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Traffic Accident Characteristics in Madurai City

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Abstract— Road traffic accidents are considered among the leading causes of death locally and globally. In Madurai, road traffic accidents were responsible for about 20% of fatalities during the year 2013 and were named as the high cause of death in the country during the year 2013. Madurai suffers from a serious traffic accidents problem that must get more attention from the decision makers. A total of 4005 accidents have occurred over the study period (2008-2013) with an average of 667 accidents/year. Traffic accidents in Madurai were continuously increasing over the study period as a result of continuous increase in population and auto ownership represented by the motorization level (number of registered vehicles/1000 population). This study has utilized the traffic accidents data in Madurai for six years period to mainly investigate their trends and characteristics over that period. Based on the available data, traffic accidents were analyzed considering several variables including accident type, fatality rate, and fatality risk and severity level.

Keywords— Traffic accident, Madurai, Fatality rate, India

I. INTRODUCTION

The rapid population growth and increasing economic activities have resulted in the tremendous growth of motor vehicles. This is one of the primary factors responsible for road accidents in many metropolitan cities, including Madurai, India. The increasing number of road accidents is imposing considerable social and economic burdens on the victims, and various direct and indirect costs. Road accidents are essentially caused by improper interactions between vehicles, between vehicles and other road users and/or roadway features. The situation that leads to improper interactions could be the result of the complex interplay of a number of factors such as pavement characteristics, geometric features, traffic characteristics, road users' behavior, vehicle design, drivers' characteristics and environmental aspects. Thus, the whole system of accident occurrence is a complex phenomenon.

Many researchers have devoted their work in the area of road accidents and traffic safety aspects. Works have been undertaken on accident characteristics, accident forecasting and better roadway and vehicular design for the improvement of road safety in different traffic and roadway conditions.

A number of studies on road safety have also been carried out in India, in different cities such as Delhi, Mumbai, Chennai and Kolkata as well as on some highways. The notable studies include Kadiyali et al. (1983), Valli and Sarkar (1997), Victor and Vasudevan (1998), Sikdar et al. (1999), Chand (1999), Baviskar (1999), Saija et al. (2000), Sing and Misra (2001), and Chakraborty et al. (2001). However, no significant studies have appeared on the accident characteristics of passenger vehicles in Madurai. In this article, an assessment of the current level of road safety in Madurai has been made.

II. MADURAI TRAFFIC AND TRANSPORT SYSTEM

A Madurai is the administrative headquarters of Madurai District in the South Indian state of Tamil Nadu. With the population of 10 million spread over the banks of River Vaigai and it has been a major settlement for two millennia and is one of the oldest continuously inhabited cities in the world.

The existing street network in Madurai consists of arterial roads, sub-arterial roads and local streets. The total length of highways, arterial and other major roads in is about 532 km. However, most of the roads are narrow and their geometrics and surface conditions are not very good. Lane discipline of traffic seldom is the norm. Intersections are closely spaced and are not properly designed. Vehicles of different size, shape and manoeuvrability share the same right of way. The non-observance of the lane concept and movement of more than one type of vehicle through a single lane is a common phenomenon. The road-based passenger transport system of Madurai mainly consists of cars, buses, minibuses, auto rickshaws (three-wheeled motorized vehicles), motorcycles, taxis, bicycles and hand-pulled rickshaws. In a number of corridors tramcars also share the same right of way along with other vehicles.

In Madurai there were 440,182 registered motor vehicles in 2008 which increased to 743,366 in 2013, indicating a total growth of 68.88 per cent over a six-year period. Between 2008 and 2013, the number of buses increased by 19.43 per cent, cars

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(including jeeps and taxis) by 34.83 per cent, two-wheelers by 37.38 per cent and three-wheelers by 68.9 per cent. The traffic operation in Madurai is managed by the Madurai City Police and the TamilNadu Police. Both agencies have specific areas of operation. In the present study the data obtained from Madurai Police within its jurisdiction have been used.

III. TRAFFIC ACCIDENT SITUATION IN MADURAI

A. General

In Madurai traffic accidents occur for various reasons. Poor traffic management specially in respect of the reckless driving of buses, minibuses and auto rickshaws, inefficient traffic control at intersections, poor road geometrics, lack of public awareness, road users' indiscipline and inefficient movement, undefined bus stops, etc. are the major causes of road accidents.

In the recent past some measures regarding improvement of traffic operations have been undertaken in the city. Some of these measures are a one-way road system on a number of major arterials, construction of flyovers, improvement of geometrics of the intersections, and greater attention to road markings and signage. As a result there has been some improvement in the average travel speed of vehicles.

B. Accident data collection and analysis

An accurate and comprehensive system of collecting and recording accident data is required for studying the traffic accident characteristics in a city. Such data serve to identify the basic causes of accidents and to suggest means for overcoming the deficiencies that lead to such accidents. For the present accident characteristics study in Madurai, the past accident data for the years 2008 to 2013 were collected from published reports of the Transport Research Wing, MORTH, Government of India. The data obtained were analyzed to calculate various indices that indicated the road safety characteristics of the city.

