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Research Paper

Perceived Traffic Risk on Road Infrastructure Conditions among Car Drivers in Lhokseumawe City, Aceh, Indonesia

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Abstract

According to the Indonesian Department of Transportation, 86% of traffic accidents are attributed to human factors. Additionally, road conditions are identified as a contributing factor to road accidents. Therefore, this study aimed to explore road conditions and their impact on the driving behaviour of car drivers. Data for this exploration were collected by distributing questionnaires to 200 respondents, utilizing a Likert scale for answer options. The technique used was random sampling, utilizing descriptive statistical analysis and a Confirmatory Factor Analysis model. Consequently, the result showed that each latent variable construct examined by car drivers had a value exceeding 80%. The most prominent latent variable was the "Condition of Road Surface Facilities," accounting for 88.1% and featuring eight indicators. The indicator "Disturbed when passing through a narrow road," part of the latent variable "Condition of Road Equipment Facilities," had the highest standardized value at 1.223. Finally, this study suggested that the government should prioritize attention to road infrastructure conditions to enhance driver comfort and mitigate the risk of traffic accidents.

Keywords *Confirmatory Factor Analysis, Driving Behavior, Safety Driving, Traffic Accidents*

INTRODUCTION

In Indonesia, National Police statistics show that 84% of accidents are attributable to driver factors. Meanwhile, the Department of Transportation data revealed that the value was 86.8%. These factors include driving without proper equipment, signs and traffic controller violations, and poor driving techniques and skills. It is important to be aware that driving under poor control, such as inebriation or substance intoxication, is not advisable. The primary cause of accidents is human error, accounting for 91% of accidents, while other factors, including vehicle, road, and environment, contribute 5%, 3%, and 1%, respectively. In general, noncompliance with traffic regulations is a significant issue, signifying the need for drivers in densely populated cities such as Lhokseumawe City, Aceh Province, to prioritize safety on the road. To resolve this problem, individuals must take responsibility, prioritize safety, use proper driving equipment, and alter thought patterns that could cause problems (Furna, 2022).

Accidental deaths are a global challenge caused by the increasing number of vehicles on the roads each year. Approximately 94% of this scenario results from driver errors, classified as recognition errors (41%), decision errors (34%), performance errors (10%), and non-performance errors (7%). Although non-performance errors are less common, drivers are challenging to address due to their random nature. Because driver error is a significant cause of accidents, automotive companies and study experts are actively developing vehicles with advanced features to reduce human intervention, influence driver behaviour, and enhance safety. This development's main aim is to mitigate future traffic accidents through automation (Gouribhatla & Pulugurtha, 2022).

The rise in the number of vehicles in Lhokseumawe City has led to a corresponding increase

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in traffic accidents. This trend is closely tied to driving behaviours and safety considerations. As a result, this study focuses on analyzing the characteristics of vehicle drivers concerning driving safety. The objective is to examine the relationship between driving safety factors in the city and pinpoint the most influential driving safety factors (Lhokseumawe City Central Statistics Agency, 2023).

RESEARCH METHOD

Sampling Technique

This study focused on individuals using vehicles in Lhokseumawe City, including those with addresses, residences, or those who had traversed the city's roads. The study was conducted in the geographical confines of Lhokseumawe City. Furthermore, the population and respondents were individuals who operated vehicles and either currently resided or had lived in the city. Table 1 shows the city's total population for 2021, sourced from data provided by the Central Statistics Agency (Lhokseumawe City Central Statistics Agency, 2023). Based on this population, the study determined a sample size of 200 car drivers using the Slovin formula.

Data Collection Technique

The data collection technique used Nonprobability Sampling via Purposive Sampling. Furthermore, the method included selecting all population members as samples based on specific criteria (Sugiyono, 2017). The data collection process utilized questionnaires distributed to both car and motorcycle drivers.

Latent variables (factors) and observed variables (indicators)

Latent variables (factors) and observed variables (indicators) were the predetermined aspects considered to obtain information and draw conclusions (Sugiyono, 2017). The details of the indicators can be seen in Table 1.

Table 1. Latent variables (factors) and observed variables (indicators)

Factor	Indicators	Source
Road Surface Conditions	Disturbed when passing through potholes	Pemareda (2020)
	Disturbed when the road surface height is higher than the road shoulder	
	Disturbed when drainage opens on narrow roads	
	Disturbed when passing through flooded roads	
Condition of Road Equipment Facilities	Disturbed when the traffic lights do not work	Pane et al. (2021)
	Disturbed when passing speed bumps	
	Disturbed when the road markings fade	
	Disturbed when the zebra crossing markings are faded/unclear	
	Disturbed when the street lights go out at night	
	Distracted when traffic signs are confusing	
	Disturbed when warning/information signs are not there when the road is being repaired	Pane et al. (2021)
	Disturbed when shady trees interfere with visibility	
Road Geometric Conditions	Disturbed when passing through narrow roads (≤ 5.5 m per 2 directions)	Pemareda (2020)
	Disturbed when passing through roads that do not have medians	
	Disturbed when the road median is too small (<0.5 m)	

