Analysis of Traffic Accidents Before and During Covid 19 Pandemic and Alternative Countermeasures on Daan Mogot Road

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Article Info

ABSTRACT

Daan Mogot Road is a national road that connects West Jakarta and Tangerang City which is always passed by many road users every day like motorcycles, cars, and trucks as well as public transportation such as city transport and bus. According to the data from the Traffic Unit of Tangerang City Police Station in the year 2018, there are 45 cases of traffic accidents, in the year of 2019 there are 29 cases of traffic accidents, in the year of 2020 there are 37 cases of traffic accidents and in the year of 2021 there are 34 cases of traffic accidents on Daan Mogot Road. Within 3 years there were 145 cases of accidents occurred on the Daan Mogot Road. Therefore, Daan Mogot Road was chosen as the area to be evaluated for road safety to know the cause of accidents and accident rate seen from various aspects so that alternative countermeasures can be provided. There are three methods used in this study, Accident Equivalent Rate and Upper Control Limit to analyze accident-prone areas and The Gross Output (Human Capital) method to count accident victim costs. According to the inspection of accident data, segments 3 and 4, or Kel. Tanah Tinggi and Kel. Batuceper in Tangerang City has the highest accident rate of the five Daan Mogot sections. The human factor is the main factor of accidents in every segment. Front-rear collisions are the most common type of accident, followed by side-to-side collisions and pedestrian collisions.

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1. INTRODUCTION

Almost all Indonesian people currently own private vehicles, both motorcycles and cars, which causes traffic density to increase every year. One element that contributes to the occurrence of accidents from several other aspects is traffic density [1].

West Jakarta and Tangerang City are connected by the national route Daan Mogot Road which is frequently traversed by motorcycles, private cars, large trucks, and buses as well as other road users. According to Data from the Tangerang City Police Metro Traffic Unit, in 2021 there were 34 traffic

accidents, compared to 2020 there were 37 accidents, in 2019 there were 29 accidents, and 45 accidents occurred in 2018. On Daan Mogot Road, there were 145 cases of traffic accidents in the last three years. Therefore, it was decided to assess road safety in Jalan Daan Mogot [2].

Of course, this situation is a problem, and the government and related institutions will always try to prevent it. Therefore, it is very important to conduct research and analysis on the Daan Mogot road accident rate to identify the root causes and appropriate countermeasures.

Finding out how often there were accidents on the Daan Mogot road from 2018 to 2019 (before the pandemic) and 2020 to 2021 (during the pandemic) from various aspects is the aim of this research. Then to know the cause of traffic accidents on Daan Mogot road and deliver the alternative prevention method for traffic accidents in the future.

Previous research has been carried out by Nunung Fadylah (2017) which found out the causes of traffic accidents on the National road section in the city of Surabaya using literature and literature, observation, and documentation methods [3]. Riana Pangestika (2019) to reduce the number of traffic accidents that occur on Jalan Raya Serang Km 23 – Km 35 using the AEK and UCL methods [1]. Heru Aditriansyah (2018) to determine the level of traffic accidents on the Batu Ampar road section in Batam City using Accident Rate [4]. Andre Jonathan Sihombing and Hera Widyastuti (2021) to reduce the number of accidents on the Cipularang Toll Road using One Way – ANNOVA from IBM SPSS 25 program [5]. Arvian Zanuardi and Hitapriya Suprayitno (2018) analyze the characteristics of traffic accidents on Jalan Ahmad Yani Surabaya using Knowledge Discovery in Databases with data mining supported SPSS applications and Rapid Miner [6].

According to Law Number 22 of 2009 which regulates Road Traffic and Transportation, what is meant by "traffic" is the movement of cars and people within areas that are permitted to carry out these movements, which includes roads and their supporting facilities. A person in traffic is a person who travels from one location to another with or without propulsion equipment [7]. Traffic, according to Soekanto, is something related to moving from one location to another. Along with land travel, it also includes air and sea travel [8].

A traffic accident is an unexpected incident that occurs on a road involving a vehicle and one or more other road users and results in loss of life or property damage. Victims of traffic accidents can include fatalities, serious injuries, and minor injuries estimated no later than 30 days after the collision [9].

