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AN ANALYSIS OF TRAFFIC ACCIDENTS BY TIME IN TIRUCHIRAPPALLI REGION

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Abstract

Previous studies have shown that peak hour accidents account for more than 50% of all accidents occurring annually in Trichirappalli, a city in Tamil Nadu, India. More than half of these accidents are classified as fatal and major accidents. In this study, an attempt has been made to investigate traffic accidents that occurred at both intervals of time, peak hours and off-peak hours. The goal was to analyse the nature of such accidents to determine their characteristics so that remedies could be sought or at least future research could be suggested. For this purpose, a sample of 610 reported annual accidents were collected in a systematic and random manner for the period January 2002 – December 2002 (94 fatal accidents, 105 major accidents, 216 minor accidents and other non-injury accidents). Contingency probability analysis was used to make inferences from the data. This study found that speeding beyond legal limits and improper overtaking are the primary causes for accidents during peak hours in Tiruchirappalli. The analysis indicates that there is an urgent need to review the mode of transportation during peak hours and creating awareness among the drivers about the proper driving behaviour. In addition, public education and law enforcement strategies are urgently needed.

Key words : Accidents, Transportation, Fatal accidents, Major accidents, Minor accidents.

1.Introduction

Several studies have dealt with the traffic safety problem in Tiruchirappalli, a city in Tamilnadu,India. All the studies reveal the economic loss due to accidents [1,2,3,4]. In this study, 4.00 AM – 8.00 PM was considered as day time and 4.00 AM-6.00 AM, 10.00 AM – 4.00 PM are considered as off –peak hours and 6.00 AM –10.00 AM, 4.00 PM-8.00 PM are considered as peak hours. According to official statistics, nearly 610 accidents occurred within the city limit during the period from January 2002 to December 2002. Out of them, 349 accidents occurred during the daytime. Official statistics show that nearly 76% of fatalities, 49% of major accidents and 86% of minor accidents occur annually during daytime. Again statistics shows nearly 57% of fatalities, 59% of major accidents and 54% of minor accidents occur during peak hours. Ali S.Al – Ghamdi analysed the intersection related accident in Riyadh and suggested future investigation is needed for peak and off - peak hours accidents [5]. So research has been carried out to investigate such periods in order to estimate the magnitude of the problems and find remedies for typical accidents.

This study aims at investigating accidents that have occurred at such periods with an emphasis on peak hours, on the basis of data collected from Tamil Nadu State Transport Corporation, Kumbakonam Division II. This study attempts to answer the following objectives related to accidents:

- § to identify the general characteristics of accidents during peak and off - peak hours
- § to find out the similarities and differences between fatal, major and minor accidents during these periods.

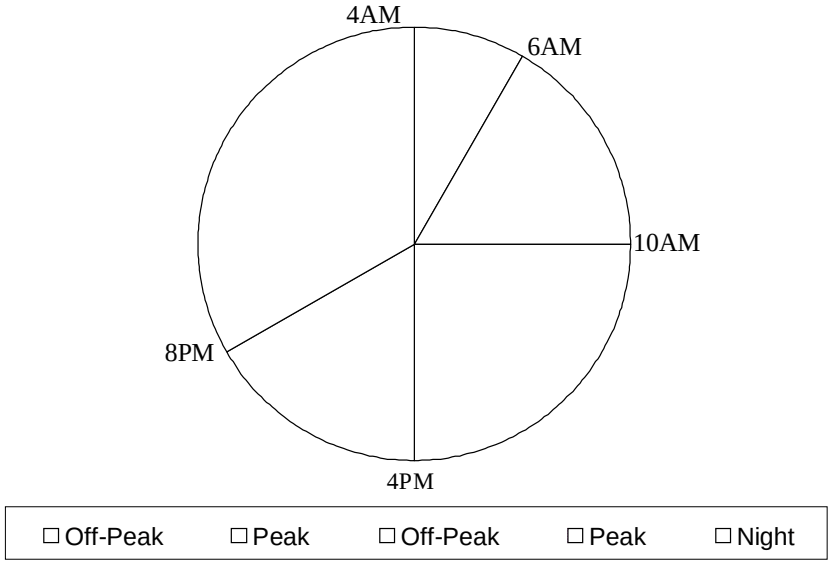
Different analysis techniques were used to investigate traffic accidents occurrence at the two periods. Techniques include simple descriptive statistics, proportion comparisons, X^2–test of independence and conditional probability analysis. The primary objective of the study was to understand the traffic safety problems at each period so that better counter measures for effective accident prevention and to improve traffic safety could be suggested.

