

# Calculation of Economic costs on the basis of black spots in two districts of Uttarakhand using human capital approach

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## Abstract:

**Background:** Road traffic accidents (RTAs) become a serious problem throughout the world especially in developing countries including India. India is the second populous country in the world, where there are maximum demands of vehicles, which further leads to road accidents. However, in point of humanitarian view, there is an urgent requirement to reduce deaths and injuries due to RTAs in India. Simultaneously, a strong policy should be developed to reduce the road accidents on black spots as they also exhaust huge financial loss to the economy of the state as well as country.

**Methods:** A retrospective cohort study were conducted to determine the impact of deaths due to road traffic accidents for which secondary data was collected from Traffic Police Department records in Dehradun and Haridwar, after getting the written approval. Primary data was collected from the attendants of death subjects through the pre-designed structured questionnaire along with informed consent.

**Research Findings:** From the results of the current study, we are able to estimate the economic loss due to road traffic accidents on the basis of blackspots and found to be significantly affecting the GDP of the family as well as State and country.

**Conclusion:** The present study concluded that the economic loss due to road traffic accidents is higher in Haridwar due to more number of accidents occurred than in the district Dehradun with respect to age, gender, month, time, geography, epidemiological factors, morbidity and mortality pattern due to RTAs .

**Keywords:** Road Traffic Accidents, Blackspots, Economic Burden, Hilly terrain, Human Capital Approach

## Introduction:

In current scenario, Road traffic accidents become a major problem in developing countries such as India. It is mounting as one of the leading cause of injuries, disabilities and deaths. Road deaths and injuries are found to be one of the common issues worldwide as enormous magnitude. According to a statistical report from the World Health Organization, more than 1.17 million people die on the road each year [1]. Road traffic accidents are the largest cause of mortality by injury worldwide (20.3 percent of all injury deaths) and the major cause of ill-health and premature death among adult men (second only to HIV/AIDS) (aged 15-44) [2].

## Status of death in India:

According to the Ministry of Road Transport & Highways (MoRTH), Government of India, black spot on National Highways is a road stretch of about 500m in length in which either 5 road accidents (involving fatalities/grievous injuries) took place during last three calendar years or 10 fatalities took place during last three calendar years” [3]. Several studies have evaluated the cost due to injuries and deaths in India as well as abroad. A report published by “Sadak Suraksha Ek Paridrashya” by Transport Research Wing, Government of Uttarakhand (2019) showed that there is decrease in the number of accidents in India, but increase in severity of accidents to 1.3% from 2018 to 2019. Moreover In Uttarakhand, there is decline in severity of accidents by 7.2% in 2019 as compare to 2018 [4].

The annually expenses of road traffic accidents in low- and middle-income countries are projected to be between US\$65 billion and \$100 billion, which is more than the total annual sum received for development aid (5). Road accidents are expected to cost in the UK more than £9 million per year (6), while a hospital-based research from Nepal found that a single injury case costs US\$ 126.2. (7). However, road traffic accidents are projected to cost between 1 and 1.5% of gross national product in low- and middle-income nations each year, putting an additional pressure on health-care resources (8). The economic loss due to road traffic accidents (RTA) may or may not be possible to measure exactly. Based on available literature and to our understanding, no such studies or database are available from last two decades to assess the economic burden due to road traffic accidents on black spots from hilly terrain yet. Hence, it is anticipated that this study would address such a problem for the first time in India.

However, initiating awareness programmes in various forms in accordance with the local needs and reducing traffic deaths will be the best option to reduce the road fatalities in the future. Therefore, the present study was designed with a main focus to estimate the economic loss on the basis of different reported black spot in two major districts of the state Uttarakhand.

**Methodology:**

Uttarakhand was chosen for the study because of the supportive attitude of the state's government, as well as the easily assessable nature of the study subjects in both districts. Retrospective study was conducted on the secondary data provided by the Transport Research Wing and Police Records, Government of Uttarakhand for analysis.

