Safety Behaviour Tendency Among Welders By Utilising Personal Protective Equipment

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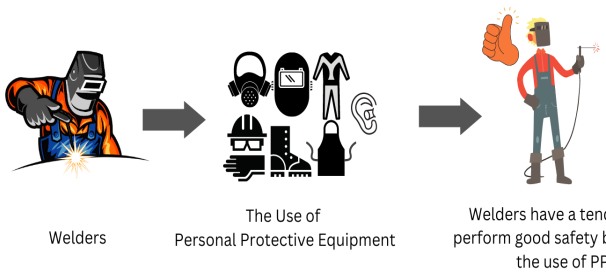
ABSTRACT

Welding is one type of work potentially triggering work accidents. It is thus necessary to prevent work accidents in welding to minimize potential hazards and to prevent both work accidents and significant losses by the safety behaviour by using personal protective equipment. This current study aims to analyze the tendency of safety behaviour among welders in using PPE properly. This research was conducted through an analytic observational study using a cross-sectional design. It was carried out on welders at one of the shipbuilding companies in Indonesia. Sampling was chosen using a total population of 58 respondents. All research instruments, questionnaires, and analysis sheets have been tested for validity and reliability. The researchers looked at the Odds Ratio in the Ordinal Regression test to see behaviour tendency. The results suggest that the variables of knowledge, OSH training, and the reward system have a value of OR > 1. the variables of attitude, work readiness, availability of PPE, OSH promotion, and interaction between workers have a value of OR <1. This study found that welders tend to perform good safety behaviour using personal protective equipment based on determinants of behaviour such as knowledge, attitude, work readiness, availability of PPE, the interaction between workers, OSH promotion, OSH training, reward system, and supervision. Nevertheless, based on the OR value, the safety behaviour tendency differs for each behavioural determinant.

ABSTRAK

Pengelasan merupakan salah satu pekerjaan yang berpotensi menyebabkan kecelakaan kerja. Oleh karenanya diperlukan upaya pencegahan kecelakaan kerja pada pekerjaan pengelasan untuk meminimalisir potensi bahaya, mencegah kecelakaan kerja, dan kerugian besar karena perilaku keselamatan dalam menggunakan alat pelindung diri. Tujuan penelitian ini adalah untuk menganalisis kecenderungan perilaku keselamatan tukang las dalam menggunakan alat pelindung diri dengan baik. Penelitian ini adalah penelitian observasional analitik dengan desain cross-sectional. Penelitian ini dilakukan pada tukang las di salah satu perusahaan galangan kapal di Indonesia. Pengambilan sampel dilakukan dengan total populasi sebanyak 58 responden. Seluruh instrumen penelitian baik kuesioner maupun lembar observasi yang digunakan telah diuji validitas dan reliabilitas. Kecenderungan perilaku diperoleh dari Odds Ration dalam uji Regresi Ordinal. Hasil penelitian menunjukkan bahwa variabel pengetahuan, pelatihan K3, dan sistem penghargaan memiliki nilai OR>1. Studi ini menemukan bahwa tukang las memiliki kecenderungan berperilaku keselamatan yang baik dalam penggunaan alat pelindung diri berdasarkan determinan perilaku seperti pengetahuan, sikap, kesiapan kerja, ketersediaan APD, interaksi antar pekerja, promosi K3, K3 pelatihan, system penghargaan, dan pengawasan. Namun berdasarkan nilai OR, kecenderungan perilaku keselamatan berbeda untuk setiap determinan perilaku.

GRAPHICAL ABSTRACT



Keyword
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INTRODUCTION

Work accidents have been continuously a significant challenge globally. Work accidents and their consequences occur in almost all countries in the world. According to the International Labour Organization (2018), in the Asia and Pacific region, currently, there are approximately more than 1.8 million work-related deaths that occur each year. At the global level, more than 2.78 million people lose their lives annually from occupational accidents or diseases. There are approximately 374 million injuries and non-fatal occupational diseases each year, many of which result in lost days from work.

Furthermore, the incidence and consequences of work accidents also occurred in Indonesia. The Social Security Administration Body for Employment (locally known as *BPJS Ketenagakerjaan*) also counted that the number of work accidents from 2015 to 2019 was likely to fluctuate. In 2019, the number of accidents was still relatively high, namely 130,923 work accidents. Even though cases are said to be decreasing, the total number of claims is still high (IDR 1.09 trillion) (Badan Penyelenggara Jaminan Sosial Ketenagakerjaan, 2019).

