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# Analysis of Risk Factors of Workplace Accidents in Construction Workers In The Tallasa City Area

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**ABSTRACT**

**Background**: Construction workers are at high risk of experiencing work accidents due to the characteristics of heavy and complex work. Various individual and work environment factors can influence the occurrence of accidents .

Objective: This study aims to analyze the risk factors for work accidents in construction workers in the Tallasa City area .

**Method**: The design of this study was a case control with a quantitative approach. The sample consisted of 70 respondents (35 cases and 35 controls), with matching based on gender and type of employment. Data were analyzed using the chi-square test, odds ratio (OR), and multiple logistic regression .

**Results**: The results of the bivariate analysis showed that the variables significantly associated with work accidents were length of service (OR=5.073; p=0.002), education level (OR=3.039; p=0.030), training history (OR=4.463; p=0.003), working hours (OR=3.524; p=0.012), and use of PPE (OR=3.864; p=0.007). Marital status did not show a significant relationship (p=0.131). The results of the multivariate analysis showed that length of service was the most influential variable (OR=4.627; 95% CI=1.604–13.348; p=0.005).

**Conclusion**: Working period ≤ 3 years significantly increases the risk of work accidents. Therefore, special training, mentoring, and supervision for new workers are very important to reduce the number of work accidents.

**Key Words:** *work accidents , work period, construction, risk factors, PPE*

## 1. INTRODUCTION

The construction industry includes the construction and repair of buildings and facilities, which play an important role in economic growth and the fulfillment of basic needs. In addition to time, quality, and cost, aspects of occupational safety must also be considered (1). Occupational safety and health in construction projects is a complex issue influenced by management, humans, and technical aspects, but is still less recognized as a basic need for work welfare and productivity (2). According to Government Regulation Number 50 of 2012, Occupational Safety and Health or K3 is all activities to guarantee and protect the safety and health of workers through efforts to prevent work accidents and work-related diseases.

Construction Safety and K3 Construction aims to ensure the safety of workers, the public, and the environment through preventing work accidents, where the construction sector in Indonesia is ranked first with the highest accident rate of 32%, followed by the transportation sector (9%), forestry (4%), and mining (2%), with the main causes of accidents being unsafe actions (88%), unsafe conditions (10%), and factors beyond human control (2%) (3). Occupational safety and health (K3) is an important challenge for construction companies because it has a direct impact on the smooth running of projects, which are complex, short-term, and risky, and play a major role in global economic growth ( Kuwait. et al., 2021) . Indonesia's construction sector is growing by 6%–7% per year and is projected to increase by 15% by 2050, with the number of companies increasing from 159,308 in 2020 to 203,403 in 2021.

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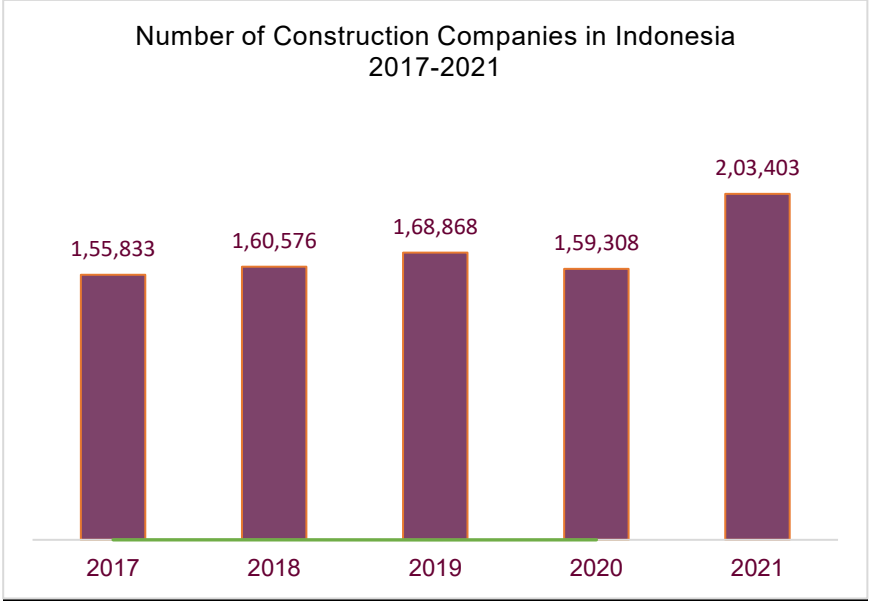


