

# Studying the Causes and Affecting Factors of Motorcycle Accidents A Case Study on the Road Accidents in Zanjan Province (IRAN) - 2007

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**Abstract**—Based on statistics released by Islamic Republic of Iran Police (IRIP), from among the total 9555 motorcycle accidents that happened in 2007, 857 riders died and 11219 one got injured. If we also consider the death toll and injuries of other vehicles' accidents resulted from traffic violation by motorcycle riders, then paying attention to the motorcycle accidents seems to be very necessary. Therefore, in this study we tried to investigate the traits and issues related to production, application, and training, along with causes of motorcycle accidents from 4 perspectives of road, human, environment and vehicle and also based on statistical and geographical analysis of accident-sheets prepared by Iran Road Patrol Department (IRPD). Unfamiliarity of riders with regulations and techniques of motorcycling, disuse of safety equipments, inefficiency of roads and design of junctions for safe trafficking of motorcycles and finally the lack of sufficient control of responsible organizations are among the major causes which lead to these accidents.

**Keywords**—Motorcycle, Motorcycle riders, Road accidents, Statistical analysis of accidents.

## I. INTRODUCTION

**I**N some countries including Iran, motorcycles and their riders are an inseparable part of traffic and consequently safety of riders should be taken into the account just like other users of roads. However, with respect to more vulnerability of motorcycle riders in compare with car passengers, they needs more attention and in spite of this fact, their needs and problems have not yet been considered by authorities, road designers and traffic managers.

In recent decades, ratio of using this vehicle had increased tremendously and it is still expanding and as the result, production of this vehicle had faced an obvious growth, as well. Based on estimations performed by Iran Ministry of Mine and Industry, amount of annual production of

motorcycle in 2006 with a 12.5% growth in compare with the previous year (2005), had reached to 900,000 vehicles. Also, based on these statistics, the total amount of motorcycle production, from 1996 to 2004 has estimated to be more than 8 million vehicles [1].

Unfortunately, along with this growth in production, number of motorcycle accidents had increased, as well. With regard to statements of Iran Road Patrol Department (IRPD) commander, more than half of motorcycle-riders in accidents leading to death or injury were culpable. In the other words, statistics shows that from among 9555 motorcycle accidents happened last years, 735 accidents had led to death and other 8820 resulted in injuries and as the result of these accidents, 857 riders and passengers were died and 11219 individuals were wounded.

Based on announcement of IRPD, the affecting factors of motorcycle accidents include disrespecting the right of way and sudden change of vehicle direction, deviation to the left (left-turn), lack of attention to the foreshore and ignoring the distance, transgressing the secure speed limits, and inability of rider in control of vehicle. In addition, the studies show that disuse of helmet is the leading cause of death among motorcycle-riders and their passengers [2].

With respect to significance of motorcycle issue in accident occurrence and road casualties, in this research we tried to gather and analyze the accident-sheets of IRPD (kam114 forms) and by taking the advantages of SPSS software and descriptive analysis, we attempted to identify affecting factors and tried to present suggestions and guidelines in order to perform effective and preventive actions to reduce the possibility and severity of accident occurrence.

## II. CASE STUDY

As it was mentioned in previous section, the major source for collecting required data in this research was accident-sheets of Zanjan Province in 2005 as the target.

Accident-sheets called KAM114 form are prepared by experienced officers having technical expert degree and based on specifications of involved vehicles, weather condition, drivers, road and road geometrical design. Currently, KAM114 forms are considered as the only available reference

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in the case of accidents [3].

#### A. Subjects

Subjects of this study include the data of all motorcycle accidents that happened in suburban roads of Zanjan Province in 2004. However, with respect to the characteristics of motorcycles, we only examined the accidents which were reported to IRPD and also their accident-sheets were prepared by IRPD officers.

