Analysis of the Level of Traffic Fatality of Road Section Conditions in Tanjung Balai City

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ABSTRACT

There are various kinds of driver behavior in Tanjungbalai city such as aggressive driving, illegal racing, against the direction and many more which are generally dominated by workers with different professions and students. A person's attitude and pattern of thinking will be influenced by that pattern of thinking, which usually results in certain patterns of behavior. Most traffic accidents occur due to human error, such as traffic violations. Every year, 1.35 million people die from traffic accidents worldwide. This means that every 24 seconds one person loses their life on the roads around the world. A person can violate traffic laws due to intentionality, ignorance, or ignorance of the applicable rules. This study explains, which means testing hypotheses to explain the causal relationship between variables. This type of research was chosen because the goal to be achieved was to explain the relationship and effect of the questionnaire as the main data collection tool. Field research requires tools to support it. The following tools and materials were used by researchers including stationery, cameras (documentation) and survey forms Traffic Accident Analysis. Data Collection Techniques The research data must be collected to obtain the necessary data and information. The following is the data collection process used in this study, namely Primary Data Survey Results where primary data collection is carried out by direct observation at the research location. Secondary Data where vehicle data and vehicle volumes used as writing material are based on direct observation data in the field and data assistance from SAMSAT and the PUPR Office of Tanjungbalai City. Field Observation is by making direct observations of motorists who are around the research subject to collect information needed for further research. As well as documentation Data collected from activities carried out at the research location or survey during the activity. This research was conducted in Tanjung Balai City, North Sumatra Province with research targets or respondents being Students, Students, and Communities who live or are in the research area and own and use motorized vehicles (cars and motorcycles) spread across Gading Village, Sijambi Village, and Pahang Village, Tanjung Balai City.Research Implementation Time Where the research took place for four days, from March 11 to 14, 2024. The research location is located at Ir. Sutami street, Husni Thamrin street, Abd Rahman Street, and SMA 3 street, Tanjung Balai City. It can be seen that the most frequent traffic accidents in the research location are on the Ir. Sutami section of Tanjungbalai City which has an accident rate which if rounded off the value is 36 events/year. From the calculation example above, it is known that the value of the fatality rate of the Ir Sutami road section, Datuk Bandar District, Tanjungbalai with TF = 47232.003> UCL = 23903.06 then the road section is an Accident Prone Area. The accident-prone road section that has the highest fatality rate is Jl. SMA 3, Tanjungbalai with TF = 105462,206 and UCL = 61843,521.

Keywords: accident; traffic; road; driver behavior; road condition.

INTRODUCTION

The government provides roads as infrastructure to provide convenience and serve the interests of the community. Roads are very important to improve the economic development of the country; in this case roads also function very well to facilitate human mobility. Road user drivers, pedestrians, and passengers are the most important elements of the traffic system, and drivers are the most

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important because they operate vehicles on the road. In addition, the behavior of vehicle users in Tanjungbalai city is one of the complex problems that require appropriate devices and tools to achieve efficiency, safety, and good road utilization.

There are various kinds of driver behavior in Tanjungbalai city such as aggressive driving, illegal racing, against the direction and many more which are generally dominated by workers with different professions and students. A person's attitude and pattern of thinking will be influenced by that pattern of thinking, which usually results in certain patterns of behavior. Most traffic accidents occur due to human error, such as traffic violations [5], [6].

Every year, 1.35 million people die from traffic accidents worldwide. This means that every 24 seconds one person loses their life on the roads around the world [1]. A person can violate traffic laws due to intentionality, ignorance, or ignorance of the applicable rules. [2]. Due to the large number of vehicles, there is traffic congestion. Motor vehicle users often do not know how to drive and do not know what they are doing. Poor driver skills and knowledge is one of the causes of traffic accidents. The number of motor vehicle accidents increases in various regions every year [7], [8].

A study entitled Evaluation of Public Attitudes of Priority Vehicle Users (Case Study in Jakarta, Depok, and Sragen*)* [9] was conducted to determine the preferences and safety awareness of motorcycle users, as well as their level of concern regarding traffic safety. Questionnaires were distributed to one hundred residents of Bantul Regency, consisting of twenty-five questions divided into two variables: rider behavior and rider equipment. The responses were processed using IBM SPSS and Microsoft Excel to test validity and reliability. After these tests were completed, a mean frequency analysis was conducted, confirming that all data were valid. From the one hundred respondents, various behavioral variables were identified, and the results showed that most people in Bantul Regency demonstrated proper behavior when riding a motorcycle.

