ROAD ACCIDENTS AND SAFETY IN INDIA

Mayank mahla

Student at Department of Civil Engineering DCRUST(Murthal)

Abstract—The scenario of road accidents taking place in India is very dismal with more than 1,40,000 people succumbing to injuries. Tolerable and necessary cause of a road accident is a combination of simultaneous and sub sequential factors, each of which is important but none of which is sufficient. The road safety situation in many developed and developing countries is improving but India faces a worsening situation. If new measures and initiatives will not be taken then total number of deaths due to road accidents is likely to cross the mark of 260,000 by the year 2025. India loses 3% of its GDP due to deaths in road accidents, the most of which were definitely avoidable. From examining the studies done in past, within last 5 years the vehicle population has been doubled but the length of existing roads has not been able to meet the increased traffic conditions. The dissemination of road accidental injuries varies according to age, gender, month and time. Thus, there is a compelling need to perceive the aggravating situation in road injuries and deaths and to take pertinent action. This paper focuses on relevance of safety analysis on Indian roads as India is one of the biggest contributors for causalities caused due to accidents as well as state of safety on roads analyzing various facets.

Keywords- Vehicle population, Fatality distribution, Analysis at state and city level, Causes, Countermeasures

1. INTRODUCTION

Road safety has become an issue of national interest acknowledging its impact on public health, economy and sustenance of people. Injuries and casualties ensuing from road accidents are a thriving public health issue in India. Nearly 2700 people are killed and over 9000 people are injured weekly in India. In 2017, latest year for which road data is available, a total of 4,64,910 road accidents have been reported by states and union territories, claiming 1,47,913 lives and causing injuries to 4,70,975 persons. With nearly 1,50,000 deaths annually India has overtaken China to top the world in road casualties. India is the only country that faces more than 10 deaths and over 50 injuries every hour due to these road accidents. If we assume the average growth rate of 6% per year declines to nil by 2030, then we can expect about 200,000 fatalities in 2030 before we see a reduction in fatalities. Road traffic injuries(RTI) have been increasing tremendously from the past three decades. This may be somewhat due to the increased number of vehicles onto the roads but mainly due to absence of well established evidence-based policy to curb the problem. In 2017, the share of two-wheeler road users has been the highest(33%). 13.8percent of persons killed by road accidents in 2017 is comprised by the pedestrian road-users. The central intent of this study is to figure out the road traffic accidents in India at various levels. Target would be to classify the extensive road safety issues and encouter solutions that would have potential to tackle specific road safety issue. The number of road accidents has seen a reduction from the value of 5,01,423 in 2015 to 4,80,652 in 2016 and furthermore to 4,64,910 in 2017. The number of people injured has been on the decline since 2015; in percentage terms, the number of accidents in 2017 reduced by 3.3 percent and injuries by 4.8 percent in comparison to 2016. But on the other hand, the number of lives lost due to road fatalities declined by just 1.9 percent. The number of casualties due to road accidents has definitely lowered but there is still a very long way for us to go. These road accidents occurring take place due to various numbers of reasons such as not having proper awareness of traffic safety rules amongst the people, due to increasing congestion which is increase in the number of vehicles on the roads etc. The figure below shows the number of deaths taking place due to road accidents in the past 10 years.

Figure-1

VEHICLE POPULATION

India is considered to be the fourth largest car manufacturer in the world as in 2017. A record 29.1 million motor vehicles were produced by the Indian car manufacturers in 2017-18(Apr-Mar) incl. 4.01 million passenger vehicles. Indian passenger vehicle exports amounted to 0.75 m (incl. 0.58 m passenger cars) units in 2017-18 while 2.82 m two-wheelers (mainly motorcycles), 97 000 commercial vehicles and 0.38 m three wheelers were shipped overseas during the same year. The graph in the figure below shows the expansion of personalized motor vehicles that were registered by the year according to the official provided data (Transport Research Wing

2016). According to official statistics 150,785 persons were killed and 494,6249 injured in road traffic crashes in India in 2016. 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.

