

# Economic Deterrents for Traffic Safety in Emerging Economies

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**Abstract**—Road accidents are a human tragedy. They involve high human suffering and monetary costs in terms of untimely death, injuries and social problems. India had earned the dubious distinction of having more number of fatalities due to road accidents in the world. Road safety is emerging as a major social concern around the world especially in India because of infrastructure project works. A case study was taken on NH – 07 which connects to various major cities and industries. The study shows that major cases of fatalities are due to bus, trucks and high speed vehicles. The main causes of accidents are due to high density, non-restriction of speed, use of mobile phones, lack of board signs on road parking, visibility restriction, improper geometric design, road use characteristics, environmental aspects, social aspects etc. Data analysis and preventive measures are enlightened in this paper.

**Keywords**—Accidents, environmental aspects, fatalities, geometric design, road user characteristics.

## I. INTRODUCTION

ACCIDENT is an event occurring suddenly, unexpectedly and inadvertently under unforeseen circumstances. Road traffic fatalities are forecast to increase over the next ten years from a current level of more than 1.6 million to more than 2.2 million by 2020 [1]. Accident fatalities rate in developing countries like India is high compared with that in the developed countries. The population of India has tremendous increasing during the last 20 years, while vehicle population has doubled in the last 5 years, since the growth of the road infrastructure could not cope up with growth in travel demand. The situation in India has worsened in recent years. Traffic fatalities increased by about 6.5% per year from 2010 to 2014 [1]. This is attributed partly to an increase in the number of vehicles on the road and partly to the absence of a coordinated official policy to control the problems. The various factors causing accidents are shown in Fig. 1.

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, 0.11 million deaths occurred in India. This is in part,

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a result of rapid increase in motorisation without improvement in road safety strategies and land use planning.

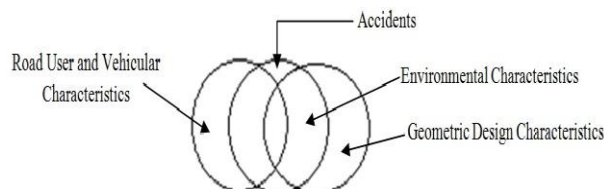


Fig. 1 Factors influencing road accidents

## II. STUDY AREA

NH-7 is an Indian National Highway entirely within the state of Uttar Pradesh, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu. National Highway passes through Varanasi – Maunanj – Rewa – Jabal Pur – Lakhnadon – Nagpur – Hyderabad – Kurnool – Bangalore – Hosur – Krishnagiri – Dharapuri – Salem – Namakkal – Kalur – Dindugal – Madurai – Virudurgon – Tirunelveli – Kanyakumari. Being the longest National Highway joins Varanasi to Kanyakumari and is around 1472 miles (2369 kms) long. It covers major cities like Madurai, Tirunelveli, Virudurgon, salem, Bengaluru, Hyderabad, Nagapur, Rewa and Varanasi. It got rename to NH-44 under the recent rationalization of highway numbers. The length per state distribution is Uttar Pradesh – 128, Madhya Pradesh – 504, Maharashtra – 232, Andra Pradesh – 753, Kurnool – 125 and Tamilnadu – 627. Bagepalli to Hosur road is part of national highway 7 which connects the city of Bangalore, capital of Karnataka and the Tamil Nadu border town of Hosur in Krishnagiri district. The study area (from bagepalli to hosur) is a stretch of 125 km selected for implementing the methodology involved shown in Fig. 2.

## III. MATERIALS AND METHODOLOGY

The present study is based on secondary source of data i.e. from the case diaries and police records of the accident cases in Chickballpur rural, Traffic police station, Gudibande rural and Bagepalli rural police station in Chickballapur district. The official records were available 2010 to 2015. Simple random sampling technique was applied that resulted in the selection of the year 2015. Complete enumeration of data for the calendar year (Jan–16<sup>th</sup> Dec 2015) was done. Besides, other relevant information was collected from concern officials through interviews and personal discussions. Data were analysed using statically package for SPSS (Social Sciences) version 13.0 and P value below 0.05 was considered as statically significant and Kruskal-Wallis Test (H-Statistic) tested [2].