#### B. Goals of the Study

The main purpose of this study was to investigate the affecting factors of motorcycle accident occurrence in suburban roads of Zanjan Province. Other goals of this study are as follows:

- 1) Studying characteristics of motorcycle accidents in compare with other vehicles'.
- 2) Identifying the factors related to the accident time.
- 3) Identifying the factors related to the accident location.
- 4) Identifying the factors related to riders.
- 5) Identifying the factors related to weather condition, road and road geometrical design.
- 6) Identifying the factors related to vehicle which effects the accident occurrence

#### C. Credibility of the Study

This study was accomplished on the basis of accident-sheets prepared by IRPD officers of Zanjan Province. From juridical points of view, the accidents-sheets are served as the basis of complaint for both sides of the accident and also organizations such as legal medicine office, administration of justice, private and state insurance companies, and road and transportation office take the necessary measures based on these information, therefore these sheets usually completed and confirmed by experienced and senior officers, respectively and as the result the data presented in them are seldom face any inaccuracy or mistake.

On the other hand, Zanjan Road & Transportation Organization authorities tried to take the advantages of the computer and civil-engineering students in order to reduce the possibility of any inaccuracy in registration of KAM114 records. Eventually, before performing any analysis by means of SPSS software, data which inherited fundamental errors were reexamined or omitted in order to preserve the accuracy of the study.

#### D. Descriptive Analysis of the Accidents

All data required for carrying out this research are available in so-called accident-sheets (KAM114 forms). In order to meet the goals of the study and also in order to identify the affective factors of accident occurrence, and with regard to type and nature of available data, we tried to perform descriptive analysis of accidents by means of several tests such as abundance test, mean test, mode test, standard deviation test, and PARETO test.

#### 1) General Survey

Motorcycle from the viewpoints of design and balance or stability state always is considered as a vehicle having the great potential of overturn or accident among other vehicles. Analysis of motorcycle accidents in compare with total accidents happened in the province reveals this fact, as well.

With respect to diagram presented in fig.1, we observe that in motorcycles the percentage of accidents leading to death or injury is 6 and 50% more than other accidents, respectively. In the other word, severity of motorcycle accidents is much more than other vehicles.

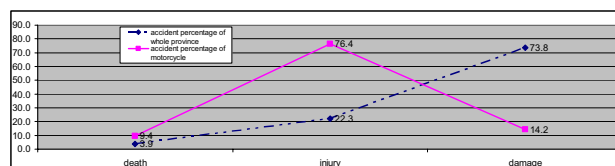


Fig. 1 Diagram of accident type in whole province in compare with motorcycle accidents

However, the average of accidents in motorcycle and other vehicle is 2.05 and 2.70, respectively (TABLE I). Regarding that the assigned codes for accident leading to death, damage and injury are respectively 1, 2, and 3, it is easy to deduce that the weight of accidents in whole province is toward damage, but in the case of motorcycle, the tendency of this weight is

TABLE I  
STATISTICAL SPECIFICATIONS OF TOTAL ACCIDENTS HAPPENED IN THE PROVINCE IN COMPARE WITH MOTORCYCLE ACCIDENTS AND BASED ON THE TYPE OF ACCIDENT

Std. Deviation	Mean	N	Total Accidents
0.537	2.70	2829	0-type accidents
		2829	Valid N (listwise)
Std. Deviation	Mean	N	Motorcycle
0.486	2.05	106	0-type accidents
		106	Valid N (listwise)

toward the injury.

Severity of motorcycle accidents on one hand and abundance of motorcycle accidents in the province on the other hand, increase the importance of this issue. Based on PARETO diagram, the culpable vehicles in the accidents including car, lorry, truck, trailer and motorcycle, totally hold the 95% of accidents that 10.4% of this statistic belongs to motorcycle.

Bearing in mind that in preparation of accident-sheets by road patrol, most of the motorcycle accidents as the result of overturn or hitting a solid object are not reported, and with respect to low rate of this vehicle trafficking in the roads of Zanjan Province, perhaps the real ranking of motorcycle accidents from road accident point of view would be higher. Regarding the inappropriate status of motorcycle from the viewpoint of high potential of accident in suburban roads, this question arise that with respect to the high percentages

motorcycle production (95%) in Iran for urban applications, what is the reason for high amount of this vehicle trafficking in the suburban roads of the province and also inheriting 10% of road accidents?

The answer to this question could be surveyed from two perspectives. First, causing disorder in road traffic from the viewpoint of inhomogeneous vehicles combination in the roads; and second, inappropriate control of police department over this kind of vehicle.

