ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Highway Safety Audit For Major Roads in Madurai City

Vickram Karppasamy K.P **Dr. Velkennedy R**

Abstract

It is estimated that more than 1.2 million people die worldwide as a result of road traffic crashes and some 50 million are injured per annum. Road traffic injury is listed in the top ten major causes of mortality and morbidity worldwide.In India about1,41,526 persons were killed and 4,77,731 injured in road traffic crashes (NCRB, 2015). However, this is probably an underestimate, as not all injuries are reported to the police .The actual numbers of injuries requiring hospital visits may be 2,000,000-3,000,000 persons. The situation in India is worsening and road traffic injuries have been increasing over the past twenty years. Road network of any country has a notable role to play for countries economy and growth.In India, road remains the important means of transport.Transportation through road networks satisfies the basic needs of people. Many lives are lost and huge amount of property damage occurs due to accidents. .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 3605 accidents have occurred over the study period (2011-2015) with an average of 721 accidents/year. Traffic accidents in Madurai were continuously increasing over the study period as a result of continuous increase in population and auto ownership. This study has utilized the traffic accidents data in Madurai for five 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. In this study the road accidents, its causes, variation with respect to yearly, hourly, user type vehicle, age are identified. Then identified black spots in the study area and given suggestion to improve safety of road users.

Keywords— ***Road traffic injury; severity level; Accident type; fatalities; Madurai; black spots***

INTRODUCTION

Road safety audit – –Road traffic fatalities are forecast to increase over the next ten years from a current level of more than 1.3 million to more than 1.9 million by 2020. The Commission for Global Road Safety believes that the urgent priority is to halt this appalling and avoidable rise in road injury and then begin to achieve year on year reductions. The world could prevent 5 million deaths and 50 million serious injuries by 2020 by dramatically scaling up investment in road safety, at global, regional and national levels. Each year nearly 1.3 million people die as a result of a road traffic collision, more than 3000 deaths each day and more than half of these people are not travelling in a car. Twenty to fifty million more people sustain non-fatal injuries from a collision, and these injuries are an important cause of disability worldwide. Ninety percent of road traffic deaths occur in low and middle-income countries, which claim less than half the world's registered vehicle fleet. Road traffic injuries are among the three leading causes of death for people between 5 and 44 years of age. Unless immediate and effective action is taken, road traffic injuries are predicted to become the fifth leading cause of death in the world, resulting in an estimated 2.4 million deaths each year. This is, in part, a result of rapid increases in motorization without sufficient improvement in road safety strategies and land use planning.

PROJECT STUDY AREA

Madurai is a major city in the state of Tamilnadu in southern India. It is the administrative headquarters of Madurai district. Madurai is the second largest

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

corporation city by area and third largest city by population in Tamil Nadu and the31st largest urban agglomeration in India. Located on the banks of River Vaigai, Madurai has been a major settlement for two millennia and is one of the oldest continuously inhabited cities in the world. Madurai is located in the south west part of Tamil Nadu. Madurai city the district head quarters of Madurai district. Madurai city is about 100 meters above mean sea level. Geographically the city is located on 95□5 north latitude and 78□7 east longitude. Madurai city is well connected by road, rail and air. Madurai Municipal Corporation, covering 51.96 sq.kms, comprises of a total population of 928,869 persons, whereas the Madurai Urban Agglomeration comprising the city and surrounding settlements accommodates a population of 11,94,665 persons.

NAME OF ROAD	
1.	Mattuthavani to Goripalayam
2.	Simmakal to Periyar
3.	Periyar to Thiruparankundram
4.	Kamarajar Salai

SELECTION OF ROAD NETWORK

The area chosen for this project is Madurai city and in Madurai East Mattuthavani to Goripalayam is 2 way 4 lane road, stretch length – 6 kms, width of carriage way – 10m, signals - 1, centre median – 0.6m.

Simmakal to Periyar is 1 way 2 lane road, stretch length – 3 kms, width of carriage way – 7m, signals - 2, median – movable boards.

Periyar to Thiruparankundram is 2 way 2 lane road, stretch length – 6 kms, width of carriage way – 7m, signals - 1, median – movable boards.

