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Road Accidental Analysis: A Case Study of Rajasthan State, India

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Abstract : *Today, according to the World Health Organization (WHO), motor vehicle crashes kill about 1.2 million people each year. That is set to rise to 2 million by 2020 unless new safety measures are taken, making road traffic injuries the third largest cause of death and disability. The present paper reviews on the road accidental analysis in the state of Rajasthan, India. In order to appreciate the scale of the problem in the state, it is common practice to relate the number of road accidents and deaths to demographic and vehicles in districts (administrative unit of a state) of Rajasthan.*

Keywords: *Deaths, Fatality Rate, Fatality Risk, Road Accidents, Severity Index*

I. Introduction

Nearly 1.3 million people die every year on the world's roads, and up to 50 million are injured.[1] Traffic fatalities measured by the proxy of motor vehicle registrations and population, increasing traffic volume leads to an increase in fatalities per capita .[2][3] In India , the motor vehicle population is growing at a faster rate than the economic and population growth. The road network facing the problem of road accidents with the expansion in motorisation. [4] Various studies already have been done to linking road traffic fatalities with vehicle ownership, regional population and economic growth. [5][6][7][8][9]This paper discusses the use of data of road accidents to evaluate the effectiveness of countermeasures and to compare the safety of different districts of Rajasthan state in different periods of time.[10][11] during this period risk factors in different districts have been compared[12] It is observed that few works have been carried out on statistical analysis of accidents particularly on two-lane National Highways. Various indices to measure fatalities also have been applied on National Highways of the state. [13][14][15]. Secondary data of population, registered vehicles and road accidents have been obtained from various government departments of India. [16][17][18]

Rajasthan state is one of the most attractive destinations in India and has a prominent place on the tourist map of the world. Rajasthan is the largest state in the country in terms of geographical area, which constitutes 10.41 per cent area of the country and 5.67 per cent of national population (census 2011). Healthy transport system is an indicator of economic health and development of a state. As on 31st March, 2012, the total length in the state is expected to be 190402 Kms. The road density in the state is expected to be 55.63 km per 100 sq. km. share of registered vehicles in state is 5.65% of total of the India.

II. Result And Discussion

Traffic accidents are major problem both in developed and developing countries. Road accident is becoming more and more common in today's society and contributes to a significant number of deaths as the result. Current traffic safety conditions in India are extremely serious. According to N**ation**al Crime Record Bureau total incidences of accidental deaths due to natural and un-natural causes increased 1.4 times, while no. of deaths due to road accidents increased 1.7 times from 2001 to 2011. The share of road accidental deaths has increased from 29.61% in 2001 to 35.01% in 2011 (Fig.1).

Table 1: Incidence of Accidental Deaths by Natural and Un-Natural Causes in India

Year	Natural Causes (A)	Un-Natural Causes			Total (A+B)	Share of Road Accidents in Total Incidences
		Other Un-Natural	Road Accidents	Total Un- Natural (B)		
2001	36651	154106	80262	234368	271019	29.61%
2011	23690	230360	136834	367194	390884	35.01%

Source: National Crime Record Bureau, Govt. of India

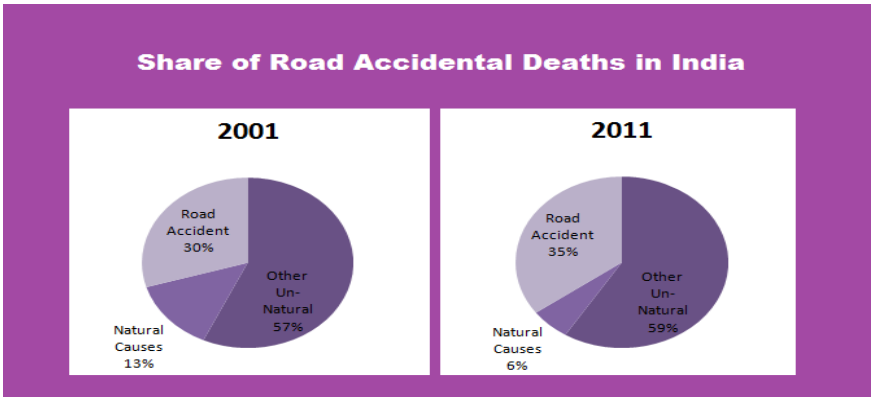

Figure 1: Share of Road Accidental Deaths in India (2001 and 2011)

