

Original Research Article

Risk Factors of Unsafe Behavior among Construction Workers

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Abstract

Globally, construction is considered the riskiest industry and construction workers have twice the risk of injury than workers in other jobs. PUPR Ministry data for 2017 states that construction is the largest contributor to accident cases in Indonesia with an average incidence of 32% each year. Unsafe behavior is the most common cause of work accidents. Based on observations, it was found that workers engaged in unsafe behavior in the Pekalongan City tidal food control project with an average incidence of 15% per day. This study aims to determine what factors are associated with unsafe behavior. The type of research used is analytic observational with a cross sectional approach and the sampling technique uses simple random sampling. The population of this study was 115 workers and the sample size was determined using the Slovin formula (error rate of 5%) obtained by 95 respondents. The research instruments used questionnaires and observation sheets. The results of the bivariate analysis showed that there was a significant connection between knowledge ($p=0.006$), supervision ($p=0.000$), and fatigue (0.000) on unsafe behavior. The results of the multivariate analysis show that supervision is the most powerful factor influencing unsafe behavior.

Keywords: Construction; unsafe behavior; risk factors

1. Introduction

The International Labor Organization (ILO) stated that from 2015 to 2019, in all industrial sectors in 71 countries, there have been 23,846,153 non-fatal accidents and the construction industry ranks second with almost 13% of accidents (Antoniou & Merkorui, 2021). The construction sector is one of the most dangerous industries with fatal accidents occurring between 30%-40%. The accident rate in the construction industry is among the highest with a 2.5 times higher probability of an accident and a five times higher probability of death compared to the manufacturing industry (Rivera et al., 2021).

The construction industry in developing countries is globally known for having a bad record of work accidents (Shao et al., 2019). According to the statistics of the Ministry of Emergency Management of the Republic of China, in the first half of 2018 there were 1,732 production accidents in construction and 1,752 deaths in the construction industry (Z. Li et al., 2021). Meanwhile, Mosly & Makki (2020) stated that the number of non-fatal work accidents in the US construction industry in 2018 was at 199,100 cases. Work accident data from the report of the Employment Social Security Administrative Agency (BPJS) (Monalisa et al., 2022) stated that "In 2017, there were 123,041 work accidents and there were 173,105 work accident cases in 2018. Meanwhile in 2019, there were 77,295 work accidents and there were 153,044 work accident cases that occurred in Indonesia in 2020" (Uyun & Widowati, 2022). Data of the Ministry of Public Works and Housing in 2017 stated that the construction sector is the largest contributor to accident cases in Indonesia with an average incident of 32% each year (Agustian et al., 2020). In Central Java Province, based on the 2018 Labor and Transmigration Statistics Book, there were 2,329 cases of work

accidents (Sudalma & Rosnaini, 2020). Meanwhile, the incidence of work accidents in Pekalongan City in 2018 was 32 cases (Transmigration, 2012).

Work accidents are unexpected and unwanted events that can result in losses (Ramadhany & Pristya, 2019). According to H. W. Heinrich, accidents at work occur due to unsafe behavior by 88%, unsafe conditions by 10%, and the rest occur due to human error itself, namely by 2% (Huda et al., 2021). Fang, et al. in the journal (Guo et al., 2020) also stated that unsafe behavior by workers is the most frequent cause of work accidents. According to Bird and Germand (1990), unsafe behavior is a violation of safe work processes so that there is a chance of work accidents (Anggraini, 2018). Lawrence Green's theory (1980) suggests that a person's behavior is determined from three factors, namely predisposing factors (age, knowledge, education, years of service, fatigue), supporting factors (regulations), and driving factors (supervision) (Notoatmodjo, 2014). Unsafe behavior can be caused by many things, such as not wearing personal protective equipment (PPE), not following work procedures, not following work safety regulations, and not working carefully (Yusril et al., 2021). Other unsafe behaviors include using improper work equipment and installing or dismantling formwork without permission (Guo et al., 2020).

