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Analysis of individual factors and safety culture on safety incidents among bus driver : A study case at. PT. X

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ABSTRACT

Background: Occupational safety in the land transport sector remains a critical concern as bus drivers are exposed to complex operational demands and potential safety risks. Purpose: This study aims to analyze the relationship between individual characteristics, individual factors, and safety culture with safety incidents among bus drivers at PT. X as well as to identify factors associated with safety incidents. Methods: A quantitative study with a cross-sectional design was conducted among 116 bus drivers at PT. X. Data were collected using a structured questionnaire consisting of measures for safety incidents, driving fatigue, sleep quality, risk perception, psychological well-being, and safety culture. The instruments included the Pittsburgh Sleep Quality Index (PSQI), Ryff's Psychological Well-Being Scale, and previously validated questionnaires for other variables. Data were analyzed using Chi-Square tests and multiple logistic regression. Result : Among 116 respondents, 46 (39.7%) reported experiencing safety incidents, while 70 (60.3%) did not. Poor sleep quality was reported by 104 respondents (89.7%). Bivariate analysis showed a significant relationship between sleep quality (p=0.043; OR=3.474; 95% CI: 0.981–12.306), psychological well-being (p=0.004; OR=0.326; 95% CI: 0.150–0.705), and safety culture (p<0.001; OR=0.113; 95% CI: 0.048–0.266) with safety incidents. No significant relationship was found between age (p-value=0.220), years of service (p-value=0.768), driving duration (p-value=0.653), trip type (p-value=0.362), and driving fatigue (p-value=0.141) with safety incidents. Multivariate analysis showed that safety culture (p-value=0.000) was the variable most strongly associated with safety incidents (OR=0.113; CI 95% CI : 0.048–0.266). Conclusion: Safety culture showed the strongest association with safety incidents among the variables analyzed.

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INTRODUCTION

Work safety in the land transport sector is an important public health and occupational safety issue because transport activities involve continuous interactions between drivers, vehicles, passengers, road conditions, and organizational systems. The complexity of these interactions means that road safety cannot be addressed solely through technical and regulatory measures, but also requires consideration of human and organizational factors. In Indonesia, road traffic accidents remain a substantial safety problem. According to the World Health Organization (WHO), approximately 31,063 people died from road traffic injuries in Indonesia in 2021 (WHO, 2023). National data also shows that the number of traffic accidents increased from 103,645 incidents in 2021 to 139,258 incidents in 2022 and 152,008 incidents in 2023, before reaching 150,906 incidents in 2024 (Badan Pusat Statistik, 2025). In the bus transportation mode, 2020 data shows that 20,762 bus units were involved in accidents out of 233,261 registered bus units, or approximately 8.90% of the total national bus fleet (Badan Pusat Statistik, 2024). These figures demonstrate the continuing urgency of strengthening safety management in bus transportation and provide a basis for examining factors associated with safety incidents among bus drivers.

The safety performance of bus operations is strongly related to driver conditions because drivers are responsible for making continuous decisions and responding to dynamic road situations. Driver-related conditions such as fatigue, sleep quality, risk perception, and psychological well-being may affect attention, decision-making, emotional regulation, and the ability to respond to hazards. Previous studies show that relatively similar incident patterns still recur, such as incidents related to driving fatigue (Mabry et al., 2022), sleep disorders, job demands, and psychosocial conditions can be related to the safety of professional drivers (Amoadu et al., 2025). However, some studies still examine individual and organizational factors separately (Miyama et al., 2020). Research on safety culture also shows its influence on driver safety behavior and performance (Al-Mekhlafi et al., 2021), but there has not been much research that simultaneously examines driving fatigue, sleep quality, risk perception, psychological well-being, and safety culture towards safety incident among bus drivers within the context of a single company in Indonesia.

In the present study, the term individual factors is specifically defined as driver-related conditions consisting of driving fatigue, sleep quality, risk perception, and psychological well-being. This definition is intended to distinguish individual conditions from demographic and operational characteristics. Age, years of service, driving duration, and trip type are treated as individual or operational characteristics examined in the analysis, whereas driving fatigue, sleep quality, risk perception, and psychological well-being represent the principal individual conditions of interest. This distinction is important because the concept of individual factors may otherwise become too broad and overlap with demographic, operational, and organizational variables Theoretically, this condition can be explained through the Accident Causation Theory or the Swiss Cheese Model, which views incidents as the result of interactions between active failures at the individual level and latent conditions at the organizational level. (Reason, 2016). Individual factors such as fatigue and psychological conditions can increase the likelihood of active errors, while a weak safety culture can create latent conditions that allow errors to develop into incidents (Wiegmann, D. A., Shappell, 2017). The importance of this study is also reinforced by previous findings that sleep quality is related to accidents and near-misses among bus drivers (Miyama et al., 2020), whereas psychosocial conditions and safety culture are related to professional driver safety (Amoadu et al., 2024).