Kamarajar Salai is 1 way 2 lane road, stretch length – 4 kms, width of carriage way – 7m, signals - 4, median – movable boards.

The laid traffic island which might help in regulating vehicular movement and bring down the speed of the vehicles. It was decided to partially route the vehicles proceeding towards Mattuthavani bus stand from KK Nagar road and periyar bus stand from TPK road. If the size of the roundabout was reduced, heavy vehicles may find it tough to access and negotiate the curves. Moreover, by reducing the speed of vehicles, the accident rate had fallen substantially.

The major issue in the selected stretchs are no medians in Periyar to Thiruparankundram road, Simmakal to Periyar road and kamarajar salai. Simmakal road stretch is narrow.Similarly, Traffic congestion will be more during the peak hours.An average 24-hour traffic volume occurring on weekdays for some period of time less than one year, such as for a month or a season.

Figure 1. Selected Road Stretch

ISSUES IDENTIFIED IN SURROUNDING TEMPLE AREA

Like any other metropolitan cities in India, Madurai also faces many transport problems. Low travel speed, high accident rate involving fatalities and increased vehicular pollution are mainly due to:

- Increases in vehicle volume.
- Delays in signal.
- Parking problems.
- Improper management in Bus stops.
- Violation of traffic Rules and Regulations.
- Improper road management.
- Narrow roads with heavy traffic congestion.
- Little possibility of expansion of road network due to heavily built-up areas.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

- Frequent traffic jams at numerous road intersections;
- More encroachments in road..
- Two-wheelers are parked in a haphazard way and auto rickshaw drivers never follow traffic rules, causing inconvenience to the public.
- Very high number of auto rickshaws', share autos
- High parking demand due to proliferation of personalized vehicles.
- In fact, there is no space for pedestrians to walk because even the platforms are occupied by two-wheelers. Hence it is requested that the traffic police streamline traffic flow on these streets.
- Very high population density pattern noticed inside the Corporation limits is deteriorating the quality of life.
- Currently, increased demand for urban services is proving as bottleneck for present development of the City.

METHODOLOGY

The main objective of this project is to study the accident issues and provision of safety to be implemented in the study area and to analyze its feasibility. Thus arises the need to explore the possibility of the use road safety auditing process for the Madurai city. It is proposed to sort out the conflicts of safety issues so that proper information can be obtained and the necessary implementation to maintain traffic safety can be done appropriately.

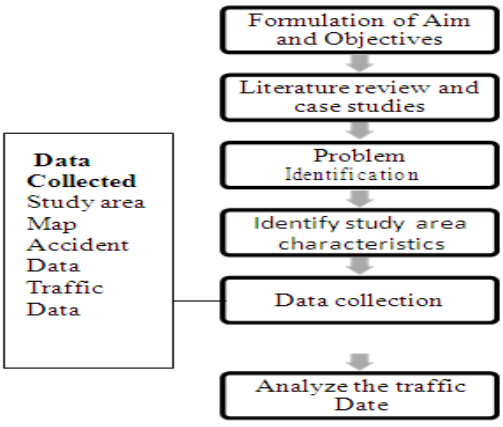


Figure 2. Methodology

METHODOLOGY ADOPTED FOR THE PROJECT

The following figure gives a pictorial representation of the step by step method to be procedure of the study. Study involves selected issues to solve the problems by steps. Design elements involves Signage and Road markings upgrades, Sight triangle, Sidewalk provisions of selected road etc. The process involves preparation, analyzing of accidents and provide safety to selected roads.

The data regarding the road accidents in Madurai City have been collected for a period of five years, i.e. 2011 to 2015 from the Traffic

DECADE OF ACTION FOR ROAD SAFETY

On 11 May 2011, the Decade of Action for Road Safety 2011-2020 was launched in more than 100 countries including India, with one goal: to prevent five million road traffic deaths globally by 2020. Moving from the Global Plan for the Decade to national action, many countries have taken measures towards improving road safety, either by developing national plans for the Decade (e.g. Australia, Mexico, the Philippines); introducing new laws (e.g. Chile, China, France, Honduras); or increasing enforcement of existing legislation (e.g. Brazil, Cambodia, the Russian Federation), among other concrete actions. The recent UN General Assembly resolution on global road safety sponsored by more than 80 countries gives further impetus to the Decade by calling on countries to implement road safety activities in each of the five pillars of the Global Plan.