Previous research (Utami, 2021) shows that there is a connection between knowledge and unsafe behavior. In addition, this study also shows other factors related to unsafe behavior, namely supervision. This is in line with research (Uyun & Widowati, 2022) that supervision is one of the internal factors that can encourage workers to behave safely. In the journal (Ramadhany & Pristya, 2019), it is said that the education of a worker also affects the way they think about their work and the way they take behavior to prevent work accidents. Research conducted by (Ramadhany & Pristya, 2019) shows that there is a connection between fatigue and unsafe behavior. Physical fatigue is one of the individual factors that influences unsafe behavior in construction workers (Meng et al., 2021). The research by Fang et al (Fang et al., 2015), found that workers made more mistakes when they were tired. This is in line with research conducted by (Yusril et al., 2021) that work fatigue is related to unsafe behavior and can result in work accidents.

The Pekalongan City tidal flood control project is a water resources infrastructure building construction project which is included in the project of the Pemali Juana River Basin Center (BBWS). Implementation of this project will begin in 2021 and is planned to be completed in 2023. The flood and rob control work include the construction of parapets, retention ponds, embankments, weirs, regular gates, long storage, and pump houses. Based on observations conducted from July to November 2022, it was found that there were workers who carried out unsafe behavior in the Pekalongan City tidal flood control project with an average incidence of 15% every day. The unsafe behavior is not using PPE according to standards such as not using a safety helmet, not wearing safety shoes, not wearing a safety vest, not wearing gloves, not using welding goggles, not using a safety belt/body harness when working at height, and not use a life jacket when working near or on water. In addition, other unsafe behaviors include using or placing work equipment and materials improperly, climbing formwork, smoking, and using mobile phones while working. This unsafe behavior can be the cause of work accidents. Therefore, from the findings of the problem, researchers intend to know what factors are related to unsafe behavior among workers in the tidal flood control project in Pekalongan City. This research aims to determine the factors related to unsafe behavior in construction workers.

2. Methods

The type of research of this study is an analytic observational study with a cross-sectional approach to determine the factors associated with unsafe behavior in construction workers. The research was conducted in the tidal flood control project in Pekalongan City. The population of this study were 115 workers under the foreman with the determination of the number of samples using the Slovin formula (5% error rate) and obtained a minimum sample size of 90 workers. Furthermore, an additional sample of 5% was carried out to prevent if there was a discrepancy, that the final sample became as many as 95 workers under the foremen in the tidal flood control project in Pekalongan City.

The sampling technique used is simple random sampling, which means that all workers in the population have the same opportunity to be selected as the sample and the sampling is done randomly using SPSS, where the sample has previously been given a serial number. Sampling in the field was carried out on January 21-23 2023. The research instruments used were questionnaires and observation sheets which had previously been tested for validity and reliability. The validity test for knowledge, supervision, and unsafe behavior shows valid results with *Pearson Correlation* (>0.361) and reliability of knowledge (0.719), supervision (0.748), and unsafe behavior (0.662), which means reliable.

Table 1. Categorization and research instruments

Variable	Category	Instrument
Age	<ol style="list-style-type: none"> Young, if 12-35 years old Old, if 36-65 years old Source: (Al Amin & Juniati, 2017)	Questionnaire
Work period	<ol style="list-style-type: none"> New period, if work period <1 year Long period, if work period ≥ 1 year Source: (Pranowo, 2016)	Questionnaire
Education	<ol style="list-style-type: none"> Low level of education, if only have elementary-junior high school equivalent High level of education, if level of education senior/ vocational high school equivalent Source: (Departemen Pendidikan Nasional, 2003)	Questionnaire
Knowledge	<ol style="list-style-type: none"> Low, if knowledge score of $\leq 75\%$ High, if knowledge score of $>75\%$ Source: (Untari et al., 2021)	Questionnaire
Supervision	<ol style="list-style-type: none"> Less, if supervision score of 5-15 Good, if supervision score of 16-25 Source: (Sebrina & Wahyuningsih, 2021)	Questionnaire
Fatigue	<ol style="list-style-type: none"> Fatigue, if fatigue score of ≥ 23 Less of fatigue, if fatigue score of <23 Source: (Sebrina & Wahyuningsih, 2021)	Questionnaire adapted from Questionnaire Measuring Feeling of Work Fatigue (KAUPK ₂)
Unsafe behavior	<ol style="list-style-type: none"> Unsafe behavior, if the worker has committed ≥ 1 unsafe behavior Safe behavior, if the worker has never engaged in unsafe behavior Source: (Sebrina & Wahyuningsih, 2021)	Observation sheets