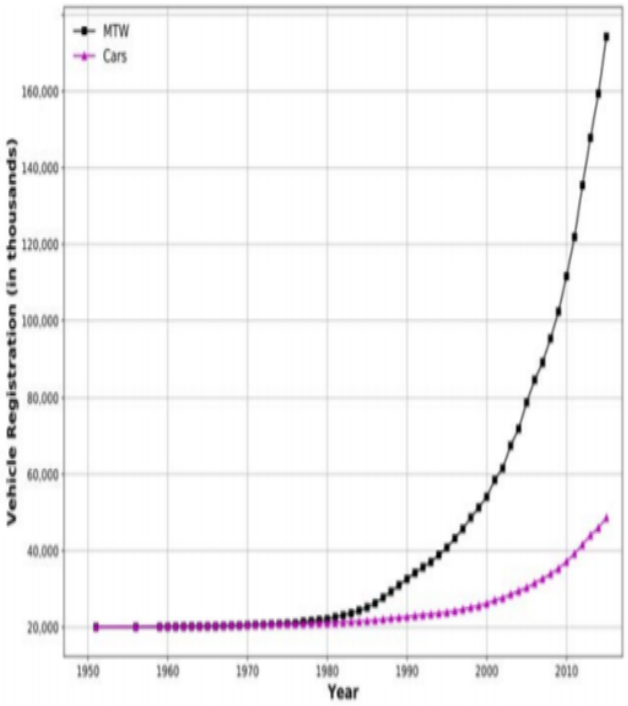


Figure-2

The number of motorized two wheelers (MTW) and cars was 154.2 million and 26.4 million respectively as in 2015. If it is assumed that 50-60% of these were actually on the roads, then the actual number of MTWs and cars present would be nearly 93 and 16 million respectively, and the total personal vehicle holding was estimated at 8-9 persons per 100 persons in 2015. Since the number of vehicles officially registered is more than the actual number on vehicles present on the roads, any RTI causality rates calculated per vehicle on the basis of official recorded data will give impractically low evaluations. Sustained economic growth and increased per capita income have led to brisk growth of motorized vehicles in the country. There were 230 million registered vehicles in India as on 31st March 2016. The total number of registered motor vehicles in the country grew at a compound annual growth rate (CAGR) of 9.9 per cent between 2006 and 2016. Among different class of vehicles, highest CAGR of 10.1 per cent each were filed by two-wheelers and cars, jeeps and taxis. Good vehicles and buses recorded CAGR of 9.0 per cent and 5.9 per cent, respectively. Configuration of vehicular population in 2016 shows the biggest share of two-wheelers (73.5 %) followed by cars, jeeps and taxis (13.1%), other vehicles (8.1%), goods vehicle (4.6%) and buses (0.8%). An analysis of road accidents, registered vehicles, and road length from 1970 to 2017 is shown in the table below.

Year	Road Accidents ('000)	Road Accident Deaths ('000)	Road Accident Injuries ('000)	Registered Vehicles ('000)	Road Length ('000 km)	Fatality rate (no. of accident deaths per 10,000 vehicles)	Vehicle density (no. of vehicles per km of road)
1970	114	15	70	1401	1,189	103.50	1.18
1980	153	24	109	4,521	1,492	53.09	3.03
1990	283	54	244	19,152	1,984	28.25	9.65
2000	391	79	399	48,857	3,316	16.15	14.73
2010	500	135	528	1,27,746	4,582	10.53	27.88
2015	501	146	500	2,10,023	5,472	6.96	38.38
2016	481	151	495	2,30,031	5,603	6.55	41.05
2017	465	148	471	NA	NA	-	-

Table-1

The data shown in the table above represents the road injuries and deaths taking place in context to the total number of vehicles as well as the road length in the country. Now let us take a look at the data between personal vehicle ownership and official road traffic fatality rates per 100,000 population for ten countries including India(World health organisation 2015). The table below shows eight countries with much greater vehicle ownership rates than India but lower road traffic injuries fatality rates. The data provided below deos not necessarily shows that increase in vehicle ownership results in decrease of RTI fatality rates.

Country	MTW + light 4-wheelers per 100 persons	Official fatality rate per 100,000 population
India	9*	12
Australia	71	5.1
Canada	61	6
Chile	45	12
Greece	60	7.8
Hungary	32	6
Japan	69	4.5
Portugal	56	6
Sweden	56	2.7
United Kingdom	54	2.8

Table-2

FATALITY DISTRIBUTION BY AGE AND SEX

In India the age group of 30-44 years is considered to be the most prone to road accident fatality. This age group comprises only 20percent of the total Indian population but encounters almost 35percent of total road accident fatality. Age profile of fateful road accident casualties of 2017 remains approximately similar with that of 2016. Road accident victims largely include young people in the productive age groups accentuating major implication on economic cost of road accidents, apart from their emotional and psychological impact. The gender-wise correlation in road accident deaths for the year 2017

showed that the total number of males and females killed during the calendar year 2017 were 1,27,787 (86.4%) and 20,047 (13.6%) respectively.

In the year 2017 males contributed around 84.5% in total road accidental deaths while 15.5% were contributed by the females in India. The table below shows gender-wise age profile of fatal road accident victims in 2016 and 2017.

Age-group	2016		2017	
	Male	Female	Male	Female
Less than 18	8,347	2,275	7,443	1,965
18-25	27,417	4,358	30,148	4,096
25-35	32,609	5,467	34,728	4,821
35-45	28,564	4,994	28,538	4,250
45-60	18,592	3,582	19,235	3,227
60 and Above	6,964	1,850	7,696	1,688
Age not known	4,960	806	79	
Total	1,27,453 (84.5)	23,332 (15.5)	1,27,787 (86.4)	20,047 (13.6)

Table-3

Now let us take a look at chart which shows age wise distribution of road accident victims in the year 2017.

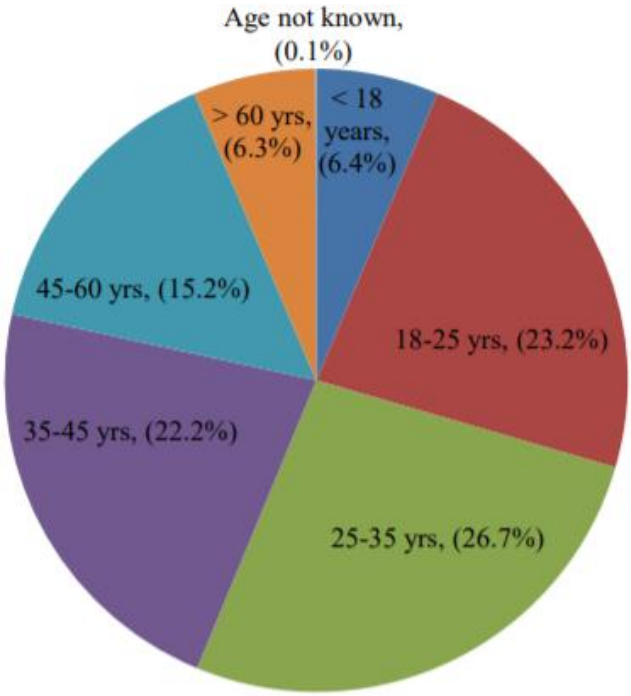


Figure-3

During the last ten years, number of fatalities faced by males has increased by 64.6%, from approximately 75,000 in 2007 to 120,000 in 2017. This is significantly higher than the increase in fatalities faced by females; number of fatalities faced by females has increased by 54%, from 14,500 in 2003 to 23,000 in 2013. However, tendency in injuries is just opposite to that in fatalities. During the last ten years, number of injuries faced by males has increased by 23%, from 316,055 in 2007 to 3892,872 in 2017. This is relatively lesser than the increase in injuries faced by females; number of injuries faced by females has increased by 28%, from 72,543 in 2007 to 91,624 in 2017.