Thus, identifying the determinants of safety incident simultaneously has scientific relevance for expanding the understanding of the interaction between individual and organizational factors as well as practical relevance for developing more targeted safety interventions. The research gap in the present study is therefore not the absence of research on individual factors or safety culture, but the limited evidence concerning the simultaneous examination of specific driver-related conditions and safety culture in relation to safety incidents within a single bus transportation company in Indonesia. Previous studies have generally focused

on particular individual conditions, psychosocial factors, safety culture, driving behavior, or accident involvement using different populations and analytical approaches. The present study integrates driving

This study aims to analyze the relationship between individual characteristics, driving fatigue, sleep quality, risk perception, psychological well-being, and safety culture with safety incidents among PT. X bus drivers and to identify the most dominant factors. The research contribution lies in the integration of individual factors and organizational factors into a single analysis model within the population of bus drivers in the Indonesian transportation company environment. This approach provides empirical evidence that incident prevention is not sufficient if only directed at changing driver behavior, but also needs to strengthen organizational conditions that shape such behavior. This perspective is in line with the Swiss Cheese Model, which positions safety culture as one of the organizational defense layers in preventing individual errors from developing into a safety incident. (Reason, 2016). And Accident Causation Theory or the Swiss Cheese Model (SCM) was developed by James Reason as a primary conceptual framework to explain the occurrence of incidents in complex transportation systems.

RESEARCH METHOD

This study uses a quantitative approach with an exploratory cross-sectional design. The quantitative approach was chosen because the study aims to measure variables objectively and test relationships between variables using statistical analysis and the resulting data can be measured, while the cross-sectional design is used to obtain a picture of the relationship between independent variables and safety incident during the same measurement period (John W. Cresswell, 2009). This study examines the influence of variables objectively and measurably using data obtained from standardized questionnaires (Casula et al., 2021), Data collection was conducted at a single point in time, thereby providing an overview of the actual condition of the variables being studied at the time of measurement (Kupers et al., 2023).

The research was conducted at PT. X, Jalan Raya Bogor, Ciracas, East Jakarta. Data collection was carried out from December 2025 to March 2026, encompassing instrument preparation, permitting, data collection, processing, analysis, and research report preparation. The location was selected because it has bus operational activities with relevant safety risks and provides data on safety incidents, near misses, investigation reports, Medical Check Up results, and Hazard Identification Risk Assessment and Determining Control (HIRADC) documents.

The study population consisted of all 130 active bus drivers of PT. X based on operational data from 2025. The minimum sample size was calculated using Slovin's formula with a 5% margin of error, yielding 100 respondents and increased by 10% to anticipate data shortages, resulting in a minimum requirement of 110 respondents. Based on the data collection process and inclusion criteria, namely being active drivers, holding a valid driver's license corresponding to the vehicle driven, and being willing to participate as respondents. A total of 116 active bus drivers participated in the study and were included in the analysis. The respondents represented the operational bus driver population of the study site.

The research instrument uses a structured questionnaire. Safety incident is measured through a self-report questionnaire referring to (Sedlár, 2021). Driving fatigue is adapted from Ahmad et al. (2025), sleep quality uses the Pittsburgh Sleep Quality Index (PSQI), risk perception (Darmawan et al., 2019), psychological well-being using Ryff's Psychological Well-Being Scale, and safety culture (Safitri et al., 2020). The instrument uses indicators that have been utilized in previous research. The reliability of the driving fatigue instrument is reported to have a Composite Reliability of 0.87–0.90, the PSQI has a Cronbach's alpha of 0.80–0.83, while the risk perception instrument has outer loadings and cross loadings above 0.70 as well as a composite reliability >0.70.

Primary data were obtained through a survey using questionnaires distributed both online and offline, while secondary data were obtained from company documentation in the form of

safety incident data, near misses, investigation reports, Medical Check Up results, and HIRADC (Jakobsen et al., 2023). The data were checked for completeness and consistency before being analyzed. Univariate analysis was used to describe variable distributions, bivariate analysis used the Chi-Square test with a 95% confidence level, and multivariate analysis used multiple logistic regression because the safety incident variable was categorized into two groups, namely not experiencing and experiencing a safety incident. Variables with a p-value ≤0.25 in the bivariate analysis were considered for inclusion in the multivariate model.