The data analysis techniques used in this study were univariate, bivariate and multivariate analysis using SPSS. Univariate analysis was carried out to determine the percentage frequency distribution of each variable, while bivariate analysis was carried out using the chi square test (provided that the p-value was <0.050) to determine the relationship between the dependent and independent variables. Multivariate analysis was carried out using a logistic regression test (provided that the results of the chi square test have a p-value <0.25 to be able to perform a logistic regression test) to determine the independent variables that most influence unsafe behavior.

3. Result and Discussion

Table 2. Univariate analysis

Variable	N	%
Age		
Young	56	58.9
Old	39	41.1
Work Period		
New	61	64.2
Long	34	35.8
Education		
Low	60	63.2
High	35	36.8
Knowledge		
Low	64	67.4
High	31	32.6
Supervision		
Less Good	34	35.8
Good	61	64.2
Fatigue		
Fatigue	36	37.9
Less Fatigue	59	62.1
Unsafe Behavior		
Unsafe	57	60.0
Safe	38	40.0
Total	95	100

Based on table 1, it is known that of the 95 respondents, 56 respondents (58.9%) were in the young age category and 39 respondents (41.1%) were in the old age category. Respondents with new service category were 61 respondents (64.2%), more than respondents with long service category of 34 respondents (35.8%). Respondents in the low education category were 60 respondents (63.2%) and respondents in the higher education category were 35 respondents (36.8%). The category of respondents with low knowledge was 64 respondents (67.4%) and 31 respondents (32.6%) with high knowledge category.

Of the 95 respondents, it was found that 34 respondents (35.8%) felt that the supervision carried out by the supervisor was not good, while as many as 61 respondents (64.2%) felt that the supervision by the supervisor was good. Respondents in the fatigue category were 36 respondents (37.9%) and respondents in the less fatigue category were 59 respondents (62.1%). Respondents who carried out unsafe behavior were 57 respondents (60.0%) and those who were included in the category of safe behavior were 38 respondents (40.0%).

Table 3. Bivariate analysis

Variable	Unsafe Behavior				Total		p-value	PR	CI 95%	
	Unsafe		Safe		N	%			Lower	Uper
	N	%	N	%						
Age										
Young	38	67.9	18	32.1	56	100	0.097	-	-	-
Old	19	48.7	20	51.3	39	100				
Work Period										

New	41	67.2	20	32.8	61	100	0.088	-	-	-
Long	16	47.1	18	52.9	34	100				
Education										
Low	39	65.0	21	35.0	60	100	0.278	-	-	-
High	18	51.4	17	48.6	35	100				
Knowledge										
Low	45	70.3	19	29.7	64	100	0.006	1.816	1.134	2.908
High	12	38.7	19	61.3	31	100				
Supervision										
Less Good	30	88.2	4	11.8	34	100	0.000	1.993	1.466	2.710
Good	27	44.3	34	55.7	61	100				
Fatigue										
Fatigue	30	83.3	6	16.7	36	100	0.001	1.821	1.330	2.492
Less Fatigue	27	45.8	32	54.2	59	100				