2. Methodology

2.1. Data

Data were collected from the files of Tamilnadu State Transport Corporation, Kumbakonam Division II, Tamilnadu, India. A total of 610 accidents were arranged by systematic sampling. Out of this, 349 accidents occurred during day time and remaining occurred in the night time. The duration of accident selected for the study is represented as follows:

Distribution of time for the study



The areas of data classified :

- § Accident category (fatal, major and minor)
- § Accident characteristics (time, location, type, cause and collision type).
- § Persons involved (drivers, passengers and pedestrian)
- § Vehicle class (passenger car, pick up truck or taxi).

2.2 Association between time and accident related factor

In this study, the relation between time of accident and other accident related factors was investigated. Other accident related factors were classified as the variables of type of accident, type of collision , cause of accident, area of accident, passenger response. Some of these factors were related to driver, excess speed and other improper behaviour. Road way –related factors were represented in a general way by classifying the accident time into peak hours and off-peak hours.

The relationship between the accident time and each of these variables was investigated using conditional probability. The proportion of accidents related to some undefined factors (others) are high. Therefore using conditional

probability to account implicity for exposure would be justified under these circumstances [6,7].

3. Analysis

3.1. General Analysis

Several characteristics of fatal accidents, major accidents and minor accidents were compared. After the data were classified and proportions for variables obtained, a well known statistical X^2 analysis was conducted. The purpose of this test is to check the null hypothesis.

H_o : There is no significant difference between the operation of buses in peak and off-peak hours against the alternative.

H_1 : There is a significant difference between operating the buses in the peak hours and off –peak hours.

3.2 Peak hours versus off-peak hours analysis

3.2.1 Cause of accident

Table 1. shows the distribution of causes for fatal, major and minor accidents during peak and off –peak hours. There is a significant difference between the two periods regardless of the accident category. From the results it was observed that speed related accidents like excess speed and improper overtaking are at a higher proportion both in peak and off –peak hours (peak rate = 32.6, off-peak rate = 33.3, mean = 33.0). Past studies have shown that a strong relationship exists between speed and accident severity [8,9,10]. Among the fatal, major and minor accidents, the proportion of minor accidents during the peak hours are high (rate = 29.7, mean = 29.6). It is interesting to note that improper overtaking leads to higher proportion of fatal accidents during peak hours (rate =14.0, mean = 11.8).

Apart from excess speed, vehicles following too closely leads to higher proportion of accidents (rate =13.9, mean =11.5) during off –peak hours. Improper overtaking leads to higher proportion of fatal accidents (rate=14.0, mean= 11.8) during peak hours. Minor accidents due to driving wrong way during peak and off-peak hours are almost in similar proportion. Among the total accidents, accidents due to excess speed rank first, followed by driving wrong way and improper overtaking. The X^2 analysis shows a significant difference between cause of accident and accident time.

The percentage of accidents occurring during peak hours for all the three categories exceeds 50% while comparing with off-peak hour accidents, irrespective of the causes of accidents.

3.2.2. Type of Collision

The X^2 analysis for the data shows a significant difference between type of collision and accident time [Table 2]. Although the percentage difference of head on collision leading to fatal accidents and major accidents between the two periods is less (27.9%, 27.3% - fatal), (25.5%, 25.0% - major), number of accidents during peak hours are high. This is because of the overtaking by the drivers. Again it is interesting to note that rear–end accidents are at higher proportion during peak hours (fatal, rate=18.6 major, rate=5.9) than off –peak hours for all the three categories of accidents.

In peak hours, availability of vehicles on the road are high. All the vehicles aim to reach the target area within the deadline. In case of dilemma zone in the road, possibility of rear - end accidents are high irrespective of the category of the accidents. During off-peak hours, competition among vehicles are less and therefore accidents are less. Major accidents in sideswipe (right) during peak hours are high and this is because of the parking of vehicles. The percentage of accidents occurring during peak hours for all the three categories of accidents exceeds 50% while comparing with off-peak hours accidents, irrespective of the causes of accidents.