Jan		6.5		
Feb	2	6.5		
Mar	5	6.5		
Apr	9	6.5		
May	6	6.5		
June	6	6.5		
July	8	6.5	19.675	8.461
Aug		6.5		
Sep		6.5		
Oct		6.5		
Nov		6.5		
Dec		6.5		
Total				

over the year is accepted. Thus, it indicates that major accidents have a uniform distribution over a year.

TABLE I  
THE ASSOCIATION BETWEEN THE OCCURRENCE OF ACCIDENTS AND FACTORS (H-STATISTIC)

Contributory factor	Fatal accidents		Major accidents		Minor accidents	
	N <sub>1</sub>	R <sub>1</sub>	N <sub>2</sub>	R <sub>2</sub>	N <sub>3</sub>	R <sub>3</sub>
1. Road environment contributed		4.0		10.5		14.0
2. Vehicle defects		1.0		2.5		5.0
3. Injudicious action		10.5		16.0		21.5
4. Driver/rider error or reaction		19.5		23.0		24.0
5. Impairment or distraction		7.5		12.5		18.0
6. Behavior or inexperience		9.0		16.0		21.5
7. Vision affected by external factors		2.5		7.5		12.5
8. Pedestrian only (casualty or uninjured)		6.0		16.0		19.5
Total		60.0				
d.f.						
Critical $\chi^2$				5.991		
Calculated $\chi^2$				80.78		

TABLE II  
THE ASSOCIATION BETWEEN THE OCCURRENCE OF FATAL ACCIDENTS AND FREQUENCY

Months	Observed frequency	Expected frequency	d.f.	Critical $\chi^2$	Calculated $\chi^2$
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TABLE III  
THE ASSOCIATION BETWEEN THE OCCURRENCE OF MAJOR ACCIDENTS AND FREQUENCY

Months	Observed frequency	Expected frequency	d.f.	Critical $\chi^2$	Calculated $\chi^2$
Jan					
Feb	20	14			
Mar	13	14			
Apr	12	14			
May	17	14			
June		14			
July		14		19.675	
Aug					
Sep					
Oct					
Nov					
Dec					
Total					

TABLE IV  
THE ASSOCIATION BETWEEN THE OCCURRENCE OF MINOR ACCIDENTS AND FREQUENCY

Months	Observed frequency	Expected frequency	d.f.	Critical $\chi^2$	Calculated $\chi^2$
Jan		23.75			
Feb	35	23.75			
Mar	21	23.75			
Apr	22	23.75			
May	29	23.75			
June		23.75			
July		23.75		19.675	34.45

Aug	23.75
Sep	23.75
Oct	23.75
Nov	23.75
Dec	23.75
Total	

d.f	
Critical $\chi^2$	5.991
Calculated $\chi^2$	0.00831

Table IV shows a calculated  $\chi^2$  - value of 34.45 for 11 d.f. and a critical  $\chi^2$  - value of 19.675 at 0.05 alpha level. Since the calculated  $\chi^2$  - value is greater than the critical  $\chi^2$ - value, the No. 4 null hypothesis i.e. minor accidents are not uniformly distributed over the year is rejected. Thus, it indicates that minor accidents have a not uniform distribution over a year.

Table VI shows a calculated  $\chi^2$  - value of 0.00831 for 2 d.f. and a critical  $\chi^2$  - value of 5.991 at 0.05 alpha level. Since the calculated  $\chi^2$  - value is less than the critical  $\chi^2$  - value, the No. 6 null hypothesis i.e. accidents are uniform throughout weather conditions is accepted. Hence, the number of accidents does not depend on seasons. More ever there is lack of enough evidence indicate such a weather pattern.