Table 2: Decadal Growth of Population and Registered Vehicles

Country /State	Population (in millions)		Decadal growth	Registered vehicles (in thousands)		Decadal growth
	2001	2011		2001	2011	
India	1028.61	1210.19	17.64%	54991	114953	109.03%
Rajasthan	5.65	6.85	21.31%	2943	6490	120.52%

Source: Census, Govt. of India

Rapid growth of population coupled with increased economic activities has favoured in tremendous growth of motor vehicles. From 2001 to 2011 growth of population in India is 17.64%, while it is 21.31% in Rajasthan. Population increased 1.2 times, which is equal both in India and Rajasthan, while there has been more than two fold increase in number of registered vehicles. It means number of vehicles per person is increased (Table 2).

Table 3 displays number of road accidents and number of deaths occurred in India and Rajasthan during these years. Growth of road accidental cases is 35.96% in India, while it is 16.23% in Rajasthan. Decadal growth in number of deaths due to road accident is very high both in India and Rajasthan, which is 70.48% and 77.98% respectively.

Table 3: Decadal Growth in Number of Road Accidents and Deaths

Country /State	No. of cases of road accidents		Decadal growth	No. of deaths due to road accident		Decadal growth
	2001	2011		2001	2011	
India	323720	440123	35.96%	80262	136834	70.48%
Rajasthan	19999	23245	16.23%	5187	9232	77.98%

Source: National Crime Record Bureau, Govt of India

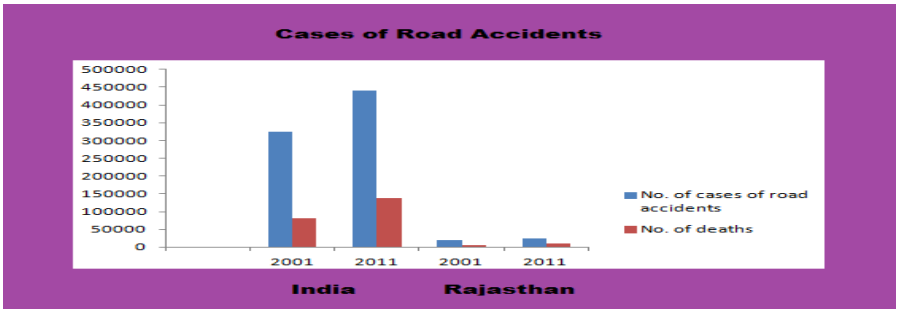

Figure 2: No. of Road Accidents and No. of Deaths due to Road Accidents during these years

Fig. 2 shows that the decadal growth in number of road accidental cases in India is higher than in Rajasthan. But decadal growth in number of deaths due to road accidents in India is lower than in Rajasthan, which shows greater severity in Rajasthan.

The accident severity index measures the number of deaths per 100 road accidents. From 2001 to2011 it increased 1.25 times in India, while 1.5 times in Rajasthan. Fatality risk is defined as number of deaths per 1,00,000 population. During this decade it increased 1.5 times both in India and Rajasthan. Fatality rate is defined as number of deaths per 1,000 vehicles, which decreased in this decade (Table 4). These formulas were used for estimating road accidents in districts of Rajasthan

Table 4: Analysis of Road Accidents through various Indices

Country /State	Severity Index		Fatality Risk		Fatality Rate	
	2001	2011	2001	2011	2001	2011
India	24.79	31.09	7.80	11.31	1.46	1.19
Rajasthan	25.94	39.72	9.18	13.47	1.76	1.42

