



Anatomy of Injury Severity and Fatality in Indonesian Traffic Accidents

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Abstract. There has been a steady increase in traffic accidents with major injuries in Indonesia over the last 10 years, especially those with a score higher than 3 on the Abbreviated Injury Scale (AIS). Frontal, side, and rear collisions, as well as pedestrian impact are modes of accident that contribute to the majority of injuries or fatalities. Based on age classification, the 16-30 age group are the most vulnerable road users in Indonesia. Traffic accidents in Indonesia are dominated by motorcycles, which also contribute the highest portion of fatalities and major injuries (AIS score > 3). Most traffic accidents can be attributed to human, road and environmental, or vehicle factors. Careless driving and unruly behavior of the driver are the main causes of accidents in Indonesia. Statistical data and analyses on traffic accidents in Indonesia can be used to develop a comprehensive strategy and policy to reduce the number of fatalities and severe injuries of road accidents in Indonesia. There is a need to balance the high growth of motor vehicles with adequate infrastructure. Good driver education as well as vehicle safety and crashworthiness regulations are required in order to reduce traffic accident fatalities.

Keywords: *AIS; injury severity; traffic accidents; traffic fatalities; driving behavior; crashworthiness.*

1 Introduction

In Indonesia, the slow growth of road infrastructure contributes to traffic congestion, while the fast growth of vehicles contributes to smog pollution in urban areas. The problems of traffic congestion, pollution and high number/cost of traffic fatalities are signs of an unsustainable transportation system. In Jakarta, for example, the financial loss due to traffic congestion amounts to 31.4 IDR trillion per year [1]. This financial loss was calculated by considering vehicle operating cost (VOC), value of time (VOT), and health aspects during traffic congestion; these three parameters were considered to comprehend the cost of fuel, working hours, and health impact due to pollution.

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Fatal and severe-injury accidents in Indonesian traffic have been increasing steadily over the last ten years. Several factors contribute to traffic problems in Indonesia, namely unbalanced growth between road infrastructure and vehicles, lack of vehicle safety and occupant protection regulations, and lack of driving education. New car and motorcycle registrations in 2014 reached more than 1 million and 8 million, respectively. The total number of cars and motorcycles on the road in Indonesia in 2014 was about 200% higher than in 2004. Meanwhile, the total length of road infrastructure (national, provincial and city roads) only grew by 36% between 2004 and 2014 [2]. During this period, the number of fatalities in traffic accidents increased by almost 200%, with financial loss growing by 400% [2].

In terms of major injuries (AIS score > 3), Indonesian traffic accidents showed an increase of more than 300% between 2004 and 2014. Moreover, traffic accidents with minor injuries (AIS score < 3) showed an even more alarming growth at more than 1000%. Data collection, vehicle and infrastructure growth, and number of accidents in Indonesian traffic are presented in the accompanying paper entitled 'Macro Data Analysis of Traffic Accidents in Indonesia' [3]. In this paper, the anatomy of traffic accidents in terms of type of collision, accidents by age group, main causes of traffic accidents are discussed and analyzed. All data presented in this paper were provided by the Indonesian National Traffic Police Corps (KORLANTAS).

2 Traffic Accidents and Regulation in Indonesia

Traffic accident data are classified according to fatality and injury severity based on the Abbreviated Injury Scale (AIS). 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 fatality term refers to the occurrence of death caused by an accident. The data collection standard to record fatalities due to traffic accidents is typically defined as within 24 hours or 48 hours of the accident. Unfortunately, there is no clear standard in collecting fatality data on Indonesian traffic accidents. Most of the fatality data are collected at the time of the accident. The injury scale AIS > 3 is classified as major injuries while AIS < 3 is classified as minor injuries. Traffic accidents involving fatality or major injury in Indonesian traffic accidents have shown a significant increase over the last 10 years, as depicted in Figure 1.

The number of fatalities in 2014 was about 28,000, which was almost three times higher than that of in 2004. This number is considered to be very high compared to fatal traffic accidents in Europe and the US, as can be seen from Figure 2. It should be noted that the number of vehicles in Indonesia is much smaller compared to the number of vehicles in Europe or the US. In 2014, the

total number of registered vehicles in Indonesia, US, and Europe were 113 million, 253 million, and 308 million, respectively [4].