Moreover, welding is one type of work which potentially trigger work accidents. It is a hazardous occupation since, almost every day, workers are in a work environment that can cause work accidents, such as from fire and electricity. According to the Bureau of Labor Statistics (BLS), there were 21 welding accidents in the US for every 100.000 workers, also for every 100 million-work hours, about 1.000 workers suffered a welding-related injury. Based on the Japan Ministry of Health, Labor, and Welfare claimed that there are 100 welders injured during the welding process each year; 25 of them suffer serious injuries (Japan Ministry of Health Labour and Welfare, 2012).

Welding has several potential hazards, including the danger of welding light/beam, welding smoke and gas, noise, heat, electrical hazard, fire hazard, and explosion hazards (American Federation of State County and Municipal Employees, 2011). The existence of various potential hazards can cause work accidents. Thus, it is necessary to prevent work accidents in welding to minimize potential hazards and prevent work accidents and significant losses. One of them is behaviour and its determinant. There are several determinants of individual behaviour, one of which is the Lawrence Green Theory which believes that the cause of a person to perform certain behaviours is based on predisposing, enabling, and reinforcing factors. In this case, safety behaviour does not cause work accidents since it is more directed at work safety. This study focuses on the use of PPE as a safety behaviour for welders with the indicators of the proper use of PPE and the correct procedure for using PPE.

Prior research revealed that The majority of participants, 86.5%, were aware of potential occupational dangers associated with welding (Tadesse et al., 2016). Furthermore, Esu & Ekanem (2021) found that only 14.4% of welders use PPE consistently. Joshi et al. (2020) also found that do not use all types of PPE for their protection in the workplace. Sanda & Nughble (2019) said welders generally lack knowledge of important PPE requirements associated with welding activities. Therefore, the aim of this study was to analyze the safety behaviour tendencies among welders in using PPE correctly and following the applicable SOPs based on behavioural determinants.

METHODS

This research was conducted through an analytic observational study using a cross-sectional design. It was carried out on welders at one of the shipbuilding companies in Indonesia. This shipbuilding company was the largest shipyard in Indonesia. It had various work pro-

Table 1
The Characteristics Respondents

Characteristics	n = 58	%
Educational Level		
Senior High School	45	77.58
Diploma	11	18.96
Undergraduate School	2	3.45
Working Period		
≥ 5 years	38	65.51
< 5 years	20	34.48
Work Duration		
> 8 hours/day	27	46.55%
≤ 8 hours/day	31	53.45%
PPE Usage		
Good	24	41.4
Moderate	15	25.9
Poor	19	32.8

cesses at risk of causing work accidents, especially in the welding section. This study was conducted in 2020. Sampling was selected using a total population of 58 respondents. The inclusion criteria were workers in the welding section willing to participate in the study. All respondents have received an explanation regarding informed consent. The respondent and the supervisor signed the informed consent as a witness.

The variables examined in this study were behavioural determinants (knowledge, attitude, work readiness, availability of PPE, OSH promotion, OSH training, interaction between workers, reward system, and supervision). In this study, knowledge is the respondent's knowledge about PPE. Attitude is the respondent's response or reaction to using personal protective equipment. Work readiness is the overall condition of the worker that makes them ready to give a specific response or answer to a situation. The availability of PPE is a worker's assessment of the availability of PPE in the company. OSH promotion is a sign or instruction that contains orders, warnings, or information regarding the use of PPE. Also, OSH Training is an activity to increase workers' awareness and skills. Interaction between workers is a relationship and good communication between workers and workers and management. A Reward system is an action the company takes for its workers who have safe behaviour by giving gifts, promotions, salary increases, and sanctions. Supervision is an activity carried out to supervise the use of PPE by workers. Data on behavioural determinants were obtained through the adopted questionnaires by previous research on this company (Ayu et al., 2018). Furthermore, observations on safety behaviour were also carried out twice for 2 days for 15-20 minutes for each worker using the observation sheet. The researcher looked at the Odds Ratio in the Ordinal Regression test to see behaviour tendency. This study had received ethical approval from the Faculty of Public Health, Airlangga University.

RESULTS

Based on table 1, most respondents' education was in senior high school (77.58%). The most working period comes from ≥5 years (65.51%). Most of the work duration was ≤8 hours per day and also most respondents used PPE in a good category (41.4%). However,

Table 2
Simultaneous Test Results of Behavioural Determinants Variables on Safety Behaviour

Pseudo R-Square		
Cox and Sneel R Square	**Nagelkerke R Square**	**McFadden**
0.476	0.541	0.305

some respondents did not use PPE (32.8%).

