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Empirical Analysis of Street Safety: Driver Behavior and Traffic Characteristics on Traffic Accidents in Semarang

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Abstract

Transportation issues are a common challenge faced by both developed and developing countries, including Indonesia. The transportation sector's primary goal is to establish a system that facilitates smooth, safe, fast, cost-effective, comfortable, and environmentally friendly movement of people, vehicles, and goods. In accordance with Law No. 22 of 2009 on traffic and road transportation, traffic accidents are defined as unexpected, non-intentional incidents occurring on the road involving vehicles, with or without other road users, resulting in human casualties and/or property damage. This research aims to assess the influence of driver behavior, intersection traffic characteristics, and traffic sign violations on traffic accidents at the Tlogosari Intersection in Semarang. The problem formulation, research objectives, and hypotheses in this study intend to analyze the positive and significant effects, both individually and collectively, of the independent variables on the dependent variable (traffic accidents). The study's subjects comprise motor vehicle users at the Tlogosari intersection in Semarang, with primary and secondary data serving as data sources. The study sample consists of 100 respondents who are Tlogosari Intersection users in Semarang, selected through non-probability sampling using the Incidental Sampling method. The data analysis technique employed is multiple linear regression analysis.

Keywords

Driver behavior, intersection traffic accidents, traffic sign violations and traffic accidents.

1. Introduction

One of the common challenges faced by both developed and developing countries, including Indonesia, is transportation issues. One of the objectives of the transportation sector is to establish a transportation system that ensures and supports the movement of people, vehicles, and goods smoothly, safely, quickly, affordably, comfortably, and in an environmentally friendly manner. Transportation problems are a major challenge encountered by both developed and developing nations, with the goal of creating an efficient, safe, and community-oriented transportation system. The aspiration is for transportation to be smooth, safe, fast, affordable, comfortable, and environmentally friendly in everyday life (Chehri & Mouftah, 2019). In Indonesia, one significant issue is traffic safety, with a high rate of road accidents being a pressing concern. Numerous serious accidents and loss of lives underscore the need for serious attention to improving road safety for all users (Vanlaar et al., 2016).

In modern society, transportation has become an essential need, intertwined with economic, social, and daily life activities. At the macroeconomic level, transportation plays a crucial role in supporting economic growth, both nationally, regionally, and locally. Therefore, traffic accidents have a significant impact on various aspects of community life. In Indonesia, the continuous increase in the number of motor vehicles each year, combined with human negligence, is the primary factor contributing to the rise in traffic accidents (Damani & Vedagiri, 2021).

According to Law No. 22 of 2009 concerning traffic and road transportation, traffic accidents are defined as unexpected and unintended events on the road involving vehicles, resulting in accident victims (Pratama & Kusriyah, 2023). Therefore, addressing traffic safety is essential to reduce the negative impacts of accidents, including injuries and property damage. In this context, there is a need for more serious efforts from the government, society, and relevant parties to create a safer and more efficient transportation system. This includes raising awareness about the importance of traffic regulations compliance, improving road infrastructure, and enforcing laws related to traffic violations (Afukaar, 2003). Road user safety is a shared responsibility that must be prioritized in the efforts to create a better and safer transportation system in Indonesia.

This research has a highly relevant objective, which is to identify the factors influencing the rate of traffic accidents at the Tlogosari intersection in Semarang City. One crucial factor that needs analysis is the behavior of road users, especially motorcycle riders who often violate traffic signs (Susilo et al., 2015). Awareness and compliance with traffic rules are key elements in ensuring road safety, and this research will provide valuable insights into how road user behavior affects accidents. In addition to road user behavior, the traffic characteristics at the Tlogosari intersection are also a focus of the research. With five road segments converging at this intersection, road layout and traffic flow have the potential to impact traffic density and accident rates significantly. An analysis of traffic characteristics at this intersection will help authorities understand how road design and layout can be improved to reduce accident risks (Zegeer et al., 2001).