RESULTS AND DISCUSSIONS

Tabel 1. Univariate Analysis result

Variable	Category	Sum (n).	Persentase (%).
Age	< 36 years	33	28,4%
	≥ 36 years	83	71,6%
working period	≤ 5 years	70	60,3%
	> 5 yers	46	39,7%
long time driving	Normal (≤ 8 hours/day)	71	61,2%
	Not Normal (> 8 hours/day)	45	38,8%
Work Shift	Tourism	30	25,9%
	Shuttle	86	74,1%
Safety Incident	No	70	60,3%
	Yes	46	39,7%
Driving Fatigue	low	112	96,6%
	high	4	3,4%
Sleep Quality	Good Sleep Quality	12	10,3%
	Poor Sleep Quality	104	89,7%
Risk Perception	low	89	76,7%
	high	27	23,3%
Psychological Well-Being	low	54	46,6%
	high	62	53,4%
Individual Factors	less	2	1,7%
	good	114	98,3%
Safety Culture	less	51	44,0%
	good	65	56,0%

Based on the research conducted on the analysis of factors such as age, tenure, driving duration, driving fatigue, sleep quality, risk perception, psychological well-being, individual factors, and safety culture related to safety incidents, the results show that the age category of ≥ 36 years consists of 83 respondents, while those aged under 36 years consist of 33 respondents, or 28.4%. The analysis also found that the majority of respondents have a tenure of ≤ 5 years, totaling 70 respondents or 60.3%, while those with a tenure of more than 5 years amount to 46 respondents or 39.7%. Regarding driving duration, 71 people (61.2%) fall into the normal category (≤ 8 hours/day), while respondents with abnormal driving duration (> 8 hours/day) amount to 45 people (38.79%). It is known that the majority of respondents did not experience safety incidents, namely 70 respondents or 60.3%. Meanwhile, respondents who experienced safety incidents totaled 46 respondents or 39.7%. There are 86 people (74.1%) working in shuttle shifts, while respondents working in tourism shifts total 30 people (25.9%). It is known that 70 respondents or 60.3% did not experience safety incidents. Meanwhile, 46 respondents or 39.7% experienced safety incidents. The analysis results show a low level of driving fatigue, with 112 respondents or 96.6%. Meanwhile, respondents with a high level of driving fatigue account for only 4 people or 3.4%. The analysis also found that most drivers have poor sleep quality, with 104 respondents (89.7%). Meanwhile, only 12 respondents (10.3%) have good sleep quality.

Based on risk perception, it was found that nearly all respondents had a low level of risk perception, namely 89 respondents or 76.7%. Meanwhile, only 27 respondents or 23.3% had a high level of risk perception. The results of the analysis on psychological well-being showed that the majority of respondents had a high level of psychological well-being, namely 62 respondents or 53.4%. Meanwhile, 54 respondents or 46.6% had a low level of psychological well-being. The results of the analysis on individual factors in the good category showed 114 respondents (98.3%).

Meanwhile, only 2 respondents (1.7%) were in the poor category. Most drivers were found to have a good safety culture, with 65 respondents (56%). Meanwhile, 51 respondents (44%) were in the poor category.

Tabel 2. Bivariate Analysis result

Variabel	Kategori	No		Yes		Total		*p-value*	OR CI 95%
		n	%	n	%	n	%		
Age	< 36 years	17	24,3%	16	34,8%	33	28,4%	0,220	0,601
	≥ 36 years	53	75,7%	30	65,2%	83	71,6%		(0,266-1,361)
working period	≤ 5 years	43	61,4%	27	58,7%	70	60,3%	0,768	1,121
	> 5 years	27	38,6%	19	41,3%	46	39,7%		(0,525-2,394)
long time driving	≤ 8 hours/day	44	62,9%	27	58,7%	71	61,2%	0,653	1,191
	> 8 hours/day	26	37,1%	19	41,3%	45	38,8%		(0,556-2,550)
Work Shift	Tourism	16	22,9%	14	30,4%	30	25,9%	0,362	0,677
	Shuttle	54	77,1%	32	69,6%	86	74,1%		(0,292-1,569)
Driving Fatigue	low	69	98,6%	43	93,5%	112	96,6%	0,141	4,814
	high	1	1,4%	3	6,5%	4	3,4%		(0,485-47,775)
Sleep Quality	Poor Sleep Quality	66	94,3%	38	82,6%	104	89,7%	0,043	3,474 (0,981-12,306)
	Good Sleep Quality	4	5,7%	8	17,4%	12	10,3%		
Risk Perception	low	51	72,9%	38	82,6%	89	76,7%	0,224	0,565
	high	19	27,1%	8	17,4%	27	23,3%		(0,224-1,428)
Psychological Well-Being	low	25	35,7%	29	63,0%	54	46,6%	0,004	0,326
	high	45	64,3%	17	37,0%	62	53,4%		(0,150-0,705)
Safety Culture	Less	17	24,3%	34	73,9%	51	44,0%	0,000	0,113
	Good	53	75,7%	12	26,1%	65	56,0%		(0,048-0,266)