Injuries were classified as Minor (Primary), Major (Secondary), and Severe (Tertiary) in this study, and deaths were classified as fatal cases. There are 13 districts in Uttarakhand (Table 1) that belong to both the Kumaun and Garhwal regions. On the basis of population, number of sub-districts, hilly and plain road segments, and number of black spots, two Uttarakhand districts namely Dehradun and Haridwar were included in the current study. The rationale for choosing these two districts, Dehradun and Haridwar, was that they were the state's most populous cities, accounting for roughly 40% of the state's total population and acting as a representative of the state.

These two districts contain 9 sub-districts, accounting for more than 60% of Uttarakhand's total black spots. In terms of geographical area, these two districts have both flat and hilly road segments. To assess the cost of road traffic accidents, this study tends to use the Human capital or gross output approach as it addressed the RTAs' direct and indirect costs. The Human Capital Approach/ Gross Output Approach is based on identifying and defining the individual components that are involved in an international traffic accident and create an economic loss, either directly or indirectly, and then adding them up to a concrete value. The monetary value of sorrow, sadness, and suffering caused by the loss of human lives was included in the process.

**Table 1: Identified Black spots in 13 districts of Uttarakhand**

S. No	District Name	Number of Black Spot	S.No	District Name	Number of Black Spot
1.	Dehradun	50	7	Pithoragarh	2
2.	Udham Singh Nagar	32	8	Champawat	2
3.	Haridwar	30	9	Bageshwar	0
4.	Nainital	7	10	Almora	2
5.	TehriGarhwal	6	11	PauriGarhwal	2
6.	Chamoli	2	12	Uttarkashi	4
			13	Rudraprayag	0

**Source: Transport Research Wing, Government of Uttarakhand<sup>9</sup>**

**Results:**

A total of 81 black spots were identified by government of Uttarakhand, out of which 50 are in Dehradun and 30 in Haridwar. In both the districts, almost 50% of subjects got minor injury and 16-20% of severe injury and rest have major injury while driving two and four wheeler.

**Table:2 Distribution of average cost for per person per accident calculated from data of Dehradun and Haridwar in Uttarakhand.**

S.no	Variables	Minor (Primary) Injury		Major (Secondary) Injury		Severe (Tertiary) Injury		Death	
		Two wheeler	Four wheeler	Two wheeler	Four wheeler	Two Wheeler	Four wheeler	Two wheeler	Four wheeler
1	Administrative cost	5433	22540	6872	27200	6955	29547	5433	6304
2	Medical expenses	7354	7598	39400	40385	87423	112354	23470	27830
3	Human capital cost	1534	4520	8953	107366	17422	132554	3604631.4	3604631.4
4	Human suffer cost	3223	5320	55635	67820	80964	102325	1164752	1295413
5	Vehicle cost	3740	16980	14870	38260	19830	56965	39418	419246

The above table illustrates the cost per accident in different heads (i.e. Administrative costs, Medical costs, Human costs, Human suffer costs and vehicle costs) in both two wheeler and four wheeler accident victims. It is also found that administrative costs and medical costs were maximum in severe injuries while human capital costs, human suffer costs and vehicle damage costs were maximum in death victims.