According to the type of collision, the characteristics of the accident can be divided into four. The first one is Angle (Ra) is a collision between two moving objects that do not move in opposite directions. Second, Rear-End (Re) where one vehicle is obstructed by another vehicle traveling in the same direction. Third, Sideswipe (Ss) occurs when a vehicle moving in the same direction or in the opposite direction collides with another vehicle from the side. Last is Head-on (Ho), which occurs when two cars move in opposite directions (no sideswipe) [10].

According to Barbara Sabey quoted by Tjahjono (2011) said that in traffic collisions, the human factor is very important. The skill level of the driver, his ability to accurately predict oncoming traffic conflicts, his ability to think clearly, and his physical condition all play a role in his ability to avoid accidents [11].

According to the rules of Article 1 No. 7 Law Number 22 of 2009 about Road Traffic and Transportation, vehicles are modes of transportation on roads which include motorized and non-motorized vehicles. According to this understanding, vehicles are divided into motorized and non-motorized vehicles. Motorized vehicles are any vehicles other than those running on rails that move using mechanical devices called engines, while non-motorized vehicles are vehicles that move using human or animal power [12].

The following are several factors that affect the interrelationship of roads and traffic accidents, as stated by Marsaid referred to by Wijayana (2018) namely, potholes, damaged roads, slippery roads, cornering roads, and rain [13].

The built environment, especially man-made products, and natural environmental factors have a significant impact on traffic safety. Natural elements such as steep ascents and descents, sudden surroundings, and trees or hills that obstruct vision should be considered when managing traffic. Some of these natural habitats can be changed to meet traffic safety and security requirements, but others cannot be changed because of environmental sustainability concerns or because doing so would be very expensive. The position of the sun towards the driver which causes distraction due to glare is a natural factor that cannot be controlled [14].

Prone areas are very important for the problem of traffic accidents because they help identify places that need more attention. If a road section has an area with a high accident rate, accident risk, or accident potential, then that area requires additional maintenance [15].

2. METHODS

In this research, primary data and secondary data are needed. Primary data can be obtained directly in the field. The data was obtained by surveying the research site as a secondary data reinforcement. The primary data needed in the initial investigation to mark accident-prone locations are direct documentation at the research location, observations of the completeness of traffic signs and road accessories, as well as geometric and road surface conditions. Secondary data is information collected from existing data sources such as those found in relevant publications, reports, books, and journals. Secondary data in this study, namely this is a traffic accident report including data on the number of accidents per month for three years from 2018 – 2021 obtained from the Tangerang City Metro Police.
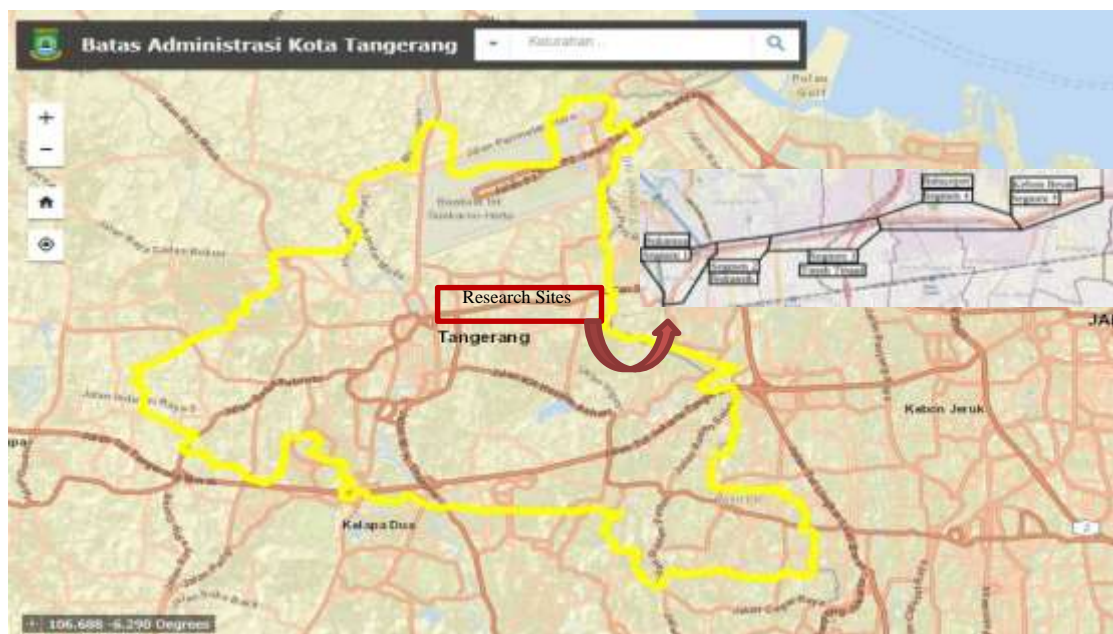

