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Estimation of Economic Loss Due to Road Traffic Injuries using Human Capital Method

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Abstract: ***In the present scenario, Road traffic accidents (RTAs) become an alarming problem over the globe as they leads to approx. 2.6% total loss of country's gross domestic product (GDP). It is considered as one of the leading cause of mortalities, disabilities and morbidities due to road accidents in developing countries like India. To enable governments to take policy decisions on road safety, it is necessary that good research is undertaken to estimate the cost of accidents. This study will help government to take decisions while planning investment on road safety, facilities on roads, awareness signs and board etc. Meanwhile, estimation and evaluation of economic loss due to RTAs will help governments to frame policy and take important decisions within limited economic resources. Apart from humanitarian losses, there is increase in economic loss due to RTAs because most of the victims involved in accidents are from productive age groups of a society. The main objective of this study is to estimate the cost components of road accidents in two major districts namely Haridwar and Dehradun, Uttarakhand, India. The methodologies for such studies generally vary according to traffic pattern, number of accidents, black spots, population etc. This study makes use of an empirical approach as Cost benefit Analysis consist of Human Capital Approach for cost estimation which provides a vast understanding of the problem for hilly scenario. Secondary data were taken from Transport Research Wing, Government of Uttarakhand for all road accidents from 2016 to 2018 and primary data were collected from randomly selected victims through structured questionnaire and informed consent.***

Keywords: ***Economic burden, Human capital approach, Injuries, Road traffic accidents.***

I. INTRODUCTION

Nowadays, Road Traffic Accidents are considered as one of the leading causes of Injuries, disabilities and deaths worldwide. As per the statistics of the World Health Organization (WHO) around 1.2 million fatal/deaths are due to road traffic accidents and 20–50 million cases of injuries or disabilities every year over the globe [1]. Road traffic accidents are one of widely faced problems by people, countries, government etc which affect emotionally as well as financially. Aside from humanitarian aspect of decreasing injuries and deaths due to RTAs in developing countries, a strong case can be made for diminishing road casualties on economic loss alone, as they exhaust excess financial burden that the countries can ill afford to lose.

Rapidly increasing population and to maintain living standard in society leads into vast growth in the market of motor vehicles over the last two decades in India. The public transport in both districts namely Dehradun and Haridwar in Uttarakhand comprises of autos, city buses, but the timings and services on all routes were not fulfilling the people's desire. Thus the existing public transport is not adequate and that's why people prefer to use private vehicles as mode of transportation [2]. The growing number of personal vehicles are one of the primary factors responsible for road accidents in these cities. In India, motor vehicles are growing at a faster rate than economic and population growth. Road traffic injuries are one of the leading cause of death in India, resulting in an extent proportion of hospitalization, disabilities and socioeconomic losses among the young and middle aged peoples. From a humanitarian point of view, there is an urgent need to reduce deaths and injuries due to RTAs in developing countries like India. Simultaneously, a strong policy should be made to reduce road-crash deaths as they exhaust huge financial assets that countries cannot stand to lose.

Road traffic accidents are considered as the ninth leading cause of death and leads to approx. 2.2% of total deaths over the globe as per the report of Association for Safe International Road Travel from USA. This is predicted that death rate will hike by approximately 2 per 10,000 people in developing countries by 2020 [3]. The economic loss due to road traffic accidents are approx. 2% of GDP in middle and low income countries, which leads to massive loss to the country as per statistics provided by World Bank. Many studies on DALYs has projected that road accidents will be the third highest cause of death by 2020 according to World Health Organization (WHO) [4].

A study conducted by Jose et al [5]. in Kerala which indicates that there is a vast gap between money spent on patients admitted to the ICU and in the general wards. The money spent on patients in the general ward seen as impressively low. The duration of hospital stay can be can be limited if the essential consideration framework is reinforced by back up referral of RTA cases to PHCs. The findings infer that there is significant economic loss on hospitals due to RTA and they should take initiative in educating the peoples about awareness and prevention of road traffic accidents.

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Another study revealed by Partheeban, P. et al [6]. stated that detailed study on economic loss due to road traffic accidents should carried out for Chennai city. The costs involved in accidents needs to be calculated separately for urban and rural areas. Three situations were investigated to predict the accident cost in future by considering income growth and discount rate per annum. It is seen that the combined changes in pay growth and discount rate per annum results in higher total accident cost.

A study by Reddy, M [7]. conducted in Chandigarh in which cost benefit analysis consists of Human capital method, Health and labour questionnaire (HLQ) and Work productivity and activity questionnaire (WPAI) were used to calculate the economic loss due to road traffic accidents. The total productivity loss acquire was about Rs. 8,06,24,530 ($1,883,750) due to road traffic injuries. Lost wages due to the crash constituted less than 1% [Rs. 1,40,230 ($3276)] of the total productivity loss.