Table 2 shows the coefficient of determination that behavioural determinants simultaneously affect safety behaviour of 54.1%, while other factors influence the other 45.9%. Table 4 shows that the order of the most influential behavioural determinants on safety behaviour based on the OR value includes knowledge, OSH training, reward systems, the interaction between workers, supervision, availability of PPE, OSH promotion, work readiness, and attitudes. The variables of knowledge, OSH training, and the reward system have a value of OR > 1. These variables are risk factors that allow respondents to perform safety behaviour. More importantly, the variables of attitude, work readiness, availability of PPE, OSH promotion, and interaction between workers have a value of OR <1. These variables are protective factors that allow respondents to perform safety behaviours.

Based on the results of this relationship and influence test (Table 3), it can be seen that these various variables are confounding variables, meaning that these variables interacted with each other and affected their respective OR values. It can be concluded that respondents with good knowledge tended to perform good safety behaviour by 2.327 times more than respondents with poor knowledge. In contrast, respondents with moderate knowledge tended to perform good safety behaviour by 1.578 times more than respondents with poor knowledge. Respondents with good attitudes tended to perform good safety behaviour by 0.101 times more than respondents with poor attitudes. In contrast, respondents with moderate attitudes tended to perform good safety behaviour by 0.190 times more than respondents with poor attitudes.

Also, respondents with good work readiness tended to perform good safety behaviour by 0.241 times more than respondents with poor work readiness. In contrast, respondents with moderate work readiness tended to perform good safety behaviour by 0.155 times more than respondents with poor work readiness. Respondents who rated good the availability of PPE tended to perform good safety behaviour by 0.232 times more than respondents who rated poor the availability of PPE, while respondents who rated moderate the availability of PPE tended to perform good safety behaviour by 0.211 times more than respondents who rated poor the availability of PPE.

Respondents who rated good the OSH promotion tended to perform good safety behaviour by 0.231 times more than respondents who rated poor the OSH promotion, while respondents who rated moderate the OSH promotion tended to perform good safety behaviour by 0.164 times more than respondents who rated poor the OSH promotion. Respondents with good OSH training tended to perform good safety behaviour by 1.210 times more than respondents with poor OSH training. In contrast, respondents with moderate OSH training tended to perform good safety behaviour by 2.450 times more than respondents with poor OSH training.

Respondents with good interaction between workers tended to perform good safety behaviour by 0.910 times than respondents with poor interaction between workers, while re-

Table 3
Effect of Behavioural Determinants Variables on Safety Behaviour

Variable	Estimate	Odd Ratio (OR)
Knowledge		
Good	0.845	2.327
Moderate	0.456	1.578
Poor (ref)	-	-
Attitude		
Good	-2.286	0.101
Moderate	-1.659	0.19
Poor (ref)	-	-
Work Readiness		
Good	-1.542	0.214
Moderate	-1.862	0.155
Poor (ref)	-	-
Availability of PPE		
Good	-1.461	0.232
Moderate	-1.558	0.211
Poor (ref)	-	-
OSH Promotion		
Good	-1.465	0.231
Moderate	-1.807	0.164
Poor (ref)	-	-
OSH Training		
Good	0.191	1.21
Moderate	0.896	2.45
Poor (ref)	-	-
Interaction Between Workers		
Good	-0.098	0.91
Moderate	-0.373	0.698
Poor (ref)	-	-
Reward System		
Good	0.513	1.671
Moderate (ref)	-	-
Supervision		
Good	-0.877	0.416
Moderate (ref)	-	-

spondents with moderate interaction between workers tended to perform good safety behaviour by 0.698 times than respondents with poor interaction between workers. Respondents who rated good the reward system tended to perform good safety behaviour by 1.671 times more than respondents who rated moderate the reward system. Respondents who rated good supervision tended to perform good safety behaviour by 0.416 times more than respondents who rated moderate the reward system.

DISCUSSION

Based on the OR value, respondents with excellent and moderate knowledge are likelier to perform safety behaviour than respondents with poor knowledge. It is because most welders were high school graduates, so they knew and understood the information in the workplace, particularly regarding PPE use and safety behaviour. Knowledge is a form of someone's sensing of an object that can underlie one's behaviour and is one of the domains in measuring behaviour and its change. According to Bloom, knowledge in behaviour is divided

into six levels: knowing, understanding, applying, analyzing, synthesizing, and evaluating. Thus, the higher the workers' knowledge, the higher the chance to perform the related behaviour. (Zhang et al., 2020)

Moreover, welders frequently received training related to welding, one of the goals of which was to increase the workers' knowledge. Tool Box Meeting (TBM) was also held in the morning and afternoon. TBM is a place to remind workers to use PPE while welding. Safety briefings (in this case, TBM) relate to workers' knowledge, so suitable methods and communication are needed to convey knowledge to workers (Raheem & Issa, 2016).