Based on table 2, it is known that there are 56 young workers (12-35 years old) with 38 workers (67.9%) having unsafe behavior and 18 workers (32.1%) having safe behavior at work. Meanwhile, 39 workers (36-65 years) aged 39 with 19 workers (48.7%) having unsafe behavior and 20 workers (51.3%) having safe behavior at work. The results of the chi square test showed that there was no connection between age and unsafe behavior in workers with a p-value of 0.097. Unsafe behavior by workers in the Pekalongan City tidal flood control project is dominated by young workers compared to old workers. Psychologically, young workers tend to do their jobs quickly, aggressively, and in a hurry, so they are at risk of engaging in unsafe behavior and potentially experiencing work accidents (Ayu, 2019). This is in line with research (Rahmawati & Hananingtyas, 2020) which stated that young workers engage in more unsafe behavior than older workers because young workers have unstable emotions and underestimate the hazards and risks that exist in the workplace. This is also in line with research (Nalahudin & Oktasara, 2019) which concluded that there is no connection between age and unsafe behavior with a p-value of 1.000.

The results showed that there was no connection between length of service and unsafe behavior in workers with a p-value of 0.088. 41 workers (67.2%) with new service period (<1 year) have more unsafe behaviors than 16 workers (46.9%) with long period (≥ 1 year). Workers in the Pekalongan City tidal flood control project tend to be more of workers with new working period, due to the change of workers and several work locations that have just started their work. Workers with new working period (<1 year) were 61 workers with 41 workers (67.2%) having unsafe behavior and 20 workers (32.8%) having safe behavior, while workers with long working period (≥ 1 year) were 34 workers with 16 workers (47.1%) having unsafe behavior and 18 workers (52.9%) having safe behavior. Unsafe behavior that is often carried out by new workers is caused by workers who are not aware of the dangers that exist in the workplace (Zahiri Harsini et al., 2020). However, workers with long working period also do not guarantee that they will not engage in unsafe behavior while doing their job (Sebrina & Wahyuningsih, 2021). This research is in line with research (Setiarsih et al., 2017) which obtained a p-value of 0.347, which means that there is no significant connection between length of work and unsafe behavior in workers.

The majority of workers in the tidal flood control project in Pekalongan City have low education (Elementary-Junior High School equivalent). There are 60 workers with low levels of education (Elementary-Junior High School equivalent), with 39 workers (65.0%) having unsafe behavior and 21 workers (35.0%) having safe behavior at work. Meanwhile, workers with a high level of education (Senior/Vocational High School equivalent) were 35 workers with 18 workers (51.4%) having unsafe behavior and 17 workers (48.6%) having safe behavior at work. This study shows that there is no significant connection between education and unsafe behavior with a p-value of 0.278. The results of this study contradict the research conducted by (Untari et al., 2021) which concluded that there is a significant

connection between education and unsafe behavior. Education is a risk factor for unsafe behavior, because education can affect workers' ability to identify risks (Yang et al., 2022). In addition, education also influences ways of thinking and taking preventive measures against work accidents (Ramadhany & Pristya, 2019). However, this does not match the facts in the Pekalongan City flood and tidal control project because workers with low or high levels of education both engage in unsafe behavior while carrying out their work.

Knowledge has a significant connection with unsafe behavior with a p-value of 0,006 and PR 1.816 (CI 95% 1.134-2.908) which indicates that someone with low knowledge is 1,816 times more at risk of unsafe behavior at work. Based on the results of research at the tidal flood control project in Pekalongan City, workers with low knowledge (obtaining a knowledge score of $\leq 75\%$) commit more unsafe behaviors than workers who have high knowledge (gaining a knowledge score of $>75\%$). Workers with low knowledge are 64 workers with 45 workers (70.3%) having unsafe behavior and 19 workers (29.7%) having safe behavior while working, while workers with high knowledge are 31 workers with 12 workers (38.7%) behave unsafely and 19 workers (61.3%) behave safely while working. Lawrence Gren's theory states that knowledge is a predisposing factor that influences a person's behavior or behavior (Lucida, 2022). A person's knowledge influences him to carry out unsafe behavior at work. When a worker has high knowledge, they are able to identify hazards and are aware of the risks they receive (Monalisa et al., 2022) This is in line with research (Lusida, 2022) which obtained an OR value of 3.5, which means workers with less knowledge are 3.5 times at risk for unsafe behavior in a high category compared to workers with high knowledge.

