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A Silent Tsunami on Indian Road: A Comprehensive Analysis of Epidemiological Aspects of Road Traffic Accidents

P. Mondal[1*], Abhishek Kumar[1], U. D. Bhangale[1], and Dinesh Tyagi[1,2]

[1]International Centre for Automotive Technology, Manesar, India
[2]National Automotive Testing and R&D Infrastructure Project, New Delhi, India

Review Article

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ABSTRACT

This paper aims to critically analyze the epidemiology of road traffic accident in India. It is noteworthy to mention that India already accounts for about 9.5% of the total 1.2 million fatal accidents in the world. In 2009, for every 4.14 minute and 1.13 minute one death and one injury took place in India from road accident, respectively. Between 1970 and 2009 the number of accidents has quadrupled (1.1 lakh in 1970 to 4.22 lakh in 2009) with nearly 6.5 fold increase in injuries (0.7 lakh in 1970 to 4.67 lakh in 2009) and nearly 9.5 fold increase in fatalities (0.14 lakh in 1970 to 1.27 lakh in 2009). During the period of 2004 to 2009, road accident rate, injury rate and casualty rate per 10^5 population have been increased by 8.5%, 4.7% and 29.8%, respectively. In 2009, total 1,08,409 male and 18,487 female died in road accident. It was also observed that in last five years (2005 to 2009) average 84.9% male and 15.1 % female died in road accident. In 2009, total 90,298 people, out of total 1,26,896 accident victims died from age group of (5-44 Yrs), which is the most productive age group for nation. Average percentage share of last five years (2005-2009) for the age groups (Up to 14 Yrs), (15–29 Yrs), (30–44 Yrs), (45–59 Yrs), and (Above 60 Yrs) were 6.35, 29.84, 35.05, 20.97 and 7.79, respectively. The month-wise distribution of 'Road Accidents' has also shown more accidents during May (38,928) and June (36,234) sharing 9.2% and 8.6% respectively. Maximum 'Road Accidents' (68,835) were reported during 3 p.m. to 6 p.m (16.3%), 64,191 cases during 9 a.m. to 12 noon (15.2%), and least number (28,984) of these accidents (6.9%) was reported during 1200 to 3 AM in the night. The cause-wise number of persons killed in road accidents indicates that almost three-fourths of the accidents were due to driver's fault.

Keywords: Epidemiology, crash, road accident, economy, India;

* *Corresponding author: E-mail: mondal.pinaki@gmail.com*

1. INTRODUCTION

Tsunami in the Indian Ocean on December 26th, 2004 had a devastating effect on India. According to the Indian government, almost 11,000 people died in the tsunami and over 5,000 are missing and feared dead (Ministry of Home Affairs). It is estimated that 3,80,000 Indians have been displaced by the disaster and reconstruction is expected to cost more than 1.2 billion dollars (approx. 5,500 crore Indian rupees) (World Bank). In 2009 only, 1.27 lakh people died in road accident in India resulting a financial cost of approximately 1,36,000 crore Indian rupees (Mondal et al, 2011). Therefore, road accidents can be easily compared with gigantic infamous tsunami. Road crashes deserve to be a strategic issue for any country's public health and can lead to overall growth crisis, if not addressed properly. Road traffic injuries are the leading cause of death globally among 15-19 year-olds, while for those in the 10-14 years and 20-24 years age brackets they are the second leading cause of death (WHO, 2007[a]). The projected 40% increase in global deaths resulting from injury between 2002 and 2030 is predominantly due to the increasing number of deaths from road traffic accidents (WHO, 2007[b]). Road traffic crashes kill 1.2 million people each year and injure 50 millions. It is estimated that road traffic deaths will increase worldwide, from 0.99 million in 1990 to 2.34 million in 2020 (representing 3.4% of all deaths). India already accounts for about 9.5% of the total 1.2 million fatal accidents in the world. In 2009, 1.27 lakh people in India lost their lives in road mishaps (Mondal et al., 2011). In 2009, for every 4.14 minute and 1.13 minute one death and one injury took place in India from road accident, respectively. Figure 1 reveals that 35.5% of total accidental death (natural and un-natural) was caused by road accidents (GoI, 2010). The Planning Commission of India had assessed the social cost at Rs. 55,000 crore (Rs. 550 billion) on account of road accidents in India (Mondal et al., 2008). A huge number of researches have been conducted to analyze road crashes. This paper aims to critically analyze the epidemiology of road traffic accident in India.

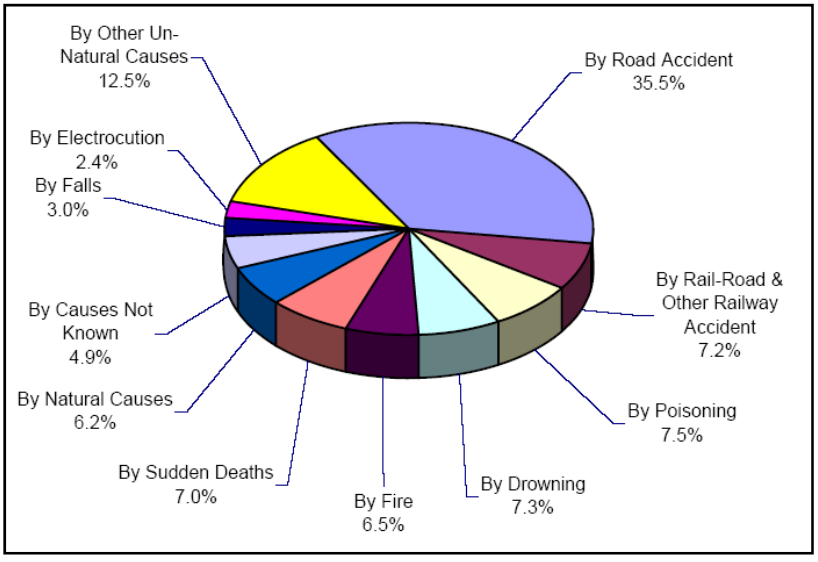

Figure 1: Percentage share of different causes of accidental death in India during 2009.