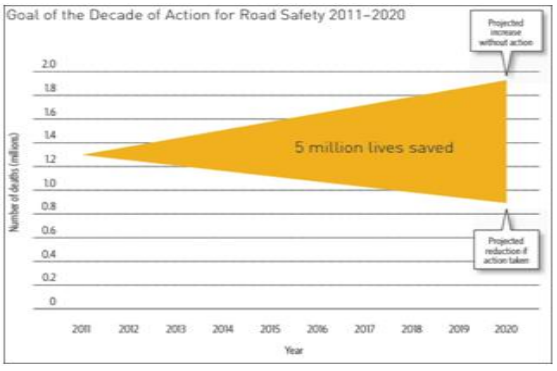


Figure 3. Goal of the Decade

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

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 maneuverability 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.

The traffic operation in Madurai is managed by the Madurai City Police and the Tamil Nadu Police. Both agencies have specific areas of operation. In the present study the data obtained from Madurai Police within its jurisdiction have been used.

TRAFFIC ACCIDENT SITUATION IN MADURAI

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 Present situation some measures regarding improvement of traffic operations have to be taken 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.

ANALYSIS OF ACCIDENT DATA

The data regarding the road accidents in Madurai City have been collected for a period of five years, i.e. 2011 to 2015 from the Traffic Investigation Wing, Madurai City. The date, time, approximate place, types of vehicles involved etc., are entered in the First Information Report (F.I.R) and details are recorded in case diaries. In order to analyze accident data for Madurai city.

DATA COLLECTED FROM POLICE RECORDS

With the prior permission of the concerned S.P, traffic investigation wing, Madurai. The accident data were collected on urban road stretch from traffic investigation wing I,II, and III which covers our study area. The police stations have their own FIR records of several years. The data from these records of last five years were extracted from the FIRs filled under(IPC NO.279/337/338/304 A). Accident details during 2011 – 2015 on this road. Accident data were collected year wise from each police station records. Average yearly variation of accidents during 2011 – 2015 is shown in table.

Table 1 Details of accidents (2011-2015)

Year	Fatal	Non-Fatal	
		Grievous Injury	Minor Injury
2011	125	390	266
2012	137	402	421
2013	148	319	341
2014	107	318	309
2015	144	191	440
Total	661	1620	1777

ACCIDENT DATA FROM POLICE STATION

Accident data should be collected from First Information Report (FIR) from the concerned police stations of the selected stretch. After getting the FIR information, database is to be created Vehicle type, cause of accident, day-wise, year-wise distribution of accidents. This

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

would help in identifying the black spots.

CAUSE OF ACCIDENTS

It show that Major reason for the cause of accident is over speed and drivers negligence manner. Speed of the vehicle within the city can be reduced by laying speed breakers where needed. Enforcing Strict traffic rules should implemented to prevent rash driving.

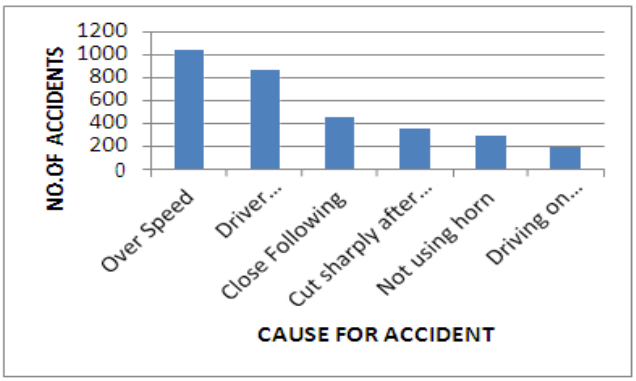


Figure 4 Causes Analyzed For Accidents Data

HOURLY VARIATION OF ACCIDENTS

It shows that maximum accidents occurred during day time between 15:00 to 16:00. Also, it is seen that persons going for working place (morning 8:00 to 12:00) and leaving working (18:00 to 21:00 hours) place shows the rise in accidents. To reduce congestion and accidents during peak hours, staggered working hours, work at home, etc. have to be followed.