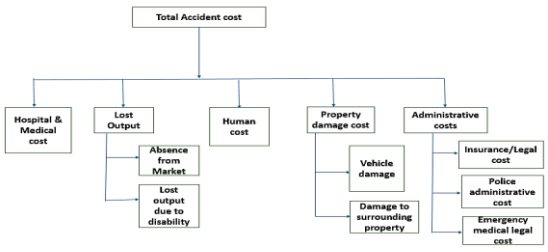
A similar study conducted by Pillai, B. and Joseph, K [8] in Kerala stated that economic loss due to RTAs includes hospital costs, administrative and legal expenses and other costs of intangible consequences like pain, grief and sufferings. The study conclude that to minimize road traffic casualties and initiate awareness programme in various countries as per our prerequisites which would decreases the fatalities on roads in future.

The objective of the study is to assess the costs of injured peoples due to road traffic accidents using human capital approach in hilly areas of Uttarakhand.

I. METHODOLOGY

A retrospective study was conducted on secondary data provided by Transport Research Wing and Police Records by the Government of Uttarakhand. In our study, we select Uttarakhand as the study area because of supportive nature of the government of the state and also due to the easily assessable of the study subjects in both districts.

In this study, we included only injured cases categorized as Minor (Primary), Major (Secondary) and Severe (Tertiary) Injuries. In Uttarakhand, there are 13 districts of both the region namely Kumaun region and Garhwal region. In this study, We will include two districts of Uttarakhand namely Dehradun, Haridwar on the basis of population, number of sub-districts, hilly and plane road segment and number of black spots. Other reason for selecting these two districts namely Dehradun and Haridwar is that these are also most populated cities which cover around 40% of the total population of Uttarakhand and act as a representative of the state. There are 9 sub-districts in these two districts and consists of more than 60% of total black spots in Uttarakhand. Geographically these two districts consist of both plane and hilly road segment.



This study tends to adopt the Human capital or gross output approach to calculate the cost of road traffic accidents. Since it deals with the direct and indirect costs involved in the RTAs [9]. The Human Capital Approach/ Gross Output Approach is based on identifying and determining the individual factors which are involved in a road traffic accident, and which causes a loss to the economy, either directly or indirectly, and adding them up to a concrete value. The method includes the monetized value of pain, grief, and suffering caused by the loss of human lives.

Identified Black spots in 13 districts of Uttarakhand

S. No	District Name	Number of Black Spot	District Name	Number of Black Spot
1.	Dehradun	48	Pithoragarh	2
2.	Udham Singh Nagar	31	Champawat	1
3.	Haridwar	25	Bageshwar	1
4.	Nainital	7	Almora	0
5.	TehriGarhwal	3	PauriGarhwal	3
6.	Chamoli	2	Uttarkashi	0
			Rudrapraya g	1

Source: Transport Research Wing, Government of Uttarakhand [10]

II. RESULTS

Study data was collected from year 2016 to 2018 from Transport Research Wing and Police Records, Govt of Uttarakhand on the recorded subjects. Out of total subjects, only permanent resident of Dehradun and Haridwar were included in the study. Average life expectancy in Uttarakhand is quiet high as compare to other states and average age of accident victim is half than average life expectancy in all type of injury which depicts into more human loss as shown in **Table 1.** Total 79 black spots were identified by government of Uttarakhand, 48 were in Dehradun and 31 in Haridwar. In both district, almost 50% of subjects got minor injury and 16-20% of severe injury and rest have major injury driving through two and four wheeler as shown in **Table 2.**

There is significant ($p<0.05$) differences in all type of cost (Administrative cost, Medical expenses, Human capital cost, Human suffer cost, Vehicle cost) of two wheeler and four wheeler. Understandably, the costs of four wheelers were higher than two wheeler in all types of injuries as mentioned in **Table 3.** The economic loss due to all types of injury was higher in Haridwar than Dehradun in both types of vehicle accidents viz., four and two wheeler Table 3. Although, the population of Haridwar (2.29 Lakh) is less than Dehradun (5.78Lakh), as shown in table 1 more number of accidents (590) happened in Haridwar than Dehradun (232) yet less number of black spots in Haridwar (39) than Dehradun (49). This resulted

in higher economic loss cost of Haridwar (almost more than double) than Dehradun (Table 4).

Table 1: Summarize Average life expectancy and Average age of accident victim during various type of injury

Variable	Minor Injury	Major Injury	Severe Injury
Average Life expectancy (years)	71.5 years	71.5 years	71.5 years
Average age of accident victim (years)	28.6 years	29.4 years	29.1 years

Table: 2 Distribution of total number of injured peoples according to types of vehicles in Dehradun and Haridwar

District Name	Number of black spots	Minor (Primary) Injury		Major (Secondary) Injury		Severe (Tertiary) Injury	
		Two wheeler	Four wheeler	Two wheeler	Four wheeler	Two wheeler	Four wheeler
Dehradun	49	98	19	51	18	37	9
Haridwar	32	294	22	157	19	71	27
Total	81	392	41	208	37	108	36

Table: 3 Distribution of average cost for person accident calculated from injured data of Dehradun and Haridwar Uttarakhand.

