# Macro Data Analysis of Traffic Accidents in Indonesia

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**Abstract.** This paper presents a macro data analysis of Indonesian road accidents in the form of statistical data. Traffic accidents and their subsequent fatalities bring enormous social and economic consequences. A good understanding of the problem is expected to initiate major action toward the improvement of road and vehicle safety. One important milestone is the collection and analysis of road accident data. The results from this study portray the 'tangled threads' problem of traffic in Indonesia. The population number and number of vehicles have increased steadily, as has been accurately predicted by experts. Meanwhile, there is not enough infrastructure growth. Motorcycles are the main contributor to traffic accidents and fatalities due to their popularity as an effective vehicle to jump traffic jams. The 'tangled threads' need an extremely creative and comprehensive solution.

**Keywords:** *macro data analysis; statistical data; traffic accidents; traffic fatalities; vehicle safety.*

## 1 Introduction

Road accidents are a very serious problem in Indonesia. In 2014, the police reported approximately 28,000 fatalities due to accidents on the streets and roadways of Indonesia and the fatality rate from traffic accidents per 100,000 population was about 12. This is very high compared to neighboring countries like Singapore (4.8) and Australia (5.2), while most researchers assume that fatality numbers are still under-reported. Moreover, the data are inconsistent and difficult to verify. Based on current trends in traffic fatality data it is estimated that in 2020, traffic fatality in Indonesia will reach 40,000 per year. Up to 65,000 fatalities per year have been estimated for 2035. For this reason, the Indonesian police have set an ambitious target to reduce these numbers by 50% in the year of 2020 and 80% in the year of 2035 and being the best in ASEAN. [1]

These missions are aligned with the United Nations (UN) campaign "Make Roads Safe", which urges governments, businesses and community leaders in

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the world to support the UN Decade of Action for Road Safety. The United Nations claim that road accidents are the leading cause of death globally for young people and kill 260,000 children under the age of 18 every year. Road safety experts believe that with the right action up to 5 million lives could be saved and 50 million injuries could be prevented during the Decade of Action for Road Safety. This will be a reduction of approximately 50% compared to global mortality predictions for 2020 [1].

Traffic accidents have long been the subject of extensive research in Indonesia, since traffic accidents have been identified as a very important factor in identifying discrepancies in traffic management and the entire transportation system [2]. Suthanaya [3] investigated the factors that influence fatal traffic accidents involving motorcycles. Later, Joewono, *et al.* [4,5] investigated the factors underlying traffic violation behaviors and types of traffic violations committed by young motorcyclists on urban roads in Indonesia. In the most recent study, Sugiyanto [6] analysed the financial cost of traffic accidents using a gross output method and determining the value of an equivalent accident number based on accident cost.

The present research was conducted to analyze macro data of Indonesian road accidents. It was expected that the analysis of crash data obtained collected from police reports would help form a decision-making basis for policy development and project selection toward improving the safety of Indonesian roadways and also help vehicle design engineers to investigate crash dynamics.

## 2 Data Collection of The Accidents

Indonesia crash data reports are a compilation of statistical data based on information obtained from traffic crashes submitted by the Regional Police (*Polisi Daerah: Polda*) from 34 provinces in Indonesia as part of the National Traffic Police Corps Republic of Indonesia (*Korps Lalu Lintas Kepolisian Republik Indonesia, Korlantas Polri*). Data from crash reports are collected periodically from Polda through written crash reports submitted to *Korlantas Polri*. A wide variety of crash data reporting information and accident statistical analyses regarding motor vehicle crashes and their contributing factors are available. The accident data used in this work were collected from *Korlantas Polri* and Indonesian Central Bureau of Statistics (BPS) for the calendar years (CY) 2004-2014.

## 3 Traffic Accidents Data in Indonesia

Motor vehicle travel is the primary means of transportation in Indonesia because of its agility and unmatched degree of mobility. Despite all advantages,

injuries resulting from motor vehicle crashes are the leading cause of traffic accident fatalities.