3.2.3 Area of accident

The X^2 analysis shows a significant difference between distribution of accidents by area and time [Table 3]. Accidents occurred in and arround the bus stand ranks first during peak and off-peak hours.

All the three categories of accidents are at higher proportions during peak hours (fatal = 27.9%, major=21.6%, minor=19.8%). Near factory site ranks second with higher proportion of fatal accidents (rate =23.0) than major accidents (rate = 15.7) and minor accidents (rate = 17.8). Number of minor accidents are high comparing major and fatal accidents in and around the bus stand.

From this we can infer that the accidents are mainly due to the excess population during peak hours near bus stand and factory side.

3.2.4 Type of accident

The X^2 analysis shows a significant difference between accident type and accident time for all the three categories of accidents [Table 4]. This finding indicates that the proportion of accident types are not uniformly distributed during peak and off peak hours, regardless of the nature of the accidents.

Majority of the vehicle accidents occur during peak hours. Fatal accidents due to vehicles are at higher proportions (rate = 41.9, mean = 38.2). Comparing major and minor accidents in peak hours, fatal accidents due to cyclist and pedestrians are at higher proportions during off-peak hours than peak hours. During peak hours usage of vehicles are high compared to off-peak hours. Major accidents due to pedestrians are high during off-peak hours (rate = 25.0, mean = 23.0), but due to cyclists are high during peak hours (rate = 19.6, mean = 18.6). Minor accidents due to cyclists and pedestrians are at higher proportions during off-peak hours. Fatal accidents due to fixed object during peak hours is of lower proportion than off-peak hours. The proportion of major and minor accidents in peak and off -peak hours due to fixed object is of almost similar proportions.

The percentage of accidents occurring during peak hours for all the three categories exceeds 50% while comparing with off-peak hours accidents, irrespective of the causes of accidents.

3.2.5. Passenger response accidents

From the type of accidents, all the three categories of accidents due to vehicles are high comparing other types. Major contributor of vehicle accidents is passengers. The distribution of accidents by passengers' response and time were tabulated [Table 5].

Among these, footboard travel ranks first, which causes fatal accidents (rate = 22.2, mean = 20.7), followed by overhanging from sides of the bus (rate =16.7, mean = 13.8) during peak hours. Falling from the moving bus and overhanging from sides of the bus contribute equally to the major accidents (rate = 13.3, mean =12.0) during peak hours and off - peak hours.

Again proportion of major accidents is high during peak hours due to foot board travel (rate =26.7, mean = 20.0). Also, minor accidents due to foot board travel are at higher proportion (rate = 25, mean = 21.4) during peak hours. This indicates that crowd in the bus is high during peak hours and contributes to a major proportion of accidents.

4. Conclusion and recommendations

- An annual accident report from Tamilnadu State Transport Corporation was examined in this study. The goal was to examine the characteristics of accidents by time (peak and off – peak hours), so that remedies could be sought or future research could be suggested . In each category of time, the data set was divided into three categories, fatal, major and minor accidents. Conditional probability

and contingency table analysis were implemented .

- The analysis of causes of accident in this study indicates that excess speed, improper overtaking and driving wrong way accounts for more than half of all accident causes. This indicates that there is a need for creating awareness about the road rules to the group associated with this safety problem.
- Head on collision leads to excess fatal accidents on peak hours. Sideswipe (right) type collision leads to higher proportion of minor accidents during off-peak hours. This is due to lack of concentration of the drivers. Proper training programmes and awareness programmes should be conducted periodically for the drivers. Instead of giving punishment to the drivers, it was suggested that the drivers involved in fatal accidents and major accidents are to be identified and given proper counselling in the given observation period for about six months. During this observation period, if the rate of accident caused by the driver is minimized, then he can be allowed to drive again. Punishment can be given only when the driver fails to mend his ways.
- The analysis of accidents by area and time shows that all the three categories of accidents near bus stand and near factory side are high during peak hours. This indicates that population in these areas during peak hours is high. In order to control the excess population during peak hours, a new mode of transportation should be introduced .
- The analysis of accident type indicates that accidents by vehicles are high during peak hours. Among the accidents by vehicles, accidents due to passengers' response are high. Accidents due to foot board travel, followed by overhanging from sides are at higher proportions during peak hours. This shows that many accidents occur due to excess population inside the bus. Hence, minimization of rush inside the bus by proper planning is an immediate need. The new mode of transportation should minimize the rush inside the bus. Creating public awareness would be reduce accident related road behaviour.
- The authors have suggested a new mode of transportation to reduce these problems and they would be ready for publication in part II –Analysis.

