THE PATTERN OF SEVERITY OF TRAFFIC ACCIDENTS ON TRAFFIC CONDITIONS HETEROGENEOUS

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ABSTRACT
This article portrays the descriptive characteristics of the accident in the city of Makassar based on the severity of the victim. The method used is descriptive statistical analysis method of taking the case in Kemerdekaan Perintis Street Makassar the period 2012-2015. The research concludes that in this way had an accident 533 cases with the number of accident victims reached 183 people per year. The highest overall percentage of each variable is for the male sex by 75%, the adult age group by 56%, the type of vehicles by 71%, accidents on a straight road with a percentage of 72%. And generally the accident occurred on Monday and in the morning with a percentage of 20% and 40%. of the six variables tested, the location of the accident, the day of the accident and the time of the accident are variables that affect the severity of the victim.

Key words: Traffic Accident, Severity, Heterogeneous

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1. INTRODUCTION
One of the main transport problems today is the increasing population of vehicles is quite high in heterogeneous traffic conditions in big cities, especially in developing countries. This has an impact on the performance decrease [1]. Other impacts on traffic safety is that accident on the road network [2] and [3].

The World Health Organization (WHO) recorded deaths from non-communicable diseases are expected to increase from 28.1 million a year in 1990 will reach 49.7 million in 2020 (an increase in the absolute amount of 77%) and accidents contribute significantly to this increase. According to the report, traffic accidents rose from ninth to third in the ranking order of disease burden in 2020 and every year the incidence of traffic accidents has resulted in an average of 1.24 million people were killed and about 50 million mental scars and permanent disabilities [4].

Characteristics of traffic accidents is a picture of the accident which is the hallmark, the quality and quantity going somewhere. Several studies provide information on the demographic characteristics of the accident on the number of accidents, age, mode of transportation and type of accident [5] and [6]. Other studies also illustrate the characteristics of the portrait on the severity of the accident victims due to traffic accidents [7].

As one of the major cities in Indonesia, Makassar City has many areas crowded with a variety of activities such as industrial zones, commercial district, and educational areas and offices. Perintis Kemerdekaan Street which is an example which has a wide range of activities around it. This road is the main road that connects the city of Makassar Maros. Perintis Kemerdekaan Street has a length of ± 15 km. As a primary arterial road density is quite high, especially at peak hour will have an impact on the occurrence of a high accident rate anyway.

It required a study to obtain a description of the characteristics of victims of traffic accidents in Perintis Kemerdekaan Street of Makassar in relation to the severity of a traffic accident.

Accident characteristics obtained from a survey of accident data in the police traffic accident unit of Makassar and from several institutions relating to an accident. Characteristics which are reviewed include vehicle type, time and day of the accident, sex, age, severity and type of vehicle in which the accident occurred. This research is expected to provide benefits to all parties concerned with the prevention and handling of traffic accidents.

2. LITERATURE REVIEW

2.1. Definition of Accident
Definition of traffic accidents is contained in various studies, journals and in state law. One definition of a traffic accident referred to in Rule Government of Indonesia. The regulations state that a traffic accident is an event in a way unexpected and unintentional involving a moving vehicle with or without other road users, resulting in human casualties and property loss [8].

Accidental loss can be measured based on the severity thereof. severity classification is divided into four levels [9]:

- Fatal Accident, was the victim of an accident is going to die in a traffic accident within a maximum period of 30 days after the accident.
- Serious accident is an accident victim that his injuries suffered permanent disability or hospitalization at the hospital in a period of more than 30 days since the accident occurred.
An event is classified as permanently disabled if something limbs missing or cannot be used at all and can not be cured or reversed forever.

- Minor accident is an accident victim who suffered injuries that do not require hospitalization or to be admitted to hospital than 30 days.
- Material losses, which only leads to accidents causing material losses.

### 2.2. Factors affecting traffic accident

Many factors can lead to a traffic accident, both internal factors and external factors of the motor vehicle. Internal factors derived from the human factor as the people who use the road system and which control the movement of the vehicle and himself. Meanwhile, internal factors are the factors of vehicle and road and environmental factors. These three factors are the main factors causing accidents [10].

In addition to the three main factors as a cause of traffic accidents, other causes are the interaction of several factors. The interaction can be a combination of two or more of these factors. It can be seen from the picture below [11].

