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STATISTICAL STUDY OF PUBLIC HEALTH DISASTER DUE TO ROAD TRAFFIC ACCIDENTS IN INDIA

Pitambar Y. Patil [1]

[1] Associate Professor of Statistics, Devchand College, Arjunnagar–591237, India

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Corresponding Author
Pitambar Y. Patil,
pypatil@rediffmail.com

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ABSTRACT

This research article studies the general trend of traffic accidents on Indian roads for the last 28 years. The study includes accident severity, number of deaths, and injuries due to accidents. The rate of accidents, deaths, and injuries are studied concerning population, number of registered vehicles, and road length. Monthly and timely indices are computed for the number of accidents to study which months of a year and time durations of a day show more accidents than its average and with what percentage? We study the general trend of accidents in rural and urban areas and see which categories of vehicles are more vulnerable to accidents in Million Plus Cities. Comments and suggestions are given to minimize road accidents and avoid serious consequences.

Keywords: Accidents, Deaths and Injuries, Accident Severity, Monthly and Timely Indices, Vulnerable Vehicles

1. INTRODUCTION

Any activity of every human being is for his/her wellbeing as well as wellbeing of his /her civilization. Field of medical science is also functioning for the well being of human health. One of the outcome of this, due to research in this field, is that the life expectancy of an Indian in the year 2019 is increased to 70.8 years WHO (2023). That is, in a normal course of life, an Indian citizen can survive peacefully on an average up to 70.8 years. Transportation is one of the obvious activity in human life and a road transportation is an essential part of it. In India, events of road accidents are very serious and its consequences are very miserable. Due to accidents, we are

losing precious lives and creating lifelong injuries to some individuals involved in accidents. In 2021, 47 road accidents occured, 18 citizens were killed and 44 injured every hour on Indian roads as per officially reported data Ministry of Road Transport and Highways Transport (2023).

These untimely deaths and injuries to citizens, usually belongs to earning age group: 18 to 60 years, contradict to human wellbeing. In this article we take statistical review of these events.

Throughout this article we refer to annual reports of Ministry of Road Transport and Highways Transport Wing, Government of India for the years 2008 to 2021 as a secondary data source and World Health Organization Reports for the years 2020 and 2023.

Many factors are involved into the incidence of an accident. Since we consider secondary data, there are some limitations on availability of statistical information on some factors, so we consider only few of these factors in this article. We study accidents occurred in India over past 27-28 years with respect to:

1) Number of accidents, fatal accidents, injuries and severity.
2) Number of accidents, fatal accidents, injuries per lakh population.
3) Number of accidents, fatal accidents, injuries per ten thousand registered vehicles.
4) Number of accidents, fatal accidents, injuries per ten thousand km of road length.
5) Duration of accident in a day and month of a year.

Also, we study trend of number of accidents and its percentage share in urban and rural areas during the years 2008 to 2021. We observe share of accidents, fatalities and injuries by type of impacting vehicle in million plus cities.

2. METHOD OF STUDY

This study is mere data oriented. We simply rearranged statistical data on various factors responsible for accident in chronological order which is already published by Ministry of Road Transport and Highways Transport Wing, Government of India for various years Ministry of Road Transport and Highways Transport (2023). We compute averages of observations for given period, percentage of contributions of different categories/ classes with respect to totality of all and indices with respect to overall average for some factors. Table 1 to Table 6 are prepared below and observations are made with respect to various factors under study.

Table 1

Table 1 Yearwise Human Population, Registered Vehicles, Road Length etc.

Year	P	V	L (in KM)	A	D	I	S
1	2	3	4	5	6	7	8
1994	904000000	27660000	2890950	325864	64463	311500	20
1995	924359000	30295000	2975035	351999	70781	323200	20
1996	941579000	33786000	3202515	371204	74665	369502	20
1997	959792000	37332000	3298788	373671	76977	378361	21
1998	978081000	41368000	3228356	385018	79919	390674	21