Figure 1. Research sites

The research location is located on Jalan Raya Daan Mogot, Tangerang City. This location is a national route that is often traversed by many vehicles and serves as a link between the two provinces, namely DKI Jakarta and Banten provinces.

2.1 Accident Equivalent Rate Method

This method is used to analyze the highest accident points (blackspots) that occur in the area to be reviewed. Accident Equivalent Rate (AER) is a number for weighting accident classes. The AER calculation is tied to the traffic accident fatality rate and the number of accidents that cause material loss [1]. The Research and Development Agency of the Ministry of Settlement and Regional Infrastructure (2004), has created a mathematical formula to calculate the AER (Accident Equivalent Rate) value with the following formula :

$$AER = 12MD + 3LB + 3LR + 1K \qquad (1)$$

2.2 Upper Control Limit Method

In determining the accident-prone points, a quality control statistical method is used as a UCL control chart which is based on the number of accidents per kilometer or road segment that has an AEK weight value that exceeds the UCL limit value. The UCL (Upper Control Limit) value is determined using the following equation:

$$UCL = \lambda + [\psi \times \sqrt{(\lambda / m)} + (0.829 / m) + (1 / 2 \times m)] \qquad (2)$$

2.3 The Gross Output (Human Capital)

The calculated traffic accident cost is the accident cost per victim. Calculation of the cost of traffic accident victims is calculated by the formula of multiplying the incidence of accidents in one year on each road segment by the unit cost of traffic accident victims (BSKO) according to the level of severity. The severity level is fatal (MD), serious injuries (LB), and slight injuries (LR) on accident-prone roads in the Jalan Daan Mogot area, Tangerang City, Banten using The Gross Output (Human Capital) method as below:

$$BBKO \ (Tn) = \sum_{j=1}^{m}(JKOj \ x \ BSKOj \ (Tn)) \qquad (3)$$

Table 1. Unit Cost for Victims of Traffic Accidents BSKOj

Casualty Category	Victim Unit Cost (Rp/victim)
Fatal	119.016.000
Serious casualty	5.826.000
Slight casualty	1.045.000

The unit cost of traffic accident victims for a certain year (Tn) can be calculated using the following equation:

$$BSKOj \ (Tn) = BSKOj \ (T0)x \ (1 + g)t \qquad (4)$$

3. RESULTS AND DISCUSSION

In this thesis the location to be analyzed and discussed is Jl. Raya Daan Mogot, Tangerang City, has a span of 7 km with the starting point from Jalan Daan Mogot in the Sukarasa area, Tangerang, Tangerang and the endpoint is on Jalan Daan Mogot in the Kebon Besar area, Batuceper, Tangerang.
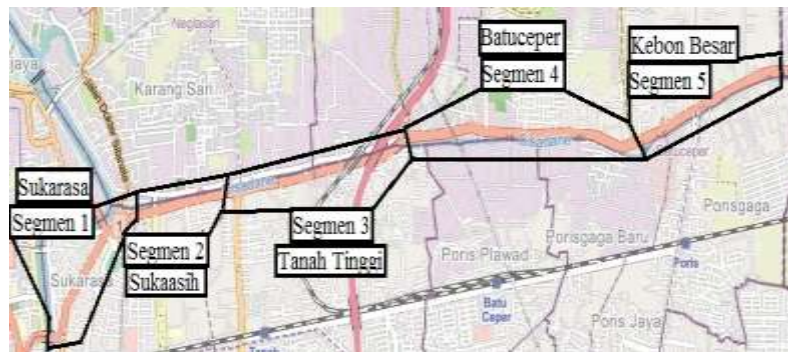
Figure 2. Distribution of Research Location Segments