Additionally, knowledge-based behaviour can last longer than behaviour without knowledge (Serpella et al., 2014). Consequently, giving and sharing knowledge with workers is highly recommended. The more information a person receives, the more it will affect one's behaviour. Besides, most respondents were aware of the dangers arising from their work and learned from coworkers' experiences, so they performed safety behaviour. During the research, respondents showed a positive attitude toward using PPE entirely with or without supervision, were willing to report if PPE was damaged or lost, and reprimanded coworkers who did not use PPE kept and cared for PPE. Researchers assume that this is supported by the working period and word duration. The longer a person works, the more accustomed to using PPE.

Attitude is an individual's response to a particular object which is a readiness to act, so it is included in the predisposition of behaviour (Wachinger et al., 2016). Based on the results of the interviews, most respondents were willing to use PPE since they were aware of the dangers posed by their work and learned from coworkers' experiences. Notably, it strongly advocated that attitudes can change depending on the situation; attitudes can be turned into actions based on the experiences of others, and attitude depends on the values one holds. Therefore, other factors that can support workers' attitudes are needed so that they can take the form of safety behaviour.

According to research, SOPs and implementing applicable regulations are some ways to support workers' attitudes toward safety behaviour (Fuller et al., 2014; Unnikrishnan et al., 2015) Also, Reichard et al. (2017) stated that SOPs are designated by companies with several goals, including preventing workers from potential occupational accidents. In addition, attitudes must be balanced by other factors, such as the availability of PPE, comfort of PPE, regulations, and supervision (Wireko-Gyebi, et al., 2022).

Workers' readiness is presumably owned because of the Tool Box Meeting (TBM), held every morning and afternoon. This activity was a forum for sharing information and reminding one another to perform safe behaviour at work. In addition, respondents were also provided with mental and entrepreneurial guidance, which aimed to increase knowledge or skills for welders in preparing themselves before being placed in their respective posts. Work readiness is one of the personal readiness factors for work. In this case, personal readiness is an essential factor that influences workers' behaviour, so it is necessary to prepare workers' readiness, starting from recruiting workers and holding training. It is because personal factors are one of the causes of work accidents (Sun et al., 2018). One of the primary causes of work accidents is inadequate mental or psychological factors, for example, poor determining attitudes, poor coordination, poor reaction time, and inability to understand the surrounding conditions. Also, workers' causes of work accidents and health problems are unstable emotions, fragile personalities, weak thinking and perceptual

abilities, low work motivation, careless attitude, less carefulness, and lack of knowledge in using work equipment (De-las-Heras-Romero et al., 2017; Feng et al., 2015; Manyisa & van Aswegen, 2017).

Also, the influence of the availability of PPE is assumed to occur because the PPE facilities in this company were fully available and regulated in the SOPs for Personal Protective Equipment, including the application and replacement of PPE. According to Guo et al. (2016) the availability of facilities and equipment is one of the factors in the emergence of behaviour. The availability of facilities in this company has been regulated by the company's Standard Operating Procedures (SOPs). Based on Law No. 1 of 1970 on Occupational Safety Article 14 number 3, management obliges the provision of free all personal protective equipment required to workers under their leadership and to provide it for every person who enters the workplace, accompanied by the necessary instructions according to the instructions of the supervisory officer or occupational safety experts. Therefore, management should provide PPE facilities in the workplace.

The OSH promotion of the influence of them presumably occurs because this company has promoted OSH through the installation of OSH posters and signs, toolbox meetings, disciplinary raids, provision of safety permits, safety induction, and OSH training. OSH promotion can encourage, increase, and strengthen the awareness and behaviour of workers. Therefore, it is necessary to pay attention to the principles of OSH promotion. The principles of OSH promotion include all of the practices of OSH promotion, such as management commitment to safety, safety training, employee involvement, safety communication and feedback, safety rules and procedures, and safety promotion policies (Vinodkumar & Bhasi, 2010). Therefore, OSH promotion in the workplace should pay attention to aspects related to OSH communication. According to Hadipoetro, OHS promotion is a form of communication carried out by management through visual, audio, and audio-visual communication media (Hadipetro, 2014). OSH communication media is related to the behaviour of using PPE. Here, sufficient OSH communication media allows workers to behave safely in the workplace. Thus, the management should complete the form and promotional media for OSH.