1999	996130000	44875000	3296650	386456	81966	375051	21
2000	1014825000	48857000	3316078	391449	78911	399265	20
2001	1028610000	54991000	3373520	405637	80888	405216	20
2002	1045547000	58924000	3426603	407497	84674	408711	21
2003	1062388000	67007000	3528654	406726	85998	435122	21
2004	1079117000	72718000	3621507	429910	92618	464521	22
2005	1095722000	81502000	3809156	439255	94968	465282	22
2006	1112186000	89618000	3880651	460920	105749	496481	23
2007	1128521000	96707000	4016401	479216	114444	513340	24
2008	1144734000	105353000	4109592	484704	119860	523193	25
2009	1160813000	114951000	4471510	486384	125660	515458	26
2010	1176742000	127746000	4582439	499628	134513	527512	27
2011	1210193000	141866000	4676838	497686	142485	511394	29
2012	1208116000	159491000	4865394	490383	138258	509667	28
2013	1223581000	181508000	5231922	486476	137572	494893	28
2014	1238887000	190704000	5402486	489400	139671	493474	29
2015	1254019000	210023000	5472144	501423	146133	500279	29
2016	1268961000	230031000	5603293	480652	150785	494624	31
2017	1283601000	253311000	5897671	464910	147913	470975	32
2018	1298043000	272988000	6215797	467044	151417	469418	32
2019	1312241000	297190000	6331757	449002	151113	451361	34
2020	1326155000	326299000	N.A.	366138	131714	348279	36

P= Population, V= Registered Vehicles, L = Road Length (in KM), A= Number of Accidents, D = Number of Deaths, I = Number of Injuries, **S: Accident Severity** = Number of Persons Killed per 100 Accidents. N.A. = Not Available.

From Table 1: Over the twenty-seven years i.e. 1994 to 2020, population of nation, number of registered vehicles and road length are increasing. Also, general trend of number of accidents, number of deaths and injuries due to accidents are increasing. Number of persons killed per 100 accidents (i.e. accident severity) is also increasing. Number of persons killed and accident severity in the year 1994 are 64463 and 20 respectively; and these respective numbers in the year 2020 are further increased to 131714 and 36, which is very serious.

Table 2

Table 2 Rates of Accidents, Deaths and Injuries

Year	A/LP	A/10KV	A/10KL	D/LP	D/10KV	D/10KL	I/LP	I/10KV	I/10KL
1	2	3	4	5	6	7	8	9	10
1994	36.0	117.8	1127.2	7.1	23.3	223.0	34.5	112.6	1077.5
1995	38.1	116.2	1183.2	7.7	23.4	237.9	35.0	106.7	1086.4
1996	39.4	109.9	1159.1	7.9	22.1	233.1	39.2	109.4	1153.8
1997	38.9	100.1	1132.8	8.0	20.6	233.3	39.4	101.4	1147.0
1998	39.4	93.1	1192.6	8.2	19.3	247.6	39.9	94.4	1210.1

1999	38.8	86.1	1172.3	8.2	18.3	248.6	37.7	83.6	1137.7
2000	38.6	80.1	1180.5	7.8	16.2	238.0	39.3	81.7	1204.0
2001	39.4	73.8	1202.4	7.9	14.7	239.8	39.4	73.7	1201.2
2002	39.0	69.2	1189.2	8.1	14.4	247.1	39.1	69.4	1192.8
2003	38.3	60.7	1152.6	8.1	12.8	243.7	41.0	64.9	1233.1
2004	39.8	59.1	1187.1	8.6	12.7	255.7	43.0	63.9	1282.7
2005	40.1	53.9	1153.2	8.7	11.7	249.3	42.5	57.1	1221.5
2006	41.4	51.4	1187.7	9.5	11.8	272.5	44.6	55.4	1279.4
2007	42.5	49.6	1193.1	10.1	11.8	284.9	45.5	53.1	1278.1
2008	42.3	46.0	1179.4	10.5	11.4	291.7	45.7	49.7	1273.1
2009	41.9	42.3	1087.7	10.8	10.9	281.0	44.4	44.8	1152.8
2010	42.5	39.1	1090.3	11.4	10.5	293.5	44.8	41.3	1151.2
2011	41.1	35.1	1064.2	11.8	10.0	304.7	42.3	36.0	1093.5
2012	40.6	30.7	1007.9	11.4	8.7	284.2	42.2	32.0	1047.5
2013	39.8	26.8	929.8	11.2	7.6	262.9	40.4	27.3	945.9
2014	39.5	25.7	905.9	11.3	7.3	258.5	39.8	25.9	913.4
2015	40.0	23.9	916.3	11.7	7.0	267.0	39.9	23.8	914.2
2016	37.9	20.9	857.8	11.9	6.6	269.1	39.0	21.5	882.7
2017	36.2	18.4	788.3	11.5	5.8	250.8	36.7	18.6	798.6
2018	36.0	17.1	751.4	11.7	5.5	243.6	36.2	17.2	755.2
2019	34.2	15.1	709.1	11.5	5.1	238.7	34.4	15.2	712.9
2020	27.6	11.2	N.A.	9.9	4.0	N.A.	26.3	10.7	N.A.