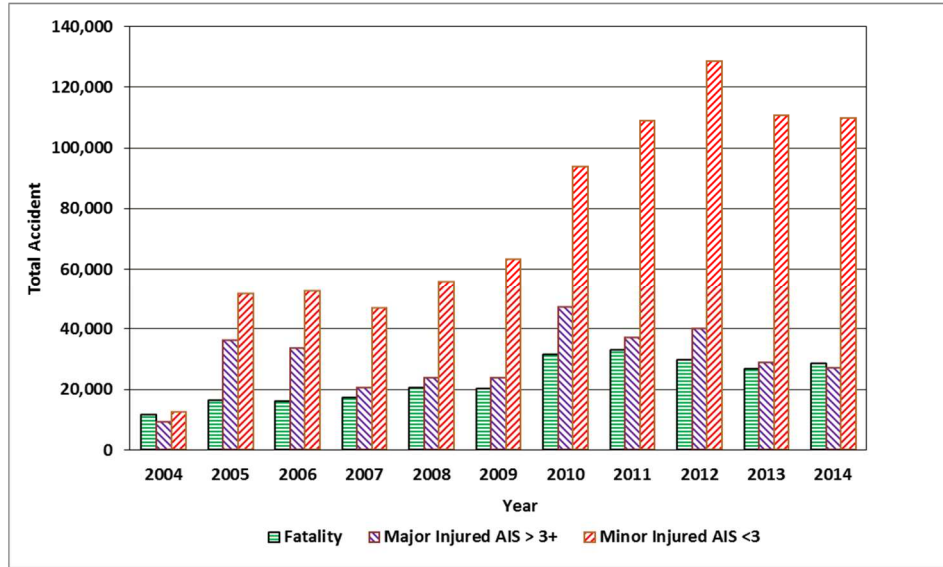


Figure 1 Traffic accident data in Indonesia from 2004 to 2014.

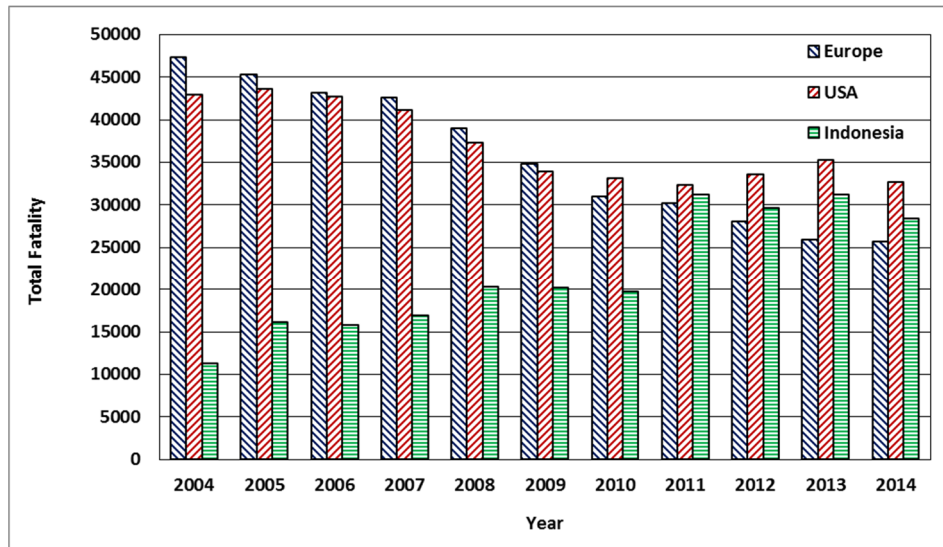


Figure 2 Traffic fatalities in Indonesia, USA, and Europe.