Table 2 Causes Analyzed For Accidents Data

Cause For Accident	2011	2012	2013	2014	2015	Total
Over Speed	204	239	204	204	191	1042
Driver Negligence Manner	141	208	174	175	173	871
Close Following	105	104	71	93	87	460
Cut sharply after over taking	64	84	74	66	62	350
Not using horn	54	81	55	35	66	291
Driving on wrong side	33	31	36	44	48	192

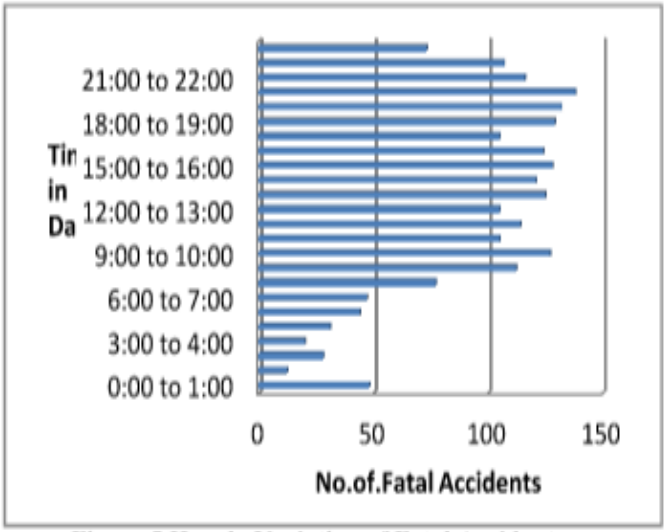


Figure 5 Hourly Variation of Fatal Accidents

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

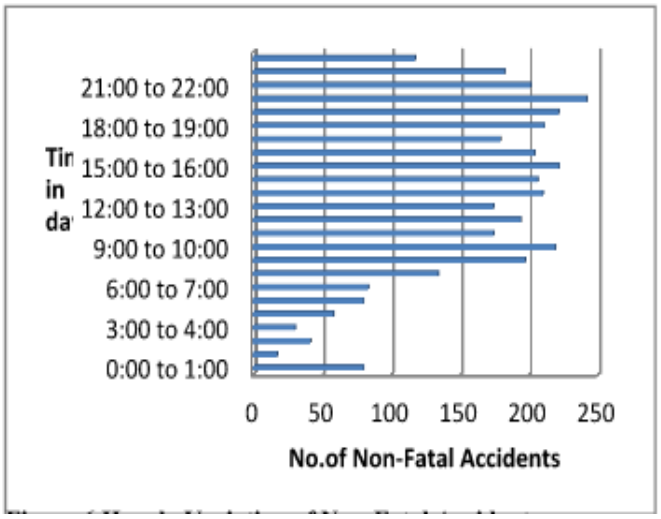


Figure 6 Hourly Variation of Non-Fatal Accidents

ACCIDENT IDENTIFY AS PER VEHICLE TYPE

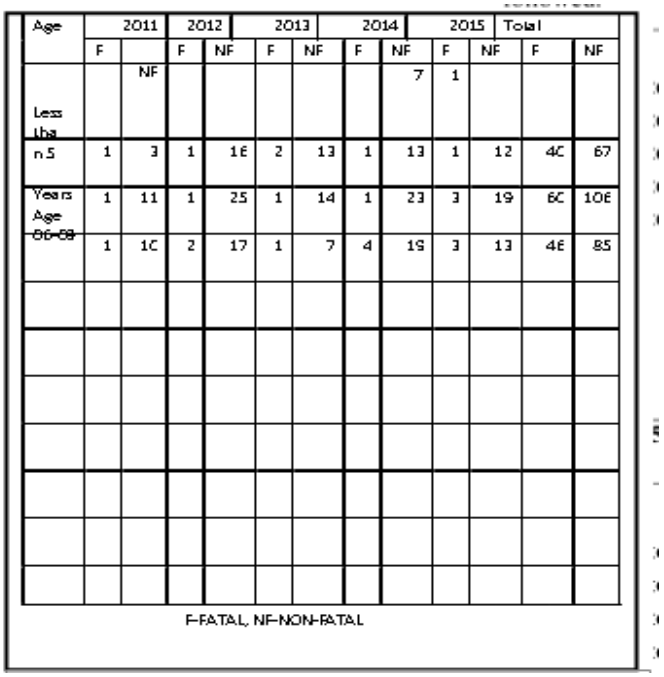
It shows that maximum number of accidents occurred in Motor Cycle, Car, Bus and Auto. carriageway width for Madurai city is not sufficient to meet the traffic demand.