![Figure 1](image1.png)

**Figure 1** The cause of the accident and their interactions

### 2.3. Characteristics of Accidents

Accidents can be classified based on several factors. Based on the type of accident, accident victims, the condition of the vehicle during an accident, the vehicle involved in the accident, the accident time (day and hour), weather when the accident occurred, the accident site, the type of collision, vehicle type and cause of the accident [12].

### 2.3. Statistical Analysis Methods

One of the statistical test that is often used for variable chi-square test. Chi-square is a non-parametric statistical tests (where the distribution of large - population size is unknown) which are quite often used in studies using two variables, where both variables nominal scale data or to test differences in proportions between the two samples or more. Chi square test is applied in cases where it will be tested whether the frequency to be observed (observation data) to prove or there is no real difference or not the expected frequency. Chi-square is the analytical techniques used to determine the differences in the observed frequencies (Oi) with
the expected frequency or the expected frequency \((E_i)\) produced a particular category. This test can be performed on discrete data or frequency.

As a basic formula of Chi Square test is the following formula [13].

\[
\chi^2 = \sum_{i=1}^{k} \left( \frac{f_o - f_h}{f_h} \right)^2
\]

Where;
\(\chi^2\) = Chi Square
\(f_o\) = frequency in the observation
\(f_h\) = Frequency expected

To be able to make a decision on the proposed hypothesis is accepted or rejected, then the chi squared price needs to be compared with the Chi-square Table with degrees of freedom and at the level of certain errors. In this case the provisions applicable when the Chi-square count is smaller than the table, then Ho is accepted, and if greater than or equal to \((\geq)\) price table then Ho is rejected.

The degrees of freedom for the Chi Square does not depend on the number of individuals in the sample. Degrees of freedom depends on freedom in filling the columns on the expected frequency \((f_h)\) once compiled into the following table.

### Table 1 Chi Square

<table>
<thead>
<tr>
<th>Variabel</th>
<th>I</th>
<th>II</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(X)</td>
<td>(A)</td>
<td>(M)</td>
<td>(e = A + M)</td>
</tr>
<tr>
<td>(Y)</td>
<td>(B)</td>
<td>(N)</td>
<td>(f = B + N)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>(c = A + B)</td>
<td>(d = M + N)</td>
<td>(g = A + B + M + N)</td>
</tr>
</tbody>
</table>

In this case the observed frequency \((f_o)\) must be equal to the expected frequency \((f_h)\). So \((a + b) = (m + n)\) thus we have the freedom to set the expected frequency \((f_h) = (m + n)\). So the freedom that living one of freedom in setting \(m\) or \(n\).

### 3. METHODOLOGY

This research was conducted in the city of Makassar. accident data obtained from the police traffic accident unit of Makassar. Data collected accident data crash last four years (2012-2015). The collected data is then compiled for subsequent analysis, is descriptive analysis. Descriptive analysis is used to describe the accident that occurred at Perintis Kemerdekaan Street Makassar, such as the number of occurrences of accidents and the number of victims of accidents, deaths, serious injuries and minor injuries, and the characteristics of the victims involved in the accident.

**Statistical analysis techniques**

Variable: define the variable/type of accident is good for the observed locations (sites) as well as the overall offset locations reviewed (control).

Hypothesis: make a statement on the assumption - the assumption to examine similarities or differences with the control conditions of the site, with the null hypothesis \((Ho)\) and alternative \((Hi)\) as follows:
\textbf{Ho:} There is no significant difference between the severity of traffic accident victims (site) with a typical group similar accident on the road or in an area (control) in general.

\textbf{Hi:} There is a significant difference.

Observed values obtained by calculation Chi - squared referring to the 2 x 2 contingency table as in the example Table-1. By: $\chi^2$ is the value of Chi - squared, A is the proportion of typical accidents (site), B is the proportions typical of other accidents (site), C is the proportion of typical accidents (control), D is the proportions typical of other accidents (control) c, d, e, f and g as shown in Table-1

\section*{4. RESULTS AND DISCUSSION}

\subsection*{4.1. Overview of Traffic Accidents In The City of Makassar}

Within the last four years as illustrated in Table 1, shows that the number of cases of traffic accidents in the city of Makassar reached 3,603 cases or the number of accidents at 2.5 accidents per day. Lowest cases occurred in 2014 with the number of cases of 781 cases whereas the highest occur in 2012 the number of accidents reached 1,051 cases. For victims of accidents in the same period, the number of victims 4,654 people, equivalent to 3.2 people per day. Losses due to accidents in the last four years to reach Rp. 7.8 billion.