Traffic fatalities in the US and Europe continued to decline between 2004 and 2014. Traffic safety improvements in both regions may be attributed to crashworthiness and occupant safety regulations to protect passengers. There has been a gradual update of vehicle safety regulations between 2000 and 2014, such as frontal and side crash safety regulations ECE R94 and R95 in Europe, and FMVSS 208 and 214 in the US. These regulations were updated based on feedback from the review of recent accident statistical data. In contrast, there are no crashworthiness regulations in Indonesia. Traffic fatality in Indonesia will continue to rise if there no vehicle crashworthiness and safety regulations based on accident statistical data are introduced.

3 Anatomy of Traffic Accidents in Indonesia

To analyze traffic accidents in Indonesia, the collected data were classified based on several parameters so that trends and critical modes of accidents could be evaluated thoroughly. The analysis and evaluation of the data can be used to formulate vehicle safety regulations as a part of Indonesian traffic safety policy.

3.1 Traffic Accident and Severity Based on Type of Vehicles

In order to see the magnitude of the traffic accident problem in Indonesia, one may group the accident data based on type of vehicle. Figure 3 shows the traffic accidents in Indonesia between 2010 and 2014. It can be seen that they are dominated by motorcycles, which contributed more than 70% of road traffic accidents. Road traffic accidents involving passenger cars and trucks contributed approximately 12% and 10%, respectively. Road traffic accidents involving buses and special vehicles such as three-wheelers accounted for 5% and 1%, respectively.

The high proportion of accidents involving motorcyclists is due to the large population of motorcycles in Indonesia. The 2014 statistic data show that out of 113 million total registered vehicles in Indonesia, more than 81% are motorcycles [3]. There are few or no special motor vehicle lanes in Indonesia, which increases the probability of traffic accidents between motorcycles and cars, trucks or buses. Meanwhile, infrastructure development in Indonesia has been slow in the last 10 years. The disproportion between infrastructure growth of about 4% and motor vehicle growth of about 15% plays an important role in the increase of the number of traffic accidents and fatalities in Indonesia.

Motorcycles also dominate the number of road accidents in Indonesia resulting in fatalities and major injuries, as can be seen in Figure 4 based on the data for 2014. Motorcyclists were responsible for 73% of fatalities and major injuries in Indonesian traffic accidents, while passenger cars and trucks contributed about

10% of fatalities and major injuries (AIS > 3) [5]. These data show that motor vehicle growth and motorization have a direct correlation with the number of fatalities in Indonesian road traffic accidents.

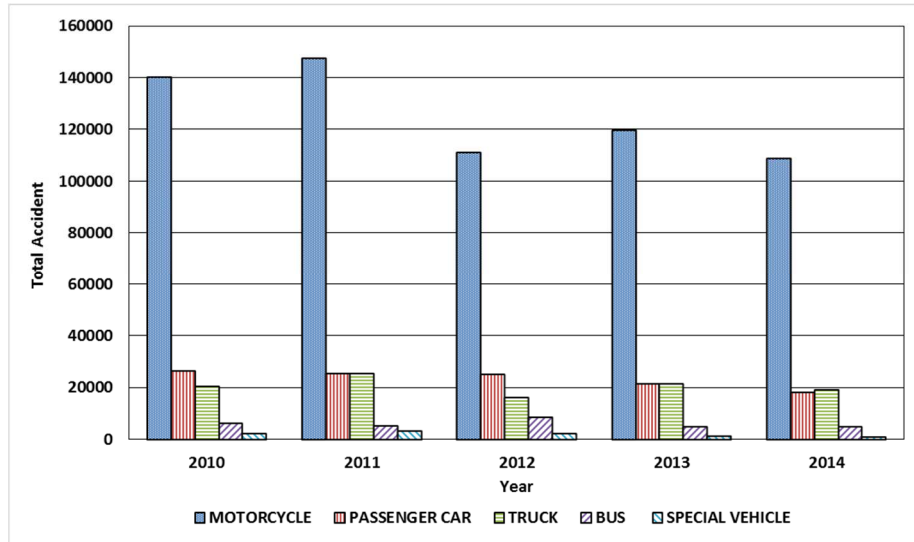


Figure 3 Total number of accidents based on type of vehicles (2010-2014).