Furthermore, training is a due to action, an encouragement to take action that can influence a person to determine what actions are taken based on the knowledge and information obtained from training (Guo et al., 2016). Workers who do not receive training are 2 times more likely to engage in unsafe behaviour than workers who regularly attend training (Asriani et al., 2011). OSH training for new workers aims to increase understanding of the company's mission and their role in securing the work area, which will increase production. Meanwhile, for old workers, OSH training aims to refresh the previous work safety training (Hadipetro, 2014). OSH training is intended to increase knowledge, skills, and attitude as well as awareness. Training is one of the critical factors in the success of the OSH program. Based on the abovementioned consideration, OSH training as a forum for workforce development is mandatory for the workplace.

In addition, the influence of interaction between workers is caused by the majority of respondents who think that teamwork and reminding each other are the keys to working comfortably since interaction makes each other closer. Moreover, this influence proves that coworkers' roles can help respondents carry out safe behaviour. The encouragement of coworkers can determine workers' behaviour in using PPE. In addition, there is a relationship between the role of coworkers and the behaviour

of using PPE (Liang et al., 2018). According to Geller, the greater the encouragement provided by coworkers, the more likely a worker is to behave according to that encouragement (Geller, 2011). Therefore, safe behaviour and a work environment that cooperate and avoid conflict must start from the stage of selecting prospective workers to the correct placement. Importantly, job descriptions, organizational structures, job appraisal systems, and assignments must be designed to be appropriate and precise.

Also, safety behavior can be realized because of the reward and punishment system that is enforced in this company. Most respondents stated that the rewards received were in the form of congratulations and thank-you notes. Giving rewards is a form of appreciation for the excellent behaviour of workers, so workers tend to repeat this behaviour to improve OSH and safe work behaviour (Fernández-Muñiz et al., 2014). Furthermore, most respondents stated that the punishment received was a verbal warning and a warning letter. There is a relationship between the imposition of sanctions and compliance with PPE. This sanction is an effort of the management in the context of foster workers' work discipline (Wong et al., 2020). Also, punishment can be used as a penalty and control over workers' behaviour so that they can prevent themselves from unsafe behaviour, while appreciation is a form of appreciation and support for workers so that they can maintain positive behaviour (Setyawan et al., 2020).

The reward system is a consequence that can change behaviour in the form of motivation (Tsai et al., 2016). Geller added that safety rewards are an activator in creating appropriate behaviour to motivate and activate workers to perform safety behaviour and improve OSH in the company (Geller, 2011). Besides, the influence of supervision on safety behaviour is because of the management's supervision program. Supervising the use of PPE in this company was carried out through inspection activities involving HSE and the head of the workshop. HSE performed workplace inspections every morning and afternoon. Inspections carried out show a form of concern of the management for workers so that they are motivated to take responsibility and be involved in the OSH program. Inspection can help management to find methods or work practices that can cause harm to the company (Hadipetro, 2014).

Workers who did not wear PPE received verbal warnings and warning letters. Based on the results of observations, most respondents used complete PPE, but there were still some workers who did not use PPE properly with or without supervision. Nevertheless, supervision needs to be carried out since weak control, or poor supervision is the initial factor and triggers work accidents that cause losses.

CONCLUSIONS

Welders tend to perform good safety behaviour in using personal protective equipment based on determinants of behaviour such as knowledge, attitude, work readiness, availability of PPE, the interaction between workers, OSH promotion, OSH training, reward system, and supervision. Besides, the variables of attitude, work readiness, availability of PPE, OSH promotion, and interaction between workers are protective factors that allow respondents to perform safety behaviours. Companies should intervene in the reward system through improvements to the reward system, especially the rewards given to workers when supporting or carrying out safety behaviour and conducting OSH socialization and training for workers. This research provides important information regarding the factors that become the basis for workers to use personal protective equipment, as it is known that workers are still lacking in using PPE. This research can be used as a considera-

tion in conducting safety behaviour interventions, especially using PPE. The limitation of this study is the observation of PPE use which was carried out in only 2 days. We recommend that further research observe PPE use behaviour for several months to get more varied data.

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AUTHORS' CONTRIBUTIONS
Rizky Maharja: Conceptualization, methodology, analyzed the data, interpretation of the result, and drafted the original paper. Jihan Faradisha: Data collection, validation, interpretation of the result, and review-editing the paper. Andi M. F. Panggeleng: Data collection, analyzed the data, interpretation of the result, and review-editing the paper. All authors read and approved the final manuscript

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COMPETING INTERESTS
The authors confirm that all of the text, figures, and tables in the submitted manuscript work are original work created by the authors and that there are no competing professional, financial, or personal interests from other parties.

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