Factor	Indicators	Source
	Disturbed when the road shoulder is too small (<0.5m)	
Vehicle Condition	Not servicing the vehicle regularly	Marsaid et al. (2013); Najmy et al. (2018)
	Not checking vehicle tires before driving	
	Not checking your rearview mirror before driving	
	Not checking vehicle lights before driving	
	Not checking the brakes before driving	
	Not checking the fuel before driving	
Vehicle Equipment	Do not bring SIM A	Indonesian Law No. 22 (2009)
	Do not carry vehicle registration	
	Do not bring a tools kit (jack, wheel wrench, etc.)	Ridho (2010)
	Does not provide a first-aid kit	
	Does not provide fire poison	Topolšek (2018)

FINDINGS AND DISCUSSION

Respondent Characteristics

Table 2 shows the details of the indicators used to address 200 car drivers, including respondent characteristics such as gender, age, education level, occupation, accident history, driving experience, and daily driving duration.

Table 2. Characteristics of Respondents

Characteristics	Car Driver	
Gender	**Respondents**	**Percentage**
Man	95	47,50%
Woman	105	52,50%
Total	200	100,00%
Age (Years)	**Respondents**	**Percentage**
17-25	86	43,0%
>25-35	77	38,5%
>35-45	26	13,0%
>45	11	5,5%
Total	200	100,0%
Occupation	**Respondents**	**Percentage**
Students	45	22,5%
Civil servants	51	25,5%
Private employees	54	27,0%
Entrepreneur	33	16,5%
Other	17	8,5%
Total	200	100,0%

Characteristics	Car Driver	
Education Level	**Respondents**	**Percentage**
Senior High School	60	30,0%
Associate Degree	42	21,0%
Bachelor Degree	53	26,5%
Master Degree	22	11,0%
Doctoral Degree	12	6,0%
Others	11	5,5%
Total	200	100,0%
Accident History (Times)	**Respondents**	**Percentage**
Never	92	46,0%
1-2	95	47,5%
3-4	7	3,5%
>4	6	3,0%
Total	200	100,0%
Driving Experience (Years)	**Respondents**	**Percentage**
<1	23	11,50%
1-5	80	40,00%
5-10	73	36,50%
>10	24	12,00%
Total	200	100,0%
Driving Duration (Hours/Day)	**Respondents**	**Percentage**
<2	89	44,50%
2-4	79	39,50%
4-6	24	12,00%
>6	8	4,00%
Total	200	100,0%

According to Table 2, female respondents comprised the majority at 52.50%, with 43% falling in the 17-25 age range. The dominant occupational characteristic was private employment, with 27% of respondents falling into this category. Similarly, the most common educational attainment was private employment at 27%. Regarding accident history, 47.5% of respondents experienced 1-2 accidents, and the majority (40%) had 1-5 years of driving experience. The driving duration analysis revealed that 44.5% of respondents drove for less than two hours per day.

Data Analysis

The data analysis used confirmatory factor analysis (CFA) to validate the factorial analysis of driving safety. The results of the analyzed models were compared using chi-square ($\chi 2$), GFI, AGFI, CFI, RMSEA, and RMR.

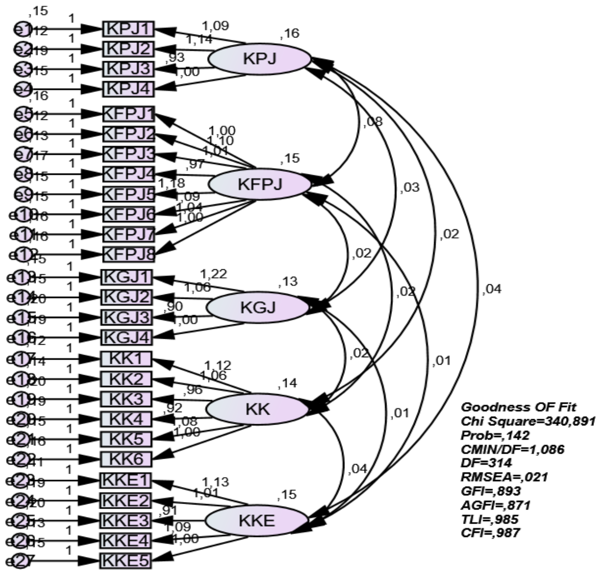

Figure 1. The measurement model of traffic risk on road conditions by car drivers