C. Nature of accidents

During the period 2008-2010, the total number of accidents in Madurai decreased by 16 per cent from 663 to 568. However, between 2010 and 2012 the number of accidents increased by around 48 per cent, but has since 2013 been decreasing. By contrast, the number of deaths due to road accidents went down by 11.8 per cent from 142 to 127 during the period 2008-2012 but increased by to 145 in 2013. On the other hand, the number of injuries due to accidents had decreased by around 20 per cent during 2008-2010 but increased by 58.3 per cent during 2010-2012 and again decreased in 2013.

D. Accident Severity Index

The Accident severity index measures the seriousness of an accident. It is defined as the number of persons killed per 100 accidents. Table 1 presents the Accident severity index for Madurai during the period 2008-2013. It is seen that the Accident severity index has increased from 21.4 in 2008 to 22.8 in 2009, and then gradually decreased from 2009-2012 of around 50 per cent, but has, since 2013 been increasing. It is observed that in 2013 there was a sudden increase of persons killed in accidents resulting in the increase of the accident severity index. Figure 1 represents graphically the accident severity index for the said period.

TABLE I
ACCIDENT SEVERITY INDEX

Year	No of persons killed	Total no of road accidents	Accident severity index (col.2*100/col.3)
2008	142	663	21.4
2009	127	555	22.8
2010	120	568	21.1
2011	125	685	18.2
2012	127	839	15.1
2013	145	695	20.8

Source: Transport Research Wing, MORTH, Government of India (2008-2013)

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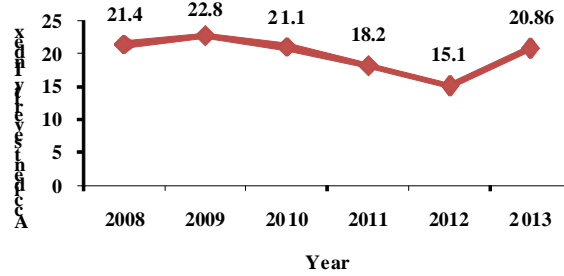


Fig. 1 Accident severity Index (persons killed per 100 accidents)

E. Accident fatality rate

The accident fatality rate is defined as the number of deaths per 10,000 vehicles. Table 2 presents the fatality rates in Madurai during the period 2008-2013. There was a substantial decrease in fatality rate from 3.22 in 2008 to 1.85 in 2013. It may be noted here that although the number of accident deaths in Madurai did not decrease significantly, the vehicle population in the same period increased from 440182 to 679510, which resulted in a decrease of fatality rates of more than 74 per cent. Figure 2 is the graphical representation of the accident fatality rate for the period 2008-2013.

TABLE III
ACCIDENT FATALITY RATE

Year	Total number of deaths	Total no of motor vehicles	Accident fatality rate (col.2*10,000/col.3)
2008	142	440182	3.22
2009	127	477791	2.65
2010	120	529844	2.26
2011	125	602852	2.07
2012	127	679510	1.86
2013	145	743366	1.85

Source: Road Transport year book 2010, 2013, Ministry of Road Transport and Highway, Government of India, New Delhi

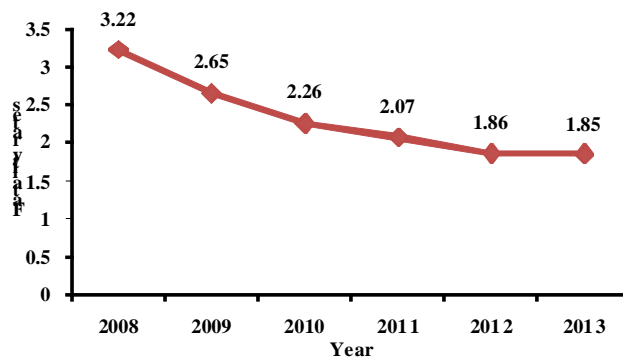


Fig. 2 Accident fatality rates (number of death per 10,000 vehicles)

F. Accident fatality risk

The accident fatality risk, defined as the number of accident deaths per 100,000 populations. From table 3 it is seen that the

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fatality risk has decreased from 14.21 in 2008 to 11.80 in 2010 but from 2010 to 2013 the fatality risk has been increased from 11.80 to 13.89. The accident fatality risk in Madurai was higher compared with the all-India condition (Table 4). While the all-India rate has an increasing trend, the rate in Madurai in the initial years of the period under investigation had a generally decreasing trend. However, this decreasing trend was reversed in 2011. It showed an upward trend thereafter when the number of deaths owing to accidents increased compared with 2011. Figure 3 is the graphical representation of the accident fatality risk in Madurai and India for said period.

TABLE III
ACCIDENT FATALITY RISK

Year	Road accident deaths	Estimated mid-year population	Accident fatality risk (col.2*100,000/col.3)
2008	142	999281	14.21
2009	127	1008082	12.59
2010	120	1016883	11.80
2011	125	1025684	12.18
2012	127	1034284	12.27
2013	145	1043287	13.89

Source: Road Transport year book 2010, 2013, Ministry of Road Transport and Highway, Government of India, New Delhi

TABLE IV
ACCIDENT FATALITY RISK IN INDIA

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013
Fatality risk	9.09	9.65	10.14	10.29	10.88	11.26	11.50	11.54	11.89

Source: Accidental Deaths and Suicides in India 2005, 2007, 2009, 2013, published by the National Crime Records Bureau, Ministry of Home Affairs, Government of India, New Delhi.