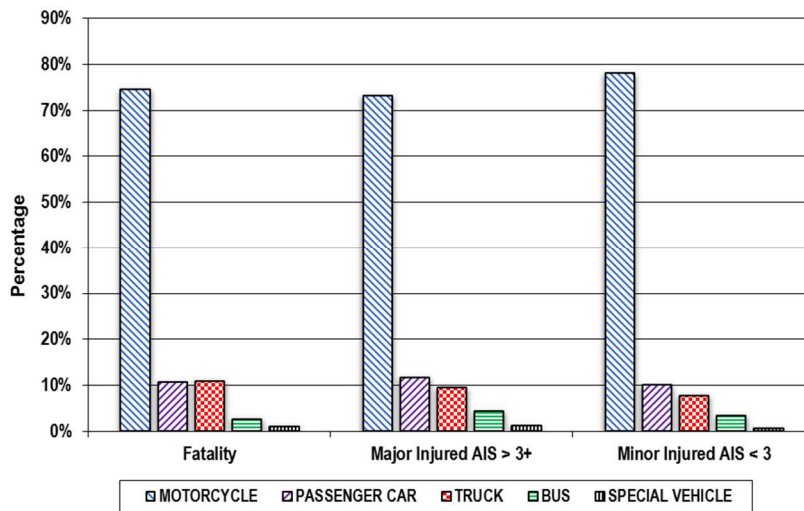


Figure 4 Severity level of injuries by the types of vehicles (2014).

3.2 Traffic Accidents Based on Type of Collision

The types of vehicle crashes during traffic accidents were categorized in terms of direction of impact and object being struck. Based on crash category, the accident data were grouped into several types of collisions, i.e. single vehicle collision, head frontal collision, rear impact collision, side impact collision, side-swipe collision, multi vehicle collision, pedestrian impact, etc. The types of collision in Indonesian traffic accidents from 2012-2014 are presented in Figure 5.

The most common types of crashes in Indonesia were due to head frontal collisions (24%), followed by side impact collisions (23%), rear impact collisions (17%), and pedestrian impact (13%). Based on the above statistics, vehicle safety policies that will lead to crash safety regulations need to be developed to protect vehicle occupants and pedestrians.

The safety policy priority should start with frontal and side impact regulations. Europe, Japan, and the US have also embarked on developing pedestrian protection regulations. Due to the high number of pedestrian impact accidents in Indonesia, it is prudent to start developing policies and regulations to protect pedestrians in Indonesia.

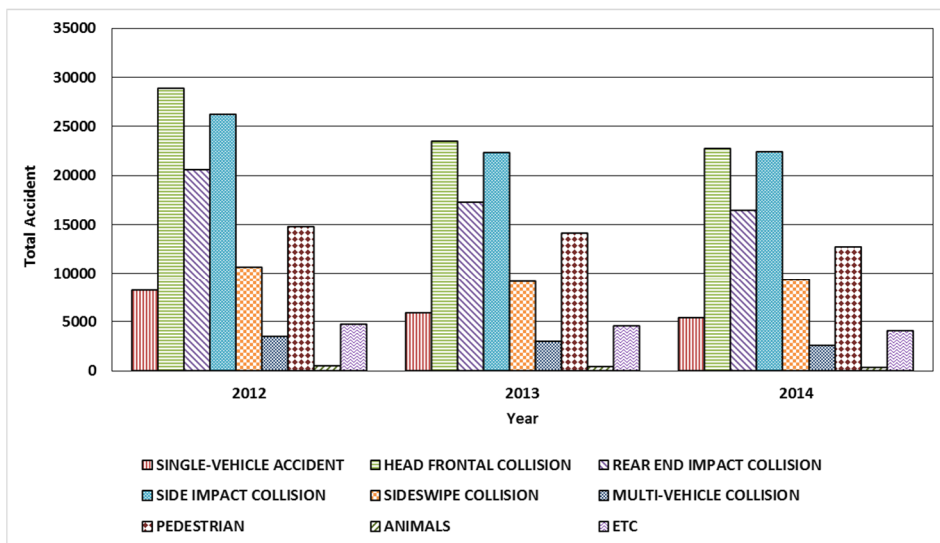


Figure 5 Traffic accidents based on direction of impact and types of collision.

