Road Accidents in India: Need for Post Accident Health Care Facilities

Absar Alam

ABSTRACT

The paper attempts a causal analysis of road traffic accidents and related deaths with other macroeconomic indicators like percapita expenditure on health, motorisation and urbanisation, etc. using panel data regression for analysing data from all Indian states. The findings reveal that public expenditure on health services significantly and negatively affect fatalities in road crashes. This implies that there is a need for post accident health care facilities in most of the Indian states. It also establishes the fact that road crashes and fatalities on national highways attract special attention, especially the roads passing through rural areas. The study also highlights that there are states with relatively lower number of road accidents and higher number of deaths per accident. These states need policy measures in respect of post accident health care facilities. States with larger share in road accidents and related fatalities are equally important. The paper recommends for increasing expenditure on services like public transport and public health.

Key words: Transportation system, Safety and Accidents, Road Safety, Road Accidents, Accidental Deaths and Expenditure on Road Safety

1. Introduction

Road accident is one of the leading causes of deaths worldwide. Global status report of the year 2018 on road safety, published by World Health Organisation (WHO), highlights this fact. The report says that almost 1.35 million people died in road crashes in 2016. In the same year, road crashes emerged as the 8th largest cause of deaths in the world with 2.5 percent share in total deaths caused by all kind of diseases. This is almost the same scale of deaths caused by HIV/AIDS (WHO, 2018 and 2014). In India, total number of deaths due to road traffic crashes was estimated to be 147,913 in 2017 (MoRTH, 2017). Number of fatalities in road crashes increased by about ten-folds against the increase of total number of crashes by merely four-folds during the period from1970 to 2017 (MoRTH, 2017).

Demographic classification suggests, population below 35 years of age constituted more than 56 percent of the total deaths in road crashes (MoRTH, 2017), affecting the very young population of the country. Recognising this as a global threat, the member countries of the United Nations (UN) agreed to reduce the number of fatalities in road crashes by bringing it into the global commitments as enlisted in the Sustainable Development Goals (SDGs). Goal 3 of SDGs focuses on good health and well-being. Besides, the objective includes reducing the global deaths and injuries in road crashes by half during the next five years. This goal is directly linked with the road crashes. In addition to the goal 3.6, goal 11 of the SDGs advocates about sustainable cities and communities having indirect impact on road crashes.

Goal 11.2 stresses on the commitments to "*provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons".*

By 2030, these goals must be achieved. Goal 10.7 of SDGs aims at reducing inequality by "facilitating orderly, safe, regular and responsible migration and mobility of people, including the implementation of planned and well-managed migration policies". Keeping in mind, these direct and indirect SDGs, countries have pledged to tackle road crashes by adopting strategies and policies.

Based on the defined targets under SDGs, member states of the UN reached a consensus on the following 12 voluntary global performance targets on road safety risk factors and service delivery mechanism (WHO, 2018);

1. By 2020, all countries establish a comprehensive multi-sectoral national road safety action plan with time-bound targets.
2. By 2030, all countries accede to one or more of the core road safety-related UN legal instruments.
3. By 2030, all new roads must achieve technical standards for all road users that take into account road safety, or meet a three star rating or better.
4. By 2030, more than 75 percent of travel on existing roads is on roads that meet technical standards for all road users that take into account road safety.
5. By 2030, 100 percent of new (defined as produced, sold or imported) and used vehicles meet high quality safety standards, such as the recommended priority UN Regulations, Global Technical Regulations, or equivalent recognized national performance requirements.
6. By 2030, halve the proportion of vehicles travelling over the posted speed limit and achieve a reduction in speed related injuries and fatalities.
7. By 2030, increase the proportion of motorcycle riders correctly using standard helmets to close to 100 percent.
8. By 2030, increase the proportion of motor vehicle occupants using safety belts or standard child restraint systems to close to 100 percent.
9. By 2030, halve the number of road traffic injuries and fatalities related to drivers using alcohol, and/or achieve a reduction in those related to other psychoactive substances.
10. By 2030, all countries have national laws to restrict or prohibit the use of mobile phones while driving.
11. By 2030, all countries to enact regulation for driving time and rest periods for professional drivers, and/or accede to international/regional regulation in this area.
12. By 2030, all countries establish and achieve national targets in order to minimize the time interval between road traffic crash and the provision of first professional emergency care.