Figure 1 presents traffic accident data in Indonesia from 2004 to 2014 comparing the total number of accidents (left *y*-axis), number of fatalities (left *y*-axis), fatality rate per 100,000 population (right *y*-axis), fatality rate per 10,000 registered vehicles (motorcycle excluded) (right *y*-axis), and number of fatalities per 10,000 registered vehicles (motorcycles included) (right *y*-axis).

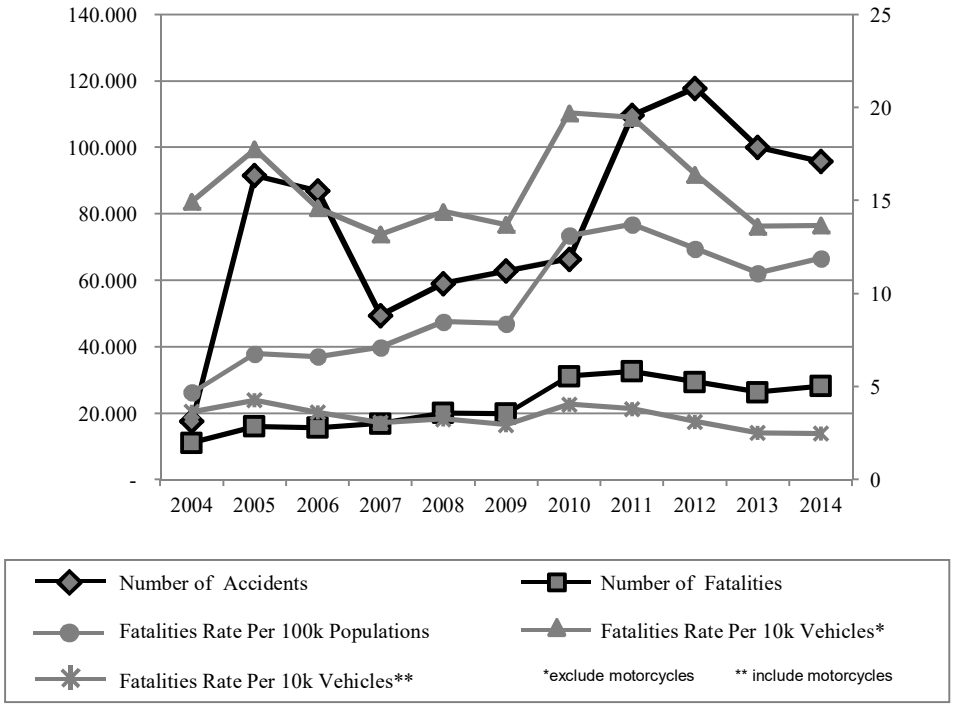


**Figure 1** Traffic accident data for Indonesia from 2004 to 2014.

As depicted in Figure 1 (left *y*-axis), 11,204 people lost their lives in motor vehicle crashes in 2004, the lowest number in 10 years. After a steady increase of the number of fatalities from 2004 to 2007, the overall fatality number remained flat at about 20,000 from 2008 to 2009. However, there was a significant increase in passenger vehicle occupant fatalities starting in CY 2010. The number of traffic fatalities jumped from about 20,000 to 31,000, or an increase of 55%, from 2009 to 2010. There are two possible explanations as to why the number of registered fatalities increased significantly in 2010. The first possibility is that this was due to a better reporting system so that the under-reporting issue was improved significantly. The second possibility is that it was

due to a significant increase in the number of vehicles on the road, not supported by an expansion of road capacity. It may also be a combination of both. On a different note, from 2011 to 2014, traffic fatality decreased by 9%.

Improvement of the traffic accident data reporting system by Korlantas Polri was started in 2010 with the issuance of INPRES (Instruction of the President) No. 4/2010 to support United Nations Resolution No. 64/255, dated 10 March 2010, regarding the Improvement of Global Road Safety through Decade of Action for Road Safety 2011-2020 Program. With this INPRES, Korlantas Polri initiated the centralized collection of traffic accident data at the District Police Offices (*Polsek*), Municipal Police Offices (*Polres*), Provincial Police Offices (*Polda*), after which the data are compiled at the *Korlantas Polri* office in Jakarta. This initiative improved the coordination of traffic accident data collection by traffic police offices throughout 34 provinces in Indonesia [7].