**Figure 1. Number of Construction Companies in Indonesia 2017-2021**

*Source* : Central Statistics Agency (2021)

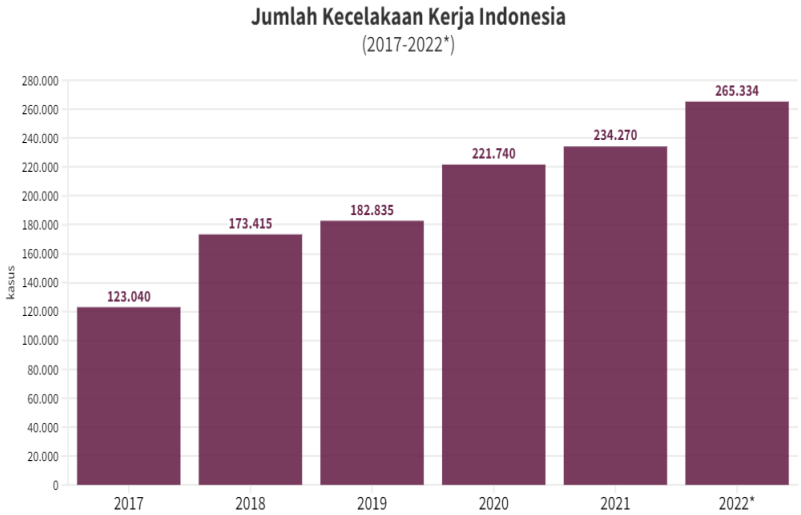


**Figure 2. Number of Work Accidents in Indonesia 2017-2022**

*Source* : BPJS Employment (2022)

Although the construction industry has a high economic impact, the construction services industry is also one of the industrial sectors with a high risk of work accidents (4). According to the ILO, the rate of work accidents in Indonesia is still high, especially in the construction sector, with 6,000 cases occurring every day and 20 fatalities per 100,000 workers. BPJS data recorded 265,334 cases of work accidents in January–November 2022, up 13.36% from 234,270 cases in 2021, with an increasing trend since 2017. The construction industry is the highest and most serious contributor to work accidents, indicating the need for improvements in K3 policies and supervision. Every construction project has a high risk of danger, such as falling from a height, being crushed, electrocuted, or trapped, which can cause minor injuries, permanent disability, or death, as well as causing losses to workers and other parties (5). Work accidents are detrimental to workers and companies, causing claims costs, overtime, compensation, and potential project terminations which add additional costs (6).

Workplace accidents are influenced by the interaction of worker factors (age, gender, experience), machines or jobs, and the

environment (physical, chemical, biological). Causes of accidents include human error due to excessive workload, lack of control, underlying causes, and direct causes. Generally, accidents are caused by factors of workers who lack experience and knowledge of K3, unsafe workplace conditions, inadequate equipment, and lack of safety equipment or PPE. Based on research conducted by Hamudya et al., (2023) with a significant relationship between age and work accidents with a P value = 0.000. Then it has an *Odds Ratio value* of 4.118 with a 95% *Confidance Interval* (CI) of 1.915-8.885, meaning that age ≥ 34 years provides a 4 times greater chance of experiencing a work accident compared to age <34 years (7). This study is in accordance with that conducted by Sanur & Suwandi, (2020) that there is a significant relationship between Work Period and work accidents with a P *value* = 0.042. Then it has an *Odds Ratio value* of 5.833 with *a Confidence Interval* (CI) of 95% = 1.298 – 26.223, therefore the length of service has an influential relationship with the occurrence of work accidents (8).