**Table 3: Accident Statistics on Identified Black Spots along with the costs of Dehradun district**

Name of the Identified blackspots in Dehradun	“No. of fatal accidents at the spot in the last 3 Year”	Estimated cost_Deaths	“No. of serious accidents at the spot in the last 3 year”	Estimated cost_Severe Injuries	No. of major accidents at the spot in the last 3 year	Estimated cost_Major Injuries	No. of minor accidents at the spot in the last 3 year	Estimated cost_Minor Injuries
Shimla Bypass ChowkPatelnagar	1	5095564	7	2262186.5	9	1830424.5	13	508573
Chhidarwala Raiwala	1	5095564	5	1615847.5	10	2033805	14	547694
Sai MandirRajpur	1	5095564	4	1292678	5	1016902.5	6	234726
Kale kiDhaal Haridwar Road Rishikesh	1	5095564	4	1292678	3	610141.5	10	391210
Dharmawala ChowkSahaspur	1	5095564	2	646339	4	813522	8	312968
Before Kulhaal power house mod	1	5095564	2	646339	4	813522	8	312968
Old Chowki Bypass Road	2	10191128	2	646339	3	61041.5	3	117363
Satyanarayan Temple Raiwala	2	10191128	2	646339	3	61041.5	3	117363
TelapurChowkNayagaon.	0	0	2	646339	6	1220283	7	273847
MotichurRaiwala	3	15286692	1	323169.5	2	406761	2	78242
Near MiyawalaBridgeDoiwala	3	15286692	1	323169.5	2	406761	3	117363
Shiv MandirMussorie Road Rajpur	2	10191128	1	323169.5	2	406761	4	156484
SaraswatiViharChowk Bypass Road	1	10191128	2	646339	2	406761	3	117363
Ambadi mod DaakpatharVikashnagr	0	0	3	969508.5	2	406761	4	156484

Kali Mandir Dehradun Road Rishikesh	1	10191128	1	323169.5	2	406761	2	78242
Langha Road Tri Junction Sahaspur	1	10191128	1	323169.5	3	610141. 5	1	39121
Amitabh Textile Mill Chakrata Road	0	0	3	969508.5	2	406761	1	39121
MothroWala Chowk Bypass Road	1	10191128	1	323169.5	0	0	2	78242
Maggi Point Rajpur	1	10191128	0	0	0	0	2	78242
D.I.T. Mussoorie Road Rajpur	1	10191128	0	0	0	0	2	78242
Near Bhardwaj Clinic Haridwar Road Rishikesh	1	10191128	0	0	0	0	2	78242
Near KafalaniMuss oorie.	1	10191128	0	0	0	0	2	78242
Bypass Road Hotel Solitaires Nehru Colony	1	10191128	0	0	0	0	2	78242
Near HarbatpurMa zarVikashnag ar	1	10191128	0	0	0	0	2	78242
Opposite Law College	1	10191128	0	0	0	0	2	78242
Near Harrawala Police Chowki , Laxman Siddha Temple mod Doiwala	1	10191128	0	0	0	0	2	78242
Near R.T.O. office Haridwar bypass Road Rishikesh	1	10191128	0	0	0	0	1	39121
N.I.V.H. JakhanRajpur	1	10191128	0	0	0	0	1	39121
I.T. Park Sahastrdhara	1	10191128	0	0	0	0	1	39121

Rajpur								
Near ShaniMandir Chakrata Road	1	10191128	0	0	0	0	1	39121
Charba Road Tri Junction Sahaspur	1	10191128	0	0	0	0	1	39121
Yamuna Pul mod Badwala	1	10191128	0	0	0	0	1	39121
Ranghnwala Chungi Near I.M.A.	1	10191128	0	0	0	0	1	39121
Khand Village PuliaRaiwala	1	10191128	0	0	0	0	1	39121
St.JudeChowk	0	0	1	323169.5	0	0	1	39121
RatanpurChowk mod Nayagaon	0	0	1	323169.5	0	0	1	39121
AnahajareChowk Patel Nagar	0	0	1	323169.5	0	0	1	39121
Saat Mod Dehradun Road Rishikesh	0	0	0	0	0	0	0	0
Shimla bypass PratitpurSahaspur	0	0	0	0	0	0	0	0
Near Kishan Nagar ChowkChakrata Road Cantt.	0	0	0	0	0	0	0	0
ChadniChowkNayagaon.	0	0	0	0	0	0	0	0
Near Wood Stark School	0	0	0	0	0	0	0	0
Before Maharani SuvakholiMussorie.	0	0	0	0	0	0	0	0
Bright angle School line Jiwangarh	0	0	0	0	0	0	0	0
Near Lehman bridge mod both sides.	0	0	0	0	0	0	0	0
Pir Baba mod DehariChowkPremnagar	0	0	0	0	0	0	0	0