Traffic sign violations and the accident rate are highly relevant aspects in this research. Traffic sign violations often indicate non-compliance with rules, which can significantly contribute to accidents at the Tlogosari intersection. The results of this research will help identify whether law enforcement concerning traffic sign violations can have a positive impact on the accident rate at this intersection. Overall, this study has a significant impact on the understanding and

improvement of traffic safety at the Tlogosari intersection (Yoh et al., 2017). With a focus on driver behavior, traffic characteristics, and traffic sign violations, this research provides a strong foundation for enhancing the traffic system and safety in the area. The aim of this research is to identify and analyze the factors influencing the rate of traffic accidents at the Tlogosari intersection in Semarang City, with a specific focus on driver behavior, traffic characteristics, and traffic sign violations, to provide insights for enhancing traffic safety and the transportation system in the area.

2. Theoretical Framework and Hypothesis Development

A complex system consisting of various essential elements, one key element in traffic is the headway system, which refers to the time gap between two vehicles following each other when crossing a point on the road. The concept of headway is important because it can affect traffic flow, especially in congested traffic situations (Schakel & Van Arem, 2014). Traffic itself encompasses various components, ranging from road networks, road infrastructure, road facilities, to various types of vehicles used in the transportation process. This reflects the complexity of the transportation system, which plays a crucial role in the mobility of people and goods worldwide. Within the framework of transportation, transportation or transport is the activity involving the movement of people or goods from one initial location to a specific destination using various means or vehicles.

This activity involves a diverse range of transportation modes, including public transportation and private vehicles, which form the backbone of societal mobility. This approach focuses on the movement of people and goods within and between cities and countries. Therefore, transportation plays a vital role in maintaining connectivity and economic growth. According to Traffic and Road Transportation Law No. 22 of 2009, a traffic accident is defined as an unexpected and unintentional event involving vehicles on the road. Such accidents can result in serious injuries to individuals requiring further medical treatment in hospitals. In the context of traffic accidents, the role of the driver is highly significant.

Drivers are individuals who sit behind the wheel and control the vehicle when accidents occur. Unfortunately, statistics show that around 90% of traffic accidents are a result of driver negligence, often involving violations of traffic regulations. Non-compliance with traffic rules is one of the most common forms of negligence in the field. This includes violations such as exceeding the specified speed limits, running red lights, driving under the influence of alcohol or drugs, and various other potentially hazardous actions (Fynbo, 2014). Therefore, enforcing traffic regulations and educating about rule compliance are crucial to minimize the risk of traffic accidents. Understanding the role of drivers and how their behavior affects traffic safety is a vital step in reducing accident rates and protecting human lives on the road (Safarpour et al., 2020).

Categorizing traffic accident victims based on the definitions of fatalities and severe injuries within a 30-day time limit after the accident is a common practice in accident data collection. However, in practice, this categorization is often not carried out accurately in Indonesia. This situation creates problems in recording accident statistics, where victims who have died because of the accident are often identified as severely injured victims because they require medical treatment for longer than 30 days. This inaccuracy affects the understanding of the accident rates in Indonesia and can hinder accident prevention and traffic safety efforts (Suriyawongpaisal &

Kanchanasut 2023). The importance of accurate and consistent monitoring of accident victims' conditions during the critical period following the incident becomes increasingly evident. To understand and address traffic safety issues in Indonesia, there needs to be an increased awareness of the importance of accurate victim categorization and monitoring. Improvement measures in the accident reporting and victim monitoring system can help create more accurate data and support traffic safety improvement efforts. Traffic safety is a critical issue that should be addressed seriously, and it requires attention to all aspects of data collection, including victim categorization.

Accidents are typically caused by three main factors: human factors, vehicle factors, and road and environmental factors. In essence, traffic accidents do not occur due to just one factor. It cannot be denied that the primary cause of accidents is the lack of discipline among road users themselves. More than 70% of accidents are caused by the lack of discipline in road usage. The behavior of drivers when crossing pedestrian crossings and intersections yields results indicating that in developing countries like ours, only 10% to 17% of vehicles stop when they are required to do so. Human behavior, especially while driving, is influenced by various factors, including the physical, social, and cultural environment around them. In traffic management, it's important to understand the characteristics of traffic flow, such as volume and speed, to plan effective intersection control. An equally important aspect is driving ethics, where drivers are expected to follow traffic norms and rules while considering overall safety. Traffic sign violations also need to be considered, as they can threaten safety and comfort on the road. Therefore, efficient traffic management and awareness of driving ethics are key to creating safe and smooth traffic in increasingly congested environments (Barth & Boriboonsomsin, 2009).