Month and Time-wise distribution of road accidents in India-2017

The accumulated data on month-wise distribution of road accidents for the year 2017 shows that in the month of May the accidents and fatalities were on a crest and in the month of September they troughed. Major states such as UP, Maharashtra, Kerala, Karnataka recorded maximum number road traffic accidents in the month of May which results in the aggregate data for the whole country. The figure shows that during the period of June-September road accidents and fatalities are lowered and advances again in October and September.

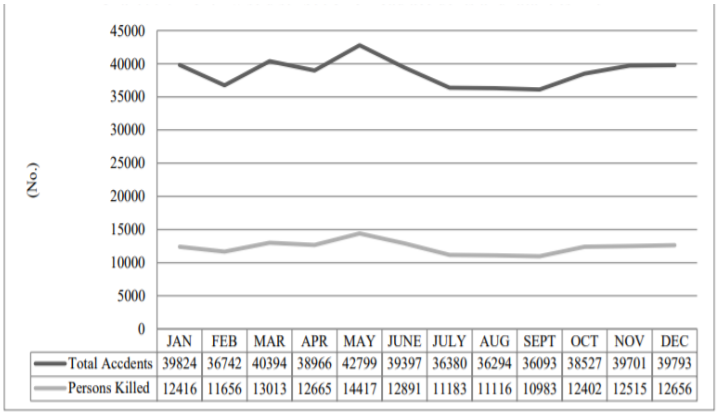


Table-4

The pattern in 2017 is predominantly same as in 2016.

The time interval between 6:00 PM and 9:00 PM recorded the maximum number of road accidents computing for 18.4% of total number of accidents happening in the country. 17.7% of total road accidents were accumulated within the time interval 3:00 PM and 6:00 PM which is considered to be second highest time interval. As per the official data, afternoon and evening times are considered to be the most dangerous times for road users. A comparison has been of road accidents taking place at different times between the years 2016 and 2017 as shown in the table below.

Time	2016		2017	
	Number of Accidents	% share in total accidents	Number of Accidents	% share in total accidents
06:00 - 09:00 hrs (Day)	54,522	11.3	51,551	11.1
09:00 - 12:00 hrs (Day)	75,771	15.7	71,426	15.4
12:00 - 15:00 hrs (Day)	73,380	15.3	71,594	15.4
15:00 - 18:00 hrs (Day)	85,834	17.9	82,456	17.7
18:00 - 21:00 hrs (Night)	84,555	17.6	85,686	18.4
21:00 - 24:00 hrs (Night)	50,970	10.6	49,567	10.7
00:00 - 03:00 hrs (Night)	25,976	5.4	25,050	5.4
03:00 - 06:00 hrs (Night)	29,644	6.2	27,580	5.9
Total 24 hrs	**4,80,652**	**100.0**	**4,64,910**	**100.0**

Table-5

If we valuate accident risk per vehicle-km or passenger-km during day as well as nighttime, we will find that driving during nighttime is unsafe than daytime. Unavailability of data restricts us to estimate the accident risk during daytime vis-à-vis nighttime.

Causes of road accidents

Road accident is the most undesirable thing to happen to a road user. Road accidents are a result of interplay of numerous factors which can be widely classified into manual error, environmental factors, bad road condition and vehicular condition. Now let us take a look at different factors responsible for a road accident and into the data pertaining to the situations under which it has taken place.

Traffic rules violations

During 2017 over-speeding was considered to be the most crucial factor resulting in a road accident. Over speeding and driving on wrong side together resulted in about 76.7 per cent of total accidents and 73.1 per cent of total deaths in the country.

Traffic rules violation	Number of accidents	Persons Killed	Persons injured
Over-speeding	3,27,448 *(70.4)*	98,613 *(66.7)*	34,3083 *(72.8)*
Driving on wrong side	29,148 *(6.3)*	9,527 *(6.4)*	30,124 *(6.4)*
Drunken driving/consumption of alcohol & drug	14,071 *(3.0)*	4,776 *(3.2)*	11,776 *(2.5)*
Use of mobile phone	8,526 *(1.8)*	3,172 *(2.1)*	7,830 *(1.7)*
Jumping red light	6,324 *(1.4)*	1,826 *(1.2)*	5,977 *(1.3)*
No violation & not known	79,394 *(17.1)*	29,999 *(20.3)*	72,185 *(15.3)*
Total	**4,64,910**	**1,47,913**	**4,70,975**

Table-6

The data corresponding to the violation of various other rules such as drunken driving, use of mobile phone etc. has also been shown in the table above.

In 2017, the maximum numbers of road accident were caused due to two wheelers which accounts for almost 34% of total number of road accidents taking place in the country. Various data is shown in the chart below for the year 2017.

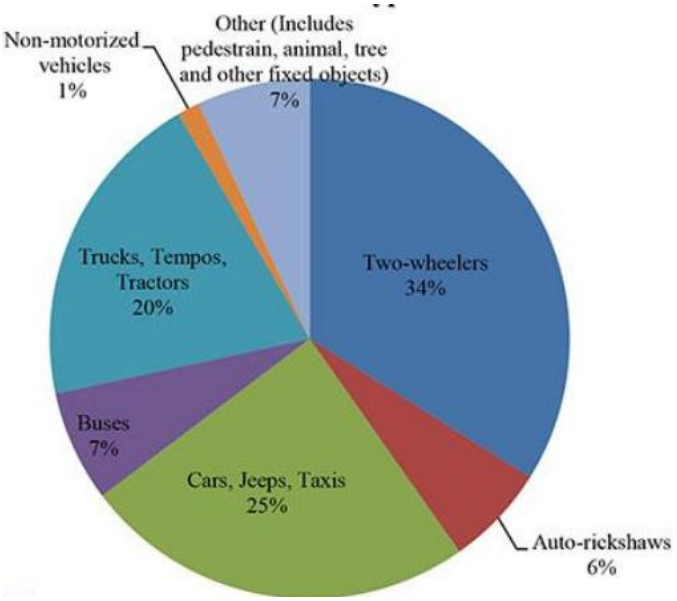


Figure-4

Road accidents by type of license

Vehicles driven by unskilled drivers are serious traffic threat. We do know that this is basically an imposition issue, but it must also be tackled with better opportunities for training and evaluation.