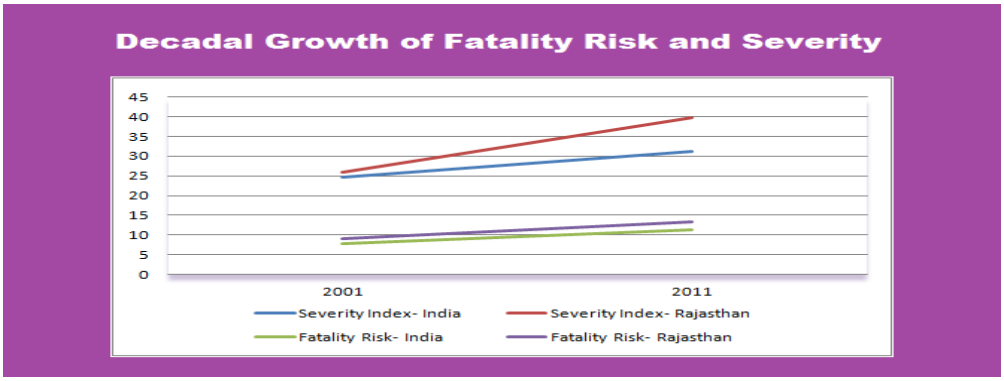

Figure 3: Severity Index and Fatality Risk in India and Rajasthan

It can be seen in Fig.3 that severity index, fatality rate and fatality risk of India and Rajasthan have been increased and the value of these indices is higher in Rajasthan than in India.

The Rajasthan has thirty three districts, which are administrative units of a state. Population of 2011 and number of registered vehicles of 2012 of various districts are obtained from Census, Govt. of Rajasthan and Department of Transport, Govt. of Rajasthan respectively. Districts have been classified in various categories according to their obtained values of fatality risk and fatality rate (Table 5).

Table 5: Fatality Risk and Fatality Rate in Different Districts of Rajasthan

S.No.	District	Population (2011)	Fatality Risk (2011)	Vehicles registered(2012)	Fatality Rate (2012)
1.	Ajmer	2583052	20.05	581133	1.00
2.	Alwar	3674179	14.29	476038	1.15
3.	Banswara	1797485	9.40	184618	0.86
4.	Baran	1222755	10.96	191008	0.78
5.	Barmer	2603751	10.06	139361	1.85
6.	Bharatpur	2548462	11.18	269116	1.02
7.	Bhilwara	2408523	14.08	414977	0.85
8.	Bikaner	2363937	13.58	319845	1.13
9.	Bundi	1110906	14.04	150748	0.98

10.	Chittorgarh	1544338	14.18	278492	0.90
11.	Churu	2039547	11.62	106652	2.71
12.	Dausa	1634409	19.76	143618	1.80
13.	Dholpur	1206516	11.44	87671	1.79
14.	Dungarpur	1388552	9.58	130118	1.21
15.	Ganganagar	1969168	10.82	330149	0.61
16.	Hanumangarh	1774692	11.27	134694	1.10
17.	Jaipur	6626178	19.65	1999625	0.61
18.	Jaisalmer	669919	10.45	42706	1.97
19.	Jalore	1828730	6.99	124378	1.23
20.	Jhalawar	1411129	8.36	150070	1.0
21.	Jhunjhunu	2137045	10.90	180274	1.31
22.	Jodhpur	3687165	14.16	771244	0.79
23.	Karauli	1458248	8.16	78701	1.75
24.	Kota	1951014	11.89	542768	0.39
25.	Nagaur	3307743	10.94	275303	1.20
26.	Pali	2037573	15.99	274649	1.37
27.	Pratapgarh	867848	9.79	46046	1.78
28.	Rajsamand	1156597	17.72	134620	1.58
29.	Sawai Madhopur	1335551	8.46	131714	0.80
30.	Sikar	2677333	14.30	211313	1.94
31.	Sirohi	1036346	23.06	115625	1.79
32.	Tonk	1421326	12.31	224468	0.89
33.	Udaipur	3068420	14.60	561541	0.88
Total	Rajasthan	68548437	13.47	9803283	0.97

Source: Transport Department, Govt. of Rajasthan

Fatality risk shows relation between numbers of death occurred due to road accident and population. Average value of fatality risk in Rajasthan is 13.47 in 2011. Here six categories for fatality risk have been identified for districts of Rajasthan. There are 11 districts in category of 10-12, which is maximum in number and 4 districts having fatality risk more than 18 (Table 6).