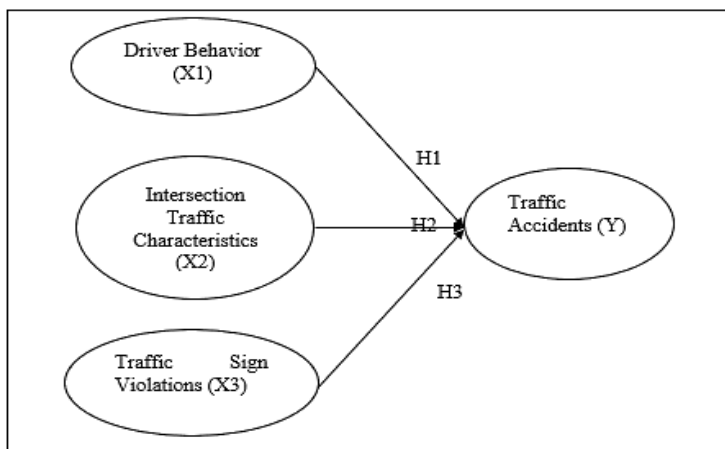


Figure 1. Theoretical Framework

3. Research methods

In this research, a survey-based analytical methodology is employed to systematically collect, organize, analyze, and interpret data. The study focuses on motorcycle riders who cross the Tlogosari Intersection in Semarang. Given the challenge of an infinite number of potential subjects and a finite population, the research uses the Incidental Sampling method, which

involves selecting research samples through chance encounters. Anyone who coincidentally meets the researcher can become a research sample. The primary objective of this study is to evaluate the relationships between independent variables, such as driver behavior, intersection traffic characteristics, and traffic sign violations, and the dependent variable, which is traffic accidents. The core aim is to determine whether there exists a cause-and-effect correlation among these variables.

To process non-numerical data that requires detailed elaboration, qualitative analysis is employed. This approach involves drawing upon theories, expert opinions, responses from respondents, and data tabulation related to the research object's specific issues. Additionally, the research uses the coefficient of determination (R-squared) to quantify the percentage of change in the dependent variable explained by the independent variables. A higher R-squared value signifies a more substantial influence of the independent variables on the dependent variable. The research encompasses 100 respondents, specifically motorcycle riders who traverse the Tlogosari Intersection in Semarang and relies on a qualitative method.

4. Results and Discussion

The Tlogosari Intersection in Semarang is an example of what is referred to as a secondary road junction. In this classification, secondary intersections are places where roads connecting primary areas with secondary areas, or linking one secondary area to another, intersect. These intersections typically feature long-distance and high average-speed traffic, usually exceeding 10 km/h. A road width of no less than 8 meters is crucial to accommodate high traffic volume and maintain fast traffic flow without disruption by slower-moving traffic. However, the Tlogosari Intersection in Semarang faces its own challenges.

The condition of the Tlogosari Intersection in Semarang reflects the reality in many urban areas in Indonesia. Despite being classified as a secondary road junction, this intersection experiences challenges such as high traffic congestion, limited space, and frequent traffic violations. Many drivers feel trapped in traffic jams, which may lead them to violate traffic rules, such as disregarding traffic signs, to reach their destinations faster (Jensupakarn & Kanitpong, 2018).

As a result, such conditions increase the risk of traffic accidents at the intersection (Moore et al., 2011). To enhance traffic safety at the Tlogosari Intersection, concrete steps need to be taken. This includes road infrastructure improvements, enhanced traffic monitoring, and education about traffic rule compliance. Furthermore, it is important to understand the traffic characteristics at this intersection, including traffic volume and vehicle movement patterns, to design appropriate solutions. Raising awareness of the importance of traffic rule compliance and its consequences is a key step in reducing the risk of accidents at this intersection and making traffic safer for all road users (Oxley et al., 2004).

This research begins with an analysis of the characteristics of the respondents who are the subjects of the study, primarily motorcycle riders who frequently pass through the Tlogosari Intersection in Semarang. One of the pieces of information collected is data about the respondents' gender, gathered through questionnaire completion. This identity information is an essential initial step in the research, as it provides an overview of the individuals who are the subjects of the study. Additionally, analyzing gender can provide insights into whether there are differences

in driver behavior based on their gender. This can help the researchers understand the variability in rider responses and actions, which may play a role in understanding the factors contributing to traffic accidents at the Tlogosari Intersection (Armawi et al., 2022).