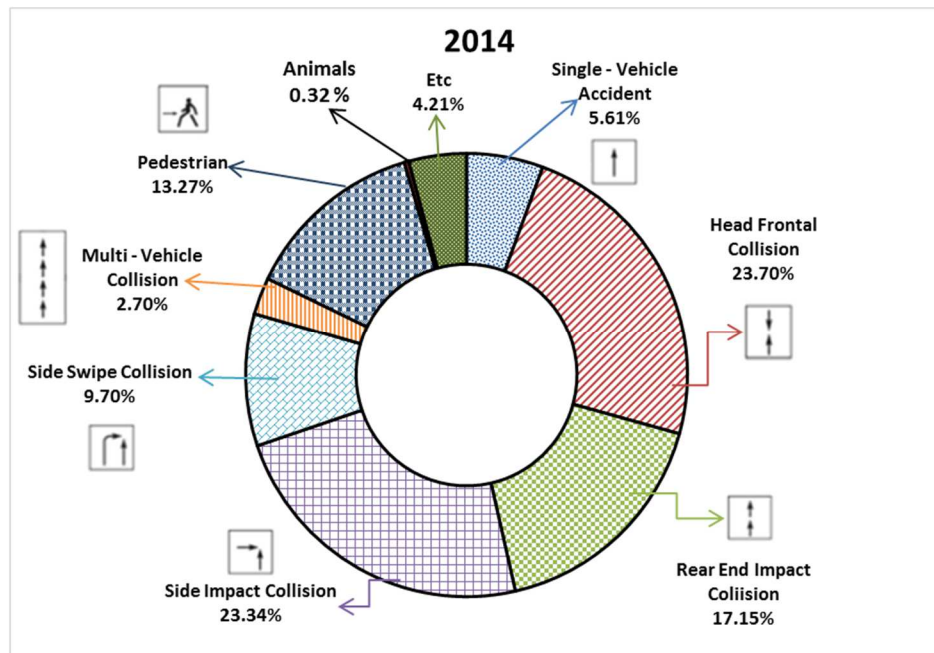


Figure 5 Continued. Traffic accidents based on direction of impact and types of collision.

3.3 Traffic Accidents Based on Age Group and Time

The distribution of traffic accidents by age group is shown in Figure 6. The distribution was fairly similar from 2010 to 2014. Based on this distribution, the most vulnerable road users in Indonesia appear to be the age group from 16 to 30 years of age. Young drivers lack driving experience and typically are not fully aware of the impact of risky driving behavior.

Most of the traffic accidents occurred during the daytime/working hours. As shown in Figure 7, 30% of accidents occur between 06.00 and 12.00, and 32% of accidents occur between 12.00 and 18.00. Most accidents occurred during rush hours when most people were on their way to work in the morning and on the way home in the afternoon. During these hours, high traffic density and traffic congestion add to the traffic accident potential. It is interesting to note that the traffic accident frequency remained significantly high (23,000-24,000) during the time period from 18.00 to 24.00. This high frequency of traffic accidents was coincident with a high volume of traffic of people who elected to avoid the afternoon rush hour.