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 within the city.

Table 3 Accident as per Vehicle type

Type Of Vehicle	2011	2012	2013	2014	2015	Total
Motor Cycle	245	311	252	256	240	1304
Car	102	151	123	99	116	591
Auto	101	97	61	73	72	404
Bus	86	99	92	82	96	455
Van	66	67	67	70	55	325
Lorry	56	67	58	62	55	298
						3377

Table 4 Accident identify as per Age



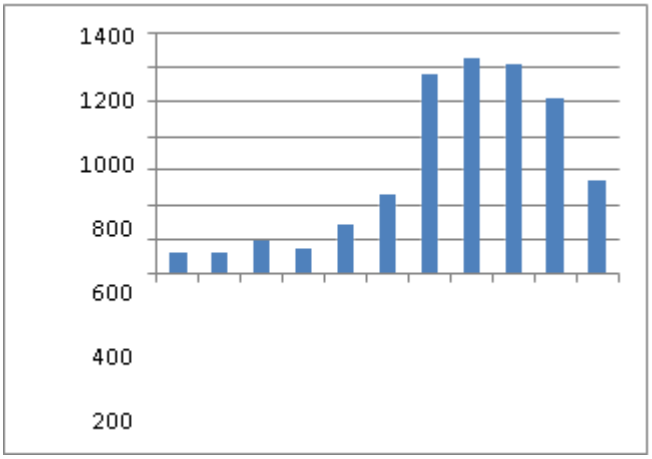


Figure 7 Accident as per Vehicle type

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

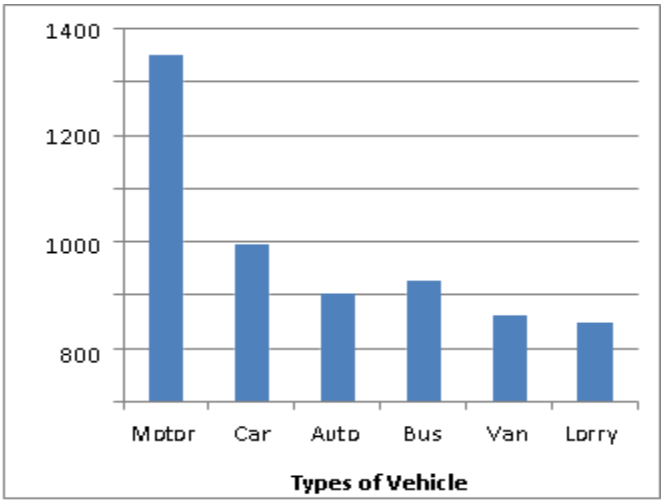


Figure 8 Fatal Accident identify as per Age

ACCIDENT IDENTIFY AS PER AGE

It shows that involvement people of affect of accident having age limit between 25-35 and 35-55 are maximum. Persons having age limit less than 20 and greater than 65 are less involved in accident.