Records indicate that there have been a total of 250,000 road deaths in Indonesia from 2004 to 2014. To get a better characterization of the total number of fatalities per year, one may normalize the total number of accidents/fatalities for every 100,000 population or 10,000 vehicles. The fatality rates per 100,000 population are shown in Figure 1 (right *y*-axis). It can be seen that the fatality rate per 100,000 population in 2004 was 4.71. Then the rate increased linearly until 2011. In 2014, a decrease of 13.3 percent from the 2011 rate of 13.74 is observed.

The fatalities per 10,000 vehicles have similar accident trend data. Due to the large volume of motorcycles on the road, the normalized fatality rate per year was calculated in two ways, without motorcycles and with motorcycles. As shown in the Figure (right *y*-axis), the average fatality rate per 10,000 automobiles, excluding motorcycles, between 2004 and 2014 was 13. However, the average fatality rate per 10,000 automobiles drops to 2.5 with motorcycles included in the calculation. The impact of motorcycle riders in Indonesia is significant in contributing to the number of fatal traffic accidents.

## 3.1 Relating Traffic Accidents to Severity Level of Injuries

The data and graph in Figure 2 demonstrate the number of crashes in Indonesia per year by severity level (left *y*-axis). There are three terms included in this report, i.e. fatalities, major injuries according to the Abbreviated Injury Scale (AIS > 3+), and minor injuries (AIS < 3). The Abbreviated Injury Scale (AIS) is an anatomical-based coding system created by the Association for the Advancement of Automotive Medicine to classify and describe the severity of injuries. The fatalities term refers to the occurrence of death by accident, the major injury term (AIS > 3+) means that passengers experienced a severe

injury, and the minor injury term (AIS < 3) indicates that passengers experienced a light injury [8].

From Figure 2, the proportion of the injuries based on this classification for each year from 2004 to 2014, the overall trend of the distributions of minor injuries, major injuries, and fatalities shows a consistent proportion, minor injuries being the highest, followed by major injuries, and fatalities as the lowest.

The data show that from 2004 to 2012 the trend in the number of crashes occurring from year to year was upward. It can be seen from Figure 2 (left *y*-axis) that the number of minor injuries increased dramatically from 12,000 in 2004 to 128,000 in 2012. This increase may be related to the significant increase in the total number of vehicles in Indonesia between 2004 and 2012. Meanwhile, from 2012 to 2014, the total number of traffic accidents at different levels of injury decreased by about 16%.