Research shows that low education levels, neglected OHS training, and working hours of more than 40 hours per week increase the risk of work accidents, while low compliance with the use of personal protective equipment (PPE) worsens the condition. Complex construction projects such as the Tallasacity development in Makassar still experience OHS violations due to lack of worker discipline and inadequate facilities. PT. X, which is working on the project, even though it has implemented a Construction Safety Management System according to HSE standards, still recorded 4 cases of work accidents between March–May 2023 due to unsafe behavior and lack of use of PPE by 60% of workers out of a total of 118 people with various educational backgrounds. Therefore, a more effective risk analysis and preventive measures are needed, and this study aims to examine the risk factors for work accidents in the Tallasacity Area.

**Participants & Methods**

This study uses an analytical observational approach with a Case Control design, comparing two groups, namely cases and controls. Conducted in Tallasa City, Tamalanrea, Makassar City, South Sulawesi, in August–December 2024, with a population of 118 construction project workers. The minimum sample was calculated using the Lemeshow formula, obtaining 35 samples per group for a total of 70 samples, with a purposive sampling technique (non-probability sampling). Data were collected through questionnaires and direct observation, then analyzed using SPSS. Data analysis includes univariate to describe variables independently and bivariate to test the relationship between variables using the chi square test with a significance level of 95%. Decisions are made based on the p-value: p> 0.05 rejects the hypothesis and p ≤ 0.05 accepts the hypothesis. In addition, the Odds Ratio (OR) value is used to assess the strength of the relationship between risk factors and the occurrence of work accidents.

**Findings**

PT Royal Damboo Infrastruktur is a construction company that focuses on housing and commercial development in Tallasa City, prioritizing quality, efficiency, and sustainability. Supported by professional workers and a clear organizational structure, the company prioritizes occupational safety and health (K3) and complies with construction regulations. In addition to physical development, the company is also committed to human resource development through training and the use of personal protective equipment (PPE). This study was conducted on a 5-kilometer water channel construction project in Tallasa City, Makassar, with 118 workers from various construction fields actively working during January–June 2024, to examine aspects of occupational safety and health in a complex project environment.

The distribution of respondents showed that the majority of workers who experienced work accidents (cases) were in the 25–44 age group as many as 21 people (30.0%), had a work period of ≤3 years as many as 33 people (47.1%), and a junior high school/equivalent education level as many as 23 people (32.9%). As many as 23 people (32.9%) in the case group were married, 32 people (45.7%) had received training, 30 people (42.9%) worked more than 8 hours per day, and 32 people (45.7%) used complete PPE. Meanwhile, in the control group (not experiencing work accidents), the majority had a work period of >3 years as many as 26 people (37.1%), an education level of >junior high school/equivalent as many as 27 people (38.6%), had never received training as many as 26 people (37.1%), worked ≤8 hours as many as 26 people (37.1%), and 25 people (35.7%) used incomplete PPE. Male gender dominated both groups, namely 27 people (38.6%) in cases and 26 people (37.1%) in controls, while the type of heavy work was most often found in the case group, as many as 19 people (27.1%). This distribution indicates that short work periods, low education, lack of training, and long working hours are more often found in workers who experience work accidents.