The above listed targets were devised under five important pillars i.e. a) road safety management, b) safer roads and mobility, c) safe vehicles, d) safe road users and e) post crash response. The target number 12 listed above comes under post crash response that relates to post accident health and emergency care. This paper deals with this particular aspect of strategies to deal with fatalities in road crashes. The paper empirically investigates causal relationship between expenditure on health care facilities and number of deaths in road crashes. For this purpose, it presents a panel data regression analysis using different indicators like accidental deaths, expenditure on health facilities, number of buses, etc. for all the States and Union Territories (UT) in India. It is important to mention here that India is comprised of several provinces called States and UT.

The paper also investigates the trend of road accidents on national highways, state highways, rural and feeder roads in India.[1] This analysis includes the examination of state wise number of road accidents, persons killed in road accidents, and persons injured. This analysis will help finding the vulnerable states and areas where the government needs to intervene in post accident healthcare facilities on priority level. In the next section, a brief review of existing literature is discussed.

2. Literature Review

There exist several studies on road accidents vital for strategies to tackle this serious problem. Some of the literature on road accidents has contradictory findings when compared to other researches carried out in this area. For instance, Agustus (2012) establishes that increase in the length of roads leads to the increase in road crashes. It concludes that the area with higher traffic volumes have higher rate of accidents as compare to the areas having low traffic volume. This finding is contradictory to Smeed's law. Smeed finds that increase in motorisation level leads to increase in fatalities per capita

[1] Indian roads are classified into five categories i.e. national highways, state highways, other PWD roads, rural roads, urban roads and project roads. National highways are main interregional/inter-provincial roads financed and managed by the Central Government. State highways are intra-provincial roads financed and managed by State Governments. PWD roads and rural roads are district roads connecting villages with district headquarters and other villages.

and decrease in fatalities per vehicles (Smeed, 1949). While, Andreassen (1985) revisits this conclusion and finds that Smeed's proposition is not viable for all countries and has no universal application.

Kopits and Cropper (2005) studied 88 countries based on their macro level data. It establishes causal relationship between the total number of fatalities on fatality rates per unit vehicle, vehicles per unit population, and per-capita income and also makes a projection of the future level of fatalities in road crashes as a result of changes in the level of income, population and motorisation.

Some of the researches on India highlight the causes of road crashes at national level. Findings establish that the higher the level of motorisation, higher will be the incidents of road crashes. Pramada (2004) presents empirical analysis of causes and factors leading road crashes in India. The paper is, however, confined to earlier empirical models and factors dealing with motorisation only. This study does not consider other factors like urbanisation, road design, traffic control, speed of vehicle, etc.

Mohan and Tiwari (2000) conclude that pedestrians, bicyclists, and motorized two-wheeler riders accounted for 60-90 percent of all traffic fatalities. Mohan et al. (2009) present both macro and micro level causes of accidents based on the city level data. They conclude that the pedestrians and users of non-motorised transport are more vulnerable as they are more exposed to road accidents than other road users. According to time, night time exposure of accidents on roads are lower than that of day time, yet night time crashes has higher share in fatalities (Tiwari et al. 1998). Indian cities with higher slow-moving traffic are unsafe due to absence of separate carriageway or lane for slow-moving traffic (Wilbur Smith Associates, 2008). The study also highlights the need for better traffic management in smaller and medium cities which have potential to reduce traffic crashes.

Rapid motorisation, lack of adequate design in road construction and driver's behaviour like drunk driving are among the leading causes of road crashes. In addition, other causes include lack of safety policies and measures as well as absence of coordination among government departments and road users. Kharola et. al (2010), based on crashes by buses, highlights factors leading to road accidents which includes bus design, absence of road crossing for pedestrians, lack of infrastructure for non-motorised transport, etc. This research also suggests that 71 percent of the total road crashes were two wheelers victims and were travelling in the same direction of buses. The case of cyclist is almost the same. It suggests the need for separate lanes for two wheelers and cycle users.

Revisiting the causes of traffic accidents in India, Grimm and Treibich (2012) empirically examined the causal relationship of road fatalities with macroeconomic indicators such as income, motorisation and urbanisation. Using panel data approach with data from 1989 to 2006, the study applies two way fixed effect models on the sample data for 26 states and UTs. The results established positive relationship between fatalities in road crashes and factors like motorisation, urbanisation and income. The study found that expenditure per policeman has significant and negative effect on road crashes suggesting higher the expenditure on policemen, lower the level of road crashes. However, a gap exists in literature examining causal relationship between expenditure on health services and fatalities in road crashes. This gap is partially filled by Garg and Hyder (2006). This study found that absolute burden of fatalities in road crashes is increasing in India and therefore recommended the arrangement of post accident health care facilities. Notwithstanding, there remains a gap in literature investigating relationship between expenditure on health services and deaths in road crashes. The current paper tries to fill this research gap. Its findings are likely to help policy makers in planning and executing strategies to tackle the issue of road crashes and resultant fatalities.