The findings of [9] emphasized that the growing popularity of motorcycles has contributed to an increase in accidents involving motorcycle users. This is mainly because motorcycles provide less protection compared to other vehicles, and many road features are often not visible to riders. Furthermore, motorcycle drivers frequently perform maneuvers that are dangerous to other vehicles due to their small size and ability to navigate narrow roads [10], [11].

RESEARCH METHODS

This study explains, which means testing hypotheses to explain the causal relationship between variables [3], [4]. This type of research was chosen because the goal to be achieved was to explain the relationship and effect of the questionnaire as the main data collection tool. Field research requires tools to support it. The following tools and materials were used by researchers including stationery, cameras (documentation) and survey forms Traffic Accident Analysis.

Data Collection Techniques The research data must be collected to obtain the necessary data and information. The following is the data collection process used in this study, namely Primary Data Survey Results where primary data collection is carried out by direct observation at the research location. Secondary Data where vehicle data and vehicle volumes used as writing material are based on direct observation data in the field and data assistance from SAMSAT and the PUPR Office of Tanjungbalai City. Field Observation is by making direct observations of motorists who are around the research subject to collect information needed for further research. As well as documentation Data collected from activities carried out at the research location or survey during the activity.

The following flow chart shows the stages of the research

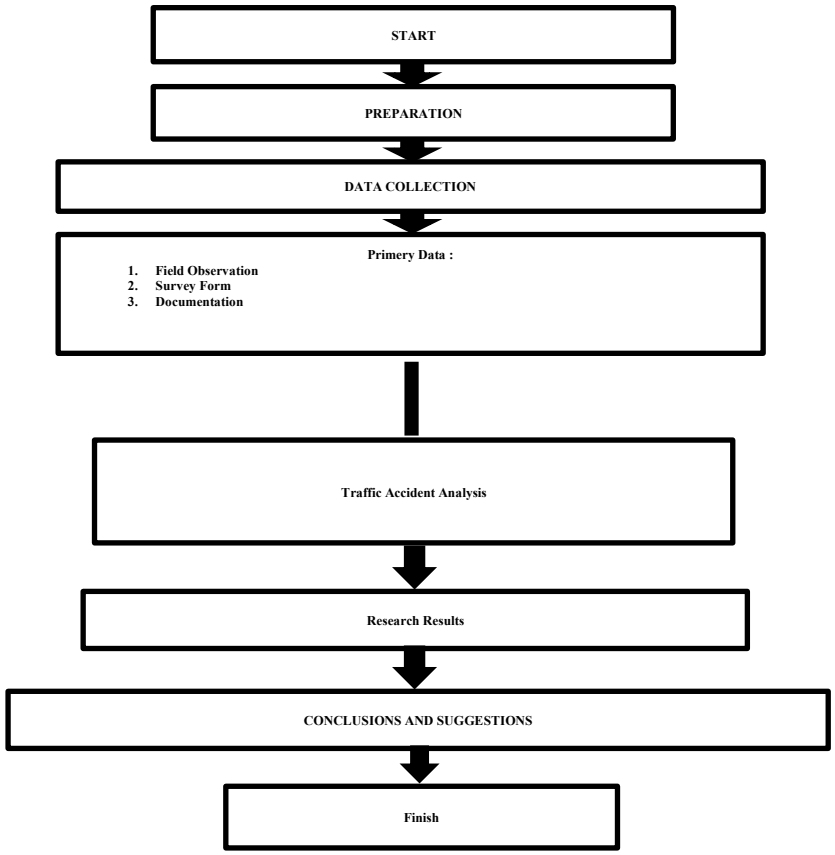

Figure 1. Flow Chart Research Stages

Methods

Place of Research

This research was conducted in Tanjung Balai City, North Sumatra Province with research targets or respondents being Students, Students, and Communities who live or are in the research area and own and use motorized vehicles (cars and motorcycles) spread across Gading Village, Sijambi Village, and Pahang Village, Tanjung Balai City. Research Implementation Time Where the research took place for four days, from March 11 to 14, 2024.

Survey Form Distribution Method

When distributing questionnaires, there are many ways to distribute questionnaires such as, directly coming to the research location, making broadcasts to social media, using survey services to the research location.

In this study, the authors distributed questionnaires by coming directly to the research location so that they could interact with the respondents and see firsthand the conditions at the research location.