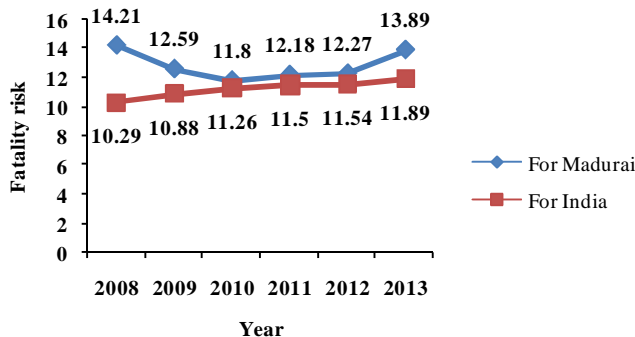


Fig. 3 Accident fatality risk (number of deaths per 100, 000 populations)

G. Accident risk

Accident risk is defined as the number of accidents per 100,000 populations. Table 5 presents the accident risk in Madurai for the period 2008-2013. It is seen that accident risk decreased from 66.34 in 2008 to 55.85 in 2010 but then increased to 66.78 in 2011. The decreasing trend of accident risk indicated that the chances of non-fatal accidents were gradually decreasing, making the people of Madurai more vulnerable to the fatal type of accidents. However, the situation was improving since 2011 with the increasing trend of accident rate once again. Figure 4 is the graphical representation of the accident risk for the period 2008-2013.

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TABLE V
ACCIDENT RISK IN MADURAI

Year	Total no of road accidents	Estimated mid-year population	Accident risk (col.2*100,000/col.3)
2008	663	999281	66.34
2009	555	1008082	55.05
2010	568	1016883	55.85
2011	685	1025684	66.78
2012	839	1034284	81.11
2013	695	1043287	66.61

Source: Transport Research Wing, MORTH, Government of India (2008-2013)

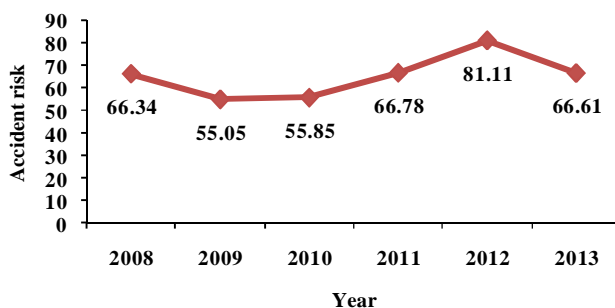


Fig. 4 Accident risk (number of accidents per 100,000 populations)

H. Vehicle wise-accident rate

Table 6 reports the number of different categories of vehicles responsible for accidents in Madurai during the period 2008-2013. From table 6 it is clear that the 2-wheelers were the most common type of vehicle involved in accidents. In 2008, 2-wheelers were responsible for accidents but this number decreased to 29 in 2011. Vehicles falling in the “not known” category indicating that the event of accident occurrence is not informed and/or recorded in time.

TABLE VI
NUMBER OF VEHICLES RESPONSIBLE FOR FATAL ACCIDENTS

Year	G-bus/ P-bus	Lorry/ Mini	Car/ Jeep	Auto	2- W	Other	Not Known	Total
2008	28	18	21	06	41	4	21	139
2009	21	19	14	04	39	6	22	125
2010	17	07	37	04	35	8	12	120
2011	22	16	13	06	29	7	30	123
2012	19	19	16	11	37	6	13	121
2013	24	11	23	07	43	7	25	140

Source: Road Transport year book 2010, 2013, Ministry of Road Transport and Highway, Government of India, New Delhi
G-bus-Government bus; P-bus-Private bus; Mini-Mini lorry/Van;

IV. CONCLUSIONS

The following conclusions are drawn from the study.

- A. In general, the accident severity index of Madurai has shown an decreasing trend, although there was a increase in 2012. Various traffic engineering measures undertaken in the last few years may have helped in curbing the number of total

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accidents as well as fatal accidents. In 2012 there was a marked decrease of total accidents but some increase of fatal accidents.

- B. A general decrease in accident fatality rates despite the considerable increase of motor vehicles indicates that the traffic operation management in the city may have improved.
- C. The rate of decrease of accident fatality risk was higher than that of the all-India average. This indicates that the safety improvement measures undertaken in the city have been effective.
- D. The accident risk showed a decreasing trend between 2008 and 2010, but has since been increasing. This reiterates that the traffic management measures taken in the recent past have been not effective.
- E. It is observed that among all the categories of vehicles, 2-wheelers comprised the single higher number of involvement in accidents. This suggests that some studies should be undertaken in the future to investigate the possible causes of involvement of 2-wheelers in accidents in order to find appropriate remedial measures. This would in turn help to improve the overall safety situation in Madurai.

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