**Table 1. Distribution of Respondents Based on Occupational Accident Incidents**

| **cupational Accident Incident** | **equency (n)** | **rcentage (%)** |
|---|---|---|
| **er Had a Work Accident (Case)** | | |
| **ver Had a Work Accident (Control)** | | |
| **ne of Accident Occurrence** | | |

| | | |
|---|---|---|
| **ile Working** | | 7 |
| **ring the trip to the work location** | | 3 |
| **e of Accident Experienced** | | |
| **len** | | 7 |
| **by a falling object** | | 6 |
| **bbed** | | 4 |
| **t** | | 9 |
| **ck** | | 3 |
| **ctrocuted** | | |
| **ured part** | | |
| **ad** | | 9 |
| **ck** | | 1 |
| **dy** | | 9 |
| **nd** | | 0 |
| **t** | | |
| **nditions When Having an Accident** | | |
| **acture** | | 4 |
| **ious Injury** | | 3 |
| **ke Is In** | | 3 |
| **nor injuries** | | 0 |

A total of 35 people (50%) had experienced work accidents (cases) and 35 people (50%) had never experienced work accidents (controls). The most accidents occurred at work as many as 39 people (55.7%) compared to during the journey to the work location as many as 31 people (44.3%). The most common type of accident was being stabbed by a sharp object as many as 22 people (31.4%), followed by being hit by a falling object as many as 13 people (18.6%), and falling as many as 11 people (15.7%). Meanwhile, the most frequently injured body parts were the head as many as 23 people (32.9%) and the neck as many as 19 people (27.1%). The most common condition experienced during an accident was a broken bone as many as 22 people (31.4%), followed by serious injuries and moderate injuries each as many as 17 people (24.3%). These findings indicate that most accidents occur in the workplace with serious injuries, especially to the head and neck, which have the potential to have a significant impact on worker safety.

M ost respondents did not use complete personal protective equipment (PPE) while working. The use of helmets was the most widely used, namely by 36 respondents (51.4%), while eye protection, gloves, safety shoes, and work clothes were only used by 16–19 respondents (22.9%–27.1%). Most respondents did not use eye protection (77.1%), ear protection (72.9%), and gloves (77.1%). This finding shows that the use of PPE among construction workers is still low, especially for PPE other than helmets .

**Bivariate Analysis**

**Table 2. Cross tabulation of variables with work accidents**

| **Variables** | **Work accident** | | | | **OR** | ***Confidence Interval*** | ***P-Value*** |
|---|---|---|---|---|---|---|---|
| | **Case** | | **Control** | | | | |
| | **n** | **%** | **n** | **%** | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ≤3 years (High risk) | 31 | 75.6 | 11 | 37.9 | 5,073 | 1,802 – 14,277 | 0.002 |
| > 3 years (Low risk) | 10 | 24.4 | 18 | 62.1 | | | |
| Junior High School/Equivalent | 22 | 53.7 | 8 | 27.6 | 3,039 | 1,096 – 8,427 | 0.030 |
| High School/Equivalent | 19 | 46.3 | 21 | 72.4 | | | |
| Marry | 31 | 75.6 | 17 | 58.6 | 2.188 | 0.784 – 6.109 | 0.131 |
| Not married yet | 10 | 24.4 | 12 | 41.4 | | | |
| Never Had Training | 30 | 73.2 | 11 | 37.9 | 4.463 | 1,610 – 12,373 | 0.003 |
| Ever Had Training | 11 | 26.8 | 18 | 62.1 | | | |
| Work >8 Hours | 28 | 68.3 | 11 | 37.9 | 3,524 | 1,300 – 9,558 | 0.012 |
| Work ≤ 8 Hours | 13 | 31.7 | 18 | 62.1 | | | |
| Incomplete PPE | 30 | 73.2 | 12 | 41.4 | 3,864 | 1,405 – 10,625 | 0.007 |
| Complete PPE | 11 | 26.8 | 17 | 58.6 | | | |