With respect to previous studies on the status of motorcycle trafficking in the roads of the province, we found that the most of motorcycle riders are farmers and workers who use the motorcycle to travel between their home in village or suburb and their farms or factories or to go to the downtown for shopping.

Motorcycle trafficking is especially more obvious in transit roads of the province, roads which pass through several villages or roads that more byways end to them and as the results, motorcycle accidents in these roads is more than other vehicles.

In fig. 2 this difference of percentage in Zanjan-Mianeh transit road is about 10% and in Zanjan-Khoramdareh transit road, Ardabil road, Mahneshan and Zanjan-Dandi byways is about 3 to 5%.

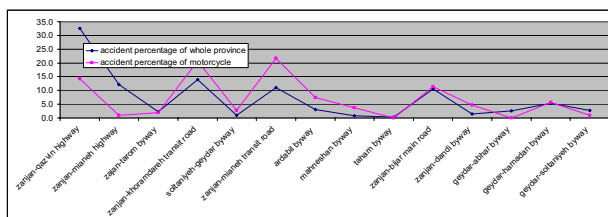


Fig. 2 diagram of accident percentage of whole province in compare with motorcycle accidents according to type of the roads

Also, the PARETO diagram of accidents, which is based on the location of accident, shows severity motorcycle accidents in Zanjan-Khoramdareh and Zanjan-Mianeh transit roads, Zanjan-Bijar main road, and Zanjan-Qazvin highway in such a way that about 70% of total amount of accidents had happened in these four roads. Unfortunately, the most pitiable issue in this case is that 15% of motorcycle accidents are happening in highways in which motorcycle trafficking is legally forbidden.

2) Road Factor

Regarding that in most of above-mentioned transit and main roads there is no suitable road shoulder, therefore motorcycle riders, who are in lower age and literacy level in compare with other drivers, tend to use main part of road for trafficking. Also the diagram of accident percentage according to the location of accident occurrence (fig. 3) shows that 91% of motorcycle accidents had happened in roadway which in compare with norms of the province is 5% higher.

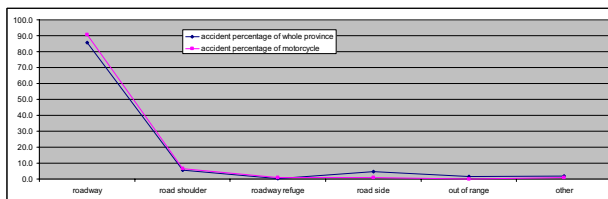


Fig. 3 diagram of accident percentages of whole province in compare with motorcycle accidents based on the location

3) Human Factor

Now, let's return to the first question. We mentioned that motorcycle riders usually use roadway and also we knew that their riding and professional information is very low as the result of their low literacy level and also because there is no obligation to have motorcycle license in Iran.

Naturally, with regard to current driving and riding regulations of the country and also considering the trend of supervising organizations that in the case of motorcycle accident with other vehicle usually declare the motorcycle riders inculpable, drivers always tend to be more cautious when they are passing a motorcycle and they even try to avoid them because they think that motorcycle is move on two wheels and there is always a high risk of overturn. On the other hand, with respect to this fact that motorcycles occupy an small space in the road, drivers usually pay no enough attention to their distance from these vehicle at time of overtaking and this also led to increase the possibility of accidents.

Statistics implies this fact that 80% of motorcycle accidents happened as the result of crash between motorcycle and other vehicles. Based on this diagram, in 14 accidents, the motorcycles were not inculpable and their accident were as the result of crash between other vehicles and in 45 cases they were directly involved.

Another issue which leads to irregularity of road traffic from the viewpoint of motorcycle attendance in the roads is the motorcycle itself and their riders or passengers. As it was mentioned before, since having license for riding motorcycle is not obligatory in Iran and also low level of literacy and age among the riders, they usually are unprofessional riders and as the result they commit lots of driving delinquencies.