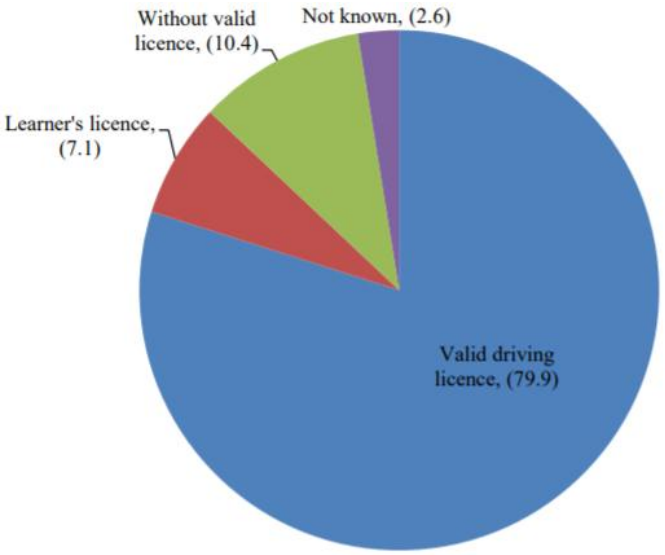
In 2017, 17.5% of total accidents are constituted by the drivers that carry a learner's license or do not carry a license at all. The number of accidental cases involving drivers without any valid driving license has risen from 32,088 in 2016 to 48,503 in 2017. This accentuates the need for improved enforcement and also for establishment of quality driving schools and testing centers. A comparison has been made between the years 2016 and 2017 as shown in the table below

Type of Licence	2016 No. of accidents	2017 No. of Accidents
Valid driving licence	4,05,079 (84.3)	3,71,387 *(79.9)*
Learner's licence	41,405 (8.6)	33,128 *(7.1)*
Without valid licence	32,088 (6.7)	48,503 *(10.4)*
Not known	2,080 (0.4)	11,892 *(2.6)*
Total	**4,80,652**	**4,64,910**

Table-7

A chart has also been prepared classifying the road accidents by type of license as shown below

Figure-5



Road accidents by weather conditions

Road surface conditions are greatly effected by the weather conditions and the visibility of the motorist gets effected too, hence enhancing the chances of misfortune. Inimical weather conditions such as thick fog, heavy rainfall and hail storms make driving conditions very dangerous for the road user. The data shows that almost 75% accidents has taken place under clear/sunny weather conditions.

Weather condition	No of accidents	Persons killed	Persons injured
Sunny/clear	3,40,892 *(73.3)*	1,02,926 *((69.6)*	3,49,597 *(74.2)*
Rainy	44,010 *(9.5)*	13,142 *(8.9)*	46,004 *(9.8)*
Foggy & misty	26,982 *(5.8)*	11,090 *(7.5)*	24,828 *(5.3)*
Hail/ sleet	3,078 *(0.7)*	1,523 *(1.0)*	2,888 *(0.6)*
Others	49,948 *(10.7)*	19,232 *(13.0)*	47,658 *(10.1)*
Total	**4,64,910**	**1,47,913**	**4,70,975**

Table-8

Accidents by road features

Road accidents can also take place due to different road features such as potholes, curves, junctions etc. In 2017, the maximum number of road accidents(64.2%) took place on straight roads, whereas accidents on curved roads, potholes and step grade together accounted for around 15.6% of total road accidents taking place in the country. This shows that it is mainly due to other factors such as drivers fault, vehicule damage etc. that these accidents are taking place because the maximum number of accidents are occuring on the straight roads.The official data of different features has been shown in the table below.

Road feature	Number of accidents	Persons killed	Persons injured
Straight road	298351 *(64.2)*	91203 *(61.7)*	302952 *(64.3)*
Curved road	54077 *(11.6)*	17814 *(12.0)*	57346 *(12.2)*
Bridge	15514 *(3.3)*	5543 *(3.7)*	15839 *(3.4)*
Culvert	11600 *(2.5)*	4144 *(2.8)*	11974 *(2.5)*
Potholes	9423 *(2.0)*	3597 *(2.4)*	8792 *(1.9)*
Steep grade	9124 *(2.0)*	3248 *(2.2)*	9753 *(2.1)*
Ongoing road works/Under construction	11822 *(2.5)*	4250 *(2.9)*	11425 *(2.4)*
Others*	55000 *(11.8)*	18115 *(12.2)*	52896 *(11.2)*
Total	**464910**	**147913**	**470975**

Table-9

Analysis of road accidents at state level

If a comparison is done in different states then it is found out that in the year 2017 the road accidents have reduced in contrast to road accidents in the year 2016 in different number of states. In this section we will see the data of top 15 states in India in which the greatest number of accidents have taken place, the study of these 15 states would in fact give us approximately the total number of road accidents happening in the entire country because these states constitute the greatest number of accidents happening in the country. The same set of states constituted the maximum number of accidents both in years 2016 and 2017 and a comparative study is to be done. In the year 2017 the maximum number of accidents happened in Tamil Nadu with 14.1% of total accidents happening in the country whereas, Bihar was ranked at the bottom position with 1.9% of the total share of accidents. The position of Maharashtra and Rajasthan was improved in 2017 as in case of 2016 while, the positions of Telangana and Uttar Pradesh worsened in 2017 when compared to their positions in 2016. An analogical study of top 15 states in the years 2016 and 2017 has been shown in the table below and the percentage shares of these states have been depicted in the chart as follows