Table 2. Geometric Data for Daan Mogot Road Tangerang

Segment	Road name	Road width(m)	Road median (m)	Roadside width (m)	Sidewalk width (m)
1	Sukarasa	13.6	-	0.37	1.54
2	Sukaasih	12.77	0.43	0.41	1.56
3	Tanah Tinggi	13.78	-	0.65	1.68
4	Batuceper	13.8	0.6	0.39	1.32
5	Kebon Besar	13.37	0.63	0.34	1.38

3.1 Accident Characteristic Analysis

Table 3. Characteristics of Traffic Accidents on the Daan Mogot Road Before and During the Pandemic

Variable	Category	Percentage amount	
		Before the pandemic (2018 - 2019)	**During pandemic(2020 - 2021)**
Day	Weekday	79%	68%
	Weekend	21%	32%
Incident time	06.00 AM - 05.59 PM	59%	46%
	06.00 PM - 05.59 AM	41%	54%
Accident rate	Death (MD)	9%	9%
	Serious injuries (LB)	41%	38%
	Minor injuries (LR)	50%	53%
Month	January - June	55%	39%
	July - December	45%	61%
Road users	2-wheeler	52%	57%
	3 wheeled vehicle	1%	0%
	4-wheeler or more	42%	37%
	Pedestrian	5%	6%
Gender	Male	89%	83%
	Female	11%	17%
Ownership of a driving license	Have	72%	41%
	Don't have	28%	59%

Accident-causing factors	Human	95%	97%
	Vehicle	3%	1%
	Road and environment	3%	1%
Type of collisions	Head-on collisions	5%	6%
	Rear-end collisions	41%	28%
	Angle collisions	22%	8%
	Sideswipe collisions	15%	35%
	Out of control	1%	7%
	Hit pedestrians	16%	14%
	Etc.	0%	1%

Based on Table 3 shows that the accident rate on Daan Mogot road in the pre-pandemic period (2018 – 2019) compared to during the pandemic (2020 – 2021) has decreased in percentage which is not too significant when viewed from various aspects of accident characteristics. Factors causing accidents from the period before and during the pandemic decreased by 2% from a percentage of 51% to 49% and the human factor caused the most accidents. Likewise, with the type of accident, there was a decrease in the percentage of the number of accidents by 2% from a percentage of 51% to 49% and rear-end collisions were the most common.

3.2 Accident Equivalent Rate

Data were obtained on the Jalan Raya Daan Mogot section in the last 3 years, namely, there were 226 victims, in the pre-pandemic period (2018 – 2019) there were a total of 117 victims and during the pandemic (2020 – 2021) there were 109 victims. No accident was suffered only material loss. The following is the result of AER values for all road segments reviewed.

Table 4. Accident Analysis Results with the AER method

Accident Equivalent Rate before pandemic (2018 - 2019)				
Road name	**MD**	**LB**	**LR**	**AEK**
Sukarasa	0	0	4	12
Sukaasih	0	3	7	30
Tanah Tinggi	4	17	16	147
Batuceper	6	23	27	222
Kebon Besar	0	4	6	30
Total			441	

Accident Equivalent Rate during the pandemic (2018 - 2019)				
Road name	**MD**	**LB**	**LR**	**AEK**
Sukarasa	0	0	4	12
Sukaasih	0	3	7	30
Tanah Tinggi	4	17	16	147
Batuceper	6	23	27	222
Kebon Besar	0	4	6	30
Total			441	

3.3 Upper Control Limit

In determining accident-prone points, a quality control statistical method is used as a UCL control chart which is based on the number of accidents per kilometer or road segment that has an AER weight value exceeding the UCL limit value. Based on the calculation of the accident rate from the accident equivalent rate (AER) method, it can be calculated using the statistical quality control method for each segment on Daan Mogot road, Tangerang City. Following are the results of the UCL values for all roads on Daan Mogot road, Tangerang City.