The results of the analysis in Table 2 show that several variables have a significant relationship with the occurrence of work accidents. Workers with a work period of ≤3 years have a 5 times higher risk of work accidents than those with a work period of >3 years (OR = 5.073; CI: 1.802–14.277; p = 0.002), which shows that work experience has a significant effect on the risk of accidents. In addition, education level also plays an important role, where workers with junior high school education/equivalent have three times greater chance of having an accident than those with high school education/equivalent (OR = 3.039; p = 0.030). Other significant factors are K3 training, working hours, and completeness of PPE. Workers who have never received training have a 4.5 times higher risk of having an accident (OR = 4.463; p = 0.003), and workers who work more than 8 hours per day have a 3.5 times higher risk (OR = 3.524; p = 0.012). The use of PPE also has a significant influence, where workers who do not use complete PPE have a risk almost 4 times higher than those who use complete PPE (OR = 3.864; p = 0.007). Meanwhile, marital status did not show a significant relationship with the occurrence of work accidents (p = 0.131). These findings indicate that individual factors and work behavior significantly influence the risk of accidents in construction projects.

**Multivariate Analysis**

**Table 3. Results of Multiple Logistic Regression Multivariate Test**

| **Variables** | | **Sig.** | **95% CIfor EXP(B)** | |
|---|---|---|---|---|
| | | | **Lower** | **Upper** |
| ***Step 1*** [a] | Years of service | 1,000 | .000 | . |
| | last education | .124 | .787 | 7.375 |
| | Experience of attending training | 1,000 | .000 | . |
| | Working time | .932 | .083 | 9,758 |
| | Use of PPE | .216 | .639 | 7.257 |
| | Constant | .001 | | |
| ***Step 2*** [a] | Years of service | 1,000 | .000 | . |
| | last education | .119 | .796 | 7,363 |
| | Experience of attending training | 1,000 | .000 | . |
| | Use of PPE | .208 | .651 | 7.229 |

| | | | | |
|---|---|---|---|---|
| | Constant | .001 | | |
| ***Step 3*** [a] | Years of service | .045 | 1,028 | 10,934 |
| | last education | .094 | .852 | 7,739 |
| | Use of PPE | .249 | .615 | 6,534 |
| | Constant | .001 | | |
| ***Step 4*** [a] | Years of service | .005 | 1,604 | 13,348 |
| | last education | .081 | .889 | 7,791 |
| | Constant | .001 | | |

Based on the results of multiple logistic regression tests, it is known that the variables of last education, length of service, and use of personal protective equipment (PPE) are factors that have an influence on the occurrence of work accidents in construction workers, although not all of them are statistically significant at the 5% level. The last education variable shows the most consistent influence with an OR value of 2.631 (p = 0.081) in the last step, which indicates that workers with low levels of education are at higher risk of experiencing work accidents. The variable of length of service also shows a tendency towards risk, with an OR of 4.632 (p = 0.062), which means that workers with a length of service ≤3 years have a greater risk of experiencing accidents. The use of PPE shows a protective tendency against work accidents, although the results are not yet significant (OR = 2.003; p = 0.204). Overall, these three variables need attention in efforts to control the risk of work accidents, especially through increasing education, job training, and consistent supervision of the use of PPE.

The results of the multiple logistic regression test in Table 3, the most influential variable on the occurrence of work accidents is the length of service. This can be seen in the fourth step ( *Step 4* ), where the length of service has an odds ratio (OR) value of 4.632 with a significance value of p = 0.062, which is closest to the significance limit (0.05) compared to other variables. Although not yet fully statistically significant, the OR value shows that workers with a length of service ≤3 years have a risk of about 4.6 times greater than workers with a length of service of more than 3 years, after being controlled by the variables of education and use of PPE. Thus, length of service is the most dominant variable influencing the occurrence of work accidents, and can be considered as the main risk factor in the context of this study.

## 2. DISCUSSION

### The Influence of Length of Service on Work Accidents

The results of the analysis showed that length of service is a risk factor for work accidents, where workers with a length of service ≤ 3 years have a 5.073 times greater risk of having an accident. However, after stratification by type of work and gender, the relationship became inconsistent: in heavy work and men the risk increased (OR = 7.250), while in light work and men it decreased (OR = 0.540). This indicates the presence of confounding factors that influence the relationship between length of service and work accidents. This finding illustrates that the longer a person's length of service, the higher their experience and understanding of work safety procedures, as well as their ability to recognize potential hazards in the workplace. Long-term work experience allows workers to be more familiar with the characteristics of work, the risks that may arise, and appropriate mitigation strategies. In contrast, workers with short periods of service generally do not have adequate experience and work skills formed from training and familiarization with K3 procedures.