\begin{table}
\centering
\begin{tabular}{|c|c|c|c|c|c|c|}
\hline
No & Year & No. of cases & The number of traffic casualties & Total (ppl) & Material losses ( IDR) \\
\hline
1 & 2012 & 1,051 & 132 & 261 & 810 & 1.203 & 1.639.240.000 \\
2 & 2013 & 961 & 133 & 257 & 912 & 1.302 & 2.212.215.000 \\
3 & 2014 & 781 & 115 & 228 & 716 & 1.059 & 2.061.865.000 \\
4 & 2015 & 810 & 117 & 56 & 917 & 1.090 & 1.887.930.000 \\
\hline
\end{tabular}
\caption{Number of traffic accidents in the city of Makassar period of 2012-2015}
\end{table}

\subsection*{4.2. Overview Traffic Accident Perintis Kemerdekaan Street in Makassar}

According to the Perintis Kemerdekaan Street functions are classified in class road artery that connects directly between the city of Makassar with the city of Maros. The area around the road is filled with educational areas, offices, commercial and industrial areas.

Table 2 illustrates the frequency of accidents on the Perintis Kemerdekaan Street. From table shows that the highest rate of accidents occurred in 2012 with the percentage reached 24.8%, equivalent to 132 events on this road. While the lowest frequency occurred in 2014 as much as 20.6%, equivalent to 110 events. Thus the average frequency of 183 cases of accidents on this road.

Figure 2 shows the number of traffic accident victims based on the severity of the victims in the Perintis Kemerdekaan Street. severity is divided into three levels, namely the deaths (M), serious injury (LB) and minor injuries (LR). Of the three levels of severity have died and minor injuries have a tendency to increase every year, while serious injuries have a tendency to decline every year. In the totality of this period that most victims occurred in 2013 amounted to 239, and the lowest as many as 161 people in 2014.
### Table 2: Frequency of traffic accidents on the Perintis Kemerdekaan Street Makassar period of 2012-2015

<table>
<thead>
<tr>
<th>No</th>
<th>Year</th>
<th>Frequency of accident</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2012</td>
<td>132</td>
<td>24.8</td>
</tr>
<tr>
<td>2</td>
<td>2013</td>
<td>164</td>
<td>30.8</td>
</tr>
<tr>
<td>3</td>
<td>2014</td>
<td>110</td>
<td>20.6</td>
</tr>
<tr>
<td>4</td>
<td>2015</td>
<td>127</td>
<td>23.8</td>
</tr>
<tr>
<td></td>
<td>Jumlah</td>
<td>533</td>
<td>100</td>
</tr>
</tbody>
</table>

**Figure 2** The number of victims of traffic accidents by severity

Reviews for demographics, gender and age is an important part of the analysis of the characteristics of the accident. Figure 3 shows that the trend of accidents occurred in the male gender higher than female victims. Number of victims of the male gender in the amount of 520 people compared with women victims only reached 212 people. The percentage of this figure is equivalent to 71% and 29% for men and women.

In the age group categories, in this study were divided into four categories: children, teenagers, adults and the elderly. The age range in each category \( \leq 12 \) years for children, for young people aged between 12-21 years, and for the category of adults aged 21-55 years age group as well as for age \( \geq 55 \) years. From Figure 4 it is known that the highest accident victim who became a victim to the adult category, followed by teenagers and the last category is the category of children. Generally severity trends show almost the same age group. This can be seen by the number of minor injuries dominate in every category with a total of 541 people were killed and categories just by 67 people.

**Figure 3** The number of traffic accident victims by gender
One factor is a factor in the accident vehicle. The number of victims involved in road accidents *Perintis Kemerdekaan* is divided into five categories based on the type of vehicles used. The first vehicle is a motorcycle (R2), the second is a three-wheeled vehicle (R3) as a tricycle etc., a third vehicle is a four-wheeled vehicle (R4), the fourth vehicle is the type of truck and bus has a number of tires as much as 6 wheel and the last is a vehicle which has a number of wheels $\geq 10$ wheels. From Figure 5 illustrates that the type of motorcycle is a type of vehicle that most deadly to the category of death, serious injuries and minor injuries. three-wheeled vehicle is a vehicle that contributes least to the victims of traffic it is because their numbers are relatively small compared to other kinds of vehicles. four-wheel drive is one of the vehicles with the highest number of victims of accidents in addition to the motorcycle with the death toll reached 158 people.
alignments *Perintis Kemerdekaan* Street has a straight street with several junctions and intersections are generally already signalized intersections regulated in the system.