The Traffic Accident Analysis

The traffic accident data collected in this study was compiled in tabular form to display the percentage of accidents and casualties [12], [13]. Then the analysis was carried out to find the TK (accident rate), TF (fatality rate) and UCL (Upper Control Limit) values so that the location of road sections identified as accident-prone areas could be determined. If on a road section A-B the value of TF (fatality rate) > UCL then road section A-B is an accident-prone area. Vice versa, if on a B-C road section the TF value < UCL then the B-C road section is not an accident-prone area. From the data analysis, it is obtained which areas are classified as accident-prone areas. Then the

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accident-prone areas are given recommendations for handling the location of the accident area such as installing traffic signs, installing street lighting and so on. With the TK, TF, UCL formulas as follows:

1. Formula TK

$$TK = JK/(T \times L) \quad (1)$$

2. Formula TF

$$TF = \frac{EPDO \times 10^8}{365 \times T \times V \times L} \quad (2)$$

3. Formula UCL

$$\lambda + \psi \times \sqrt{\frac{\lambda}{m} + \frac{0{,}829}{m}} + \left(\frac{1}{2}m\right) \quad (3)$$

Research Location

This research was conducted as a case study related to the specifications of research data collection and was conducted in Tanjung Balai City.

The research location is located at Ir. Sutami street, Husni Thamrin street, Abd Rahman Street, and SMA 3 street, Tanjung Balai City as depicted in Figure 2 below.

Figure 2. Research Location (Source: Location Survey (Google Maps))

Data Analysis
Accident Rate Analysis of Tanjungbalai City
Characteristics of Traffic Accidents

The number of traffic accidents in Tanjungbalai from 2014 to 2022 has fluctuated. People still have to be vigilant with the number of vehicle ownership that continues to increase if it is not accompanied by the development of roads and facilities that support road users, of course, it can cause problems in driving on the highway [14], [15]. In addition to these factors, if the level of discipline of road users is still low, it can also be a cause of traffic accidents in Tanjungbalai. The number of traffic accidents in Banjarbaru for more details can be seen in table 1 below.

Table 1. Number of Traffic Accident Events

No	Year	Number of Traffic Accident Events	Persentage (%)
1	2014	58	12%
2	2015	68	14%

No	Year	Number of Traffic Accident Events	Persentage (%)
3	2016	43	9%
4	2017	34	7%
5	2018	45	9%
6	2019	70	14%
7	2020	69	14%
8	2021	57	12%
9	2022	51	10%
Total		495	100%

(Source: BPS Tanjungbalai City 2014-2022)

The above description illustrates the number of traffic accidents consisting of fatalities, serious injuries and minor injuries during the four-year period (2014-2022) that occurred in Tanjungbalai related to human factors, road conditions, environmental factors and traffic factors. It can be concluded that the incidence of accidents in the last 9 years has fluctuated. Even so, the average death toll each year is still 13 people.

RESULT AND DISCUSSION

Accident Rate

The calculation of the accident rate is used to see how often accidents occur on the road section under review by using the number of accidents as the determinant. The following is the calculation of the Accident Rate (TK) on the road section at the research location in Tanjungbalai City:

Number of Accidents (2014 - 2022) : 495 events
Length of Husni Thamrin Road Section (L) : 4.590 Km
Period Year (T) : 9 Years
TK = JK/(T x L)
TK = 495/(9 x 4.590)
TK = 11.98 events/year
Total Accidents (2014 - 2022) : 495 Incidents
Length of Ir.Sutami Road Section (L) : 1.53 Km
Period Year (T) : 9 Years
TK = JK/(T x L)
TK = 495/(9 x 1.53)
TK = 35.9 events/year
Total Accidents (2014 - 2022) : 495 Incidents
Length of SMA 3 Road Section (L) : 0.743 Km
Period Year (T) : 9 Years
TK = JK/(T x L)
TK = 495/(9 x 0.743)
TK = 0.07 events/year
Number of Accidents (2014 - 2022) : 495 Incidents
Length of Abd. Rahman Road Section (L) : 0.750 Km
Period Year (T) : 9 Years
TK = JK/(T x L)
TK = 495/(9 x 0.750)
TK = 0.07 events/year

The results of the calculation of accident-prone areas based on the Accident Rate on each road section can be seen in Table 2 below.