This study is consistent with the findings of Gebretsadik et al. (2023) in Ethiopia which showed that workers with a work period of ≤ 3 years had a 3.8 times higher risk of experiencing work injuries than those with a work period of > 3 years (AOR = 3.80; 95% CI: 1.68–8.60) (9) . Isik & Isikhan (2024) in Turkey also found that 68% of work accidents occurred in workers with <1 year of experience, and only 23% in those with 1–5 years of experience (10) . These results support Heinrich's Domino Accident Theory that lack of work experience is a major factor in accidents. Social Learning Theory also reinforces that work experience plays a role in shaping safe behavior. Therefore, it is important for companies to provide intensive training and supervision to new workers.

### The Influence of Education Level on Work Accidents

The results of the hypothesis test showed that education level is a risk factor for work accidents in construction workers in the Tallasacity area. Workers with junior high school education/equivalent have a 3.039 times greater risk of having an accident compared to workers with high school education/equivalent, with 73.3% of accident cases occurring in the low education group. However, after stratification by type of work and gender, the relationship became inconsistent: the OR decreased to 0.432 in heavy work and men, and increased to 1.600 in light work and men. This indicates the presence of

confounding factors, and confirms that low education tends to be associated with limited understanding of safety instructions, which increases the risk of accidents in the construction work environment.

This study is in line with the findings of Ayalew et al. (2022) in Ethiopia which showed that workers with low education had a 3.5 times higher risk of work injuries than those with secondary education or higher (AOR = 3.51; 95% CI: 1.77–6.95) (11) . Similar results were found by Al-Turki et al. (2023) in Saudi Arabia, where low-educated workers had a 2.9 times higher risk of injury (AOR = 2.91; 95% CI: 1.45–5.84) (12) . Both studies emphasize the importance of education in shaping safe work behavior and the need for communication that is tailored to the literacy level of workers. This is reinforced by Bandura's Social Cognitive Theory which states that the ability to understand and respond to work risks is greatly influenced by education and learning experience. Therefore, construction companies need to adapt OHS training using a visual approach, simple language, and participatory methods to be more effective for workers with basic education.

**Relationship between Training History and Work Accidents**

The results showed that the history of OHS training is an important factor in preventing work accidents in the construction sector. Workers who have never received training have a 4.463 times greater risk of experiencing work accidents than those who have received training (73.2% vs. 37.9%). After stratification by type of work and gender, the OR value remained high in the heavy work and male group (OR = 3.500), but dropped drastically in the light work and male group (OR = 0.540), indicating the influence of confounding factors. This means that training has a significant impact, especially in high-risk jobs, because it helps workers understand safe procedures, use of PPE, and OHS principles in a more disciplined manner.

This finding is supported by the study by Tadesse et al. (2024) which showed that workers without OHS training had a 2.7 times higher risk of work injuries (AOR = 2.70; 95% CI: 1.56–4.67), and recorded a risk rate of 2.38 times higher (57.5% vs 24.1%) (13) . Russeng et al. (2020) also emphasized that minimal OHS training, especially in new workers, increases the risk of accidents (14) . Based on Cooper's Safety Behavior Theory, training influences safe behavior by increasing knowledge and positive attitudes towards safety. Therefore, OHS training should be a mandatory part and evaluated periodically in every construction project .