Figure 1 shows the outcomes of the calibration of the measurement model conducted through confirmatory factor analysis (CFA). The factors assessed included the road surface condition, road equipment facilities, geometric road conditions, vehicle condition, and vehicle completeness. As expected, all indicators in this latent construction group carried a substantial weight (factor loading) exceeding 5% (T-Value > 1.96) on the measured latent construction. In evaluating the model fit, the chi-square value was 340.891, with degrees of freedom (DF) at 314, a probability (P) of 0.142, root mean square error of approximation (RMSEA) at 0.021, comparative fit index (CFI) at 0.987, adjusted goodness of fit (GFI) at 0.893, adjusted goodness of fit index (AGFI) at 0.871, and root mean square residual (RMR) at 0.015. These results indicated that the entire model was categorized as a good fit. In the conducted modelling, various latent variables were described by the following information:

- KPJ = Road Surface Condition
- KFPJ = Condition of Road Equipment Facilities
- KGJ = Road Geometric Condition
- KK = Vehicle Condition
- KKe = Vehicle Completeness

Reliability Testing

The construct reliability value could be considered reliable when the value is >0.60. Below are the calculation results using the following formula.

For sum standardized loading:

KPJ_{SSL} = KPJ1 + KPJ2 + KPJ3 + KPJ4
= 1,093 + 1,138 + 0,935 + 1,000
= 4,166

$KFPJ_{SSL}$ = KFPJ1 + KFPJ2 + KFPJ3 + KFPJ4 + KFPJ5 + KFPJ6 + KFPJ7 + KFPJ8
= 1,003 + 1,101 + 1,009 + 0,970 + 1,181 + 1,087 + 1,044 + 1,000
= 8,395

KGJ_{SSL} = KGJ1 + KGJ2 + KGJ3 + KGJ4
= 1,223 + 1,058 + 0,901 + 1,000
= 4,182

KK_{SSL} = KK1 + KK2 + KK3 + KK4 + KK5 + KK6
= 1,116 + 1,062 + 0,961 + 0,916 + 1,075 + 1,000
= 6,130

KKE_{SSL} = KKE1 + KKE2 + KKE3 + KKE4 + KKE5
= 1,125 + 1,012 + 0,909 + 1,093 + 1,000
= 5,139

Regarding sum measurement error:
KPJ_{SME} = e1 + e2 + e3 + e4
= 0,150 + 0,123 + 0,192 + 0,155
= 0,620

$KFPJ_{SME}$ = e5 + e6 + e7 + e8 + e9 + e10 + e11 + e12
= 0,155 + 0,117 + 0,127 + 0,168 + 0,149 + 0,152 + 0,163 + 0,162
= 1,193

KGJ_{SME} = e13 + e14 + e15 + e16
= 0,146 + 0,153 + 0,195 + 0,185
= 0,679

KK_{SME} = e17 + e18 + e19 + e20 + e21 + e22
= 0,122 + 0,137 + 0,197 + 0,187 + 0,153 + 0,165
= 0,961

KKE_{SME} = e23 + e24 + e25 +e26 + e27
= 0,105 + 0,189 + 0,203 + 0,135 + 0,154
= 0,786

The construct reliability value of each latent variable was calculated as follows:

$$KPJ = \frac{(4{,}166)^2}{(4{,}166)^2 + 0{,}620} = 0{,}966$$

$$KFPJ = \frac{(8{,}395)^2}{(8{,}395)^2 + 1{,}193} = 0{,}983$$

$$KGJ = \frac{(4{,}182)^2}{(4{,}182)^2 + 0{,}679} = 0{,}963$$

$$KK = \frac{(6{,}130)^2}{(6{,}130)^2 + 0{,}961} = 0{,}975$$

$$KKE = \frac{(5{,}139)^2}{(5{,}139)^2 + 0{,}786} = 0{,}971$$

It was observed that the construct reliability of each construct for car drivers has a value above 0.80. Therefore, it was concluded that each construct had met the reliability requirements.

Variance extracted

A high extracted value showed that the indicators represented the formed variables being developed well. Subsequently, the variable extracted value was obtained using the following formula:

For sum of square standardized loading:

KPJ_{SOSSL} = $(KPJ1)^2 + (KPJ2)^2 + (KPJ3)^2 + (KPJ4)^2$
= $(1{,}093)^2 + (1{,}138)^2 + (0{,}935)^2 + (1{,}000)^2$
= 4,364

$KFPJ_{SOSSL}$ = $(KFPJ1)^2 + (KFPJ2)^2 + (KFPJ3)^2 + (KFPJ4)^2 + (KFPJ5)^2 + (KFPJ6)^2 + (KFPJ7)^2 + (KFPJ8)^2$
= $(1{,}003)^2 + (1{,}101)^2 + (1{,}009)^2 + (0{,}970)^2 + (1{,}181)^2 + (1{,}087)^2 + (1{,}044)^2 + (1{,}000)^2$
= 8,843