According to Lawrence Green's theory, supervision is included in the driving factors that influence a person's behavior (Lucida, 2022). Supervision in the construction sector is one of the factors that influence unsafe behavior in workers so that negligence and inadequate supervision will affect the behavior of construction workers (P. Li et al., 2022). The results showed that as many as 59 workers in the Pekalongan City tidal flood control project felt that the supervision carried out by the supervisors had been carried out properly, such as supervision regarding the completeness of PPE, work equipment, and work procedures. There are 34 workers who feel supervision is not carried out well (if they obtained supervision score of 5-15) with 30 workers (88.2%) having unsafe behavior and 4 workers (11.8%) having safe behavior. Meanwhile, there are 61 workers who feel supervision is carried out properly (if they obtained supervision score of 16-25) with 27 workers (44.3%) having unsafe behavior and 34 workers (55.7%) having safe behavior. The results of the chi square test showed that there was a connection between supervision and unsafe behavior with a p-value of 0,000 and a PR of 1,993 (CI 95% 1.466-2.710), which means that someone who feels supervision is carried out poorly 2.002 times is at risk of unsafe behavior at work. This research is in line with research (Lusida, 2022) which shows that there is a significant connection between supervision and unsafe behavior in project workers with a p-value of 0.01.

This study shows that there is a connection between fatigue and unsafe behavior with a p-value of 0.001 and a PR of 1,821 (CI 95% 1.330-2.492), which means that someone who is fatigue is 1.821 times at risk of carrying out unsafe behavior at work. From the results of the study, it was found that there were 36 workers who were fatigue (if they obtained a fatigue score of ≥ 23) with 30 workers (83.3%) having unsafe behavior and 6 workers (16.7%) having safe behavior while working, while workers who were less 59 workers are fatigue if they obtained a fatigue score of <23) with 27 workers (45.8%) having unsafe behavior and 32 workers (54.2%) having safe behavior at work. Someone who feels fatigue will affect safety behavior at work (Mahajan et al., 2019). The fatigue test in this study used a Questionnaire Measuring Feeling of Work Fatigue (KAUPK₂). Fatigue experienced by workers in the Pekalongan City tidal flood control project is caused by a hot work environment, work activities, working hours and overtime hours. Fatigue is a condition of decreasing a person's ability to carry out activities (Seong et al., 2022). Heavy workloads and prolonged working hours cause construction workers to be vulnerable to work fatigue (Zhang et al., 2015). Other research examining fatigue and alertness states that construction accidents are related to heat exposure due to working under the hot sun which causes work fatigue (Umar & Egbu,

2020). Fatigue experienced by workers can reduce the ability to process information, memory loss, decreased awareness, lack of attention, and underestimate the risks that exist in the workplace (Dahlan & Widanarko, 2022). As quoted from the Fatigue Management Fact Sheet, fatigue due to work significantly affects performance, productivity, and increases the potential for injury (Wahyuni & Indriyani, 2019). In line with research conducted by (Yusril et al., 2020) which concluded that there is a significant connection between fatigue and unsafe behavior with a p-value of 0.000.

Table 4. Multivariate analysis

Variable	B	S.E	Wald	df	p-value	Exp.(B)	CI 95% Lower-Upper
Knowledge	2.562	0.808	10.065	1	0.002	12.968	2.663 – 63.152
Supervision	3.095	0.873	12.564	1	0.000	22.078	3.989 – 122.204
Fatigue	3.005	0.866	12.037	1	0.001	20.196	3.697 – 110.312
Constant	-14.401	3.586	16.130	1	0.000	0.000	