**Relationship between Working Hours and Work Accidents**

The results showed that long working hours (>8 hours) were a significant risk factor for occupational accidents in construction workers. As many as 71.8% of workers with working hours >8 hours had accidents, compared to 41.9% in the ≤8 hours group. The Odds Ratio (OR) value = 3.524 indicated that workers with long working hours had a 3.5 times greater risk of having an accident. However, after stratification by type of work and gender, this relationship became inconsistent. In heavy work and men, the risk remained increased (OR = 1.625), but in light work and men, it decreased (OR = 0.540), indicating the presence of confounding factors.

This finding is consistent with Faisal's (2021) research at PT. Tirta Kencana Pratama, where 71.4% of drivers with abnormal working hours had accidents, much higher than 31.8% in normal working hours (p = 0.005) (15) . In theory, long working hours increase the risk of accidents because they cause physical and mental fatigue, reduce concentration, and increase the possibility of work errors. Therefore, setting ideal working hours and providing sufficient rest time are important steps in preventing work accidents in the construction sector.

**The Relationship between the Use of Personal Protective Equipment and Work Accidents**

study shows that construction workers who do not use complete Personal Protective Equipment (PPE) have a much higher risk of work accidents. Of the 42 workers who did not use complete PPE, 71.4% had accidents, compared to only 39.3% of those who used complete PPE. The Odds Ratio (OR) value = 3.864 indicates that incomplete use of PPE increases the risk of accidents almost 4 times. Stratification by type of work and gender shows that in heavy work and men, the OR remains high (3.500), but drops to 0.444 in light work, indicating a confounding factor. This confirms that the use of complete PPE plays a protective factor, especially in high-risk jobs.

This finding is in line with the research of Anjalina et al. (2023), which found that workers who did not use complete PPE had a 3.281 times greater risk of having an accident (OR = 3.281; 95% CI: 1.336–8.058; p = 0.009) (16) . Also supported by Alkahtani et al. (2021) in Saudi Arabia, which reported that 67% of accidents occurred in workers without PPE, and only 29% in users of complete PPE (17) . Theoretically, this is reinforced by the NIOSH Hazard Control Hierarchy Theory, which places PPE as the last line of defense in preventing work injuries. Therefore, the use of complete PPE is very crucial as the final protection against the risk of accidents, especially in construction work environments with high levels of danger .

**Relationship between Marital Status and Occupational Health**

This study shows that married workers appear to have a higher risk of work accidents than unmarried workers, with 64.6% of married workers experiencing accidents compared to 45.5% of unmarried workers. The Odds Ratio (OR) value = 2.188 indicates a tendency for a two-fold risk. However, after being controlled by type of work and gender, this relationship was not statistically significant because the Confidence Interval (CI) range exceeded 1 and the p value > 0.05. This means that

marital status is not a direct risk factor, but rather acts as a confounding factor that can affect other variables such as workload or type of work.

This finding is consistent with several previous studies. Suherman and Wibowo (2020) showed that marital status was not significantly associated with work accidents (OR = 0.767; CI: 0.279–2.110) (18) . Safety Behavior Theory states that social responsibility can increase motivation to maintain safety, but empirically the influence of marital status is still less than factors such as training and work experience. Thus, marital status needs to be considered as an indirect factor in work safety analysis, not as a primary risk factor.

The method of identifying potential hazards in construction project work is carried out systematically with OHS Experts and OHS Officers using the HIRARC (Hazard Identification, Risk Assessment, and Risk Control) approach. Risk is assessed by multiplying the level of impact and the likelihood of a hazard occurring, which is then grouped based on a priority scale—low, medium, or high. After that, risk control measures are designed with a layered approach: engineering control, administrative control, and the use of personal protective equipment (PPE), as well as the determination of a clear person in charge. The risk analysis presented in the table shows that various stages of construction work have various potential hazards, ranging from respiratory problems due to dust to serious injuries due to being hit by heavy equipment or landslides. High risks generally arise in work involving heavy equipment, excavations, and transportation of large materials. This emphasizes the importance of strict risk control, safe work planning, and discipline in implementing OHS procedures so that worker safety is guaranteed throughout the construction process.

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