Studying the human factors affecting the accident occurrence (fig. 4) shows that lack of attention to the regulations among the motorcycle riders is about 20% more than other drivers which led to accident. Also studying the causes of motorcycle accidents (fig. 5) reveals the delinquencies such as disrespecting of priority, deviation to the left, violating the 4<sup>th</sup> article of safety law, disrespecting the linear distance and finally continuous technical deficiency of the vehicle among the motorcycle rides is more than the norms of other vehicles' accident throughout the province.

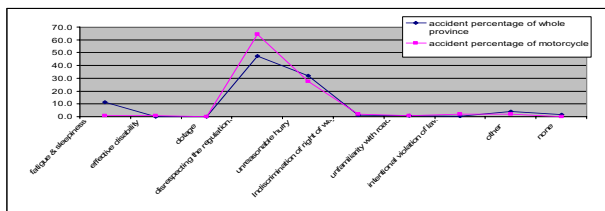


Fig. 4 Diagram of accident percentage of whole province in comparison with motorcycle accidents according to human factor

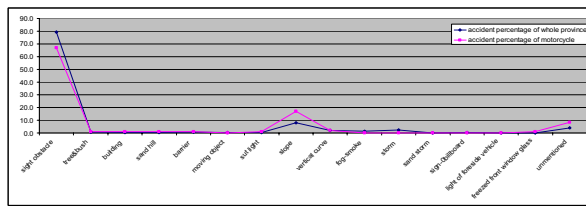


Fig. 8 Diagram of accident percentage of whole province in comparison with motorcycle accidents according to sight obstacles

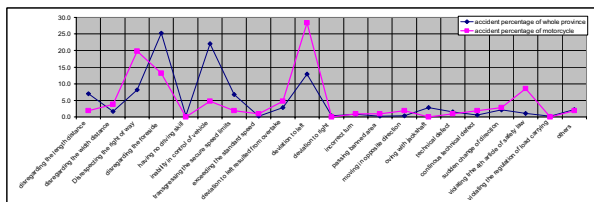


Fig. 5 Diagram of accident percentage of whole province in comparison with motorcycle accidents according to main influencing reason

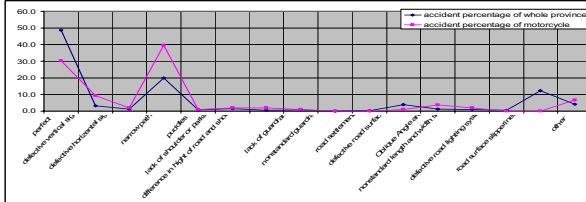


Fig. 9 Diagram of accident percentage of whole province in comparison with motorcycle accidents according to road defects

4) Road and Human Factor

This issue get more worse and acute especially in junctions in which rural roads join the main roads (fig. 6, percentages of accidents in junctions is more than norms of the province), unauthorized access roads of farms and roadside installations (fig. 7, percentages of motorcycle accidents in agricultural and residential zones is more than norms of the province), low-width pathways, bridges and some parts of the road which suddenly face the width reduction as the result of inappropriate design (fig. 9, motorcycle accidents in low-width roads is 20% more than norms of the usual roads), main and vertical slopes in which the sight range of the riders and drivers decreases and finally in the case of disrespecting safe speed by the drivers in steep roads (fig. 8, percentages of motorcycle accidents as the result of slope sight obstacle is 10% more than norms of the province).

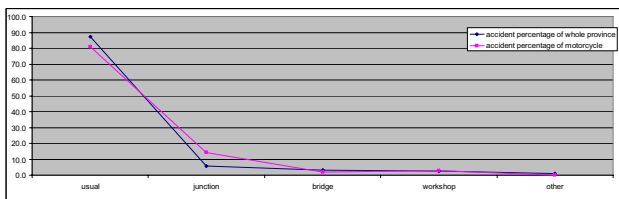


Fig. 6 Diagram of accident percentage of whole province in comparison with motorcycle accidents according to location specification

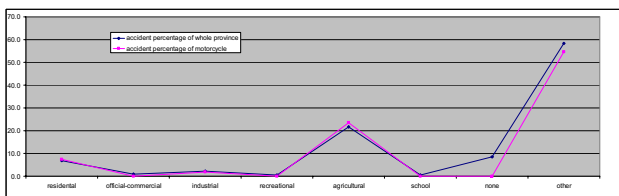


Fig. 7 Diagram of accident percentage of whole province in comparison with motorcycle accidents according to location usage

With respect to this fact that cities and important locations such as parking lots, gas stations, and resting areas are usually located in distances which are coefficients of 5km, accident status in these kilometers is more critical. Also, statistics shows that the high percentages of accidents are happening in first 5 km of transit, main and byway roads.