Fatality rate is defined as a number of death per thousand vehicles. In Rajasthan average value of fatality rate is 0.97 in year 2012. Districts of Rajasthan have been classified in seven categories of fatality rate. Table 7 presents that there are 11 districts having fatality rate between 0.75 to 1.0 and only district named Churu, having fatality rate more than 2.0.

Table 6: No. of Districts according to Categories of Fatality Risk

S. No.	Category	District	No. of Districts
1.	> 10	Banswara, Dungarpur, Jalore, Jhalawar, Karauli Pratapgarh, Sawai- Madhopur	7
2.	10 - 12	Baran, Barmer, Bharatpur, Churu, Dholpur, Ganganagar, Hanumangarh, Jaisalmer, Jhunjhunu, Kota, Nagaur	11
3.	12 - 14	Tonk, Bikaner	2
4.	14 - 16	Alwar, Bhilwara, Bundi, Chittorgarh, Jodhpur, Pali Sikar, Udaipur	8
5.	16 - 18	Rajsamand	1
6.	18 <	Ajmer, Dausa, Jaipur, Sirohi	4

Table 7: No. of Districts according to categories of Fatality Rate

S. No.	Category	District	No. of Districts
1.	> 0.75	Ganganagar, Jaipur, Kota	3
2.	0.75 – 1.0	Ajmer, Banswara, Baran, Bhilwara, Bundi, Chittorgarh, Jhalawar, Jodhpur, Sawai Madhopur Tonk, Udaipur	11
3.	1.0 – 1.25	Alwar, Bharatpur, Bikaner, Dungarpur, Hanumangarh, Jalore, Nagaur	7
4.	1.25 – 1.5	Jhunjhunu, Pali	2
5.	1.5 – 1.75	Rajsamand, Karauli	2
6.	1.75 - 2.0	Barmer, Dausa, Dholpur, Jaisalmer, Pratapgarh Sikar, Sirohi	7
7.	2.0 <	Churu	1

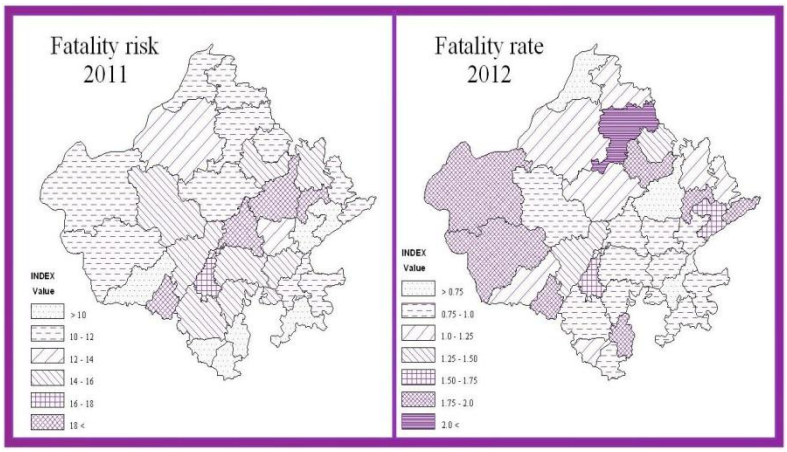

Figure 4: Fatality Risk and Fatality Rate in Districts of Rajasthan

Table 8: Severity Index in Various Districts of Rajasthan (2011 & 2012)