Sl. No.	State	2017		2016	
		No. of accidents	% share	No. of accidents	% share
1	Tamil Nadu	65,562	14.1	71,431	14.9
2	Madhya Pradesh	53,399	11.5	53,972	11.2
3	Karnataka	42,542	9.2	44,403	9.2
4	Uttar Pradesh	38,783	8.3	35,612	7.4
5	Kerala	38,470	8.3	39,420	8.2
6	Maharashtra	35,853	7.7	39,878	8.3
7	Andhra Pradesh	25,727	5.5	24,888	5.2
8	Telangana	22,484	4.8	22,811	4.7
9	Rajasthan	22,112	4.8	23,066	4.8
10	Gujarat	19,081	4.1	21,859	4.5
11	Chhattisgarh	13,563	2.9	13,580	2.8
12	West Bengal	11,631	2.5	13,580	2.8
13	Haryana	11,258	2.4	11,234	2.3
14	Odisha	10,855	2.3	10,532	2.2
15	Bihar	8,855	1.9	8,222	1.7
	Total 15 States	**4,20,175**	**90.3**	**4,34,488**	**90.2**

Table-10

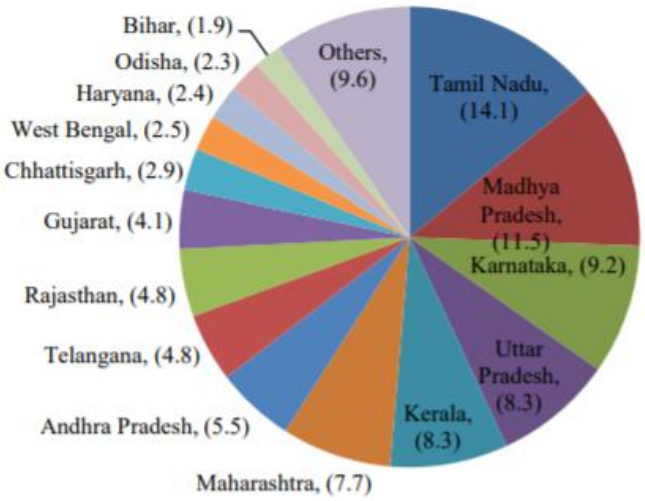


Figure-6

Analysis of road accidents in one million-plus cities

Due to dense population and high traffic congestion the road accidents tend to be fixated in urban areas of the country. In this section we study road accidents for 50 Indian cities with population of one million and above people (one million plus) are concisely discussed. 17.7% of total accidents happened in the country were accounted by these 50 cities in the year 2017. In 2017, Chennai accounted for the highest number of road accidents followed by Delhi and Indore was placed at the third position. 51.1% of the total road accidents in these 50 cities were accounted by Chennai, Delhi, Indore, Bhopal, Jabalpur, Mumbai, Kolkata, Jaipur, Hyderabad, Kochi and Malappuram alone. Amritsar, Jodhpur and Jamshedpur were placed at bottom positions. Delhi recorded the highest number of fatalities followed by Chennai in the year 2017. 49.7% of total road accidental deaths among these 50 cities were accounted by 12 cities viz., Delhi Chennai, Jaipur, Kanpur, Lucknow, Bengaluru, Agra, Mumbai, Allahabad, Raipur, Meerut and Jabalpur. The total number of road accidents, persons killed and injured in Million-plus cities is presented in table below.

S. No	Cities	Fatal Accidents	Injury Accidents	Total Accidents	No. of Persons Killed	No. of Persons Injured	Severity of Accidents*
1	Agra	379	653	1032	555	896	53.8
2	Ahmedabad	328	1235	1563	336	1443	21.5
3	Allahabad	452	669	1163	472	734	40.6
4	Amritsar	66	49	119	67	100	56.3
5	Asansol Durgapur	248	149	425	271	406	63.8
6	Aurangabad	149	335	592	157	486	26.5
7	Bengaluru	616	1301	2297	653	2083	28.4
8	Bhopal	242	2465	3393	252	2720	7.4
9	Chandigarh	103	205	342	107	302	31.3
10	Chennai	1264	5670	7257	1299	6975	17.9
11	Coimbatore	269	969	1299	277	1191	21.3
12	Delhi	1565	5017	6673	1584	6604	23.7
13	Dhanbad	194	172	366	196	199	53.6
14	Faridabad	271	441	712	276	610	38.8
15	Ghaziabad	373	544	930	402	709	43.2
16	Gwalior	273	1572	2156	317	1800	14.7
17	Hyderabad	302	2066	2834	310	2370	10.9
18	Indore	368	3341	4513	391	3676	8.7
19	Jabalpur	372	2611	3303	409	3113	12.4
20	Jaipur	753	1835	2983	813	2550	27.3
21	Jamshedpur	190	104	304	223	205	73.4
22	Jodhpur	101	167	282	104	262	36.9
23	Kannur	67	477	578	68	700	11.8
24	Kanpur	608	960	1568	682	1199	43.5
25	Khozikode	168	1150	1467	184	1544	12.5
26	Kochi	132	2149	2503	137	2600	5.5
27	Kolkata	318	2215	3131	329	2559	10.5
28	Kollam	202	1515	1780	213	1763	12.0
29	Kota	87	358	481	93	471	19.3
30	Lucknow	581	824	1515	655	917	43.2
31	Ludhiana	278	214	493	281	316	57.0
32	Madurai	187	696	920	189	891	20.5
33	Mallapuram	362	1797	2339	385	2683	16.5
34	Meerut	388	652	1040	411	794	39.5
35	Mumbai	467	2603	3160	490	3287	15.5
36	Nagpur	222	976	1242	231	1256	18.6
37	Nashik	158	345	631	171	510	27.1
38	Patna #	136	164	422	147	218	34.8
39	Pune	360	966	1508	373	1154	24.7
40	Raipur	410	975	2159	420	1288	19.5
41	Rajkot	160	428	617	161	494	26.1
42	Srinagar	59	259	363	60	345	16.5
43	Surat	243	590	902	251	819	27.8
44	Thiruvanthapuram	169	1880	2113	172	2497	8.1
45	Thrissur	103	1184	1384	106	1548	7.7
46	Tiruchirapalli	129	489	638	134	768	21.0
47	Vadodra	171	543	867	186	755	21.5
48	Varanasi	279	316	612	279	316	45.6
49	Vijaywada city	345	1146	1648	349	1525	21.2
50	Vishakhapatnam	329	1068	1667	343	1294	20.6
	Total	**15996**	**58509**	**82286**	**16971**	**73945**	**20.6**