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Table -1 Distribution of accidents by cause and time

Sl. No	Cause	Number of accidents by time				Total		Peak %
		Peak hours		Off –peak hours				
	*** Fatal**							
1	Exceeded legal speed	14	(32.6)	11	(33.3)	25	(33.0)	56.0
2	Improper signal	4	(9.3)	3	(9.1)	7	(9.2)	57.1
3	Followed two closely	4	(9.3)	3	(9.1)	7	(9.2)	57.1
4	Inattentive	3	(7.0)	3	(9.1)	6	(7.9)	50.0
5	Improper overtaking	6	(14.0)	3	(9.1)	9	(11.8)	66.7
6	Driving wrong way	5	(11.6)	4	(12.1)	9	(11.8)	55.5
7	Other responsibility	7	(16.2)	6	(18.2)	13	(17.1)	53.8
	Total	**43**	**100**	**33**	**(100)**	**76**	**(100)**	**56.6**
	**** Major**							
1	Exceeded legal speed	16	(31.4)	12	(33.3)	28	(32.2)	57.1
2	Improper signal	6	(11.8)	4	(11.1)	10	(11.5)	60.0
3	Followed two closely	5	(9.8)	5	(13.9)	10	(11.5)	50.0
4	Inattentive	4	(7.8)	2	(5.6)	6	(6.9)	66.7
5	Improper overtaking	6	(11.8)	4	(11.1)	10	(11.5)	60.0
6	Driving wrong way	5	(9.8)	3	(8.3)	8	(9.2)	62.5
7	Other responsibility	9	(17.6)	6	(16.7)	15	(17.2)	60.0
	Total	**51**	**100**	**36**	**(100)**	**87**	**(100)**	**58.6**
	***** Minor**							
1	Exceeded legal speed	30	(29.7)	25	(29.4)	55	(29.6)	54.5
2	Improper signal	10	(9.9)	8	(9.4)	18	(9.7)	55.6
3	Followed two closely	9	(8.9)	7	(8.2)	16	(8.6)	56.3
4	Inattentive	8	(7.9)	7	(8.2)	15	(8.1)	53.3
5	Improper overtaking	10	(9.9)	9	(10.6)	19	(10.2)	52.6
6	Driving wrong way	12	(11.9)	10	(11.8)	22	(11.8)	54.5
7	Other responsibility	22	(21.8)	19	(22.4)	41	(22.0)	53.7
	Total	**101**	**100**	**85**	**(100)**	**186**	**(100)**	**54.3**

The values given in parentheses are in percentage.