S.No.	District	No. of cases of road accidents (2011)	No. of deaths (2011)	Severity Index (2011)	No. of cases of road accidents (2012)	No. of deaths (2012)	Severity Index (2012)
1.	Ajmer	1439	518	35.99	1335	584	43.75
2.	Alwar	1192	525	44.04	1243	547	44.01
3.	Banswara	450	169	37.56	430	159	36.98
4.	Baran	498	134	26.91	557	149	26.75
5.	Barmer	509	262	51.47	479	258	53.86
6.	Bharatpur	585	285	48.71	531	275	51.79
7.	Bhilwara	878	339	38.61	889	352	39.60
8.	Bikaner	540	321	59.44	528	361	68.37
9.	Bundi	612	156	25.49	577	148	25.65
10.	Chittorgarh	600	219	36.5	633	250	39.49
11.	Churu	427	237	55.50	415	289	69.64
12.	Dausa	801	323	40.32	667	259	38.83
13.	Dholpur	293	138	47.09	325	157	48.31
14.	Dungarpur	299	133	44.48	326	158	48.47
15.	Ganganagar	434	213	49.07	392	209	53.32
16.	Hanumangarh	321	200	62.30	274	149	54.38
17.	Jaipur	4294	1302	30.32	4084	1227	30.04
18.	Jaisalmer	141	70	49.64	120	84	70.00
19.	Jalore	304	128	42.11	315	153	48.57
20.	Jhalawar	493	118	23.93	529	150	28.36
21.	Jhunjhunu	494	233	47.16	539	236	43.78
22.	Jodhpur	916	522	56.99	966	606	62.73
23.	Karauli	329	119	36.17	336	138	41.07
24.	Kota	946	232	24.52	988	214	21.66
25.	Nagaur	528	362	68.56	488	329	67.42
26.	Pali	790	326	41.27	821	377	45.92
27.	Pratapgarh	222	85	38.29	222	82	36.94
28.	Rajsamand	505	205	40.59	504	213	42.26
29.	Sawai Madhopur	364	113	31.04	349	106	30.37
30.	Sikar	867	383	44.17	938	409	43.60
31.	Sirohi	403	239	59.31	381	207	54.33
32.	Tonk	532	175	32.89	495	199	40.20
33.	Udaipur	1239	448	36.16	1293	494	38.21
Total	Rajasthan	23245	9232	39.71	22969	9528	41.48

Source : Transport Department, Govt. of Rajasthan

Severity Index measures the seriousness of the accidents and availability of medical facilities in the area. It was increased in 2012 as compared to previous year. There are 20 districts, where severity index slightly increased, but the rate increased highly in Churu and Jaisalmer districts, which was 1.3and 1.4 times respectively. Severity index decreased in 13 districts of Rajasthan from 2011 to 2012 (Table 8).

Table 9: No. of Districts according to categories of Severity Index (2011)

S.No.	Category	District	No. of Districts
1.	> 35	Baran, Bundi, Jaipur, Jhalawar, Kota, Sawai Madhopur, Tonk	7
2.	35 - 40	Ajmer, Banswara, Bhilwara, Chittorgarh, Karauli, Pratapgarh, Udaipur	7
3.	40-45	Alwar, Dausa, Dungarpur, Jalore, Pali, Rajsamand, Sikar	7
4.	45 - 50	Bharatpur, Dholpur, Ganganagar, Jaisalmer, Jhunjhunu	5
5.	50 - 55	Barmer	1
6.	55 <	Bikaner, Churu, Hanumangarh, Jodhpur, Nagaur, Sirohi	5

Table 9 and 10 displays the range of severity index in various districts of Rajasthan during these years. In 2012 the range has been expanded in compared to 2011.

Table 10: No. of Districts according to categories of Severity Index (2012)

S.No.	Category	District	No. of Districts
1.	> 30	Baran, Bundi, Jhalawar, Kota	4
2.	30 – 40	Banswara, Bhilwara, Chittorgarh, Dausa , Jaipur Pratapgarh, Sawai Madhopur, Udaipur	8
3.	40 – 50	Ajmer, Alwar, Jalore, Dholpur, Dungarpur, Jhunjhunu, Karauli. Pali, Rajsamand, Sikar, Tonk	11
4.	50 – 60	Barmer, Bharatpur, Ganganagar, Hanumangarh, Sirohi	5
5.	60 – 70	Bikaner, Churu, Jodhpur, Nagaur	4
6.	70 <	Jaisalmer	1