5) Weather Condition and Geographical Factors

According to fig. 10 and 11, we can strongly claim that with respect to minimum amount of motorcycle application in rainy and snowy weather, climate factor has very little impact on the accident occurrence and motorcycle and motorcycle-riders are the main factors which cause the accident, because in one hand, these riders can not professionally control the motorcycle in the roads in which there is a high possibility of accident and danger and on the other hand, the motorcycles are usually designed for urban applications and therefore they are not safe for travel in the roads.

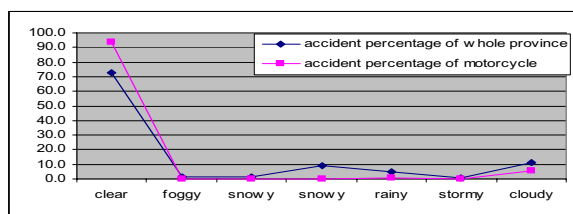


Fig. 10 Diagram of accident percentage of whole province in comparison with motorcycle accidents according to weather condition

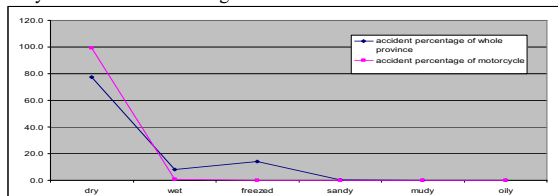


Fig. 11 Diagram of accident percentage of whole province in comparison with motorcycle accidents according to road condition

6) Vehicle Factor

By looking at the diagram of vehicle factor influencing the accident (fig. 12) we can see that the defects of lighting system and unsuitable load holding were more than the norms of the province and with respect to diagram of fig. 5, continuous technical problem of the vehicle in motorcycle is more than other culpable vehicles involved in accidents.

Expanded utilization of this kind of inefficient motorcycles for travel in the roads includes two reasons: first, insufficient production of road-specific motorcycles in the country that leads to high price of these motorcycles; and second, poor economical condition of workers and farmers which force them to use the cheapest motorcycles and also lack of attention to their reparation and maintenance issues. Another fundamental problem is the issue of carrying extra passengers and heavy loads by motorcycles.

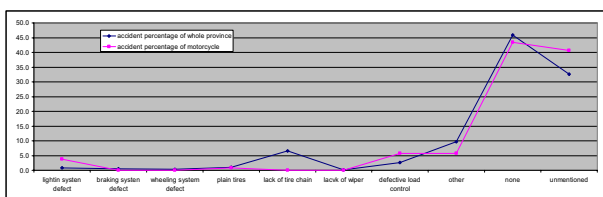


Fig. 12 Diagram of accident percentage of whole province in comparison with motorcycle accidents according to vehicle factor

7) Time Factor

Here, we will pay attention to factor of time which may influence the accident occurrence. Previously we mentioned that most of motorcycle users are farmers and workers of the cities or villages close to main roads. By taking a glance at the diagram which shows the ratio of motorcycle accidents per day and comparing it with the norms of the province (fig. 13), we can observe that this ratio in holidays is much more than other days.

These numbers add another factor to the factors which influence the motorcycle accidents. This factor is the tendency of motorcycle user to use motorcycle for going to suburban parks and gardens in holidays which may increase the ratio of accidents near to cities in these days.