A/LP = Number of Accidents per Lakh Population.
A/10KV = Number of Accidents per Ten Thousand Registered Vehicles.
A/10KL = Number of Accidents per Ten Thousand KM Length of Road.
D/LP = Number of Accidental Deaths per Lakh Population.
D/10KV = Number of Accidental Deaths per Ten Thousand Registered Vehicles.
D/10KL = Number of Accidental Deaths per Ten Thousand KM Length of Road.
I/LP = Number of Individuals Injured in Accident per Lakh Population.
I/10KV = Number of Individuals Injured in Accident per Ten Thousand Registered Vehicles.
I/10KL = Number of Individuals Injured in Accident per Ten Thousand KM Length of Road.

From Table 2: Rates of Accidents, Deaths and Injuries with respect to Population, Number of Registered Vehicles and Road Length are computed for the years 1994 to 2020. All these rates are decreasing except the Deaths per Lakh Population. It is surprising to observe that only Deaths per Lakh Population are increasing from 7.1 in the year 1994 to 11.5 in the year 2019. This rate is decreased to 9.9 for the year 2020 which is more likely due to overall reduction in transportation during lockdowns due to Covid-19 pendamic.

Table 3

Table 3 Monthly Indices of Accidents

Year \ Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2014	41,954	39899	42,524	39,867	45,404	42,448	38,916	39,213	37,360	39,791	40,040	41,984
2015	42,661	40,661	42,842	42,432	46,247	42,065	39,694	39,126	39,761	42,089	41,018	42,827

2016	41,749	40,765	42,843	42,010	43,368	39,489	37,881	37,729	36,929	39,952	38,505	39,432
2017	39,824	36,742	40,394	38,966	42,799	39,397	36,380	36,294	36,093	38,527	39,701	39,793
2018	41,780	38,238	40,640	40,841	42,730	39,176	36,991	35,845	35,387	38,238	38,417	38,761
2019	41,130	37,280	39,706	37,777	41,490	39,869	36,190	34,096	32,059	35,398	36,936	37,071
2020	39,527	39,055	31,967	7,855	19,924	27,442	27,264	29,319	31,042	34,918	38,089	39,736
2021	40,305	37,339	39,491	31,240	22,530	29,142	32,627	33,781	33,269	36,354	37,581	38,773
Average	**41,116**	**38,747**	**40,051**	**35,124**	**38,062**	**37,379**	**35,743**	**35,675**	**35,238**	**38,158**	**38,786**	**39,797**
Monthly Index	**108.7**	**102.4**	**105.9**	**92.9**	**100.6**	**98.8**	**94.5**	**94.3**	**93.2**	**100.9**	**102.5**	**105.2**

From Table 3: Over the eight years 2014 to 2021, if we classify road accidents with respect to their occurrence months in a year, we observe their periodic pattern with periodicity of one year. Majority of accidents took place in the month of January. Monthly index of number of accidents for the month of January is 108.7. Monthly indices of number of accidents for the months October to March is above 100 whereas these indices are close to 100 or less than 100 for April to September.