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Table 2. Results of Accident Rate Calculation Year 2014-2022

No	Period (Year 2014-2022)	Road Name	Road Length (Km)	City	Number of Accidents	TK
1	9	Husni Thamrin	4,590	Tanjungbalai	495	11,98
2	9	Ir. Sutami	1,534	Tanjungbalai	495	35,85
3	9	SMA 3	0,743	Tanjungbalai	495	0,07
4	9	Abd. Rahman	0,750	Tanjungbalai	495	0,07

(Source: Data Analysis 2024)

In table 2 above, it can be seen that the most frequent traffic accidents in the research location are on the Ir.Sutami section of Tanjungbalai City which has an accident rate which if rounded off the value is 36 events / year.

Fatality Rate

The calculation of the fatality rate is used to see how severe the accident that occurred on the road section. At the level of fatality, the criteria for accident victims are used which are then given a weight value for each criterion. To determine the accident-prone areas, the fatality rate value with the limit value/UCL, if the accident rate exceeds the UCL critical limit, the road section is identified as an accident-prone area.

The following is the calculation of the Fatality Rate of Jl. Husni Thamrin for the period 2014 - 2022:

Death Victims (MD) = 13 people
Victims of Serious Injury (LB) = 5 people
Minor Injury Victims (LR) = 77 people

EPDO (Equivalent Property Damage Only)

= (12xMD)+(6xLB)+(3xLR)
= (12x13)+(6x5)+(3x77)
= 417
Road Section Length = 4.590 km
Traffic Volume = 182 vehicles/day

Period Year (2014 - 2022) = 9 Years

TF = (EPDO x (10)^8)/(365 x T x V xL)
TF = (417 x (10)^8)/(365 x 9 x 182 x 4.590)
TF = 15195.556 Accidents/100 Million Vehicle-Kilometers

The following is the calculation of the Fatality Rate of Jl. Ir. Sutami for the period 2014 - 2022:

Death Victims (MD) = 13 people
Victims of Serious Injury (LB) = 5 people
Minor Injury Victims (LR) = 77 people

EPDO (Equivalent Property Damage Only)

= (12xMD)+(6xLB)+(3xLR)
= (12x13)+(6x5)+(3x77)
= 417
Road Section Length = 1.53 km
Traffic Volume = 175.6667 vehicles/day

Period Year (2014 - 2022) **= 9 Years**

TF = (EPDO x ⟦10⟧^8)/(365 x T x V xL)
TF = (417 x ⟦10⟧^8)/(365 x 9 x 175.66 x 1.53)
TF = 47232.003 Accidents/100 Million Vehicle-Kilometers

The following is the calculation of the Fatality Level of Jl. SMA 3 for the period 2014 - 2022:

Death Victims (MD) = 13 people
Heavy Injury Victims (LB) = 5 people
Minor Injury Victims (LR) = 77 people

EPDO (Equivalent Property Damage Only)

= (12xMD)+(6xLB)+(3xLR)
= (12x13)+(6x5)+(3x77)
= 417

Road Section Length = 0.743 km
Traffic Volume = 162 vehicles/day
Period Year (2014 - 2022) = 9 Years

$$TF = \frac{EPDO \times 10^8}{365 \times T \times V \times L}$$

$$TF = \frac{417 \times 10^8}{365 \times 9 \times 162 \times 0{,}743}$$

TF = 105462,206 Accidents/ 100 Million Vehicle-Kilometers

The following is the calculation of the Fatality Rate of Jl. Abd. Rahman for the period 2014 - 2022:

Death Victims (MD) = 13 people
Victims of Serious Injury (LB) = 5 people
Minor Injury Victims (LR) = 77 people

EPDO (Equivalent Property Damage Only)

= (12xMD)+(6xLB)+(3xLR)
= (12x13)+(6x5)+(3x77)
= 417

Road Section Length = 0.750 km
Traffic Volume = 173,333 vehicles/day
Period Year (2014 - 2022) = 9 Years

$$TF = \frac{EPDO \times 10^8}{365 \times T \times V \times L}$$

$$TF = \frac{417 \times 10^8}{365 \times 9 \times 173{,}33 \times 0{,}750}$$

TF = 97648,523 Accidents/100 Million Vehicle-Kilometers

Upper Control Limit (UCL)

The UCL calculation is used as a benchmark for whether the road section under review is an accident-prone area or not. The following is an example of calculating the limit value/UCL for the road section at the research location for the period 2014 - 2022:

AEK formula = 10xMD + 5xLB + 1xLR + 1xPDO
Death Victim (MD) = 13
Heavy Injury Victims (LB) = 5
Casualties of Light Injury (LR) = 77