The bivariate analysis showed no significant relationship between age (p=0.220), tenure (p=0.768), driving duration (p=0.653), trip type (p=0.362), driving fatigue (p=0.141), and risk perception (p=0.224) with safety incidents. Meanwhile, previous research results show mixed outcomes or no effect at all regarding the relationship between risk perception and safety behavior (Priolo et al., 2025). Conversely, sleep quality was significantly associated with safety incidents (p=0.043), with an OR=3.474, Among respondents who reported safety incidents, 38 (82.6%) had poor sleep quality and 8 (17.4%) had good sleep quality. The statistical analysis showed an OR of 3.474 (95% CI: 0.981–12.306), indicating that respondents with poor sleep quality were more likely to experience safety incidents compared to those with good sleep quality. Research shows that poor sleep quality directly affects cognitive function, concentration problems, and weakens a driver's ability to regulate emotions (Y. Chen et al., 2022). And other research shows a relationship between sleep quality and the occurrence of accidents (Vargas-Garrido et al., 2021). Psychological well-being was also significantly associated (p=0.004; OR=0.326), Drivers with high psychological well-being tended to have a lower risk of safety incidents. Theoretically, a good psychological condition can support concentration, emotional stability, self-control abilities, and readiness to cope with work demands (Silla & Gamero, 2018), which shows the importance of psychosocial conditions and psychological well-being in driver safety. A decline in psychological well-being can lead to general health problems, reduced cognitive function, and a higher risk of work mistakes and road safety incidents (C. F. Chen & Hsu, 2020).Driving fatigue also did not show a significant relationship with safety incidents (p=0.141). This finding needs to be interpreted carefully because almost all respondents fell into the low driving fatigue category, specifically 112 out of 116 respondents, In addition, fatigue likely does not operate independently, but interacts with sleep quality, work patterns, job demands, and the need for recovery (Zuraida & Abbas, 2020). This is in

line with previous research that positions fatigue as part of a more complex mechanism between work demands, sleep, and safety (Amoadu et al., 2024) dan (Mabry et al., 2022).

The strongest association was found in safety culture. Respondents with a poor safety culture who experienced safety incidents numbered 34 people (73,9%), whereas in the good safety culture group there were only 12 people (26,1%). The Chi-Square test yielded p=0,000 with OR=0,113 and 95% CI 0,048–0,266. These results indicate that a good safety culture is protective against the occurrence of safety incidents. This finding supports the Swiss Cheese Model, which positions organizational weaknesses as latent conditions that can increase the likelihood of active errors at the individual level (Reason, 2016).

These results are consistent with previous research, which demonstrates a relationship between organizational safety culture and unsafe behavior as well as accidents among public transit bus drivers (Mokarami et al., 2019). The findings of this study are in line with previous research that also shows the relationship between safety culture, driving behavior, and accident involvement among professional drivers (Nævestad et al., 2019) dan (Al-Mekhlafi et al., 2021). And it was found that the implementation of safety culture improves driving performance, while showing a positive relationship between safety culture and safety performance (Bautista-Bernal et al., 2024). Thus, the findings of this study reinforce the evidence that driver safety is not solely a matter of personal characteristics or conditions, but is heavily influenced by the organizational system in which drivers work.

Tabel 3. Multivariate Analysis result

Variabel	B	Sig.	Exp(B)	95% C.I.for EXP(B)	
				Lower	Upper
Budaya Keselamatan	-2.179	0.000	0.113	0.048	0.266
Constant	2.872	0.000	17.667		

The safety culture variable showed a significant relationship with safety incidents, with a P-value of 0,000 and an OR of 0,113 (95% CI: 0,048-0,266). This indicates that respondents with a better Safety Culture are 0,113 times as likely compared to the reference group. In other words, Safety Culture reduces the odds or likelihood of an incident occurring by approximately 88,7% compared to respondents with a poorer safety culture. Thus, the better the safety culture is implemented, the lower the likelihood of a safety incident occurring.

CONCLUSION

Based on the results of Research on individual factors and safety culture towards safety incidents in bus drivers found that age, length of employment, daily driving duration, type of bus service, driving fatigue, and risk perception were not significantly associated with safety incidents among bus drivers at PT. X. In contrast, sleep quality and psychological well-being showed statistically significant associations with safety incidents in the bivariate analysis. Among all the variables studied, safety culture emerged as the dominant factor in the occurrence of safety incidents

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