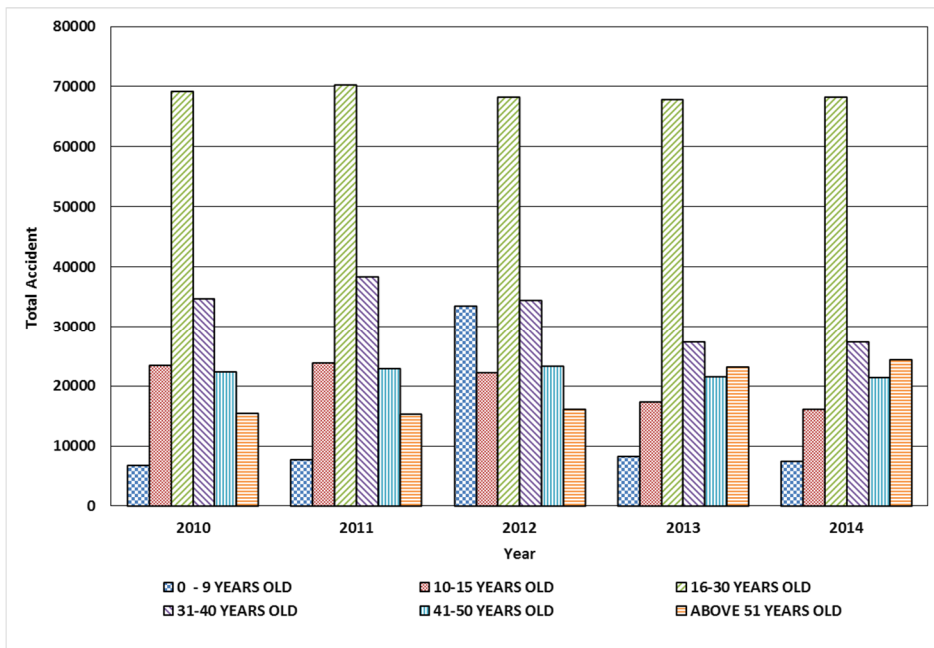


Figure 6 Accident by age group.

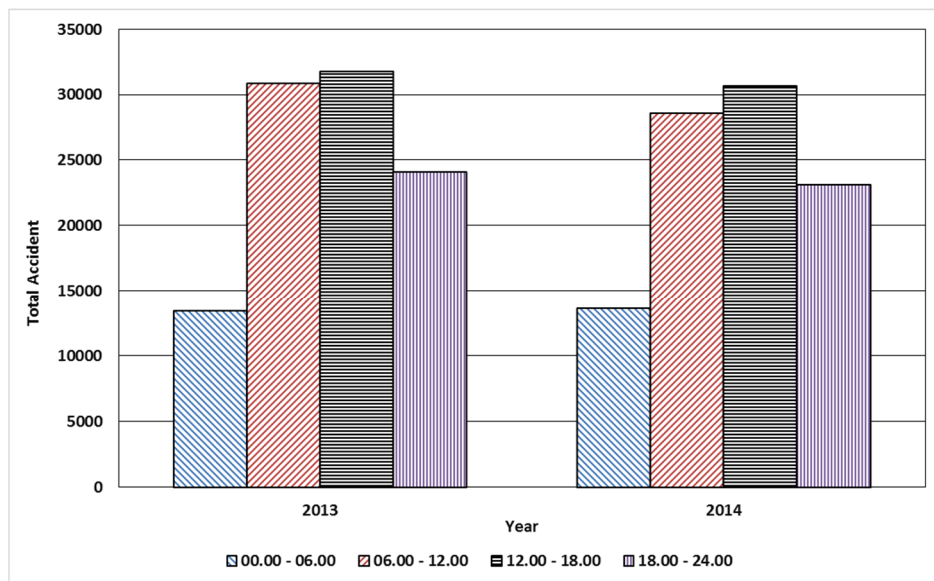


Figure 7 Traffic accidents by time of accident.

4 Main Causes of Traffic Accidents

The main causes of Indonesian traffic accidents can be classified into three categories, namely: human factors, vehicle factors, and road and environmental factors. As shown in Figure 8, the majority of traffic accidents in Indonesia are caused by human factors (88%), followed by road factors (8%), and vehicle factors (3%). Detailed data of human and vehicle factors can be seen in Figure 9. Unruly driving behavior and careless driving, which accounted for 78%, were the main contributors to traffic accidents in Indonesia. Meanwhile, the number of traffic accidents due to alcohol was not significant (1%).

Vehicle factors in traffic accidents amounted to 3% and were mainly due to brake failure, vehicle handling, poor visibility, and broken front or rear axles. Road maintenance is critical to ensure that road quality and road performance are sufficient for motor vehicles. Road and environmental factors that caused traffic accidents amounted to 8% and were mainly due to road damage and potholes, slippery roads, sharp turns, and inadequate lighting.

Based on the data of the main causes of traffic accidents dominated by human factors, it is critical to strengthen driving education to reduce careless and unruly driving behavior. Improvement of road infrastructure is also needed to reduce traffic accidents caused by driver fatigue and road conditions.