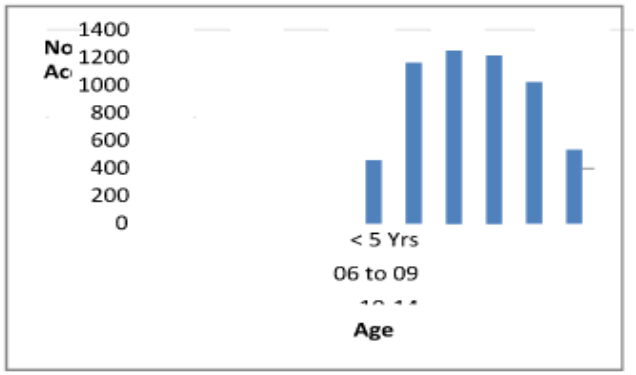


Figure 9 Non-Fatal Accident identify as per Age

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 5.5 presents the Accident severity index for Madurai during the period 2011-2015. It is seen that the Accident severity index has increased from 16.328 in 2012 to 21.294 in 2013, and then gradually decreased from 2013-2014 of around 50 per cent, but has, since 2013 been increasing. It is observed that in 2015 there was a sudden increase of persons killed in accidents resulting in the increase of the accident severity index

Table 5 Fatal Accident Severity Index

Year	No. of persons killed	Total no of road accidents	Accident severity index(%
2011	125	685	) 18.248
2012	137	839	16.328
2013	148	695	21.294
2014	107	691	15.484
2015	144	695	20.719

Table 6 Yearly Variation of Accidents data from 2011-2015

NAME OF ROAD	2011	2012	2013	2014	2015
Mattuthavani To Goripalavam	72	74	64	60	48
Kamarajar Salai	34	55	33	35	2
Periyar To Thiruparankundram	18	32	33	21	22
Simmakal to Periyar	0	5	4	6	6
Total	124	166	134	122	78

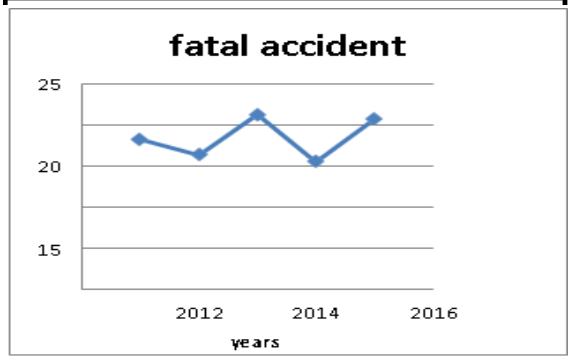


Figure 10 Fatal Accident Severity Index

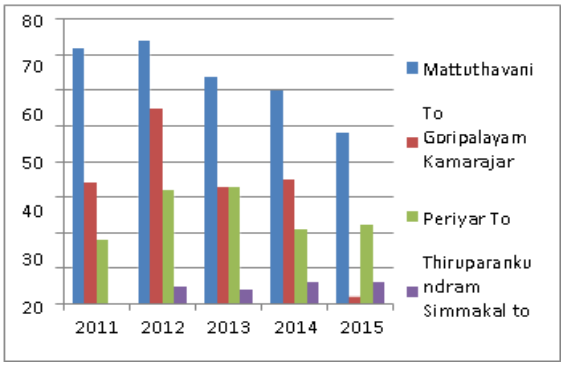


Figure 11 Yearly Variation of Accidents data from 2011-2015

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

YEARLY VARIATION OF ACCIDENTS IN SELECTED STRETCH

It shows that maximum accidents occur in year 2012 in last 5 year. Accident rate reduces for the consequent years. Safety management should be practiced to reduce the severity of accident.

BLACK SPOT ANALYSIS

The point where accident occurs frequency is known as black spot or accident point. Analysis is required for improving traffic environment. The procedure described is based on recorded accidents, data about accidents, traffic volumes and vehicle kilometres. Other methods that can be used as compliments to accident data are not dealt with in this chapter. Examples of such methods are field investigations, conflict studies and interviews, etc.