### V. DISCUSSIONS AND CONCLUSIONS

TABLE V  
THE ASSOCIATION BETWEEN OCCURRENCE OF ACCIDENTS AND TIME (HOURS)

Hours	Observed frequency		Total
	Major	Minor	
Fatal			
6.00 am - 12.00 pm	38	66	
12.00 pm - 6.00 pm	58	98	
6.00 pm - 12.00 am	54	91	
12.00 am - 6.00 am	18	30	
Total	168	285	
d.f			
Critical $\chi^2$		12.592	
Calculated $\chi^2$		0.0273176	

Analysis of qualitative data gathered during the presence summarised two principle factors viz. Pedestrians, driver and geometric design as joint significant contributor to the occurrence of road accidents in NH-7 (renamed as NH-44). Human characteristics (driver/rider error or reaction and pedestrian) make the highest contribution (ranking 24, Table I) to the road accidents in the study area. The geometric design factors are related to exceeding speed limit and travelling too fast for conditions (ranking 21.5, Table I). The study analysed that the fatal and major accidents have a uniform distribution over a year (the calculated  $\chi^2$  - value is less than the critical  $\chi^2$  - value, Tables II and III) and the minor accidents have a not uniform distribution over a year (the calculated  $\chi^2$  - value is greater than the critical  $\chi^2$  - value, Table IV). The present study recorded the accidents are uniformly distributed over the hours of the day (the calculated  $\chi^2$ -value is less than the critical  $\chi^2$ - value, Table V). The study indicates the number of accidents does not depend on seasons. More ever there is lack of enough evidence indicate such a weather pattern (the calculated  $\chi^2$  - value is less than the critical  $\chi^2$  - value, Table VI).

Table V shows a calculated  $\chi^2$ - value of 0.0273 for 6 d.f. and a critical  $\chi^2$  - value of 12.592 at 0.05 alpha level. Since the calculated  $\chi^2$  - value is less than the critical  $\chi^2$  - value, the No. 5 null hypothesis i.e. accidents are uniformly distributed over the hours of the day is accepted. Thus, it indicates that accidents are uniformly distributed over the hours of the day.

Data on road accidents in NH-7 are very poor. The police records are only source of information, but many minor accidents cases are never reported while others are settled privately. The fever data on accident reports at police stations are an indicative lack of awareness of accident reporting (geometric design aspects). Based on the police data it is not possible to make exact analysis and therefore it is impossible to implement safety measures. Road accidents are preventable and in order to reduce the problem, their needs to be close coordination's and collaboration with many sectors and disciplines (integrated approach).

TABLE VI  
THE ASSOCIATION BETWEEN OCCURRENCE FOR WEATHER CONDITIONS AND SEVERITY OF ACCIDENTS

Variable	Severity of Accidents			
	Fatal	Major	Minor	Total
Weather				
Rainy				
Dry				
Total				

### APPENDIX

Apart from the findings of the present study, the authors would like to share some additional observations and personal comments related to the causes of road accidents. But, the findings lack statistical figures as these were not included under the study objectives. In recent years' pedestrians and driver are not aware of road safety. Major human factors that contribute to the potency

of accident causation also include alcohol, indecisiveness, fatigue, distraction and confusion. Similar observations of increased use of alcohol were also made by [3]-[6]. In addition, in most of the cases the driver is found to be inexperienced, risk taker, impulsive, aggressive and casual and do not know the road signals. It is seen that most of the bikers, particularly the young boys drive at high speed without wearing safety helmet. Another important factor that has been noticed in highway accidents in and around the study area is that most of drivers usually the truck driver never use dipper at night which creates problems to the vehicle coming from opposite direction.

To reduce the road accidents, the following recommendations are suggested.

1. The effective driver communication through clear and well placed sign boards, warning signs and information sign can help drivers make decisions well in advance and give proper indications to other vehicles around them.
2. The government should undertake road safety trainings to the drivers and it should be a compulsory to the drivers who participated the training and program only allowed to drive with physical fitness certificate.
3. The role of law enforcing authority like Road Traffic authority, Traffic police system is very important. The use of the seat belt, ban of using mobile phone and helmet must be enforced.

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