Table 5. Accident Analysis Results with the UCL method
Before the pandemic (2018 – 2019)

Segment	Segment name	AER	UCL	Information
1	Sukarasa	12	95.236	Not prone
2	Sukaasih	30	92.650	Not prone
3	Tanah Tinggi	147	90.21	Prone
4	Batuceper	222	89.836	Prone
5	Kebon Besar	30	92.650	Not prone
	Total	441		

Table 6. Accident Analysis Results with the UCL method
During pandemic (2020 – 2021)

Segment	Segment name	AER	UCL	Information
1	Sukarasa	24	88.240	Not prone
2	Sukaasih	24	88.240	Not prone
3	Tanah Tinggi	90	86.387	Prone
4	Batuceper	195	85.098	Prone
5	Kebon Besar	84	85.987	Not prone
	Total	417		

3.4 The Gross Output (Human Capital)

3.4.1 The Unit cost of traffic accidents victim

Table 7. Calculation Result of Death Accident Victim Unit Cost

T2018	Rp 569.442.702,54
T2019	Rp 632.081.399,82
T2020	Rp 701.610.353,80
T2021	Rp 778.787.492,72

Table 8. Calculation Result of Serious Injuries Accident Victim Unit Cost

T2018	Rp 27.875.018,36
T2019	Rp 30.941.270,38
T2020	Rp 34.344.810,12
T2021	Rp 38.122.739,23

Table 9. Calculation Result of Minor Injuries Accident Victim Unit Cost

T2018	Rp 4.999.896,02
T2019	Rp 5.549.884,58
T2020	Rp 6.160.371,88
T2021	Rp 6.838.012,79

3.4.1 The cost of traffic accidents victim

Table 10. Calculation Result of The Cost of Traffic Accidents Victim on Daan Mogot Road (2018-2019)

No	Segment	2018			2019			Total
		LR	LB	MD	LR	LB	MD	
1	Sukarasa	2	0	0	2	0	0	Rp21,099,561.18
2	Sukaasih	1	3	0	6	0	0	Rp121,924,258.55
3	Tanah Tinggi	9	11	4	7	6	0	Rp2,853,891,890.57
4	Batuceper	14	18	1	11	5	5	Rp4,517,353,658.58
5	Kebon Besar	2	4	0	4	0	0	Rp143,699,403.77

Table 11. Calculation Result of The Cost of Traffic Accidents Victim on Daan Mogot Road (2020-2021)

No	Segment	2020			2021			Total
		LR	LB	MD	LR	LB	MD	
1	Sukarasa	3	2	0	3	0	0	Rp 107,684,774.24
2	Sukaasih	0	1	0	4	3	0	Rp 176,065,078.97
3	Tanah Tinggi	3	5	2	6	0	2	Rp3,192,028,936.02
4	Batuceper	11	17	3	19	8	0	Rp3,191,361,080.97
5	Kebon Besar	3	4	0	7	2	3	Rp2,616,334,402.27

Table 9 and Table 10 shows the cost of traffic accident victims on Daan Mogot road, the highest amount of traffic accident victim costs, when combined from the pre-pandemic period (2018 – 2019) to the time of the pandemic (2020 – 2021), in Segment 4 (Batuceper), namely for IDR 7,708,714,739.55. This is in line with the Accident Equivalent Rate (AER) which shows that this road is an accident-prone location, with the highest number of victims, namely 112 victims and 72 accident incidents.

3.5 Alternative Countermeasures for Traffic Accidents on Daan Mogot Road

Safe roads are roads that can guarantee the safety and security of other road users. This shows that the majority of road driving accidents are caused by human (user) contact with unsafe conditions on road components and sub-components. Road safety has four important criteria: self-explaining road, self-regulating road, forgiving road and self-enforcing road. The condition of the number of road components and sub-components that vary along the current road section determines the condition of the road. The route can be said to be safe if the four conditions have been fulfilled [16].

4. CONCLUSION

The accident rate on Daan Mogot road before the pandemic (2018 – 2019) compared to during the pandemic (2020 – 2021) has decreased insignificantly when viewed from various aspects of accident characteristics. Based on the accident-causing factors, humans are the factor that causes the most accidents, while the most common form of accident is Rear-end collisions. From the 5 segments of Daan Mogot road Tangerang City before the pandemic (2018-2019) and during the pandemic (2020-2021) the highest number of accidents occurred in the Kel. Tanah Tinggi (segment 3) and in the area of Kel. Batuceper (segment 4). Alternative countermeasures needed to reduce the number of accidents are traffic engineering (delineation), pavement repairs, adding traffic signs, installing Rumble Strips, installing street lights, reviewing U-Turns, fixing sidewalks, adding pedestrian bridges and zebra crossing, adding special stops for public transportation, conducting outreach and education to the public regarding driving safety and the use of crossing facilities as well as law enforcement from the authorities.

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