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Material Loss (PDO) = 45,283
AEK = (10x13) + (5x5) + (1x77) + (1x45,283)
AEK = 130 + 25 + 77 + 45,284 = 277,283

The following is the calculation of UCL for the Husni Thamrin road section:

UCL formula = λ + ψ x √(λ/m+0.829/m)+(1/2 m)
λ (average Probability Level) AEK = 277,283
ψ (99% Probability Level) = 2.576
m (Fatality Rate of the Road Section under Review) = 15195.556
277.283 + 2.576 x √ (277.283 : 15195.556) + (0.829 : 15195.556) + (1:2 x 15195.556).
= 277,283 + 2,576 x √ 0,018 + 5,455 + 7597,778
= 279,859 x √ 7603,251
= 279,859 x 87,196
UCL = 24402,585

The following is the calculation of UCL for the Ir. Sutami road section:

UCL formula = λ + ψ x √(λ/m+0.829/m)+(1/2 m)
λ (average Probability Level) AEK = 277,283
ψ (99% Probability Rate) = 2.576
m (Fatality Rate of the Road Section under Review) = 47232.003
277,283 + 2,576 x √ (277,283 : 47232,003) + (0.829 : 47232,003) + (1:2x47232,003).
= 277,283 + 2,576 x √ 1,405 + 0,001 + 23616,001
= 279,859 x √ 23617,407
= 279,859 x 153,679
UCL = 43008,451

The following is the calculation of the UCL for the SMA 3 road section:

UCL formula = λ + ψ x √(λ/m+0.829/m)+(1/2 m)
λ (average Probability Rate) AEK = 277.283
ψ (99% Probability Rate) = 2.576
m (Fatality Rate of the Road Section under Review) = 105462,206
277.283 + 2.576 x √ (277.283 : 105462.206) + (0.829 : 105462.206) + (1:2 x 105462.206).
= 277,283 + 2,576 x √ 0,002 + 7,86 + 52731,103
= 279,859 x √ 52738,965
= 279,859 x 229,649
UCL = 64269,339

The following is the calculation of the UCL for the Abd. Rahman road section:

UCL formula = λ + ψ x √(λ/m+0.829/m)+(1/2 m)
λ (average Probability Level) AEK = 277,283
ψ (99% Probability Rate) = 2.576
m (Fatality Rate of the Road Section under Review) = 97648.523
277,283 + 2,576 x √ (277,283 : 97648,523) + (0.829 : 97648,523) + (1:2 x 97648,523).
= 277,283 + 2,576 x √ 0,002 + 8,48 + 48824,261
= 279,859 x √ 48832,743
= 279,859 x 220,981
UCL = 61843.521

From the calculation example above, it is known that the value of the fatality rate of the Ir Sutami road section, Datuk Bandar District, Tanjungbalai with TF = 47232.003> UCL = 23903.06 then the road section is an Accident Prone Area.

For the results of the calculation of accident-prone areas based on the level of fatalities on road sections at the research location can be seen in table 3 below.

Table 3. Calculation Results of Fatality Rate and UCL 2014-2022 (Black Site)

No	Period (Years)	Road Name	Road Length (Km)	City	Number of Accidents	TF	UCL	Description
1	9	Husni Thamrin	4,590	Tanjung balai	495	15195,556 <	24402,585	Not Vulnerable
2	9	Ir. Sutami	1,534	Tanjung balai	495	47232,003 >	43008,451	Vulnerable
3	9	SMA 3	0,743	Tanjung balai	495	105462,206 >	64269,339	Vulnerable
4	9	Abd. Rahman	0,750	Tanjung balai	495	97648,523 >	61843,521	Vulnerable

(Source: Research Analysis, 2024)

From Table 3 above on the road sections studied, 3 road sections were identified as accident-prone areas (blacksite) in Tanjungbalai City. The accident-prone road section that has the highest fatality rate is Jl. SMA 3, Tanjungbalai with TF = 105462,206 and UCL = 61843,521.

CONCLUSION

The conclusion contains the results and the main discussion that will be discussed, presented in In table 2, the most frequent traffic accidents in the research location are on the Ir.Sutami section of Tanjungbalai City which has an accident rate which if rounded off the value is 36 events / year. With 3 road sections that are accident-prone areas based on the fatality rate and UCL value which can be seen in table 3, the accident rate on the 3 road sections of the research location is quite high. The factors that cause accidents are human factors (drivers), the environment, vehicles and road condition factors are also the main causes of accidents.

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