KGJ_{SOSSL} = $(KGJ1)^2 + (KGJ2)^2 + (KGJ3)^2 + (KGJ4)^2$
= $(1{,}223)^2 + (1{,}058)^2 + (0{,}901)^2 + (1{,}000)^2$
= 0,963

KK_{SOSSL} = $(KK1)^2 + (KK2)^2 + (KK3)^2 + (KK4)^2 + (KK5)^2 + (KK6)^2$
= $(1.116)^2 + (1.062)^2 + (0{,}961)^2 + (0{,}916)^2 + (1{,}075)^2 + (1{,}000)^2$
= 0,975

KKE_{SOSSL} = $(KKE1)^2 + (KKE2)^2 + (KKE3)^2 + (KKE4)^2 + (KKE5)^2$
= $(1{,}125)^2 + (1{,}012)^2 + (0{,}909)^2 + (1{,}093)^2 + (1{,}000)^2$
= 0,971

For sum measurement error:

KPJ_{SME} = e1 + e2 + e3 + e4
= 0,150 + 0,123 + 0,192 + 0,155
= 0,620

$KFPJ_{SME}$ = e5 + e6 + e7 + e8 + e9 + e10 + e11 + e12
= 0,155 + 0,117 + 0,127 + 0,168 + 0,149 + 0,152 + 0,163 + 0,162
= 1,193

KGJ_{SME} = e13 + e14 + e15 + e16
= 0,146 + 0,153 + 0,195 + 0,185
= 0,679

KK_{SME} = e17 + e18 + e19 + e20 + e21 + e22
= 0,122 + 0,137 + 0,197 + 0,187 + 0,153 + 0,165
= 0,961

KKE_{SME} = e23 + e24 + e25 +e26 + e27
= 0,105 + 0,189 + 0,203 + 0,135 + 0,154
= 0,786

The percentage of index/variance extracted for each construct is:

$$KPJ = \frac{4{,}364}{4{,}364 + 0{,}620} = 0{,}8756 \approx 87{,}56\%$$

$$KFPJ = \frac{8{,}843}{8{,}843 + 1{,}193} = 0{,}8811 \approx 88{,}11\%$$

$$KGJ = \frac{4{,}427}{4{,}427 + 0{,}679} = 0{,}8670 \approx 86{,}70\%$$

$$KK = \frac{6{,}292}{6{,}292 + 0{,}961} = 0{,}8675 \approx 86{,}75\%$$

$$KKE = \frac{5{,}311}{5{,}311 + 0{,}786} = 0{,}8711 \approx 87{,}11\%$$

For variance extracted, all constructs were recommended to have a value of ≥ 0.5, but for constructs, the minimum result was at least ≥ 0.7. In the above calculation, the variance extracted values for the car driver construct had a value of ≥ 0.8. This demonstrated that the construct index had an exceptionally good value.

Correlation Table

Correlation is the relationship between latent variables with a distinct value or score. A correlation value above the t-table threshold of 1.967 (N=200) indicated a close relationship between the two variables. The path diagram coefficients are shown in Table 3.

Table 3. Correlation Coefficients Between Latent Variables

Variable	Car Driver Correlation Coefficient	
	Path Coefficient	t_{count}
KPJ « KFPJ	0,083	5,070
KPJ « KGJ	0,035	2,524
KPJ « KK	0,018	1,377
KPJ « KKE	0,038	2,746
KFPJ « KGJ	0,023	1,860
KFPJ « KK	0,024	1,987
KFPJ « KKE	0,012	0,964
KGJ « KK	0,022	1,787
KGJ « KKE	0,007	0,552
KK « KKE	0,045	3,325

Discussion

Based on the analysis results, a confirmatory factor analysis equation model showed the car's perception of the latent variable of driving safety. Among the indicators, "Disturbed when passing through a narrow road" held the highest standardized value at 1.223 > 1, indicating a significant influence on the latent variable "Geometric Condition of the Road." Additionally, each variance extracted from every latent variable exceeded 80%, indicating the close relationship each variable/factor had with driving safety. For motorcycles, the highest value of the latent variable/factor construct was 88.11%, specifically the latent variable "Condition of Road Equipment Facilities," consisting of 8 indicators.

CONCLUSIONS

In conclusion, it was observed that the majority were women (47.50%), aged between 17-25 years (43.00%), working in the private sector (27%), possessing at least a high school education (30%), with a history of 1-2 accidents (47.5%), driving experience of 1-5 years (40%), and spending less than 2 hours driving daily (44.5%). The overall analysis of vehicle factors, as indicated by the latent variable indices, showed that cars consistently scored above 80%. It should be acknowledged that the most influential driving safety latent variable for car drivers was the "Condition of Road Surface Facilities," with a substantial value of 88.11%.

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