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

Table: 4 Distribution of total economic loss according to different injuries in both districts:

District Name	Minor (Primary) Injury		Major (Secondary) Injury		Severe (Tertiary) Injury	
	Two wheeler	Four wheeler	Two wheeler	Four wheeler	Two wheeler	Four wheeler
Dehradun	2085832	1082202	6412230	5058558	7865978	3903705
Haridwar	6257496	1253076	19739610	5339589	15094174	11711115

Table: 5 Distribution of overall economic loss in both the districts among study subjects:

District Name	Overall cost	GDP of Uttarakhand
Dehradun	26408505	2.63 lakh crore
Haridwar	59395060	

III. DISCUSSION

In this study, we include data of injured subjects mined from Transport Research Wing and Police records of Dehradun and Haridwar. In both the districts, there are 82 black spots, resulted in 590 accidents in Haridwar and 232 in Dehradun including all types of injuries. Various type Injuries including minor, major and severe causes losses in terms of various costs that include Administrative cost, spend on Medical facility, Vehicle expenses, Human capital & Human-suffer cost. This study reveals the human capital approach to measure the different cost involved in different types of injuries caused due road traffic accidents. There are 49 and 32 known black spots in Dehradun and Haridwar respectively as per police records and Transport Research wing, government of Uttarakhand in 2019. Black spots usually identified on the basis of number of accidents and with different types of vehicles mostly two wheelers and four wheelers as data provided by government of Uttarakhand.

The human capital cost for different types of injuries due to road traffic accidents that resulting a more part of injury values whilst the victim's destiny production and consumption losses are considered for severe injuries followed by major injuries and minor injuries. Meanwhile overall costs are higher in human suffer cost followed by medical expenses and human capital cost in different types of injuries due to road traffic accidents maximum in four wheeler vehicles than two wheeler and, all the costs are higher in Haridwar than Dehradun dist. Our study results are in good agreement with study conducted by Richmond et.al [11] in 2005 states that the human suffering cost accounted for 22%, while clinical or medical and administrative costs had been additionally impact high burden at round 1% of the charges.

There is variant form of economic-cost for different accidents, where in medical-costs or clinical-cost counted around 21%, and suffering-costs account for 18.7% of the total accident cost. This is due to long-term treatment costs, remedy charges, hospitalization prices, rehabilitation charges and the extraordinarily high economic burden on the victim and his/her own family.

In addition, accidents occasionally cause psychological imbalance (mental imbalance) or tension, which cannot be envisioned. Higher clinical charges or medical costs for major injuries have additionally been said in earlier studies [12]-[13]. The losses related to human capital cost have been comparatively lower than minor injuries, at around 7.7% and 21.5% for most major accidents, as victims could commonly go back to normal condition after restoration.

Administrative costs were highest for minor accidents at around 11.7%, as complex issues might develop, such as whether the other party is to blame, whether the victim is employed, and whether he/she earns an income, depending on the sum to be paid. Medical prices and suffering costs accounted for approximately 39%, as costs incurred from minor injuries are appreciably much less than other accident costs.

The total administrative cost accounted 25% and vehicle cost approximately 43% in all types of injuries. In this study we have calculated medical cost for severe, major and minor accidents. The medical cost varied from 16% to 24% from. The general administrative cost accounted 24% and vehicle cost approximately 44% in all kinds of injuries. In the present study, we calculated medical cost for severe, fundamental and minor injuries. Medical cost also various from 19% to 30% from mild to extreme injury or mild to severe injury. Another study stated that about 4% to 11% of total accident costs were comprised of only medical cost [14].

The economic loss due to all types of injury was higher in Haridwar than Dehradun in both types of vehicle accidents viz., four and two wheeler Table 3. Although, the population of Haridwar is less than Dehradun, as shown in table 1 more number of accidents (590) happened in Haridwar than Dehradun (232) yet less number of black spots in Haridwar (39) than Dehradun (49).

IV. CONCLUSION

The result of the present study concluded that the economic loss due to injuries in road traffic accidents are higher in Haridwar due to more number of accidents occurred than district Dehradun. The reason behind for this finding may be rash driving, less traffic control regulation, narrow roads, safety issues etc. More study required to be conduct for finding suitable reasons. Therefore, the economic burden acquired by road traffic accidents could be use systematically for productive motives, if safety measures are actualized.

Out of 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.

V. LIMITATION

The study include 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. In this study, we calculated injury cost on the basis of accidents occurred on black spots only.

CONFLICT OF INTEREST

There is none conflicts of interest.

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