3. Data and Method

Two analytical dimensions are presented in this paper. First dimension outlines the current state of road accidents in India- at both national and regional levels. For analysis, the accidents related data was obtained from the Ministry of Road Transport and Highways, Government of India. The Ministry publishes annual data for road accidents which is available up to the year 2017. However, this paper presents an analysis of status on road accidents in India for the years 2006 to 2016. The paper also presents road accidents status in rural and urban areas using data for the period from 2006 to 2015 owing to the non-availability of latest data in this category. Data from the annual reports of the Ministry is the only source of data on road accidents in India. These reports have also provincial data of different years. There are no other sources of such data at state/provincial levels. Therefore, data from the Ministry is suitable for our analysis. However, one must be familiar with the fact that these data are collected by National Crime and Research Bureau (NCRB) based on reports to the agencies like police reports. There are possibilities of data variations between Government and other agencies.

The second dimension presented in this paper is related to post accidental health care facility through a panel data regression analysis. This exercise is based on causal relationship between variables like road crashes and resultant fatalities and per capita income, motorisation and planned expenditure in health sector. Data related to road crashes and fatalities was collected from the Ministry of Road Transport and Highways for the period of 2002-12.

This data is further normalised based on population data of all the States and UTs on the basis of growth rates between the 2001 and 2011- the years of two censuses. Data on motorisation i.e. increase in the numbers of motor vehicles were obtained from annual reports published by the Ministry for the period 2002-12. Per capita Net State Domestic Product (NSDP) at current price based on 2004-05 base year and per capita planned expenditure on health were calculated based on data from Reserve Bank of India (RBI) and Planning Commission (now NITI Aayog), Government of India, respectively. State wise density is taken from census data of 2001 and 2011 and estimated the same for the rest of the years based on the decadal growth for each state.

A panel data analysis was undertaken in the study using basic regression model as described in equation 1. This equation is further augmented with relevant variables incorporated therein as per equation 2.

$Y_{it} = \alpha_i + \beta_1 X_{it} + u_{it}$ -- (eq. 1)

Where,

α_i (i=1....n) is the unknown intercept for each entity .

Y_{it} is the dependent variable where i= entity and t= time.

X_{it} represents one independent variable.

β_1 is coefficient for the independent variable.

u_{it} is the error term.

Number of accidents/100,000 population= $\alpha + \beta_1 X + \beta_2 X_1 +$ ------$+X_8+\mu$-----------(eq. 2)

In case of fatalities in road crashes per 100,000 population we have used the same independent variables.

Where,

X **=** Per capita planned expenditure on health

X_1 = Per capita income

X_2 = Urbanisation (Urban population as percent of total population)

X_3 = Population density

X_4 = Motorisation (total motor vehicle/1000 population)

X_5 = Level of two wheelers penetration (total two wheelers/1000 population)

X_6 = Trucks/1000 population

X_7 = Buses/1000 population

X_8 = Cars/1000 population

Variables described in equation 2 were used for States and UTs except UTs like Daman and Diu, Dadar and Nagar Haveli and Lakshadweep. The data for expenditure on health related services for 2011 and 2012 are approved outlay whereas for the years prior to 2011 are actual expenditure. This exercise is not extended beyond 2012 due to the fact that the data on state-wise planned expenditure on health was not available. This is noted here that the Government of India has abolished planning in the year 2014. Therefore, expenditure data has huge differences owing to the fact that now expenditure on health includes both planned and non-planned expenditure. On the other hand, the Government has also revised its base year from 2004-05 to 2011-12 which has made the recent year income data not compatible to the data prior to 2012.

4. State of Road Accidents in India

Increase in the number of road crashes in India call for an adequate strategies and policy interventions. There is a need for systematic method for data collection on road accidents. As highlighted earlier that the statistics are based on the incidents of accidents reported to the NCRB. Thus, a constraint exists before devising policies and strategies for safety related measures using the data used for the current research. Yet, despite the constraints of this data and discrepancies associated with it, National Transport Development Policy Committee (NTDPC) has formulated long term strategies to tackle accidents for all modes of transport including Airways, Railways, Waterways and Roads using the same data and sources. However, the report by the committee calls for appropriate statistical system on creating database on road accidents (NTDPC, 2014). The report also proposed a post accident safety measure. This is termed as Golden Care Initiative to ensure emergency medical facilities in the event of road accidents.