Near VanbeatChowki .kunwawala	0	0	0	0	0	0	0	0
FatehpurChowk Haridwar road Laltapad	0	0	0	0	0	0	0	0
Near PNB Bank Haridwar main road Laltapad	0	0	0	0	0	0	0	0

The above table shows that maximum number of accidents were occurred in Shimla Bypass Chowk, Patel Nagar (30), Chhidarwala, Raiwala (30), Kale Ki Dhaal Haridwar Road, Rishikesh (18) followed by Sai Mandir Rajpur (16) and so on. Furthermore, in respect to costs, Motichur Raiwala and near Miyawala Bridge Doiwala constitute maximum costs towards deaths. While Telapur Chowk Nayagaon, Saimandirraipur constitutes maximum costs in major injuries followed by Ambadi mod Dakpathar, Amitabh textile mill Chakrata, St. Jude Chowk, Ratanpur Chowk constitutes maximum costs as serious injuries.

**Table 4: Accident Statistics on Identified Black Spots along with the costs of Haridwar district**

Name of the Identified blackspots in Dehradun	“No. of fatal accidents at the spot in the last 3 Year”	Estimated cost_Deaths	“No. of serious accidents at the spot in the last 3 year”	Estimated cost_Severe Injuries	No. of major accidents at the spot in the last 3 year	Estimated cost_Major Injuries	No. of minor accidents at the spot in the last 3 year	Estimated cost_Minor Injuries
Narsanjhabre datirah to whole Gurukul	7	35668948	14	4524373	20	4067610	40	1564840
Sugar Mill to Libbarhri	7	35668948	12	3878034	13	2643946.5	18	704178
Jahanwi del	7	35668948	7	2262186.5	9	1830424.5	25	978025
Rashiyabad	7	35668948	8	2585356	11	2237185.5	19	743299
Rampur Chungi	9	45860076	6	1939017	7	1423663.5	12	469452
Padartha	8	40764512	6	1939017	8	1627044	20	782420
Peelinadi	5	25477820	6	1939017	6	1220283	16	625936
Gandikhata	5	25477820	5	1615847.5	6	1220283	10	391210
Harilok tri Junction	6	30573384	6	1939017	4	813522	8	312968
ABB Chowk	5	25477820	5	1615847.5	8	1627044	12	469452
Bongla Bypass	4	20382256	7	2262186.5	5	1016902.5	10	391210
RanipurJhaal	5	25477820	4	1292678	4	813522	10	391210
SankaraChar yaChowk	4	20382256	6	1939017	7	1423663.5	13	508573
ChandiChowk	3	15286692	5	1615847.5	5	1016902.5	11	430331

Shikariwalapi r to Deepshikha	4	20382256	4	1292678	3	610141. 5	7	273847
Karoundi	4	20382256	4	1292678	2	406761	8	312968
Daulatpur	3	15286692	3	969508. 5	4	813522	6	234726
Double Fatak over bridge Mohanpura	3	15286692	3	969508. 5	3	610142	7	273847
Shantikunj Gate	2	10191128	2	646339	2	406761	8	312968
MilitaryChow k	3	15286692	3	969508. 5	3	610142	3	117363
Puhana	1	5095564	4	1292678	6	1220283	7	273847
Devbandthira h to Kasba Market	1	5095564	4	1292678	6	1220283	7	273847
Dudhadhari	2	10191128	2	646339	2	406761	6	234726
Singhdwar	2	10191128	2	646339	2	406761	6	234726
Baderi Sulfur Road	2	10191128	3	969508. 5	2	406761	5	195605
Shanidev Temple	3	15286692	1	323169. 5	1	203380. 5	3	117363
Chidiyapur	2	10191128	1	323169. 5	2	406761	3	117363
MalakpurChu ngi	1	5095564	1	323169. 5	0	0	2	78242
Gurukul	0	0	0	0	0	0	0	0
Mandawar	0	0	0	0	0	0	0	0
Trichapul	0	0	0	0	0	0	0	0
Birla Factory to shanidevman dir	0	0	0	0	0	0	0	0