Table-11

*Number of persons killed per 100 accidents.

#Pertain to urban area only.

In 2017, cities Nashik, Kolkata, Amritsar, Chandigarh, Ahmedabad, Vadodara and Ludhiana faced a drastic

reduction in road accidents and fatalities as compared to 2016. Though, cities like Dhanbad, Jamshedpur, Varanasi, Faridabad, Kannur and Srinagar accounted for a higher number of accidents and fatalities in 2017 over 2016. In 2017, 15,996 number of fatal accidents (caused death of one or more person) took place out of a total 82,286 accidents. 16,971 number of lives were lost as a result of these accidents and 73,945 injuries were induced. In 2017, the total number of accidents, number of persons killed and injured came down significantly as were recorded in 2016. But accident extremity, i.e., accident deaths per 100 road accidents, went up by 0.8 percentage point as is shown in the table below.

S. No		2016	2017	% change
1.	No. of accidents	89,835	82,286	-8.4
2.	No. of fatal accidents	16,960	15,996	-5.7
3.	No. of persons killed	17,797	16,971	-4.6
4.	No. of persons injured	82,608	73,945	-10.5
5.	Accident severity	19.8	20.6	0.8*

Table-12

*In percentage point.

Spatial and Inter-Temporal distribution of road accidents

In this section we will compare the road accidents between rural and urban areas in the year 2017. As per the census conducted in 2011, rural areas account for 67.8% of the total population of the country, while 31.2% population resides in urban area. Urban areas face a higher number of road accidents than rural areas due to higher population density and a greater extent of vehicular congestion is seen on the urban roads. This section presents a summary of the related data for 2017 equipped by the States and UTs.

42.1% of total road accidents were accounted by urban arear while 57.9% were in rural areas. If fatalities are to be considered, 65.3% people were killed in road accidents in rural areas while, 34.7% were killed in urban areas. The number of accidents and fatalities in urban areas went down in 2017 as compared to 2016 whereas, increased in the case of rural areas. The table below correlates the number of road accidents, fatalities and injuries between urban and rural areas in the years 2016 and 2017.

	2016			2017		
	Total Accidents	Persons Killed	Person Injured	Total Accidents	Persons Killed	Persons Injured
Urban Area	2,16,813 (45.1)	57,840 (38.4)	2,12,346 (42.9)	1,95,723 (42.1)	51,334 (34.7)	1,83,703 (39.0)
Rural Area	2,63,839 (54.9)	92,945 (61.6)	2,82,278 (57.1)	2,69,187 (57.9)	96,579 (65.3)	2,87,272 (61.0)
Total	**4,80,652**	**1,50,785**	**4,94,624**	**4,64,910**	**1,47,913**	**4,70,975**

Table-13

International comparison

In this section we will look at road accident fatality risk, i.e., fatality per 1,00,000 population and injury risk, i.e., accident injury per 1,00,000 population as per world statistics 2017 presented by International Road Federation, Geneva.

Russian Federation was considered to have encountered the greatest number of road accident deaths per 1,00,000 among 22 countries. Extent of road accident deaths is at 11 in India while it was 16 in the case of Russian Federation. The number is maximum in the case of Russian Federation which can due to any reason such as high population, greater extent of vehicular congestion, less awareness amongst the people etc.

A table has been shown below presenting the incidence of road accident related deaths and injury accidents among the following 22 countries.

Sl. No.	Country	Killed per 100,000 Population	Injury Accidents per 100,000 Population
1	Australia	5	286 *
2	Canada	5	330
3	China	4	14
4	Denmark	3	50
5	Finland	5	94
6	France	5	85
7	Germany	4	374
8	India	11	38
9	Israel	4	145
10	Japan	4	422
11	Korea, Republic of	9	2,238
12	Mauritius	3 #	217
13	Mexico	3	8
14	Myanmar	10	30
15	New Zealand	7	213
16	Norway	2	88
17	Poland	8	87
18	Portugal	6	344
19	Russian Federation	16	128
20	Singapore	3	143 $
21	United Kingdom	3	215
22	United States of America	11	545

Table-14

*pertain to 2011

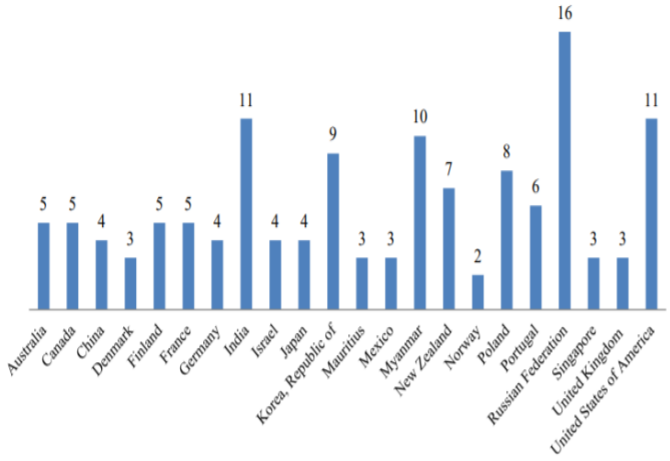
#pertain to 2013

$pertain to 2014

Injury accident may be defined as any type of accident involving at least one vehicle on road in motion causing at least one death or an injury. The injury accident per 100,000 population number in India was found out to be 38, which is substantially lower than that of various developed countries.