As for the logistic regression, the unsafe behavior regression equation model is used as follow equation (1)

$$y = \text{constant} + a_1x_1 + a_2x_2 + \dots + a_nx_n \dots \dots \dots (1)$$

$$y = -14.401 + 2.562 (\text{knowledge}) + 3.095 (\text{supervision}) + 3.005 (\text{fatigue})$$

$$y = -14.401 + 2.562 (1) + 3.095 (1) + 3.005 (1)$$

$$y = -5.739$$

The results of the multivariate analysis showed that there were 3 variables, namely knowledge (p-value 0.002), supervision (p-value 0.000), and fatigue (p-value 0.001). The variable that has the strongest contribution to predicting the occurrence of unsafe behavior is the monitoring variable because it has the lowest p-value (0.000) and the highest Wald value (12.564). This shows that the supervision carried out by supervisors in the Pekalongan City tidal flood control project greatly influenced workers in unsafe behavior. This supervision includes supervision related to the completeness of PPE, work equipment, and work procedures. According to Bird and Germain’s theory that it is important to carry out supervision during work to enforce existing regulations (Reza & Debora, 2022). Good supervision will provide encouragement and motivation for workers to do their job properly and safely (Yaqub et al., 2022). This research is in line with the results of research (Subekti, 2018) which shows that there is a significant influence between supervision on the safe behavior of workers.

4. Conclusions

Based on the results of the study, it was concluded that there were three variables related to unsafe behavior in workers in the Pekalongan City tidal flood control project, namely knowledge, supervision and fatigue, while age, years of service, and education were not related to unsafe behavior. The results of the multivariate analysis showed that supervision was the most powerful factor influencing unsafe behavior among workers in the Pekalongan City tidal flood control project.

This study has limitations, namely researchers did not examine other factors that could influence unsafe behavior, such as training and the availability of PPE. It is recommended for the Pekalongan City tidal flood control project to increase supervision regarding the completeness of PPE; work equipment, and work procedures, manage work time, overtime hours, and work breaks to reduce the risk of fatigue; as well as increase worker knowledge regarding the risks of unsafe behavior while working.

Acknowledgement

The authors are grateful to everyone who has supported this study. The authors sincerely thank the Pekalongan City tidal flood control project and Departement of Public Health Universitas Negeri Semarang for providing the facilities, documents, and respondent