Table 4 clearly depicts that maximum number of accidents were occurred in Narsan Jhabredatirah to whole Gurukul (81), Sugar Mill to Libbarhri (50), Jahanwi del (48) followed by Rashiyabad (45) and so on. Furthermore, with respect to costs Narsan Jhabredatirah to whole Gurukul and Sugar Mill to Libbarhri constitute maximum costs in deaths, severe injuries, major injuries followed by minor injuries as there are maximum road traffic accidents in these blackspots.

#### Discussion:

The retrospective data obtained in the present study was analyzed using the Human capital approach of cost benefit analysis to calculate the economic costs in different black spots. In both district, almost 50% of subjects got minor injury and 16-20% of severe injury and rest have major injury while driving through two and four wheelers. In this study, we calculate per accidents cost in different heads (i.e. Administrative costs, Medical costs, Human costs, Human suffer costs and vehicle costs) in both two wheeler and four wheeler accident victims. As shown in table 2, it is clear that administrative costs and medical costs were maximum in severe injuries while human capital costs, human suffer costs and vehicle damage costs were maximum in death victims.

Based on the results obtained from this study, it is very clearly observed that the maximum number of accidents in Dehradun district was occurring in Shimla bypass chowk, patelnagar (30), chhidarwala, raiwala (30), Kale kiDhaal Haridwar Road Rishikesh (18) followed by Sai Mandir Rajpur (16) and so on. Furthermore, in respect to costs Motichur Raiwala and near miyawala bridge doiwala constitute maximum costs towards deaths. While Telapur Chowk Nayagaon, Sai Mandir Raipur constitutes maximum costs in major injuries followed by Ambadi Mod Dak Pathar, Amitabh textile mill chakrata, St. Jude Chowk, Ratanpur chowk constitutes maximum costs as serious injuries as shown in table 3.

Whereas, the results of the study illustrates that in Haridwar district maximum number of accidents were occurred in Narsan Jhabredatirah to whole Gurukul (81), Sugar Mill to Libbarhri (50), Jahanwi del (48) followed by Rashiyabad (45) and so on. Furthermore, in respect to costs, Narsan Jhabredatirah to whole Gurukul and Sugar Mill to Libbarhri constitute maximum costs in deaths, severe injuries, major injuries followed by minor injuries as there are maximum road traffic accidents in these blackspots as shown in table 4. The costs arising from road traffic accident may emanate from injuries to casualties, property damage cost and costs due to administrative procedures. These costs can be divided further into, costs arising from diversion of current resources and costs caused by a loss of future output [10].

Moreover, in this study, it is also calculated that medical costs due to Road traffic accidents seems to be less burden to the victims as well as their families except in case of disability, which is in agreement with an earlier study conducted by Silcock in 2003 [11]. The study clearly stated that even though the cost of medical treatment of accident victims has only contributed a very small percentage of the total accident cost in most developing countries, it is often seen as the first and most visible economic burden suffered by families of victims in those countries.

This study mainly focusses on road traffic accidents occurred in mentioned blackspots by the government of Uttarakhand. There is no such study exists on the economic costs on blackspots due to road traffic accidents. Several studies have estimated the costs on overall accidents, either it were injuries or deaths due to road traffic accidents. The mean cost of treatment for an accident injury patient in Nigeria in 2005 was \$25 per person, which was 40% of the mean monthly per capita income in Nigeria for 2005 [12]. In addition, in 2006, the Federal Road Safety Commission (FRSC) reported over 17,390 road traffic injuries and 4,944 deaths due to accidents. Assuming each victim spends \$25 on care, the total annual road traffic injury burden of \$435,000 can be estimated from these records. However, the study was focused on accident injury and its extent, and did not estimate the total cost of accident for the year and its implications to the GDP of Nigeria.