Through the collection of respondent identity information, this research establishes a strong foundation for further analysis related to traffic accidents at the Tlogosari Intersection. The results of this analysis will provide important insights into whether there are specific aspects of rider behavior that need to be examined more closely in accident prevention efforts at the intersection. Thus, the analysis of respondent characteristics is a highly relevant initial step in this study to understand the contribution of gender to traffic safety at the Tlogosari Intersection in Semarang. The results of this study will offer valuable insights into motorcycle rider behavior at the Tlogosari Intersection in Semarang, which can be used to develop traffic accident prevention strategies (Massie et al., 1993).

Data analysis will help identify areas that require improvement in terms of rider behavior and potential accident-causing factors (Lee & Lee, 2022). With a deeper understanding of rider behavior at this intersection, steps and recommendations can be formulated to enhance traffic safety and reduce accident rates in the area. Motorcycle riders passing through the Tlogosari Intersection in Semarang have been used to identify three key indicators related to rider behavior. These indicators may encompass things like compliance with traffic rules, attitudes toward safety, and everyday driving practices (Huang et al., 2013). This data will form the basis for analyzing rider behavior and understanding the factors that may influence the traffic accident rate at the intersection.

Table 1. Validity Test Results

No	Indicator	r count	r table	Decision	No	Indicator	r count	r table	Decision
1	X1.1	0.941	0.2565	Valid	3	X3.1	0.853	0.2565	Valid
	X1.2	0.948	0.2565	Valid		X3.2	0.953	0.2565	Valid
	X1.3	0.938	0.2565	Valid		X3.3	0.958	0.2565	Valid
2	X2.1	0.880	0.2565	Valid	4	Y.1	0.733	0.2565	Valid
	X2.2	0.893	0.2565	Valid		Y.2	0.838	0.2565	Valid
	X2.3	0.874	0.2565	Valid		Y.3	0.841	0.2565	Valid

Table 1 shows that all the indicators used to measure the variables used in this research have a correlation coefficient greater than $r_{table} = 0.2565$ (r_{table} value for $n = 100$), so all these indicators are valid, and the reliability test was carried out using SPSS program assistance which provides facilities for measuring reliability with the Cronbach Alpha (α) statistical test. A construct or variable is said to be reliable if it provides a Cronbach Alpha value > 0.7 .

Table 2. Reliability Test Results

No	Variable	Cronbach Alpha	Standard alpha	Conclusion
1	Rider Behavior (X1)	0.937	0.7	Reliable
2	Intersection Traffic Characteristics (X2)	0.855	0.7	Reliable
3	Violation of Traffic Signs (X3)	0.929	0.7	Reliable
4	Traffic Accident (Y)	0.729	0.7	Reliable

Based on Table 2, all research variable reliability test results can be concluded to be reliable, because they have an alpha coefficient value greater than 0.7. So that for further statistical calculations all questionnaire answer items can be used because they are valid and reliable. From the results of research using SPSS, the following results were obtained.

Table 3. Hypothesis Test Results

Model	Coefficients			t	Sig.
	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta		
1 (Constant)	1.822	.659		2.766	.007
Rider Behavior	.208	.050	.288	4.124	.000
Intersection Traffic characteristics	.233	.058	.236	3.990	.000
Violation of Traffic Signs	.338	.047	.500	7.207	.000

a. Dependent Variable: Traffic Accidents

From Table 3 above, it can be obtained from testing this hypothesis and testing the influence of driver behavior (X1) on traffic accidents (Y). Based on statistical testing with SPSS, the calculated t number > t table is where driver behavior (X1) on traffic accidents (Y) is 4.124 and t table (df = n – k 1 = 100 – 3 1 = 96) of 1.984, then the calculated t value is greater than t table and Ha is accepted so that the first hypothesis (H1) states that there is a positive and significant influence between Driver behavior towards traffic accidents. Based on the tests that have been carried out, a linear regression equation is obtained, namely:

$$Y=1.822 + 0.208X1 + 0.233X2 + 0.388X3+\mu \quad (1)$$

Based on empirical evidence, as revealed through questionnaire results and multiple linear regression analysis, it becomes evident that the variable Motorcycle Rider Behavior (X1) holds the second position among the three variables exerting influence on traffic accidents. This conclusion is substantiated by the t-value of 4.124 and a regression coefficient of 0.245. Within this context, it underscores that the behavior of motorcycle riders, encompassing actions like riding under the influence of alcohol, fatigue, and engaging in reckless driving, plays a significant role in influencing traffic accidents. This result corroborates earlier research findings (Fynbo, 2014), which emphasize the pivotal role of driver behavior and violations in accident causation. These findings accentuate the imperative of promoting responsible and safe motorcycle operation, underlining the importance of rule compliance and driver education.