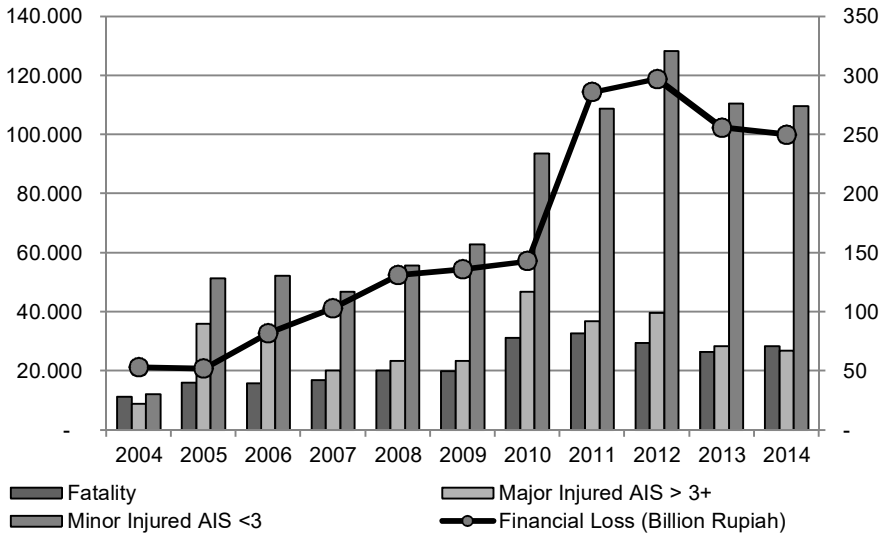


**Figure 2** Severity level of injuries and financial loss.

There was a steady increase in traffic accidents with major injuries (AIS > 3+) between 2007 (21,000) and 2012 (39,000). However, there was a significant increase from CY 2004 to 2005, which indicates there was a significant event that caused a big increase in the number of major injuries in traffic accidents in Indonesia. This significant jump in the number of major injuries in 2005 was most likely due to the additional capacity of toll roads in Indonesia. Detailed information about toll roads in Indonesia will be given in the next subsection.

## 3.2 Relating Traffic Accidents to Financial Costs

Besides causing deaths, deep trauma and minor injuries, traffic accidents also create significant property damages that increase year by year. Figure 2 shows the data of the financial cost of traffic accidents per year (right *y*-axis). In 2010, the total nationwide financial cost reached Rp. 143 billion, while in 2011 it was Rp. 286 billion, and in 2012 was Rp. 299 billion. In 2013 it was Rp. 256 billion, and in 2014 it reached Rp. 250 billion.

The government of Indonesia provides compensation for traffic accident-related costs to the public through the implementation of Law Number 33 [9] and Law Number 34, year 1964 [10] on the National Road Accident Fund, the management of which is conducted by Jasa Raharja, a state-owned insurance company. The idea behind this fund is similar to the accident insurance systems in most developed countries. The accident fund is collected through compulsory contributions from vehicle owners to compensate victims of traffic accidents. The current amount of compensation for a traffic accident fatality is Rp. 25 million (US$ 1100) and for other casualties up to a maximum of Rp. 12.5 million (US$ 550). The compensation for any cost resulted from a traffic accident is relatively low. It is not provided to recompense any material cost because of damage to vehicles or infrastructure.

## 3.3 Relating Traffic Accidents to Vehicle Growth

The automotive sector in Indonesia reflects the general picture of the national economy, which has experienced positive growth over the past decades. This trend was clearly demonstrated in the period between 2004 and 2014. Indonesia has a relatively low vehicle ownership rate, but its high population number means the overall market volume is significant. Low interest rates have helped boost consumption and economic growth over the past few years.

Recent Indonesian motor vehicle growth rates are presented in Figure 3. The data show that there was a significant increase in the number of vehicles on the road from about 30 million vehicles in 2004 to 113 million vehicles in 2014. This represents a more than 200% increase of the total number of vehicles on the road. The statistics also show that the annual growth rate of the total number of motor vehicles in Indonesia maintained double digits from 2004 to 2014, while significant growth each year was dominated by motorcycles and this number is still growing until now. Based on these data it is not surprising that motorcycles are the main contributor to traffic accidents and fatalities, due to their popularity as the most effective vehicle to jump traffic jams. The growth of vehicles of all modes may be contributed from growing domestic consumption and aggressive promotional campaigns on the supply side. The 200% increase

in fatality rate per 100,000 population coincided with a 200% increase in vehicle growth from 2004 to 2014 as shown in Figures 1 and 3.

