

Firefighting is a high-risk job involving injuries and occupational diseases that can result in disability or even death. Working in emergency and unpredictable situations, firefighters must accept all existing risks and be prepared for any possibility that may occur.

Firefighters are constantly faced with various fire incidents, so they are required to be on standby at all times while performing their duties. Firefighting is a job with a high risk of accidents due to exposure to firefighting incidents, saving lives, and property from communities affected by fires. Therefore, firefighters must be able to perform their duties well.

Based on the results of an analysis of work accidents, 69.2% of firefighters have experienced a work accident, while 30.8% have never experienced a work accident. Of the 52 firefighters studied, 36 (69.2%) had experienced work accidents, including minor pain, burns, puncture wounds from sharp objects, slips, falls, being hit by objects, and building debris.

Other hazards experienced by firefighters from the Watang Sawitto Subdistrict Fire Station in Pinrang Regency include broken bones from falling out of fire trucks when arriving at the scene of a fire, sore eyes from smoke and dust, slipping on puddles and slippery surfaces, and being struck by sharp or blunt objects during the evacuation process.

There are five potential hazards that often occur in firefighting, namely falling due to dark conditions during handling, being hit by tools in the batching plan production area, slipping while evacuating victims, being pinched during vehicle checks, and being injured by exploding batteries when installing car battery safety devices. Risk control can be done by providing Personal Protective Equipment (PPE), installing and placing safety signs, and performing maintenance.

The risks of firefighters' work at fire sites include work accidents caused by electricity, high temperatures, fire, working at heights, firefighting equipment, explosions, backdrafts and flashovers, burning building conditions, sharp objects, and physical altercations with residents. This is because residents panic and feel dissatisfied with the late arrival of firefighters at the fire scene.

From the results of research conducted by Wahyu Nuramida, et al. (2020) on the use of personal protective equipment and work accidents among firefighters, the sample used was 53 people. Using the chi-square test, it was found that there was a significant relationship between the use of personal protective equipment and work accidents, as proven by a statistical test with a P value of 0.001 (<0.05). The results of this study are in line with previous studies, which found that there is a relationship between

the use of personal protective equipment and work accidents.

According to Meilindah (2018), there is a significant relationship between the use of personal protective equipment and work accidents among workers on the new law faculty building construction project at Sam Ratulangi University in Manado, which obtained a P-value of 0.011 (0<0.05). The results of research conducted by Fatmawati Nugraheni, et al (2024) show that there is a relationship between the use of personal protective equipment and the occurrence of work accidents among sewing workers at PT. Sinar Klaten Makmur, with a p value of 0.004.

4. Conclusion

Based on the results of this study, it was found that most firefighters at the Watang Sawitto Subdistrict Fire Station in Pinrang Regency (69.2%) did not use complete personal protective equipment (PPE) while on duty, particularly heat-resistant gloves and anti-slip boots, which are essential for preventing occupational accidents. The analysis also revealed a significant relationship between the use of PPE and the occurrence of work accidents (p = 0.001), confirming that incomplete PPE use increases the risk of injury. Practically, these findings underscore the urgent need for fire departments and local authorities to ensure the procurement of standard-compliant PPE, provide regular training on its proper use, and implement periodic supervision and monitoring to improve compliance among firefighters. In addition, collaboration between local and national occupational safety agencies should be strengthened to standardize safety protocols in firefighting environments. For future research, it is recommended to expand the geographical coverage and adopt a longitudinal or mixed-method approach to better understand behavioral and organizational factors affecting PPE compliance. Broader and deeper investigations will enhance the generalizability of findings and support the development of evidence-based national policies on occupational safety for emergency service personnel.

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