Similarly, Ismail and Abdul Mageed (2010) reported on the cost of road traffic accidents in Egypt with the main focus to estimate the cost of road traffic accidents in Egypt. The human capital method was used for the estimation which covered accident data for the year 2008. The results indicated that the cost of road traffic accidents in Egypt was 1.8 billion US dollars. Unfortunately the study has not mentioned any specifics on the category of vehicles that were considered for the costing, whether 2 wheelers, passenger vehicles, freight vehicles or articulated vehicles. This lack of specific breakdown will not allow for effective development and implementation of effective counter measures and policies [13].

In South Africa, the Road Traffic Safety Management Corporation (2016), reported on the cost of crashes in South Africa. The Corporation used the Human Capital Method to estimate the cost of road traffic accidents in South Africa for 2015. The report was based on data compiled by the RTMC with provision for 5% under-reporting, which amounted to 832,560 total accidents and 1,708,414 numbers of casualties for the year. The total cost of accidents for the year was put at R142.95 billion which is equivalent to 3.4% of the GDP of South Africa in 2015 [14].

Razi-Ardakhani and Ahadi (2015), estimated the cost of road traffic accidents in Iran using the Human Capital Method. The study was based on road traffic accidents data for the year 2009. The result indicated that, the cost of road traffic accident for Iran in 2009 was 11.458US Dollars, which is equivalent to 1.41% of Iran's Gross National Product. Lost output and property damaged constituted the highest cost components [15]. However, the study has not established the cost per vehicle type, but gave a total cost based on the total number of accidents only.

It is reported that the major economic loss caused by RTAs includes not only the expenditure spent on hospital, administrative and legal charges but also other intangible costs such as pain, grief and sufferings. However, the amount of money spent on patients in the general ward is considered to be extremely low. It is also evidenced from a study by Jose et al., from the state of Kerala in India that the medical expenditures associated with road traffic injuries shows significant difference in the amount of money spent on patients admitted to the ICU versus those admitted to the general wards [16]. If the important consideration framework is strengthened by back-up referral of RTA cases to PHCs, the length of hospital stay can be reduced and thereby the cost. Taking a lead in educating the public and thereby creating awareness and prevention about RTAs, a huge loss on the financial losses can be significantly reduced.

## **Conclusion**

Out of the 13 districts of Uttarakhand, we estimated cost of various injuries due to RTA in two districts only, which shows economic loss on GDP. Therefore, intensive study will be required to measure the exact burden due to RTA injuries. Hence, economic loss to GDP can be estimated for state of Uttarakhand. The result of the present study concluded that the economic loss due to injuries in road traffic accidents is higher in Haridwar due to more number of accidents occurred than district Dehradun. The reason behind such incidents may be rash driving, less traffic control regulation, narrow roads, safety issues etc. More studies are necessary to find the appropriate reasons with proper justifications. Therefore, the economic burden acquired by road traffic accidents could be used systematically for productive motives, if safety measures are actualized.

## **Limitation**

The study includes only permanent residents of Uttarakhand state. Limited database were found related to the government property damage because it includes several departments like PWD, electricity etc. So, it is very difficult to measure the exact cost. Permanent disability and insurance related cost were also excluded from the study as such there is no relevant data available



as well as study subjects were also denied to respond regarding this information. Hence in this study, we calculated economic cost on the basis of accidents occurred on black spots only.

Even though the study has retrospectively established the economic cost of road traffic accidents in two districts of Uttarakhand, more unique additional research are recommended.

### Conflict of interest

There is none conflicts of interest.

### Source of funding

Self

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