References

- Agustian, R., Ekawati, & Wahyun, I. 2020. Faktor penyebab dasar pada terjadinya kecelakaan kerja sektor konstruksi. *Jurnal Ilmiah Mahasiswa*, 10(4), 111-117.
- Al Amin, M., & Juniati, D. 2017. Klasifikasi kelompok umur manusia berdasarkan analisis dimensi fraktal box counting dari citra wajah dengan deteksi tepi canny. *Jurnal Ilmiah Matematika*, 2(6), 1-10.
- Anggraini, A. P. H. 2018. Hubungan perilaku tidak aman dengan kejadian kecelakaan kerja pada pekerja konstruksi PT Multikon proyek apartemen citra lake suites tahun 2018. *Jurnal Kesehatan*, 1-13.
- Antoniou, F., & Merkouri, M. 2021. Accident factors per construction type and stage: a synthesis of scientific research and professional experience. *International Journal of Injury Control and Safety Promotion*, 28(4), 439-453.
- Ayu, F. & M. N. R. 2019. Pengaruh karakteristik individu dan karakteristik pekerjaan terhadap perilaku tidak aman (unsafe action) pada pekerja divisi kapal niaga PT. Pal Indonesia tahun 2018. *Medical Technology and Public Health Journal*, 3.
- Dahlan, A., & Widanarko, B. 2022. Impact of occupational fatigue on human performance among oil and gas workers in Indonesia. *Kesehatan Masyarakat*, 17(1), 54-59.
- Departemen Pendidikan Nasional. 2003. Undang-undang Republik Indonesia nomor 20 tahun 2003 tentang sistem pendidikan nasional.
- Fang, D., Jiang, Z., Zhang, M., & Wang, H. 2015. An experimental method to study the effect of fatigue on construction workers safety performance. *Safety Science*, 73, 80-91.
- Guo, S., He, J., Li, J., & Tang, B. 2020. Exploring the impact of unsafe behaviors on building construction accidents using a bayesian network. *International Journal of Environmental Research and Public Health*, 17(1).
- Huda, N., Fitri, A. M., Buntara, A., & Utari, D. 2021. Faktor-faktor yang berhubungan dengan terjadinya kecelakaan kerja pada pekerja proyek pembangunan gedung di PT. X tahun 2020. *Jurnal Kesehatan Masyarakat (Universitas Diponegoro)*, 9(5), 652-659.
- Li, P., He, Y., & Li, Z. 2022. Study on influencing factors of construction workers unsafe behavior based on text mining. *Frontiers in Psychology*, 13(April), 1-11.
- Li, Z., Mao, R., Meng, Q. F., Hu, X., & Xian Li, H. 2021. Exploring precursors of construction accidents in China: A grounded theory approach. *International Journal of Environmental Research and Public Health*, 18(2), 1-16.
- Lusida, E. T. R. A. M. F. & N. 2022. Environmental occupational health and safety journal faktor-faktor yang berhubungan dengan perilaku tidak aman pada pekerja proyek the canary apartment PT. Abadi Prima Intikarya tahun 2022. *Environmental Occupational Health and Safety Journal*, 3(1), 45.
- Mahajan, K., Velaga, N. R., Kumar, A., & Choudhary, P. 2019. Effects of driver sleepiness and fatigue on violations among truck drivers in India. *International Journal of Injury Control and Safety Promotion*, 26(4), 412-422.
- Meng, Q., Liu, W., Li, Z., & Hu, X. 2021. Influencing factors, mechanism and prevention of construction workers' unsafe behaviors: A systematic literature review. *International Journal of Environmental Research and Public Health*, 18(5), 1-23.
- Monalisa, ulfa., Subbakir., R. L. 2022. Faktor-faktor yang berhubungan dengan perilaku tidak aman pada pekerja service PT. Agung Automall cabang Jambi. 2(10), 3391-3398.
- Mosly, I., & Makki, A. A. 2020. Safety climate perceptions in the construction industry of Saudi Arabia: The current situation. *International Journal of Environmental Research and Public Health*, 17(18), 1-16.
- Nalahudin, M., & Oktasara. 2019. Tindakan tidak aman (unsafe human act) pada pekerja di proyek K PT. X tahun 2021. 37, 85-100.
- Notoatmodjo, S. 2014. Promosi kesehatan dan perilaku kesehatan. PT. Rineka Cipta.
- Rahmawati, Y., & Hananingtyas, I. 2020. Determinan perilaku tidak aman pada pegawai di unit pelayanan transmisi (UPT) Cawang tahun 2020. *Environmental Occupational Health and Safety Journal*, 1, 153-

168.