In India, increase in the number of deaths in road crashes has been striking against the increase in the number of road crashes. Surprisingly, total number of road crashes was increased at compound annual growth (CAGR) of 0.4 percent during 2006-2016 whereas the number of resultant deaths was increased at CAGR of 3.6 percent (MoRTH, 2017). This suggests that the rate of increase in number of fatalities is higher than the number of accidents. Total number of road crashes increased from 460.92 thousand in 2006 to 480.65 thousand in 2016. At the same time, number of fatalities increased from 105.75 thousand in 2006 to 150.79 thousand in 2016. Similarly, rate of deaths per 100 accidents increased from 23 in 2006 to 31 in 2016. The case of deaths per 100 injured persons follows almost the same trend. Comparing the statistics for the year 2015 and 2016, total number of accidents came down from 501.42 thousand in 2015 to 480.56 thousand in 2016 but the number of deaths increased from 146.13 thousand in 2015 to 150.79 thousand in 2016 (table 1). This trend clearly indicates that separate strategies are needed for tackling road crashes and also deaths in road crashes.

Table 1: A Summary of Road Accidents Scenario in India

Years	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Number of Accidents	460920	479216	484704	486384	499628	497686	490383	486476	489400	501423	480652
Number of Deaths	105749	114444	119860	125660	134513	142485	138258	137572	139671	146133	150785
Number of Injured	496481	513340	523193	515458	527512	511394	509667	494893	493474	500279	494624
Number of Deaths per 100 Accidents	23	24	25	26	27	29	28	28	29	29	31
Number of Deaths per 100 Injured	21	22	23	24	25	28	27	28	28	29	30
Number of Deaths per 100 Accidents (Rural)	26	27	28	30	31	34	32	32	32	33	35
Number of Deaths per 100 Accidents (Urban)	19	20	21	21	23	23	24	24	25	25	27
Number of Deaths per 100 Accidents on NH	28	29	31	32	32	35	34	33	35	36	37
Number of Deaths per 100 Accidents on SH	26	27	27	29	30	32	32	33	33	34	35

Source: Road Accident Statistics, Ministry of Road Transport and Highways, Government of India.
Note: NH is National Highways, SH is State Highways

Table 1 indicates that death rate is much higher on roads passing through rural areas and roads designated as National Highways. In 2006, deaths per 100 road accident was 26 in rural areas compared to 19 in urban areas. Similarly, the same statistics for rural areas was estimated to be 35 compared to 27 in urban areas in the year 2016. There is an increase in the death rate per 100 accidents in both rural and urban areas but this rate is higher in rural areas. Thus, a person meeting with crashes on roads passing through rural areas are more vulnerable to deaths compared to those who met with crashes on roads in urban areas. There is an obvious reason for this. Provision of trauma centres and medical emergency aid in rural areas are limited compared to urban areas.

Another important statistics is the rate of deaths on national highways and states highways. The death rate per 100 accidents on national highways increased from 28 in 2006 to 35 in 2011 and 37 in 2016. Deaths per 100 accidents on state highways is relatively low and estimated to be 26 in 2006 and 32 in 2011 and reached up to 35 in 2016. This indicates that the number of road crashes and number of fatalities are higher on both national and state highways but it is much higher on these roads if passing through rural areas. Therefore, national and state highways passing through rural areas need special attention in the context of providing post accident health care facilities.

Rural population is more vulnerable to accidents. An empirical analysis is required to substantiate this. As of now, no such data is collected by the government differentiating the incidents of road accidents on rural roads, national highways and other roads passing through rural areas. However, the present data indicate that death rate in road crashes is high in rural areas particularly on in road crashes on national highways passing through rural areas.

5. Indian States Leading the Epidemic

States like Tamil Nadu, Maharashtra, Madhya Pradesh (MP), Karnataka, Kerala, Uttar Pradesh and Andhra Pradesh account for more than 64 percent of total accidents occurred in India in the year 2016. As a result, these states also account for more than 55 percent of the persons killed in road crashes in 2016. States with higher share of deaths in road crashes are Uttar Pradesh (13 percent), Tamil Nadu (11 percent), Maharashtra (9 percent), Karnataka (7 percent), Rajasthan (7 percent) and Madhya Pradesh (6 percent). These states have high share in both number of crashes occurred and fatalities. These states are the main areas of focus on how to mitigate road crashes and resultant fatalities.