**Figure 6** The number of victims of traffic accidents based on the location of the accident

Apart from the three main factors causing accidents is human, vehicle, road and environment. There are other factors associated with the accident. As shown in Figure 7. In this figure shows the relationship between the number of accidents with fatalities. Of this figure also explains that the number of victims of accidents that occurred on the Perintis Kemerdekaan Street occurred on weekdays, especially on a Monday, the death toll reached 145 people. Compared to Sunday only reached 33 victims in the period 2012 - 2015. This is due to the high activity of this road which is a center of education, housing, offices and industrial areas. This led to high movement of vehicles on the road.

**Figure 7** The number of victims of traffic accidents by day of the accident

In addition to accidents related to traffic accident victims during the accident. time accidents are divided into four categories: morning, daylight, afternoon and night. The time span in the early morning hours ranged from 00:00am-10:00am, a span of time during the day is the time span between the hours of 10:00am-03:00 pm, for an afternoon time span between 03:00pm-07.00 pm and ranges night is an accident that occurred between the hours
of 09:00pm-12.00pm. From Figure 8 it can be seen that in the mornings and afternoons are
the time span of an accident with high severity. In the morning the death toll reached 296
people and at night reached 194 people. It is associated with high traffic events leading to and
from the Perintis Kemerdekaan Street.

Figure 8 The number of victims of traffic accidents based on the time of the accident

4.3. Analysis of the causes of accidents with analysis by Chi - Square
The statistical analysis used the chi square test to see the extent of the accident as the
dominant factor associated with the severity of the victim in Makassar Perintis Kemerdekaan
Street. The first variable analyzed were sex, the day of the accident, the time of the accident,
age, vehicle type and location of the accident, associated with the severity of the victim is
death, serious injuries and minor injuries. Analysis chi square test as in the following table:

Table 3 Chi Square value of the relationship between the severity of the accident factor

<table>
<thead>
<tr>
<th>Variabel</th>
<th>Value chi square</th>
<th>df</th>
<th>result</th>
</tr>
</thead>
<tbody>
<tr>
<td>count table</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>5.266</td>
<td>5.991</td>
<td>2</td>
</tr>
<tr>
<td>Age</td>
<td>5.242</td>
<td>12.592</td>
<td>6</td>
</tr>
<tr>
<td>Type of vehicle</td>
<td>14.883</td>
<td>15.507</td>
<td>8</td>
</tr>
<tr>
<td>Location of the accident</td>
<td>15.946</td>
<td>15.507</td>
<td>8</td>
</tr>
<tr>
<td>Day of the accident</td>
<td>27.987</td>
<td>21.026</td>
<td>12</td>
</tr>
<tr>
<td>Time of the accident</td>
<td>13.921</td>
<td>12.592</td>
<td>6</td>
</tr>
</tbody>
</table>

Of the six variables tested, the location variable accident, the accident and the accident
has a value of chi square test > value chi square table that identifies that there is a relationship
between these three variables with the severity of traffic accidents in Perintis Kemerdekaan
Street.

4. CONCLUSION
The results of the analysis of traffic accidents on the severity of casualties in road Perintis
Kemerdekaan of Makassar in the period 2012 - 2015 obtained the following conclusions:

Makassar City has a fairly high rate of accidents is characterized by many cases of
accidents at 2.5 accidents per day by the number of victims reached 3.2 people per day. On
the Road Perintis Kemerdekaan Street a road with a high accident rate that is equal to 533
cases. Overall the number of casualties occurred as many as 732 people, or an average of 183
people per year. The accident victim is dominated by men with the percentage reached to 71%. By age groups, the older age groups are a very vulnerable age group who had an accident with a percentage of 56%. The rider and passenger motorcycle or at most an accident with a percentage of 71%. While the straight road conditions is a condition that has a high proportion of accidents. The percentage of accidents on this road condition, by 72%. Overview of the accident by the accident, it is known that the condition of the working day, especially on a Monday is the day with the highest number of victims. The percentage of 20%. On the other hand, an accident that occurred at the time of the morning is the time of the accident with the highest percentage is 40%. Thus, based on a statistical test by using chi-square test found that the variable location of the accident, the day of the accident and the time of the accident are variables that affect the severity of the victim in Perintis Kemerdekaan Street Makassar.

REFERENCES