- Pranowo, R. S. 2016. Pengaruh kepuasan kerja, lingkungan kerja, dan kompensasi terhadap turnover intention karyawan dengan lama kerja sebagai variabel pemoderasi (Studi kasus pada CV. Sukses Sejati Computama).
- Ramadhany, F. A., & Pristya, T. Y. R. 2019. Faktor-faktor yang berhubungan dengan tindakan tidak selamat (unsafe act) pada pekerja di bagian produksi PT Lestari Banten Energi. *Jurnal Ilmiah Kesehatan Masyarakat*, 11(2), 199–205.
- Reza, F., & Debora, B. 2022. Program studi psikologi Universitas Binawan, Jakarta, Indonesia program studi psikologi Universitas Tarumanagara, Jakarta, Indonesia 1. 1(01), 29–38.
- Rivera, F. M. La, Mora-Serrano, J., & Oñate, E. 2021. Factors influencing safety on construction projects (Fscps): Types and categories. *International Journal of Environmental Research and Public Health*, 18(20).
- Sebrina, R. N. F., & Wahyuningsih, A. S. 2021. Unsafe action pada pekerja bagian produksi di CV Kabupaten Kendal. *Indonesian Journal of Public Health and Nutrition*, 1(3), 703–712.
- Seong, S., Park, S., Ahn, Y. H., & Kim, H. 2022. Development of an integrated fatigue measurement system for construction workers: a feasibility study. *BMC Public Health*, 22(1), 1–12.
- Setiarsih, Y., Setyaningsih, Y., & Widjasena, B. 2017. Hubungan karakteristik pekerja, promosi K3, dan ketersediaan alat pelindung diri (APD) dengan perilaku tidak aman pada pekerja mechanical maintenance. *Jurnal Kesehatan Masyarakat*, 5(5), 2356–3346.
- Shao, B., Hu, Z., & Liu, D. 2019. Using improved principal component analysis to explore construction accident situations from the multi-dimensional perspective: A chinese study. *International Journal of Environmental Research and Public Health*, 16(18).
- Subekti, A. T. 2018. Hubungan pengawasan dengan perilaku tidak aman pekerja di PT Putra Bungsu.
- Sudalma, & Rosnaini. 2020. K3 di Jawa Tengah : Analisis tren kecelakaan kerja tahun 2018. *Researchgate*, No. 1(July 2020), 2356–0231.
- Transmigrasi, D. T. K. dan. 2012. Laporan data statistik ketenagakerjaan dan ketrasmigrasian pemerintah provinsi Jawa Tengah.
- Umar, T., & Egbu, C. 2020. Heat stress, a hidden cause of accidents in construction. *Proceedings of the Institution of Civil Engineers: Municipal Engineer*, 173(1), 49–60.
- Untari, L. D., Kusumaningtiar, D. A., Handayan, P., & Yusvita, F. 2021. Faktor-faktor yang berhubungan dengan perilaku tidak aman pada karyawan departemen produksi di PT X Jakarta. *Jurnal Ilmiah Kesehatan Masyarakat : Media Komunikasi Komunitas Kesehatan Masyarakat*, 13(2), 69–77.
- Utami, S. A. 2021. Faktor-faktor yang berhubungan dengan tindakan tidak aman (unsafe action) pada pekerja bagian produksi tambang PT. Arteria Daya Mulia Kota Cirebon tahun 2021. *Journal of Health Research Science*, 1(02), 83–89.
- Uyun, R. C., & Widowati, E. 2022. Hubungan antara pengetahuan pekerja tentang K3 dan pengawasan K3 dengan perilaku tidak aman (unsafe action). *Jurnal Kesehatan Masyarakat (e-Jurnal)*, 10(3), 391–397.
- Wahyuni, D., & Indriyani, I. 2019. Faktor-faktor yang berhubungan dengan kelelahan kerja pada pekerja bagian produksi di PT Antam Tbk. UBPP Logam Mulia. *Jurnal Ilmiah Kesehatan*, 11(1), 73–79.
- Yang, L., Wang, X., Zhu, J., & Qin, Z. 2022. Risk factors identification of unsafe acts in deep coal mine workers based on grounded theory and HFACS. *Frontiers in Public Health*, 10(March), 1–15.
- Yaqub, M., Solulipu. 2022. Faktor yang berhubungan tindakan tidak aman pada pekerja konstruksi pembangunan Rumah Sakit Raudah Makassar. *Window of Public Health Journal*, 3(3), 2745–2755.
- Yusril, M., Muhammad Khidri Alwi, & Chaeruddin Hasan. 2021. Faktor yang berhubungan dengan tindakan tidak aman (unsafe action) pada pekerja bagian produksi PT. Sermani Stell. *Window of Public Health Journal*, 1(4), 370–381.
- Zahiri Harsini, A., Ghofranipour, F., Sanaeinasab, H., Amin Shokravi, F., Bohle, P., & Matthews, L. R. 2020. Factors associated with unsafe work behaviours in an Iranian petrochemical company: Perspectives of workers, supervisors, and safety managers. *BMC Public Health*, 20(1), 1–13.

Zhang, M., Murphy, L. A., Fang, D., & Caban-Martinez, A. J. 2015. Influence of fatigue on construction workers' physical and cognitive function. *Occupational Medicine*, 65(3), 245–250.