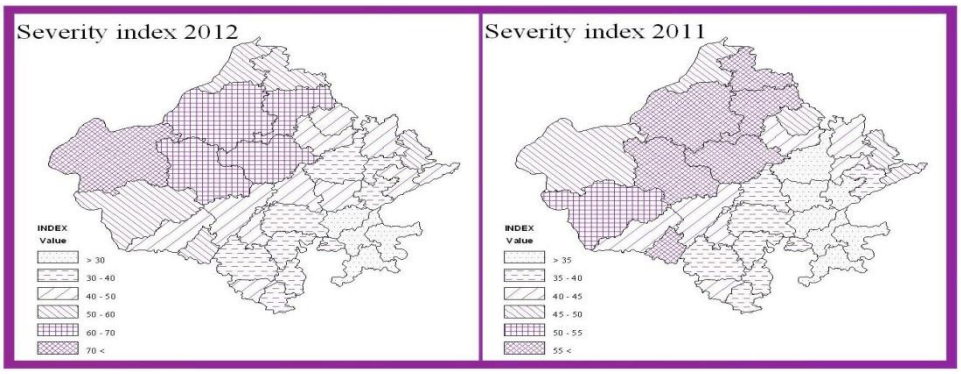

Figure 5: Severity Index of Rajasthan

Table 11: Severity Index in Various National Highways of Rajasthan (2011 & 2012)

S. No.	National Highway No.	2011			2012		
		No. of road accidents	No. of deaths	Severity	No. of road accidents	No. of deaths	Severity
1.	N.H.No.3	75	31	41.33	95	64	67.37
2.	N.H.No.8	1867	859	46.00	1758	922	52.45
3.	N.H.No.11	1260	623	49.44	1169	556	47.56
4.	N.H.No.11(A)	90	32	35.56	91	30	33.00
5.	N.H.No.11(AA)	3	2	66.67	2	1	50.00
6.	N.H.No.11(B)	105	45	42.85	109	35	32.11
7.	N.H.No.12	962	292	30.35	839	290	34.56
8.	N.H.No.14	550	262	47.64	426	231	54.22
9.	N.H.No.15	392	239	61.00	328	243	74.09
10.	N.H.No.65	347	210	60.52	377	234	62.07
11.	N.H.No.76	484	238	49.17	540	249	46.11
12.	N.H.No.79	421	237	56.29	409	217	53.06
13.	N.H.No.79(A)	54	28	51.65	50	22	44.00
14.	N.H.No.89	184	164	89.13	200	158	79.00
15.	N.H.No.90	59	17	28.81	56	13	23.21
16.	N.H.No.112	191	100	52.36	214	154	71.96
17.	N.H.No.113	135	55	40.74	162	59	36.42
18.	N.H.No.114	61	51	83.61	65	52	80.00
19.	N.H.No.116	33	8	24.24	26	7	26.92
		7273	3493	48.02	6916	3537	51.14

Source: Transport Department, Govt. of Rajasthan

There is marginal increase in severity index on National Highways from 48.02 in 2011 to 51.14 in 2012. But in both years average value of National Highways were comparatively higher than the average value

of Rajasthan, which was 1.2 times. In 2012 severity index of some National Highways were increased, while declined on others in comparison to 2011 (Table 12).

Table 12: Severity Index and Highways

Highways on which Severity Index increased	No.	Highways on which Severity Index decreased	No.
N.H.No.**3,** N.H.No.**8**, N.H.No.**12**, N.H.No.**14,** N.H.No.**15**, N.H.No.**65** N.H.No.**112**	8	N.H.No.**11**, N.H.No.**11A**, N.H.No.**11AA**, N.H.No.**11B**, N.H.No.**76**, N.H.No.**79**, N.H.No.**79(A)**, N.H.No.**89** N.H.No.**90**, N.H.No.**113**, N.H.No.**114**	11

III. Conclusion

Road accidents are a human tragedy. They involve high human suffering and monetary costs in terms of untimely death, injuries and loss of potential income. The present paper provides the magnitude and various dimensions of deaths of road accidental data in districts of Rajasthan. Rajasthan is the largest state of India in geographical perspective. In 2011, Rajasthan has accounted for 5.3% of total road accidents recorded in India, but it has accounted 6.8% of total fatalities. Fatality rate, fatality risk and severity index of Rajasthan are high in compared to India. The fatality risk of 13 districts is above than the average of Rajasthan, while 11 districts having fatality rate below the average of Rajasthan. The range of severity index of districts and National Highways of Rajasthan increased in 2012 as compared to previous year.

An attempt has been made to predict situation of fatalities among the districts of Rajasthan. This paper can help policy makers to make accidental management policy and implement remedial in the field of traffic safety.

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