Box 1: Best Practice in Post Accident Health Care

The Supreme Court of India has constituted a committee on road safety under the chairmanship of Justice K S Radhakrishnan in January, 2019. The committee takes stock of new initiatives by state governments and also by other stakeholders. The committee also monitors the situation of road safety in the country. Tamil Nadu, a state of southern part of India, established a Tamil Nadu Accident & Emergency Care Initiative (TAEI). This organisation started working with other agencies and has taken a coordinated effort to reduce the fatalities in road accidents. TAEI integrated 26 government medical college hospitals, 31 districts headquarter hospitals and 21 government hospitals working in strategic locations across the State. This coordinated effort led to the reduction in fatalities in road accidents by more than 24 percent. This effort was also lauded by Justice K S Radhakrishnan. He called all the states to adopt this model of Tamil Nadu.

Authorities identified deadliest points across the state having share of more than 40 percent of total fatalities in road accidents in Tamil Nadu. After identification of such spots, the TAEI analysed data collected from the spot and positioned ambulances appropriately on selected routes. Public hospitals in the catchment area of the identified spots were equipped with required medical facilities. Thus, providing medical care in golden hour to those who met with accidents on the identified spots saved lives and reduced fatalities in road accidents substantially. In this way, Tamil Nadu is now a model state for post accident health care facilities.

Source: The Better India, Published on June 24, 2019,
available at https://www.thebetterindia.com/186803/tamil-nadu-road-accidents-iit-supreme-court-india/

Number of deaths per 100 accidents at national level was 23 in 2006, which increased to 31 in 2016 (table 1 and table 2). The statistics also indicate that states like Mizoram, Punjab, Arunachal Pradesh and Uttarakhand recorded high number of person killed per 100 road crashes (table 2). In 2016, 84 persons were killed per 100 road crashes in Mizoram, 73 in Punjab, and 66 persons killed per 100 road crashes in Jharkhand. States like Mizoram, Arunachal Pradesh, Uttarakhand and Nagaland are mountainous states with high rate of deaths per 100 road crashes. Some of the states like Jharkhand, Bihar, Punjab, Uttar Pradesh and West Bengal are situated in plain area having high deaths per 100 accidents.

The current status of road crashes and resultant fatalities in India suggests that multiple factors are influencing both crashes and fatalities. States, which are predominantly rural and mountainous, have high death rate while states with high urban and industrial clusters higher number of crashes but relatively lower death rate (Table 2). This suggests that these states save more lives in some or other way which may be similar to post accident health care.