Meanwhile, Intersection Traffic Characteristics (X2) emerges as the third-ranked factor among the three variables impacting traffic accidents. This conclusion is drawn from the t-value of 3.990 and a regression coefficient of 0.233. It highlights that intersection traffic characteristics, encompassing elements such as traffic density, flow, and speed, exert a tangible influence on traffic accidents. This finding aligns with the perspective presented by Barth & Boriboonsomsin (2009), emphasizing the significance of traffic flow, volume, and speed in traffic management and safety.

Lastly, the variable Traffic Sign Violations (X3) takes precedence as the most influential factor among the three variables affecting traffic accidents. This conclusion is supported by the

high t-value of 7.207 and a substantial regression coefficient of 0.388. It signifies that insufficient or inadequate traffic signs, especially in conjunction with narrow roads compounded by heavy traffic, significantly contribute to the occurrence of traffic accidents. This finding resonates with earlier research (Schakel & Van Arem, 2014), which underscores the importance of maintaining proper traffic flow and ensuring adherence to traffic rules. Inadequate traffic signs and congested road conditions are identified as pivotal factors contributing to accidents, emphasizing the pressing need for improvements in road infrastructure, including the installation of traffic lights and road markings.

5. Conclusion

The study has provided valuable insights into the factors influencing traffic accidents at the Tlogosari Intersection in Semarang. Despite its classification as a secondary road junction, the intersection faces challenges such as traffic congestion, limited space, and frequent violations of traffic regulations, all contributing to an increased risk of accidents. Enhancing traffic safety at this intersection requires comprehensive measures, including road infrastructure improvements, enhanced traffic monitoring, and educational initiatives aimed at fostering greater adherence to traffic rules. The research highlights the pivotal role of three key variables in shaping traffic accident outcomes. Motorcycle rider behavior emerged as a crucial factor, with rider actions such as riding under the influence, fatigue, and reckless driving significantly impacting accident rates. Intersection traffic characteristics, encompassing factors like traffic density, flow, and speed, also played a substantial role in accident occurrence. Furthermore, traffic sign violations stood out as the most influential factor, emphasizing the critical need for proper traffic signage and stringent rule compliance. These findings collectively underscore the importance of multifaceted strategies to enhance traffic safety at the Tlogosari Intersection, with the goal of reducing accidents and safeguarding road users.

Based on the research findings, several key recommendations can be made to improve road safety at the Tlogosari Intersection Road in Semarang. Firstly, for motorcycle users traversing the Tlogosari Intersection, it is crucial to adopt a more cautious and safety-conscious approach. This involves strict adherence to traffic regulations and a commitment to avoiding any violations. By doing so, motorcycle riders can significantly reduce the risk of traffic accidents at this intersection. Secondly, considering the variable traffic conditions at the Tlogosari Intersection, motorcycle riders should be adaptable in their behavior. Whether faced with congested traffic characterized by high density or more sparse conditions, riders are encouraged to adjust their speed and driving practices accordingly to maintain safety and prevent accidents.

Lastly, in terms of road conditions, especially the state of traffic signs and signals, it is imperative that relevant authorities, such as the Semarang Transportation Agency (Dinas Perhubungan), take proactive steps to address the repair and maintenance of damaged, missing, or neglected traffic signs and signals at the Tlogosari Intersection. This maintenance effort will significantly enhance the safety of motorcyclists passing through the intersection and help reduce the risk of traffic accidents. These recommendations collectively aim to enhance road safety and minimize the occurrence of traffic accidents at the Tlogosari Intersection Road in Semarang. They underscore the importance of responsible and law-abiding behavior by motorcycle riders and the

necessity for proper maintenance of road infrastructure to create a safer environment for all road users.

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