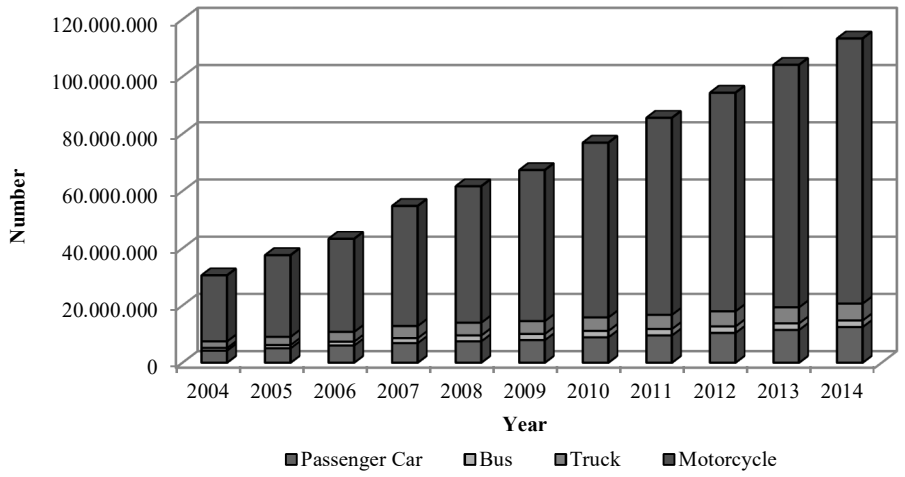


**Figure 3** Motor vehicle growth.

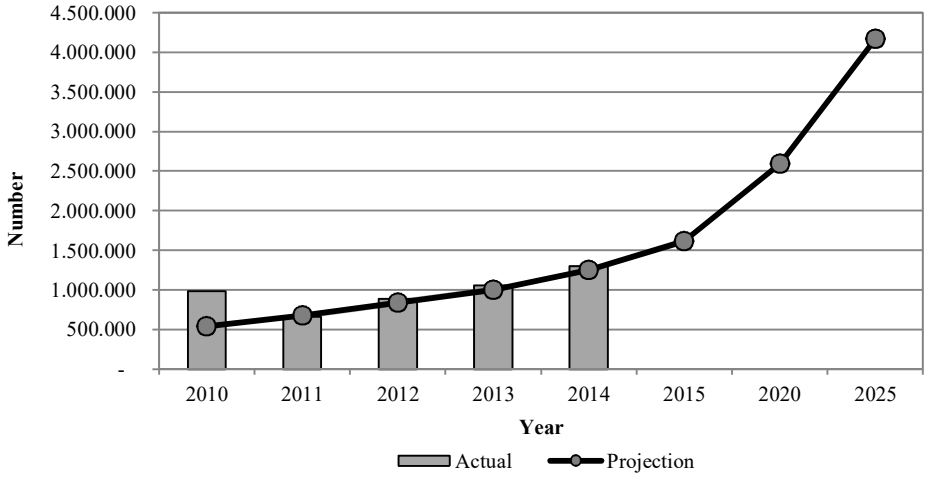


**Figure 4** Passenger cars, projected volume 2010-2025 [11].

Figure 4 shows the projection for the passenger car market and actual passenger car sales from 2010 to 2025. As shown in the projection, the actual passenger car market in Indonesia was very close to the projected volume for the years 2011 to 2014. By 2025, the passenger car market in Indonesia is predicted to be around 4 million, which is a 300% increase from 2014 to 2025. Governments

need to take immediate action, so that the increases in the number of vehicles will not contribute to an increase in the number of road accidents.

### 3.4 Relating Traffic Accidents to Road Infrastructure and Toll Road Growth

As the largest country in South East Asia, Indonesia has the region's largest road infrastructure network. However, Indonesia's ratio of road length to square kilometer of land area is one of the lowest in the region, indicating that the road system is inadequate to cover the country's almost 2 million square kilometer land area. The road systems are mainly concentrated on Java Island, which accounts for only about 7% of Indonesia's total land area, while bigger islands such as Kalimantan and Papua still have very limited land transport infrastructure.