Table 2: Deaths per 100 Road Crashes in Indian States

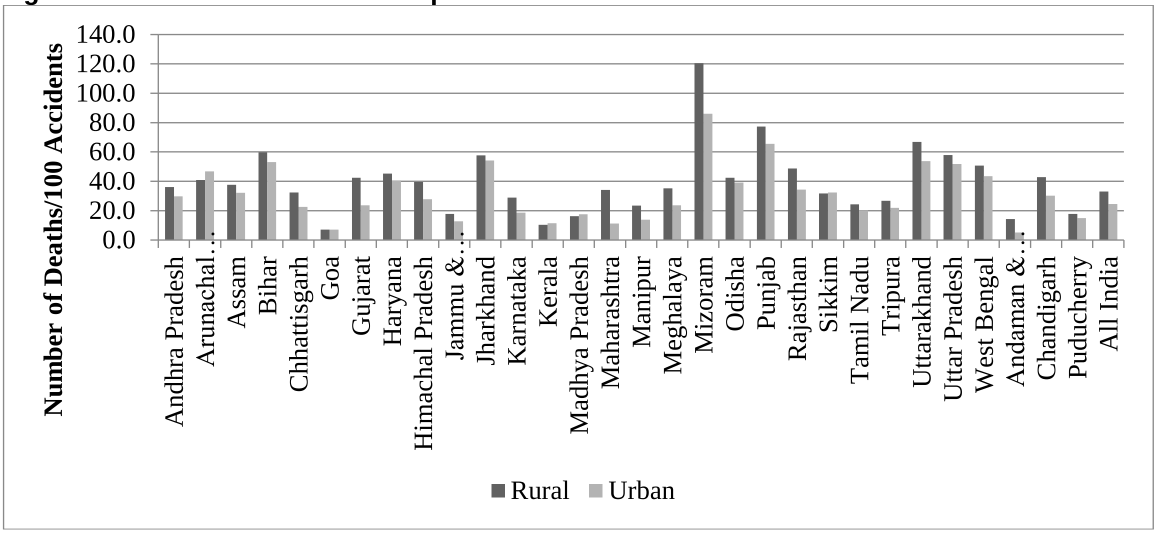
State/ UT	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Lakshadweep	10	0	0	50	0		0	0	0	0	100
Mizoram	67	65	57	70	66	84	70	85	78	103	84
Punjab	62	65	63	66	64	76	76	73	72	73	73
Dadra and Nagar Haveli	44	57	56	57	65	61	62	54	68	61	66
Jharkhand	38	39	40	43	46	47	49	49	51	56	61
Nagaland	35	37	92	87	114	64	133	42	27	56	61
Uttarakhand	67	65	76	61	62	62	57	59	62	60	60
Arunachal Pradesh	52	40	48	52	51	48	55	46	58	45	60
Bihar	43	45	44	44	47	48	49	50	51	57	60
Uttar Pradesh	56	53	51	52	54	73	54	52	52	55	54
Daman and Diu	47	48	58	52	65	66	58	53	38	60	54
West Bengal	41	41	39	44	38	38	44	44	46	47	48
Rajasthan	31	34	35	36	38	40	41	41	42	44	45
Haryana	39	37	39	39	42	43	44	43	42	44	45
Odisha	36	37	38	40	41	40	40	42	41	41	42
Sikkim	37	35	40	15	38	26	35	28	29	32	40
Himachal Pradesh	32	33	31	37	36	35	38	35	39	36	40
Gujarat	20	21	21	23	25	27	28	30	34	35	37
Chandigarh	27	28	31	40	30	31	32	29	36	31	35
Assam	39	36	39	41	39	36	35	34	35	34	35
Andhra Pradesh	29	31	32	34	35	34	35	33	32	34	34
Maharashtra	15	15	16	16	17	19	20	21	21	21	32
Telangana									34	33	32
All India Average	23	24	25	26	27	29	28	28	29	29	31
Tripura	25	28	29	26	26	29	31	28	26	24	31
Chhattisgarh	20	21	23	22	22	21	23	25	29	28	29
Karnataka	18	19	19	19	21	20	21	23	24	25	25
Meghalaya	38	42	42	36	34	35	45	25	26	30	24
Tamil Nadu	20	20	21	23	24	23	24	23	23	23	24
Delhi	23	25	25	31	30	28	27	24	19	20	22
Madhya Pradesh	14	16	15	16	16	16	16	17	16	17	18
Jammu & Kashmir	18	16	18	19	17	17	17	15	17	16	17
Manipur	31	21	26	22	26	23	20	25	23	21	15
Puducherry	13	15	12	13	16	16	16	16	14	15	14
Kerala	9	9	10	11	11	12	12	12	11	11	11
Goa	8	8	8	8	7	7	7	6	7	7	8
Andaman and Nicobar Islands	14	13	12	12	9	7	11	20	11	9	7

Source: Author's Calculation based on Data from Ministry of Road Transport and Highways

6. Rural Urban Divide in Road Accidents

Generally, road crashes are closely and directly related to urbanisation and motorisation. However, road accidents in rural areas are increasing at higher rate than road accidents in urban areas in India. Data of recent years suggest that average annual growth in number of accidents in rural areas during 2006-15 was 1.13 percent as compared to 0.75 percent in urban areas. It may be noted that motorisation is high in urban areas compared to rural areas. A state wise comparison on rural-urban scenario of deaths per 100 road crashes is presented in the figure 1.

Figure 1: Rural and Urban Deaths per 100 Accidents in 2015



Source: Author's Calculation based on Data from Ministry of Road Transport and Highways

State-wise analysis would be critical to our purpose. On the one hand, some states are doing well in terms of minimising causalities in road crashes in urban areas compared to rural areas. On the other hand, some states are not able to mitigate deaths per 100 crashes in rural areas. Tamil Nadu, Karnataka, Gujarat, Kerala, Madhya Pradesh, Punjab and Maharashtra have lower deaths per 100 accidents in urban areas. These states have higher deaths per 100 accidents in rural areas.

7. Results and Discussion

Table 3 presents a descriptive statistics of data on which panel regression was performed. Before carrying out the specific regression analysis, it was examined whether the data was fit for this analysis or not. The panel data analysis was performed using STATA, a software for data analysis using statistical tools. Unit root test was run using Levin Lin Chu test and Fisher type in order to know that data is stationary or not. The test suggests that the panel data is stationary. For testing hetroskedasticity, Modified Wald test was carried out which shows that there is a presence of hetroskedasticity in the data. Wooldridge test on the data suggests that data do not have first-order autocorrelation. Using Hausman test, it was found that fixed effect was better than random effect model.