The figure is highest for Republic of Korea (2238) which is followed by the United states of America (545) among all the 22 countries.

For the year 2015, Country-wise number of persons killed per 1,00,000 population has been shown in the following **Figure-7**



The way forward using Technological Innovations

All these road injuries and fatalities are avoidable, since the risk of happening of any road accident is definitely predictable and techniques, proven to be effective, exist. The most precise way to abridge these accidents and fatalities would through a unified approach associating close association of various sectors. Progress is being made in many parts of the world where multisectoral strategic plans are leading to incremental reductions in the number of road accidental fatalities and injuries (Evans, 2003). Such strategies focus on four key factors that contribute to the risk of occurrence of a road accident – exposure, behavioral factors, road environment, and vehicle factors.

The problem of road accidents in India is worsening because of homogenous nature of traffic slow, due to mixed nature of road traffic on its roads with pedestrians, bicycles, mopeds, scooters, motorcycles, auto-rickshaws, taxis, vans, cars, trucks, and buses using the same road space. In other words, the same road network is used by different categories of motorized and non-motorized vehicles, of varying width and speed. To lessen the vulnerability to risk, there is a need to separate these different categories of vehicles from each other on the basis of the speed with which they move as fast moving and slow-moving vehicle, and also by the weight of that particular class of vehicle.

Road accidents and related injuries and fatalities are highly dependent on the speed of motor vehicles. Empirical evidences suggest that an average increase in speed of 1 Km/h is associated with a 3% higher risk of a crash involving an injury (Finch et al., 1994; Taylor et al., 2000). For car occupants in a crash with an impact of 80 Km/h, the likelihood of death is 20 times what it would have been at an impact speed of 32 Km/h (Margie et al., 2004). Pedestrians have a 90% chance of surviving car crashes at 30 Km/h or below, but less than a 50% chance of surviving impacts at 45 Km/h or above (Ashton and Mackay, 1983). The Times of India reported on 16 July 2018 that potholes killed 3,597 people across India in 2017, claiming almost 10 lives daily; and more than 50% rise over the toll for 2016.

The goal of traffic-safety countermeasures should be a reduction in total harm. Let us take a look at what are the problems that we are facing and what measures can be undertaken in order to reduce road accidents. Some of these countermeasures already have international applicability whereas, some India-specific measures would have to be developed in upcoming years in the country and are broadly classified as follows in **Table-15**

PROBLEM AREA	COUNTERMEASURES
Pedestrians and other non-motorists	-Pedestrian-friendly front end of vehicles. -Yield to Pedestrians in a crosswalk. -Properly marked crosswalks.
Two-wheelers and small cars in urban areas	-Strict enforcement of helmet-use and seatbelt laws. -Pedestrian/motorcycle impact standards for small cars. -Smart helmet and Intelligent biking system.
Over involvement of trucks and other heavy weight vehicles	-Develop a truck rollover warning system. -Consider the use of side underride protection. -Widen pavements and post appropriate advisory speeds at sharp curves. -Rumble strips on all paved shoulders. -Truck blind spot radars.
Potholes, damaged roads	-Proper drainage systems. -Timely maintenance of roads. -Imposing duty on heavy

	load vehicles. -Pothole detecting car systems.
Nighttime driving	-Night vision auto cameras. -Anti-sleep steering wheels. -Steering wheel booze monitors.
Drunk driving (Accidents due to driver's fault).	-Inebriation-detecting lasers. -Auto-braking cars. -Sober driving devices.
Wrong-way drivers on divided highways.	-Highway designs incorporating local needs.

The maximum number of road accidents are caused due to human errors. Due to this reason, road safety capabilities traditionally focus on 'enhancing' the driver in order to avoid accidents. There is no doubt that the approaches involving road-safety enforcement such as wearing seat belts, wearing helmets while driving, saying no to drunken driving, and general adherence to traffic rules are vital in preventing traffic accidents, however, it is equally necessary to keep in mind that people will always make mistakes. Hence, there is a need to focus on mediating the outcome of accidents by designing safer vehicles and safer roads. It is indeed possible to protect the road user in the event of an accident by designing vehicles and roads to work together to ensure crash energies do not overwhelm the human. For vulnerable road users such as pedestrians, bicyclists, motorcyclists, and those using informal public transport, road design must ensure that they are not exposed to high speed traffic (Singh, 2009).

CONCLUSION

The paper is intended to draw attention towards scenario of road accidents and to analyze the traffic safety situation in India. It can be analyzed that India contains a homogenous traffic and the distribution of road deaths and injuries varies according to age, gender, month and time. It is also found that the most age group to road accidents is the economically active set of people. Males are at high probability of facing a road accident than females. In the year 2017, India was considered to be the fourth largest car manufacturer in the world which resulted in high amount of congestion and which in turns results in the increase in road accidents in the country. The time interval between 6:00 PM and 9:00 PM encountered the greatest number of road accidents, which computed for 17.7% of total number of road accidents taking place in the country. With the help of official data, it is concluded that the total number of road accidents decreased in the year 2017 when compared to 2016. Over-speeding and driving on wrong side of the road resulted in maximum (76.7%) of total road accidents and 73.1% of total deaths happening in the country. In 2017, 17.5% of total accidents are constituted by the drivers that carry a learner's license or do not carry a license at all. In 2017, the maximum number of road accidents (64.2%) took place on straight roads, whereas accidents on curved roads, potholes and step grade together accounted for around 15.6% of total road accidents taking place in the country.