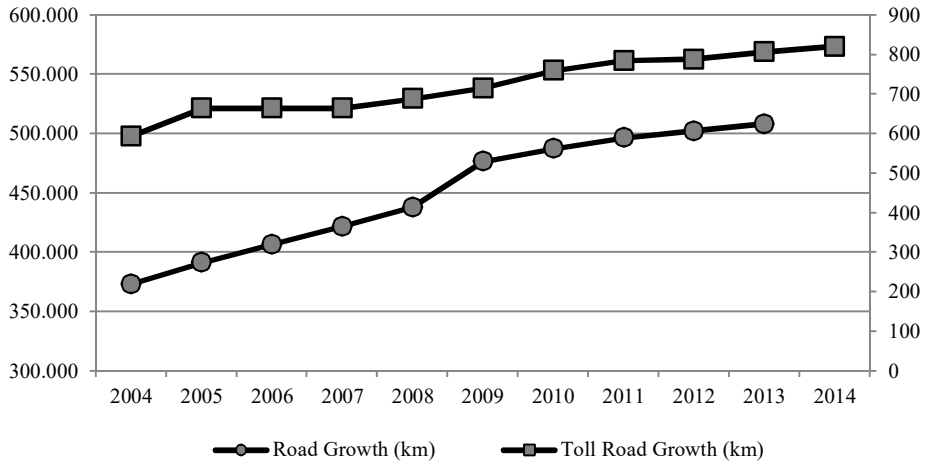


**Figure 5** Road and toll poad infrastructure growth capacity.

Indonesia's current road system does not provide optimum support for the country's economic growth. In other words, the growth of the number of vehicles on the road and the growth of vehicle production are not proportionally followed by the growth of road infrastructure. Nationwide, the speed of road development lags behind the vehicle growth and the recent annual growth rate of the number of roads is very low by comparison. As shown in Figure 5 (left *y*-axis), the road capacity in 2004 was 370,000 km, while the road capacity in 2014 was 500,000 km, which means that the growth of road capacity between 2004 and 2014 was only 35%. Meanwhile, the growth of vehicles on the road reached 200% in the last ten years, as mentioned in the preceding discussion. It can be concluded that the growth of the road infrastructure has not kept pace

with the growth of the number of vehicles, especially motorcycles, which potentially create severe traffic problems and increase the number of fatalities.

Referring to Figure 2, the significant jump in the number of major injuries in 2005 was most likely due to the additional toll road capacity in Indonesia. As shown in Figure 5 (right *y*-axis), the toll road capacity in Indonesia was increased by 100 km with the opening of the Jakarta Outer Ring Road (JORR) Sections E1 North and E3 as well as the opening of the Purbaleunyi toll road, which connects Bandung and Cikampek.

With the opening of the Purbaleunyi toll road in 2005, the travel between Bandung and Jakarta can be completed within 3 hours, which is a much shorter time compared to 5 hours using the non-toll road. Traffic between Jakarta and Bandung by way of the Jakarta toll road is high-volume, especially during weekends. This is due to the fact that many professionals leave their family in Bandung during weekdays while they are working in Jakarta. The traffic increase in the above toll section along with the increase of vehicle numbers in Indonesia most likely contributed to the significant increase in the number of major injuries (AIS > 3+) in CY 2005.

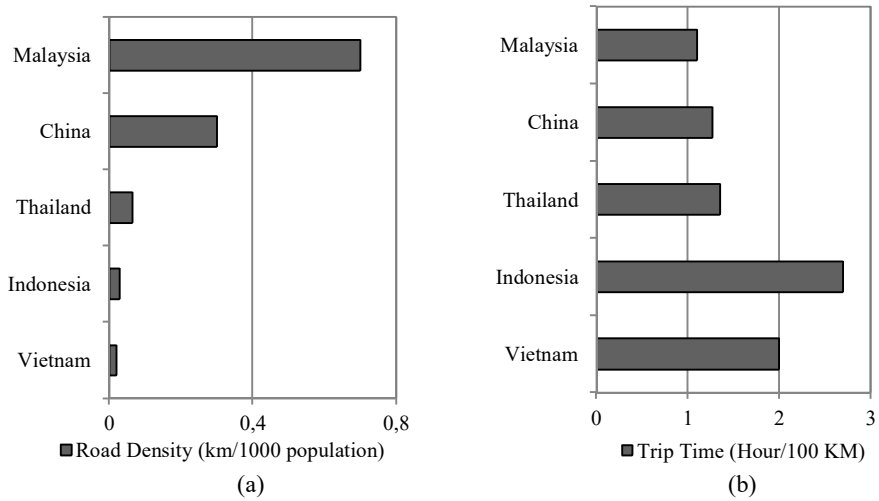


**Figure 6** (a) Density of traffic on toll roads and (b) estimated trip times [12].

In ratings of global competitiveness, Indonesia's ratings continue to reflect a lack of infrastructure availability and quality, despite recent improvements, due to non-infrastructure factors. In terms of road density per 1,000 population for toll roads, Indonesia ranks below other ASEAN countries and it is considerably lower than that of neighbors such as Thailand and Malaysia, as can be seen in Figure 6(a). The average travel time, a key factor in transport costs and

logistical competitiveness, appears to be significantly longer than in neighboring countries, as can be seen in Figure 6(b).