The result of the robust fixed effect regression is presented in table 4 and 5. Before analysing the result of regression, it would be important to describe the features of the data to check out its co-linearity, heterogeneity and stationary in the panel. Our analysis is based on the model described in equation 2.

This exercise is based on ex-ante assumption that the prior studies have already established significant causal relationship of urbanisation, motorisation and per capita income with road accidents and the resultant fatalities. In the current analysis it was aimed at proposing some new findings apart from recognising earlier research and their respective findings. The current paper incorporated additional variable i.e. per capita health expenditure, buses per 1000 population and cars per 1000 population, trucks per 1000 population, etc. To assess the causal relationship, accidents per 100,000 population and fatalities in road accidents per 100,000 population are taken as dependent variables and rest of other variables like per capita income, buses, trucks, cars, two wheelers, per capita income and expenditure on health are taken as explanatory variables. The purpose of the paper is to establish a statistically tested case for the provision of post accidental health care facilities. The results are described in table 4 and 5.

Table 3: Descriptive statistics of the observations

Variable	Observations	Mean	Standard Deviation	Min	Max
Number of accident per 100,000 population	352	47.7857	47.7343	1.57	266.74
Number of persons killed in road accidents per 100,000 population	352	10.2649	4.66404	1.11	23.84
Per capita planned expenditure on health services	352	254.396	352.131	1.23	2436.85
Per capita income	352	33567.4	20661.2	5994	112626
Urbanisation	352	33.5704	18.422	9.81	92.6
Population Density	352	975.41	2285.76	13.35	11514
Motorization	352	124.087	129.291	8.56	701.59
Two wheeler per 1000 population	352	83.7065	95.039	5.35	501.69
Trucks per 1000 population	352	4.66105	5.33665	0.25	36.93
Buses per 1000 population	352	1.26997	1.62879	0.09	12.63
Cars per 1000 population	352	19.2858	32.3745	0.31	190.04

Source: Author

A fixed effect regression analyzes the effect of independent variables on the dependent variable by holding the average impact of each panel as constant. To decide between fixed or random effect models, Hausman test was carried out on the panel data. Finally, fixed effect robust model was used for panel data analysis which corrects the problem of heterogeneity.

Table 4 shows results of regression performed using different set of variable(s) as explanatory variable(s). Model 1 in the table 4 suggests that there is no significant and positive causal relationship between accidents per 100,000 population with per capita income. Model 2 in the table 4 incorporates more variables as explanatory variables making the data a larger set for analysis. The result of model 2 suggests significant and positive impact of per capita income on number of accidents per 100,000 population in India. As per model 2, there is a significant and negative impact of urbanisation on accident per 100,000 population. Further enlarging the model by incorporating more variables as explanatory variables in model 3, which indicates that there is significant and negative relationship between accidents per 100,00 population and number of buses per 1000 persons and population density. This indicates that increase in public transport would result in decrease in the number of accidents.

Table 4: Fixed effect regression results of panel data (dependent variable = number of accident/ 100,000 population)

Description of Variable	Independent	Model 1	Model 2	Model 3
X_1	Per capita income	- 0.00000505 (0.962)	.0003 (0.030)**	.0002 (0.028)**
X_2	Urbanisation (percent)		.477 (0.505)	.817 (0.138)
X_2	Population Density		-.016 (0.035)**	-.018 (0.011)**
X_4	Total Motorization per 1000 population		-.084 (0.181)	-.036 (0.159)
X_5	Two wheeler per 1000 population			-.084 (0.372)
X_6	Trucks per 1000 population			.140 (0.872)
X_7	Buses per 1000 population			-2.232 (0.002)***
X_8	Cars per 1000 population			.255 (0.165)

Note: p-values in brackets; ***, ** and * indicate level of significance at 1 percent, 5 percent and 10 percent respectively.

The second regression is exclusively performed for number of person killed in road accidents per 100,000 population. Model 1 as in table 5 suggests a causal relationship of explanatory variables like per capita expenditure on health by states and per capita income with fatalities in road crashes. The result of model 1 indicates that there is no significant impact of per capita health expenditure on fatalities in road crashes whereas per capital income is influencing the fatalities similar to the earlier case. Model 2 of in the table 5 presents results of fixed effect regression with cluster of variables incorporated in this analysis. These variables are per capita expenditure on health, per capita income, urbanisation, population density and motorisation as explanatory variables. Per capita expenditure in this model notably affects the deaths in road accidents and has negative impacts. Model 3 further incorporates trucks, buses and cars for panel data analysis. The result of this Model also suggests that increase in per capita expenditure on health services significantly affects the dependent variable. In addition to this, result also suggests that increase in buses decreases the number of deaths in road accidents considerably indicating the similar result as in case of table 4. It outlines that public transport is important for tackling accidents on roads.