Table 4

Table 4 Timely Indices of Accidents

Year \ Time	6 to 9 (Day)	9 to 12 (Day)	12 to 3 (Day)	3 to 6 (Day)	6 to 9 (Night)	9 to 12 (Night)	12 to 3 (Night)	3 to 6 (Night)
2014	53,450	78137	76,384	84,436	83,254	52,570	29,179	31,990
2015	55,518	81,964	79,616	87,819	86,836	51,425	27,954	30,291
2016	54,522	75,771	73,380	85,834	84,555	50,970	25,976	29,644
2017	51,551	71,426	71,594	82,456	85,686	85,686	25,050	27,580
2018	51,489	70,211	71,392	81,619	86,986	49,162	25,407	26,571
2019	49,165	66,767	67,623	78,513	86,452	48,370	23,573	25,187
2020	39,435	54,496	56,090	65,263	73,607	36,432	18,003	18,921
2021	43,370	61,387	63,139	73,467	85,179	41,092	19,682	20,120
Average	**49,813**	**70,020**	**69,902**	**79,926**	**84,069**	**51,963**	**24,353**	**26,288**
TI-1	87.3	**122.8**	**122.5**	**140.1**	**147.4**	91.1	42.7	46.1
TI-2	73.9	**103.9**	**103.7**	**118.6**	**-**	**-**	**-**	**-**
TI-3	70.4	99.0	98.8	**113.0**	**118.8**	**-**	**-**	**-**

TI–1 = Timely Index for an entire day of 24 Hrs, **TI–2 =** Timely Index for Day Time only, **TI–3 =** Timely Index for 6:00 AM to 9:00 PM.

From Table 4: Over the eight years 2014 to 2021, if we classify road accidents with respect to their occurrence time in a day of 24 hours, we observe their periodic behaviour with periodicity of 24 hours. Majority of accidents took place during 9:00 AM to 9:00 PM and it is not beyond the expectation because frequency of transportation is more in this time interval. But, within these time intervals most accidents took place during 6:00 PM to 9:00 PM and Timely Index of number of accidents occurred during 6:00 PM to 9:00 PM are 147.4 which is followed by Timely Index of number of accidents occurred during 3.00 PM to 6.00 PM are 140.1. It indicates that the time durations 3:00 PM to 6:00 PM and 6:00 PM to 9:00 PM are more unfavourable for driving and these durations contribute more by 47.4% and 40.1% respectively than average accidents in 24 hours of a day.

If we restrict to observe accidents only in Day Time then leading time duration of occurance of accidents is 03:00 PM to 06:00 PM with its Timely Index is equal to 118.8. That is, around 19% more accidents occure during 03:00 PM to 06:00 PM than average number of accidents of a Day Time.

If we restrict to observe accidents during maximum transportation duration of a Day, i.e. 06:00 AM to 09:00 PM, then leading time duration of occurance of

accidents is 06:00 PM to 09:00 PM with its Timely Index is equal to 118.8, which is followed by a time duration 03:00 PM to 06:00 PM with its Timely Index is equal to 113.

Table 5

Table 5 Accidents by Type of Impacting Vehicle in Million Plus Cities During 2021			
Vehicle type	**No. of Accidents (% Share)**	**Persons killed (% Share)**	**Persons Injured (% Share)**
Pedestrian	**13,755 (20.4%)**	**3,786 (24.7%)**	**11,972 (20.4%)**
Bicycle	1,602 (2.4%)	546 (3.6%)	1,341 (2.3%)
Two Wheeler	**28,819 (42.8%)**	**6,488 (42.3%)**	**29,067 (49.5%)**
Auto Rickshaw	3,365 (5.0%)	672 (4.4%)	3,075 (5.2%)
Car/Taxis/Vans & LMV	9,906 (14.7%)	1,615 (10.5%)	6,202 (10.6%)
Truck/Lorry	2,773 (4.1%)	666 (4.3%)	1,392 (2.4%)
Bus	1,945 (2.9%)	379 (2.5%)	1,498 (2.5%)
Other Non-Motorized Vehicles	1,546 (2.3%)	392 (2.6%)	1,757 (3.0%)
Others	3,590 (5.3%)	806 (5.3%)	2,454 (4.2%)

From Table 5: During the year 2021 for Million plus Cities, first two categories of vehicles can be ordered according to their involvement in accidents are Two Wheelers, followed by Pedestrians. Average share of accidents due to Two Wheelers and Pedestrian is 43% and 20% respectively. Whereas average share of killings of individuals using Two Wheelers and Pedestrians is 42% and 25% respectively. These numbers are comparatively very small for other category of vehicles.