* X^2 =0.5271, df =6, 5% level

** X^2 =0.5688 df =6, 5% level

*** X^2 =0.0715 df =6, 5% level

Table -2 Distribution of accidents by collision type and time

Sl. No	Collision	Number of accidents by time				Total		Peak %
		Peak hours		Off–peak hours				
	*** Fatal**							
1	Head - on	12	(27.9)	9	(27.3)	21	(27.7)	57.1
2	Sideswipe (left)	8	(18.6)	7	(21.2)	15	(19.7)	53.3
3	Sideswipe (right)	7	(16.3)	6	(18.2)	13	(17.1)	53.8
4	Angular	4	(9.3)	3	(9.1)	7	(9.2)	57.1
5	Rear end	8	(18.6)	5	(15.1)	13	(17.1)	61.5
6	Unknown	4	(9.3)	3	(9.1)	7	(9.2)	57.1
	Total	**43**	**100**	**33**	**(100)**	**76**	**(100)**	**56.6**
	****Major**							
1	Head - on	13	(25.5)	9	(25.0)	22	(25.3)	59.1
2	Sideswipe (left)	14	(27.5)	11	(30.6)	25	(28.7)	56.0
3	Sideswipe (right)	12	(23.5)	7	(19.4)	19	(21.8)	63.2
4	Angular	5	(9.8)	4	(11.1)	9	(10.3)	55.6
5	Rear end	3	(5.9)	2	(5.6)	5	(5.8)	60.0
6	Unknown	4	(7.8)	3	(8.3)	7	(8.1)	57.1
	Total	**51**	**100**	**36**	**(100)**	**87**	**(100)**	**58.6**
	*****Minor**							
1	Head - on	21	(20.8)	19	(22.4)	40	(21.5)	52.5
2	Sideswipe (left)	17	(16.8)	15	(17.6)	32	(17.2)	53.1
3	Sideswipe (right)	16	(15.8)	17	(20.0)	33	(17.7)	48.5
4	Angular	15	(14.9)	13	(15.3)	28	(15.1)	53.6
5	Rear end	20	(19.8)	11	(12.9)	31	(16.7)	64.5
6	Unknown	12	(11.9)	10	(11.8)	22	(11.8)	54.5
	Total	**101**	**100**	**85**	**(100)**	**186**	**(100)**	**54.3**

The values given in parentheses are in percentage.

* X^2 =0.2385 df =5, 5% level

** X^2 =0.2791 df =5, 5% level

*** X^2 = 1.8301 df =5, 5% level

Table - 3 Distribution of accidents by area and time

Sl. No	Area	Number of accidents by time				Total		Peak %
		Peak hours		Off–peak hours				
	*** Fatal**							
1	Near institution	5	(11.6)	3	(9.1)	8	(10.5)	62.5
2	Near factory	10	(23.3)	7	(21.2)	17	(22.4)	58.8
3	Near office complex	3	(6.9)	1	(3.0)	4	(5.3)	75.0
4	Near/inside bus stand	12	(27.9)	7	(21.2)	19	(25.0)	63.2
5	Near market	7	(16.3)	5	(15.2)	12	(15.8)	58.3
6	Near recreation place	2	(4.7)	1	(3.0)	3	(3.9)	66.7
7	Others	4	(9.3)	9	(27.3)	13	(17.1)	30.8
	Total	**43**	**100**	**33**	**(100)**	**76**	**(100)**	**56.6**
	**** Major**							
1	Near institution	6	(11.8)	3	(8.3)	9	(10.3)	66.7
2	Near factory	8	(15.7)	5	(13.9)	13	(14.9)	61.58
3	Near office complex	5	(9.8)	2	(5.6)	7	(8.1)	71.4
4	Near/inside bus stand	11	(21.6)	7	(19.4)	18	(20.7)	61.1
5	Near market	7	(13.7)	3	(8.3)	10	(11.5)	70.0
6	Near recreation place	4	(7.8)	2	(5.6)	6	(6.9)	66.7
7	Others	10	(19.6)	14	(38.9)	24	(27.6)	41.7
	Total	**51**	**100**	**36**	**(100)**	**87**	**(100)**	**58.6**
	***** Minor**							
1	Near institution	16	(15.8)	12	(14.1)	28	(15.1)	57.1
2	Near factory	18	(17.8)	14	(16.5)	32	(17.2)	56.3
3	Near office complex	12	(11.9)	9	(10.6)	21	(11.3)	57.1
4	Near/inside bus stand	20	(19.8)	18	(21.2)	38	(20.4)	52.6
5	Near market	18	(17.8)	13	(15.3)	31	(16.7)	58.1
6	Near recreation place	12	(11.9)	11	(12.9)	23	(12.4)	52.2
7	Others	5	(5.0)	8	(9.4)	13	(6.9)	38.5
	Total	**101**	**100**	**85**	**(100)**	**186**	**(100)**	**54.3**

The values given in parentheses are in percentage.