## 3.5 Traffic Accident Occurrence in the Main Provinces

This section is devoted to the data and analysis of traffic accidents in the main provinces of Indonesia. Data and information about accidents presented here are based on reports from eight representative provinces, namely North Sumatera, Banten, DKI Jakarta, West Java, Central Java, DI Yogyakarta, East Java and South Sulawesi in 2014, as depicted in Figure 7. Figures of accidents in other provinces may have similar trends due to inherent fundamental problems of an imbalance between supply and demand of traffic systems in Indonesia.

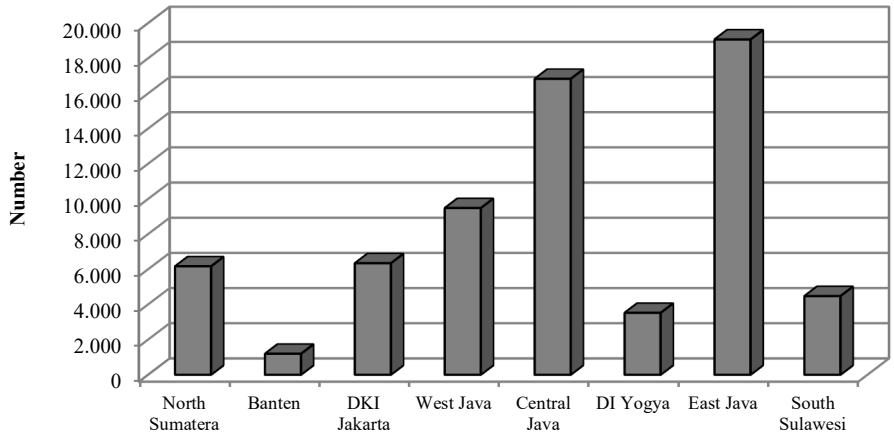


**Figure 7** Total number of traffic accidents in main provinces.

From Figure 1, the data indicate that there has been a total number of 95,000 accidents in Indonesia in the year 2014. As expected, traffic accidents in Indonesia are reflected by accidents happening in the main provinces (67,000 accidents). Generally, 70% of accidents happened in the main provinces with respect to national data (as shown in Figure 7) and 78% of accidents in the main provinces occur on Java Island. This may be due to the fact that economic activities are accumulated in the cities in Java.

As discussed previously, Indonesia has some fundamental problems that are not merely a matter of engineering. The steadily growing population, vehicle growth, and poor infrastructure may be significant causes of the rising number of traffic accidents. Also, most of the main provinces have similarities in the type of traffic accident problems, so resolving traffic accidents is a prime concern. Hence, there is a need to elaborate on the whole traffic accident

situation in Indonesia to formulate appropriate solutions. Road infrastructure development and increasing the total length of roadways should also be prioritized. The fact that the ratio of road to land area in most main provinces in Indonesia is less than 7% can be expected to create more traffic congestion, resulting in more accidents.

## 4 Conclusion

In this paper, a macro data analysis of Indonesian road accidents in the form of statistical data was carried out. The number of traffic accidents in Indonesia showed a significant increase between CY 2004 and 2014. Overall minor injuries were the highest number followed by major injuries and fatalities, respectively. Furthermore, a 200% increase in fatality rate per 100,000 population in the past ten years coincided with a 200% increase in the number of vehicles on the road, dominated by motorcycles. Meanhwile, there was not enough infrastructure road growth (35%). Furthermore, it can be concluded that 78% of the accidents in the main provinces occur on Java Island. Governments need to take action to address road safety in a holistic manner, which requires involvement from multiple sectors, addressing the safety of roads, vehicles, and road users themselves.

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