Table 7 Black Spot Location In Study Area

No	LOCATION	No.of.Accident
1	Vilakuthoon Junction	159
2	Flower Market,Melur Road	80
3	Tamukkam out Post	80
4	Goripalayam Thevar Statue	72
5	Yannaikkal bridge	21
6	Crime Branch,TPK Road	29
7	Muthu Thevar Bridge,TPK road	44
8	Alagappan Nagar Railway Gate Jn	50

CONCLUSION

The study was focused on the selected road stretches which are Kamarajar salai, Mattuthavani to Goripalayam, Simmakal to Periyar and Periyar to Thiruparankundram Road. From the Accident Data (2011-2015) obtained from Traffic investigation wing traffic accidents were analysed considering several variables including accident type, cause of accident, and severity level. Then identification of black spots in the study area and given suggestion to improve safety of road users. Accident severity index for the fatal accident is 18.33% for year (2011-2015). Major cause of accident is overspeed within the city (28.90%).Two wheeler(36.17%), car(16.39%) and auto rickshaw(11.20%) are major accident causing vehicle. Occurrence of fatal and non-fatal accident within the city is more in Kamarajar salai. some measures and suggestions regarding improvement of traffic operations have to be taken in the city. Safety management should be practiced to reduce the severity of accident. Safety management should be integrated in all phases of planning, designing and operation of road infrastructure. The accident rate can be decreased by road side clearance, proper maintenance of shoulders, lighting, and junction improvement. Speed limit should be brought down by providing humps near accident spots. Sight distance near curves should be obstruction free.

Road infrastructure and design are a contributing factor in one out of three fatal accidents. In order to increase safety of road infrastructure has a strong influence on the perception of drivers including their understanding of the way the road operates and consequently their behaviour.

REFERENCES

1.B.P. Hughes et al— A Review of models relevant to road safety‖ Accident Analysis and Prevention 74 (2015) 250–270

2.DeJoy, D.M. —An examination of gender differences in traffic accident risk perception‖. Accident Analysis & Prevention, 24, (3) (1992) 237-246

3.Gianfranco Fancello, Michele Carta and Paolo Fadda ―A Decision Support System For Road Safety Analysis‖Peer-review under responsibility of the SocietàItalianadeiDocenti di Trasporti (SIDT),Transportation Research ProcediaVol.5 (2015) PP 201 – 210

4.Karlaftis, M. G., &Golias, I. ―Effects of road geometry and traffic volumes on rural roadway accident rates‖. Accident Analysis &Prevention, 34(3), (2002) 357-365.

5.Murat Karacasua, ArzuErb―An Analysis on Distribution of Traffic Faults in Accidents, Based on Driver‟s Age and Gender‖ Eskisehir Case. Akdeniz University, Antalya, TURKEY.Procedia Social and Behavioral Sciences 20 (2011) 776–785

6.Pankaj Prajapatia1, GeetamTiwarib―Study of Relation between Actual and Perceived Crash Risk‖ Professor, Indian Institute of Technology Delhi, New Delhi, 110016, India. Procedia Social and Behavioral Sciences 104 (2013) 1095 – 1104

7.Pradeep Kumar Agarwal et al― A Methodology for Ranking Road Safety Hazardous Locations Using Analytical Hierarchy Process‖Procedia - Social and Behavioral Sciences 104 (2013) 1030 – 1037

8.Stanislaw Gaca , Mariusz Kiec "Speed management for local and regional rural roads‖ Transportation Research Procedia 14 (2016) 4170– 4179

9.VatanavongsRatanavaraha,SonnarongSuangka―
Impacts of accident severity factors and loss values of crashes on expressways in Thailand"Suranaree University of Technology, School of Transportation Engineering, Institute of Engineering,thailand. Volume 37,issue 2,march 2014, pages 130-136

10.Vaiana Rosolino et al "Road safety performance assessment:a new road network Risk Index for info mobility" Procedia - Social and Behavioral Sciences 111 (2014) 624 – 633

11.Vittorio Astarita et al "Co-operative ITS: Smartphone Based Measurement Systems for Road Safety Assessment" Procedia Computer Science 37 (2014) 404 – 409

12.Yasushi Nishida―Analyzing accidents and developing elderly driver-targeted measures based on accident and violation records". Institute for Traffic Accident Research and Data Analysis, Japan. IATSS Research 39 (2015) 26–35

13.Y.G.Wang et al "Safety performance audit for roadside and median barriers using freeway crash records: Case study in Jiangxi, China" Scientia Iranica A (2011) 18 (6), 1222–1230