* X^2 =4.7005 df =6 5% level

** X^2 =4.3431 df =6 5% level

*** X^2 = 1.7843 df =6 5% level

Table – 4 Distribution of accidents by accident type and time

Sl. No	Accident type	Number of accidents by time				Total		Peak %
		Peak hours		Off–peak hours				
	*** Fatal**							
1	Vehicles	18	(41.9)	11	(33.3)	29	(38.2)	62.1
2	Fixed object	3	(6.9)	3	(9.1)	6	(7.9)	50.0
3	Overturn	6	(14.0)	4	(12.1)	10	(13.1)	60.0
4	Cyclist	9	(20.9)	7	(21.2)	16	(21.1)	56.3
5	Padestrian	7	(16.3)	8	(24.3)	15	(19.7)	46.7
	Total	**43**	**100**	**33**	**(100)**	**76**	**(100)**	**56.6**
	**** Major**							
1	Vehicles	15	(29.4)	10	(27.8)	25	(28.7)	60.0
2	Fixed object	6	(11.8)	4	(11.1)	10	(11.5)	60.0
3	Overturn	9	(17.6)	7	(19.4)	16	(18.4)	56.3
4	Cyclist	10	(19.6)	6	(16.7)	16	(18.4)	62.5
5	Padestrian	11	(21.6)	9	(25.0)	20	(23.0)	55.0
	Total	**51**	**100**	**36**	**(100)**	**87**	**(100)**	**58.6**
	***** Minor**							
1	Vehicles	24	(23.8)	18	(21.2)	42	(22.5)	57.1
2	Fixed object	11	(10.9)	9	(10.6)	20	(10.8)	55.0
3	Overturn	18	(17.8)	14	(16.5)	32	(17.2)	56.3
4	Cyclist	22	(21.8)	20	(23.5)	42	(22.6)	52.4
5	Padestrian	26	(25.7)	24	(28.2)	50	(26.9)	52.0
	Total	**101**	**100**	**85**	**(100)**	**186**	**(100)**	**54.3**

The values given in parentheses are in percentage.

* X^2 =1.1097 df =4, 5% level

** X^2 =0.2718 df =4, 5% level

*** X^2 = 0.3587 df =4, 5% level

Table -5 Distribution of accidents by passenger response and time

Sl. No	Passenger response	Number of accidents by time				Total		Peak %
		Peak hours		Off–peak hours				
	*** Fatal**							
1	Standing inside the bus	1	(5.6)	1	(9.1)	2	(6.9)	50.0
2	Foot board travel	4	(22.2)	2	(18.1)	6	(20.7)	66.7
3	Overhanging from sides	3	(16.7)	1	(9.1)	4	(13.8)	75.0
4	Falling from the moving bus	2	(11.1)	1	(9.1)	3	(10.3)	66.7
5	Vehicles in motion	1	(5.6)	1	(9.1)	2	(6.9)	50.0
6	Other movements	7	(38.8)	5	(45.5)	12	(41.4)	58.3
	Total	**18**	**100**	**11**	**(100)**	**29**	**(100)**	**62.1**
	**** Major**							
1	Standing inside the bus	1	(6.7)	1	(10.0)	2	(8.0)	50.0
2	Foot board travel	4	(26.7)	1	(10.0)	5	(20.0)	80.0
3	Overhanging from sides	2	(13.3)	1	(10.0)	3	(12.0)	66.7
4	Falling from the moving bus	2	(13.3)	1	(10.0)	3	(12.0)	66.7
5	Vehicles in motion	1	(6.7)	1	(10.0)	2	(8.0)	50.0
6	Other movements	5	(33.3)	5	(50.0)	10	(40.0)	50.0
	Total	**15**	**100**	**10**	**(100)**	**25**	**(100)**	**60.0**
	***** Minor**							
1	Standing inside the bus	1	(4.2)	1	(5.6)	2	(4.8)	50.0
2	Foot board travel	6	(25.0)	3	(16.6)	9	(21.4)	66.7
3	Overhanging from sides	3	(12.5)	2	(11.1)	5	(11.9)	60.0
4	Falling from the moving bus	2	(8.3)	1	(5.6)	3	(7.1)	66.7
5	Vehicles in motion	1	(4.2)	1	(5.6)	2	(4.8)	50.0
6	Other movements	11	(45.8)	10	(55.5)	21	(50.0)	52.4
	Total	**24**	**100**	**18**	**(100)**	**42**	**(100)**	**57.1**

The values given in parentheses are in percentage.

* X^2 =0.6835 df =5 5% level

** X^2 =1.5277 df =5 5% level

*** X^2 = 0.7388 df =5 5% level