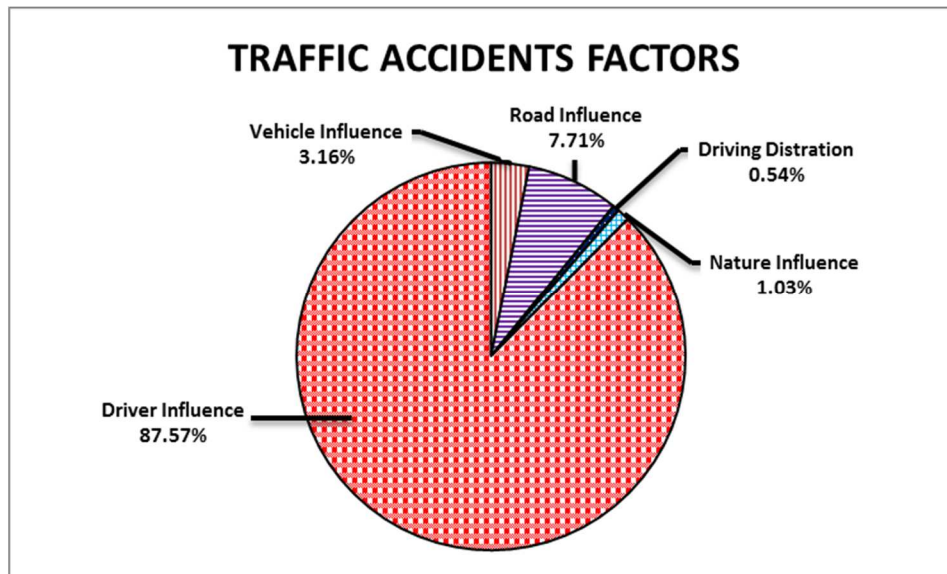


Figure 8 Main causes of traffic accidents in Indonesia (2014).

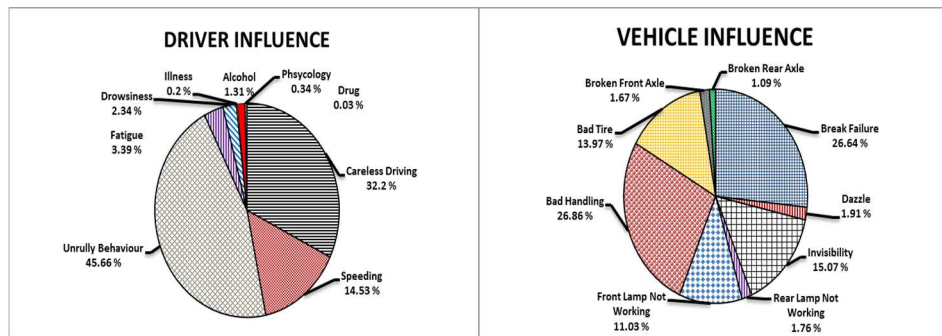


Figure 9 Human and vehicle factors causing accidents.

5 Conclusion and recommendations

The high growth of motor vehicles in Indonesia is not accompanied by high growth of road infrastructure. As a result, the rate of fatalities and major injuries (AIS > 3) have reached fairly high numbers that are similar to those in the US and Europe. Motorcycle accidents, which contributed 72%, dominated the number of traffic accidents and traffic fatalities in Indonesia. The majority of traffic accidents in Indonesia were caused by human factors (88%), followed by road and environmental factors (9%), and vehicle factors (3%).

The number of fatalities and major injuries in Indonesian traffic accidents needs to be reduced. There are several measures that can be taken, such as:

1. Balancing the growth of motor vehicles and road infrastructure.
2. Designing and providing special lanes for motorcycles to prevent collisions between motorcycles and passenger vehicles.
3. Strengthening driver education to significantly improve driver skills and to reduce careless and unruly driving behavior.
4. Implementing vehicle safety policies and regulations, with the priority on frontal and side impact regulations. Due to the high number of pedestrian impact accidents in Indonesia, it will be prudent to start developing policies and regulations to protect pedestrians in Indonesia.

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