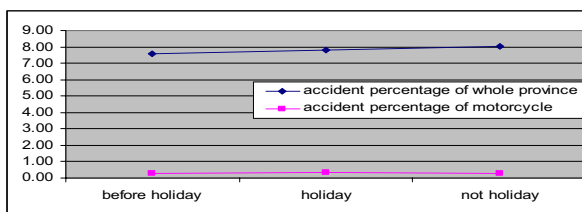


Fig. 13 Diagram of accident/day ratio of whole province in comparison with motorcycle accidents according to the type of the day in which the accident happened

PARETO Diagram of motorcycle accidents according to the month of occurrence (fig. 14) shows that months of October, September, August, July, and June are among the most critical months from accident occurrence point of view. Naturally,

knowing that the job of most Zanjanian villagers is farming, in months of October and September, as the harvesting month, the high ratio of motorcycle accident in roads near to farmlands and gardens would be inevitable. From the time point of view, the most critical hours in motorcycle accidents are 7 to 8 pm and 6 to 10 am and almost half of accidents are happening in these hours.

Problems such as riding in night, inattention to foreside or lack of sight, using defected lighting system in motorcycles and fatigue of riders at the end of day are among the factors which add to the number of accidents in hours between 3 and 8 pm. Diagram of fig. 15 shows that the number of accidents in these hours is more than the norms of the province. By taking a glance at diagram of the ratio of motorcycle accidents to day/night according to natural light of the road (fig. 16) we can observe that the amount of accidents in day and during sunset is much more than the norms of the province.

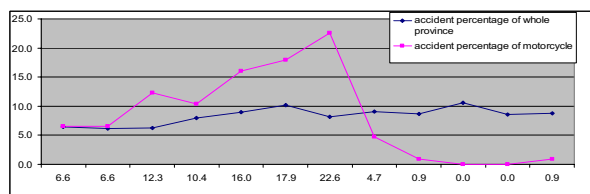


Fig. 14 Diagram of accident percentage of whole province in comparison with motorcycle accidents according to month in which accident happened

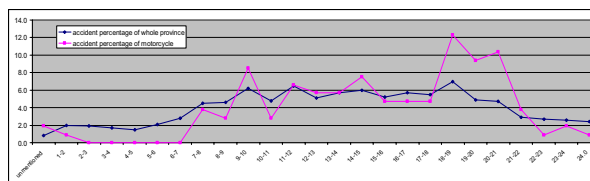


Fig. 15 Diagram of accident percentage of whole province in comparison with motorcycle accidents according to time of the accident

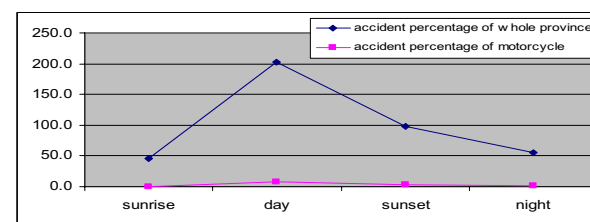


Fig. 16 Diagram of accident/hours ratio of the whole province in comparison with motorcycle accidents according to type of the day in which accident happened

III. CONCLUSION

In this study we investigated the road accidents of motorcycles from different perspectives. However, the results of this research could be summarized as follows:

- 1) The severity of motorcycle accidents is much more than other vehicles and the possibility of death or injury in this kind of accident is very high.

- 2) Farmers and factory workers from suburban areas and villages and also individuals who go to gardens in holidays are among motorcycle users who are involved in most of the accidents.
- 3) Human factor is considered as the most important influencing factor of the motorcycle accidents in compare with other factors including vehicle, road and geographical or weather condition.
- 4) Disrespecting the regulations and unfamiliarity with professional riding rules are among the most important human factors which influence the accident occurrence.
- 5) Roads which are passing from more villages or have lots of access byways have more potential of accident occurrence.
- 6) Roadways, junctions, steep roads and places in which the road got narrower are among the locations in which there is a high potential of accident occurrence.
- 7) Defective lighting system of motorcycle, carrying heavy loads and extra passenger are among the causes of accident from the viewpoint of vehicle factor.
- 8) Harvesting season and times in which farmers and workers travel between their villages and city (6 to 8 pm) are the most critical times in which the possibility of accident occurrence is very high.
- 9) Although motorcycle trafficking in the highways is basically forbidden, but everyday a lot of motorcycles travel in the highways of the province.
- 10) Motorcycles and mistakes of their riders may disturb traffic and will increase the possibility of accident occurrence.
- 11) Weather and geographical condition of the road and also the road condition have a little influence on motorcycle accidents.

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