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Road Safety and Accident Prevention in Third World Countries: A Case Study of NH-7 in India

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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 developing 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 accured in India. This is in part, a result of rapid increase in motorisation without improvement in road safety strategies and land use planning.

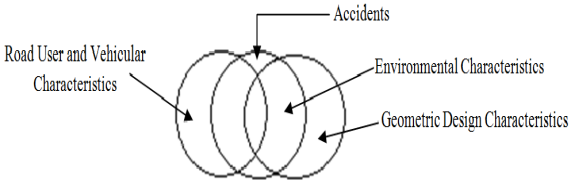

Fig. 1 Factors influencing road accidents

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 – Mauganj – Rewa – Jabal Pur – Lakhnadon – Nagpur – Hyderbad – Kurnool – Bangalore – Hosur – Krishnagiri – Dharapuri – Salem – Namakkal – Kalur – Dindegal – 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, Hyderbad, 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–16th 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

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as statically significant and Kruskal-Wallis Test (H-Statistic) tested [2].

Fig. 2 Map showing the study area

IV. Results

Causes of Traffic Accidents usually analysed from four aspects people (driver and pedestrian), vehicle, road and environment. Through the Chi - square analysis the findings of causes hidden behind the appearance.

A. Chi-Square Test for Goodness of Fit

Table I shows a calculated χ^2 - value of 80.78 for 2 d.f. and a critical χ^2 - value of 5.991 at 0.05 alpha level. Since the calculated χ^2 - value is greater than the critical χ^2 - value, the No. 1 null hypothesis i.e. accidents are uniformly distributed over all contributory factor is rejected. Thus, it indicates that accidents are not uniformly distributed over the contributory factor.

Table II shows a calculated χ^2 - value of 8.461 for 11 d.f. and a critical χ^2 - value of 19.675 at 0.05 alpha level. Since the calculated χ^2 - value is less than the critical χ^2 - value, the No. 2 null hypothesis i.e. fatal accidents are uniformly distributed over the year is accepted. Thus, it indicates that fatal accidents have a uniform distribution over a year.

Table III shows a calculated χ^2- value of 19 for 11 d.f. and a critical χ^2- value of 19.675 at 0.05 alpha level. Since the calculated χ^2- value is less than the critical χ^2 - value, the No. 3 null hypothesis i.e. major accidents are uniformly distributed 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_1	R_1	N_2	R_2	N_3	R_3
1. Road environment contributed	4	4.0	12	10.5	20	14.0
2. Vehicle defects	2	1.0	3	2.5	6	5.0
3. Injudicious action	12	10.5	22	16.0	40	21.5
4. Driver/rider error or reaction	28	19.5	60	23.0	111	24.0
5. Impairment or distraction	10	7.5	17	12.5	23	18.0
6. Behavior or inexperience	11	9.0	22	16.0	40	21.5
7. Vision affected by external factors	3	2.5	10	7.5	17	12.5
8. Pedestrian only (casualty or uninjured)	8	6.0	22	16.0	28	19.5
Total	78	60.0	168	104	285	136
d.f	2					
Critical χ^2	5.991					
Calculated χ^2	80.78					

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

Months	Observed frequency	Expected frequency	d.f.	Critical χ^2	Calculated χ^2
Jan	9	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	11	19.675	8.461
Aug	9	6.5			
Sep	7	6.5			
Oct	5	6.5			
Nov	4	6.5			
Dec	8	6.5			
Total	78	78			

TABLE III
THE ASSOCIATION BETWEEN THE OCCURRENCE OF MAJOR ACCIDENTS AND FREQUENCY

Months	Observed frequency	Expected frequency	d.f.	Critical χ^2	Calculated χ^2
Jan	19	14			
Feb	4	14			
Mar	11	14			
Apr	20	14			
May	13	14			
June	12	14			
July	17	14	11	19.675	19
Aug	19	14			
Sep	15	14			
Oct	12	14			
Nov	8	14			
Dec	18	14			
Total	168	168			

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

Months	Observed frequency	Expected frequency	d.f.	Critical χ^2	Calculated χ^2
Jan	33	23.75			
Feb	7	23.75			
Mar	18	23.75			
Apr	35	23.75			
May	21	23.75			
June	22	23.75			
July	29	23.75	11	19.675	34.45
Aug	33	23.75			
Sep	25	23.75			
Oct	18	23.75			
Nov	14	23.75			
Dec	30	23.75			
Total	285	285			

Table IV shows a calculated χ^2 - value of 34.45 for 11 d.f. and a critical χ^2 - value of 19.675 at 0.05 alpha level. Since the calculated χ^2 - value is greater than the critical χ^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 V
THE ASSOCIATION BETWEEN OCCURRENCE OF ACCIDENTS AND TIME (HOURS)

Hours	Observed frequency			Total
	Fatal	Major	Minor	
6.00 am - 12.00 pm	18	38	66	122
12.00 pm - 6.00 pm	27	58	98	183
6.00 pm - 12.00 am	25	54	91	170
12.00 am - 6.00 am	8	18	30	56
Total	78	168	285	531
d.f	6			
Critical χ^2	12.592			
Calculated χ^2	0.0273176			

Table V shows a calculated χ^2- value of 0.0273 for 6 d.f. and a critical χ^2 - value of 12.592 at 0.05 alpha level. Since the calculated $\chi 2$ - value is less than the critical χ^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.

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

	Variable	Severity of Accidents			
		Fatal	Major	Minor	Total
Weather	Rainy	39	83	141	263
	Dry	39	85	144	268
	Total	78	168	285	531
d.f	2				
Critical χ^2	5.991				
Calculated χ^2	0.00831				

Table VI shows a calculated χ^2 - value of 0.00831 for 2 d.f. and a critical χ^2 - value of 5.991 at 0.05 alpha level. Since the calculated χ^2 - value is less than the critical χ^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

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 χ^2 - value is less than the critical χ^2 – value, Tables II and III) and the minor accidents have a not uniform distribution over a year (the calculated χ^2 - value is greater than the critical χ^2 – value, Table IV). The present study recorded the accidents are uniformly distributed over the hours of the day (the calculated χ^2- value is less than the critical χ^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 χ 2 - value is less than the critical χ 2 – value, Table VI).

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).

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 inexperience, 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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