Table 6

Table 6 Accidents in Rural and Urban Area					
Year	**Urban Area**		**Rural Area**		**Total**
	Number	**% Share**	**Number**	**% Share**	
1	**2**	**3**	**4**	**5**	**6**
2008	2,28,009	47.0	2,56,695	53.0	4,84,704
2009	2,30,687	47.4	2,55,697	52.6	4,86,384
2010	2,33,757	46.8	2,65,871	53.2	4,99,628
2011	2,31,455	46.5	2,66,231	53.5	4,97,686
2012	2,23,933	45.7	2,66,450	54.3	4,90,383
2013	2,22,883	45.8	2,63,593	54.2	4,86,476
2014	2,26,415	46.3	2,62,985	53.7	4,89,400
2015	2,31,894	46.2	2,69,529	53.8	5,01,423
2016	2,12,346	44.6	2,63,839	55.4	4,76,185
2017	1,95,723	42.1	2,69,187	57.9	4,64,910
2018	1,90,956	40.9	2,76,088	59.1	4,67,044
2019	1,78,062	39.7	2,70,940	60.3	4,49,002
2020	**1,78,062**	**44.1**	**2,25,825**	**55.9**	**4,03,887**
2021	1,52,586	37.0	2,59,846	63.0	4,12,432

From Table No. 6: During the years 2008 to 2021, number of accidents in Rural Area are always dominating to that of Urban Area. There is an increasing trend in number of accidents in Rural Area, whereas decreasing trend in number of accidents in Urban Area.

Using the above observations about general trends, averages and indices we make some concluding remarks and suggestions to minimize accidets in the following sections.

3. CONCLUSION AND SUGGESTIONS

Above section shows the increasing trend of road accidents, killings and injuries of citizens and severity of accident. Ultimately, these deaths and injuries to citizens, usually belongs to earning age group: 18 to 60 years. It is a loss of human resources and G.D.P. of nation as well. It is emotional as well as an economical loss to their beloved and families, which is very serious. These incidents can be minimized off course by implementing existing traffic rules very strictly. Also, form the above observations we make some conclusions and suggestions as below:

Government is minimizing traffic density on road by widening of existing roads and/ or increasing roads though registered vehicles are increasing. As a result, number of accidents per ten thousand registered vehicles and number of accidents per ten thousand KM length of road are both decreasing. But, number of accidental deaths per lakh population are increasing. It is more likely due to careless and irresponsible driving attitude of drivers and sevirity of accidents. This is more serious cause, so this attitude should be changed. It is necessary to conduct mandatory periodic orientation course for drivers and stringent tests to examine their driving skills before issuing them a regular driving licence. It is necessary to make them aware about their responsibility. Implimenting heavy penalty and confiscating driving licence of driver or motor cyclist for some period at his/ her first mistake will be the best punishment to avoid road accidents.

More accidents due to motor cycles and Pedestrians may be due to undisciplined way of riding bikes and careless road crossing or walking on road. Well disciplined way of driving, avoiding mobile handling during driving, wearing of helmets and fastening seat belts can minimize number of accidents along with deaths and injuries to some extent. It will be more safe to use public buses, therefore Government should increase frequency and quality of public transportation facilities.

Accidents during 6:00 PM to 9:00 PM are maximum which is followed by the duration 3:00 PM to 6:00 PM. This may be due to more road traffic intensity and tiredness of driver as if he/she is driving for full day.

Accidents during 6:00 PM to 9:00 PM are maximum, these may be due to transition phase from day to night which may cause difficulty in visibility of drivers.

So, sufficient rest and/or rest between some intervals for driver is must. Precise inference will be possible if further splitting of time duration is made during data collection phase.

Monthly indices of accidents in the months of October to March are more than 100. It may be due to majority of the people prefer to arrange tours during these months of clear and pleasant weather conditions as compared to other months. During these months drivers drive or motor cyclist ride carelessly as compared to unfavourable weather conditions. Over speeding is also a major cause of accidents. So, it is necessary to become more careful and responsible while driving in these months though weather conditions are pleasant.

Trend of road accidents in rural area are increasing whereas it is decreasing in urban area. It may be due to road conditions in rural area is comparativle bad and unskilful drivers in this area. So, it is necessary to increase road quality and orientation of drivers in rural area.

We should have made roads safer for all citizens because a large percentage of population – children, pedestrians, cyclists, motorcyclists, and the elderly – are most vulnerable. Ranbir Pal et al. (2019).

We Indians believe that we must be always alert at every walk of life to avoid any mishappening, similarly every driver or motor cyclist or pedestrian must be 100% alert whenever he/ she is on the road to avoid accidents and loss of precious lives.

CONFLICT OF INTERESTS

None.

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