Similar is the case of expenditure made on health care facilities. The expenditure is basically made for medical facilities in respective states. This expenditure does not provide any provision for post accident health care facilities. Despite this fact, the increase in expenditure has major impact in reducing number of deaths in road crashes across Indian states. Increase in number of buses to strengthen public transport may also result in decrease in road crashes and also fatalities in road accidents. Urbanisation on the other hand has positive impact on fatalities in road crashes. Our purpose was to establish a scientific relationship between road crashes fatalities and public health expenditure. With the available data on planned health expenditure, we are able to establish this relationship.

Table 5 Fixed effect regression results of panel data (dependent variable = accidental deaths/ 100,000 population)

Description of Variable	Independent	Model 1	Model 2	Model 3
X	Per capita planned expenditure on health services	-.001 (0.149)	-.001 (0.053)*	-.001 (0.043)**
X_1	Per capita income	.00006 (0.021)**	.00003 (0.245)	.00002 (0.336)
X_2	Urbanisation (percent)		.276 (0.007)***	.343 (0.001)***
X_2	Population Density		-.001 (0.299)	-.001 (0.440)
X_4	Total Motorization per 1000 population		.010 (0.152)	-.002 (0.802)
X_5	Two wheeler per 1000 population			.019 (0.317)
X_6	Trucks per 1000 population			.014 (0.939)
X_7	Buses per 1000 population			-.267 (0.014)**
X_8	Cars per 1000 population			.017 (0.470)

Note: p-values in brackets; ***, ** and * indicate level of significance at 1 percent, 5 percent and 10 percent respectively.

Fatalities in road crashes are higher in some states where incidents of accidents are relatively low. This happens due to the lack of proper medical facilities. The government has provision for planned expenditure on health and medical related facilities but this expenditure remains as low as 1.4 percent of GDP in 2013. After 2014, concept of planned expenditure was removed. These focuses are more or less related to awareness among masses. Specific attention is needed for post accident health care facilities and should be considered by the government. An initiative highlighted in box 1 is important for other states. It is important to identify stretches where accidents are frequently happening and provide urgent medical care.

8. Conclusion and Recommendations

The findings indicate that road crashes and fatalities are increasing on Indian roads. It presents a study of post accident health care facilities. Among major states, Tamil Nadu, Maharashtra, MP, Karnataka, and Andhra Pradesh accounted for more than 52 percent of the total accidents in 2015. The fixed effect robust regression for number of accidents per 100,000 population as dependent variable shows that there is significant causal relationship in positive direction with per capita income. The result also suggests that there is a significant but negative relationship of dependent variable with increase in buses, population density, etc. The fixed effect robust regression of deaths per 100,000 population suggests that increase in per capita planned expenditure on health services has significant and negative effect on fatalities in road crashes. Thus, increase in public expenditure for post accident health care will have positive impact on saving lives on Indian roads.

It is recommended that there is a need to make special arrangements for national highways which are passing through rural areas. Moreover, states which are backward need major attention. These states include, Bihar, Jharkhand, UP, Orissa and West Bengal. It requires specifically designed model for tackling problem of road crashes. This model should include indicators of state wise road crashes in rural as well as urban areas. Our analysis suggests that if road accidents increases in the states which are relatively economically backward then the number of fatalities will increase due to lack of proper medical facilities. Finally, there is no reason for undermining the severity of those states lower deaths per 100 accidents and deaths per 100 persons injured in road crashes. These states include Tamil Nadu, Maharashtra, Karnataka, MP and AP having large share in road crashes.

State governments are less prepared for tackling road accidents. There is a need for coordinated efforts at both-- national and state levels. As part of SDGs, deaths due to road accidents have to be halved by 2020. As a target, this goal must be articulated in planning and policies not just by central government but also by the regional/state governments. In this context, the recommendations are as follows;

- Increase expenditure on post accident health care facilities.
- Identify spots and zones where road crashes happen frequently in order to make plan for expenditure on health care facilities.
- While providing such facilities, national highways passing through rural areas need special attention.
- Increase expenditure on public transport which will potentially decrease road crashes.
- Special attention is required for those states which are economically backward and strengthen their public health and public transport services.

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