The study also analyzed road accident scenario across various Indian states and one million-plus cities. It is also found that during the year 2017, the maximum number of accidents happened in Tamil Nadu with 14.1% of total accidents happening in the country whereas, Bihar was ranked at the bottom position with 1.9% of the total share of accidents. It is also found that the burden of road traffic accidents in India is marginally lower in its metropolitan cities. Despite the increasing risk of road traffic fatalities and injuries, road safety has received very limited attention at the central, state, and local government levels. A very obvious reason for this is that this problem does not belong to any specific body, but the responsibility of handling with the various aspects of problems including design of road networks, introduction and enforcement of road safety legislations, planning of various transport aspects, post-accident medical attention etc. is divided among many different agencies. This problem needs to be tackled so that responsibility is clearly assigned. Road user interventions have come in practice in many developed countries to overcome increasing fatalities and injuries caused due to road accidents. Although these solutions might not be fully applicable in country like India but some basic principles would still remain the same. These include, for example, good road design and traffic management, improved vehicle standards, speed control, the use of seat belts and helmets, and the enforcement of alcohol limits (Margie et al., 2004). Strong measures should be taken to better the condition of road users in India.

REFERENCES

[1.] Dinesh Mohan.,2009. Road Safety in India: Challenges and Opportunities (Indian Institute of Technology, Delhi).

[2.] Finch, et al., 1994. Speed, speed limits and accidents. Transport Research Laboratory, Project Report 58.

[3.] Chakraborty S.S, Arora S.P, Koul R.L, Bahadur A.P: A scientific approach to Road safety in India, proc. ICORT-95, 1995 pp.1349-1365.

[4.] Aarts, Letty, and Ingrid van Schagen. 2006. "Driving speed and the risk of road crashes: A review." Accident Analysis & Prevention 38 (2):215-224.

[5.] Arora, P., A. Chanana, and H. R. Tejpal. 2013. "Estimation of blood alcohol concentration in deaths due to roadside accidents." Journal of Forensic and Legal Medicine 20 (4):300-304. doi: DOI 10.1016/j.jflm.2012.12.003.

[6.] 194. Singh, S. K., 2012. The neglected epidemic: road traffic crashes in India. Metamorphosis (A Journal of Management Research) 11(2), 27-49.

[7.] Singh, S. K., 2009. Road traffic crashes: the scourge of UP's cities. Economic and political weekly XLIV (48), 22- 24.

[8.] Taylor, et al., 2000. The effects of drivers' speed on the frequency of road accidents. Transport Research Laboratory, Project Report 421.

[**9.]** Margie, P., et al., 2004. World report on road traffic injury prevention. World Health Organization, Geneva (available at http://www.who.int/violence_injury_prevention/publications/road_traffic/world_report/summary_en_rev.pdf).

[**10.]** Zaza, S., et al., 2001. Review of evidence regarding interventions to increase use of child safety seats. American Journal of Preventive Medicine 21(1), 31-43.

[11.] Singh R, Singh HK, Gupta SC, Kumar Y. Pattern, severity and circumstances of injuries sustained in road traffic accidents: a tertiary care hospital-based study. Indian J Community Med. 2014 Jan;39(1):30-4. doi: 10.4103/0970- 0218.126353. PubMed PMID: 24696537; PubMed Central PMCID: PMC3968579.

[**12.]** McManus, W. (2007). The economics of road safety: An international perspective (Technical Report No. UMTRI-2007-23). Ann Arbor: The University of Michigan Transportation Research Institute.

[13.] Anne Frank Joe, A., S. Celin, R. Thomas, and B. Vishwanath. 2016. "A Prototype Airbag Safety Device to Prevent Accidental Injuries for Bike Riders." International Journal of Pharmacy and Technology 8 (2): 13501-13505.

[14.] Comparison of International Fatality Rates published by the Monash Injury Research Institute, Monash University, Australia (available at www.monash.edu.au/miri/research/reports/papers/fatals.html).

[15.] Accidental Deaths & Suicides in India, 1970 to 2013 published by the National Crime Records Bureau, Ministry of Home Affairs, Government of India, New Delhi.

[**16.]** Ashton, S. J., Mackay, G. M., 1983. Benefits from changes in vehicle exterior design, In: Proceedings of the Society of Automotive Engineers. Detroit, MI, Society of Automotive Engineers, pp. 255-264.

[**17.]** Bijleveld, F., Churchill, T., 2009. The influence of weather conditions on road safety. SWOV Institute for Road Safety Research, Leidschendam, the Netherlands; SWOV Publication R-2009-9: 1-49. (available at http://www.swov.nl/rapport/R-2009-09.pdf).

[**18.]** Comparison of International Fatality Rates published by the Monash Injury Research Institute, Monash University, Australia (available at www.monash.edu.au/miri/research/reports/papers/fatals.html).

[19.] Mohan, D. and Tiwari, G (2000). Road safety in less motorized countries- Relevance of international vehicle highway safety standards. International conference on vehicle safety 2000, pp. 155-166. London: Institution of Mechanical Engineers.

[20.] World Health Organization. Global Status Report on Road Safety 2013: Supporting a decade of action, 2013. Available from: http://www.who.int/violence_injury_prevention/road_safety_status/2013/en/

[21.] Chatterjee P. India's Supreme Court tells government to improve road safety record. BMJ. 2014 May 12;348: g3254. doi: 10.1136/bmj. g3254. PubMed PMID: 24821491. [PubMed].

[22.] Report on Road Accidents in India 2017, Ministry of Road Transport and Highways, Transport Research Wing, Govt. of India.

[23.] Accidental deaths and suicides in India 2000. 1-178. 2002. New Delhi. National Crime Records Bureau, Ministry of Home Affairs.

[24.] NCRB [NATIONAL CRIME RECORDS BURAEU]. (2007) Accidents, deaths and suicides in India. New Delhi: Ministry of Home Affairs, National crime records bureau.