2. ROAD ACCIDENT PROFILE IN INDIA

A high prevalence of old vehicles that often carry many more people than they are designed to carry, lack of safety belt and helmet use, poor road design and maintenance and the traffic mix on roads are other factors that contribute to the high rate of crashes in India. Figure 2 gives the year

wise road accident and fatality distribution from 1970 to 2009 (GoI, 2010). In 2009, 348 deaths per day and 1278 injuries per day took place in India.

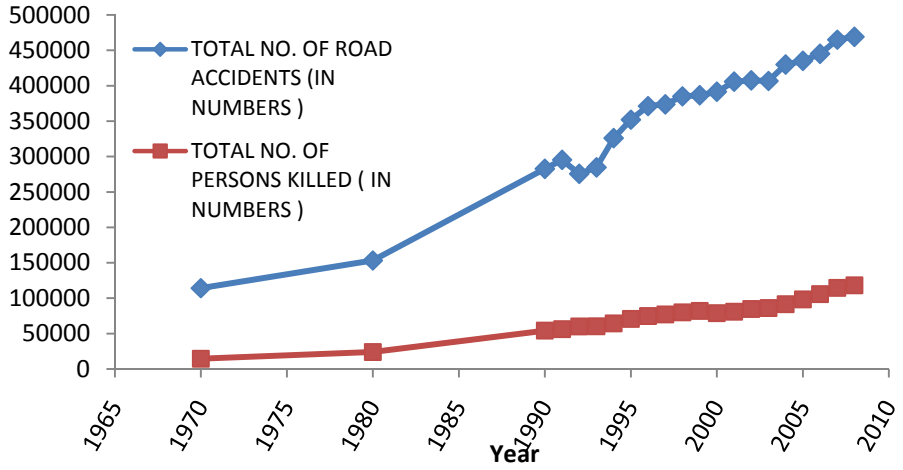

Figure 2: Year wise road accident and fatality distribution from 1970 to 2009 (GoI, 2010)

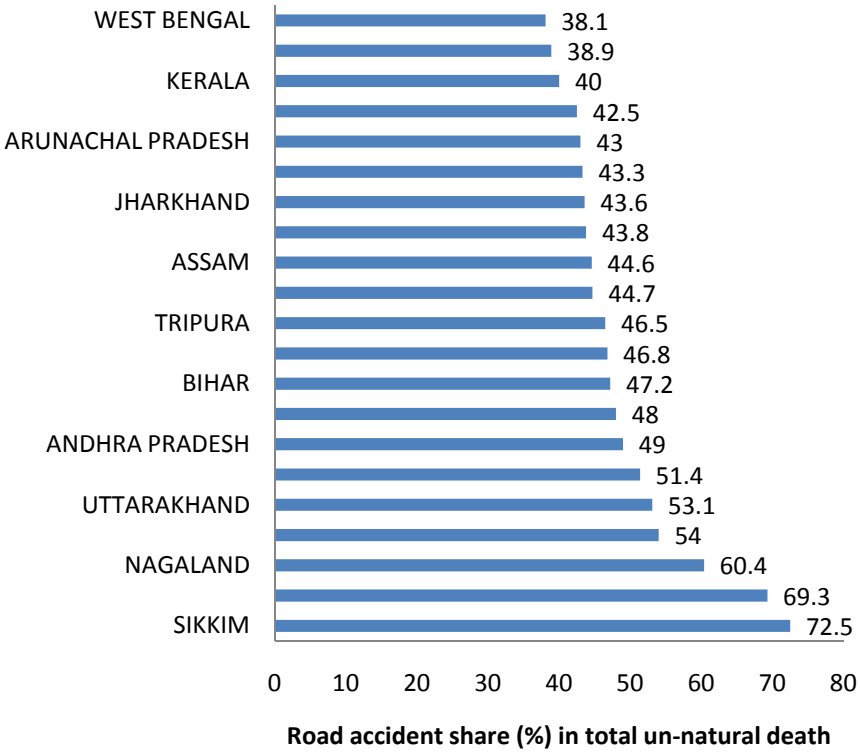

Figure 3: Percentage share of deaths of high accident prone states and UTs

Cumulative 1.27 lakh deaths and 4.67 lakh injuries took place in India due to road accidents in 2009 (GoI, 2010). While the figure of fatalities may be close to the actual number of deaths in

road accidents in India, the number of injuries reported appears to be underestimated. Various studies indicate that the actual number of injuries could be 15 to 20 times the number of deaths. The discrepancies in the number of deaths and injuries are a result of the application of different methodologies for the derivation of estimates (Sundar, 2007). An estimated 2 million people have a disability that results from a road traffic crash (Gururaj, 2006, WHO, 2009). Between 1970 and 2009 the number of accidents has quadrupled (1.1 lakh in 1970 to 4.22 lakh in 2009) with nearly 6.5 fold increase in injuries (0.7 lakh in 1970 to 4.67 lakh in 2009) and nearly 9.5 fold increase in fatalities (0.14 lakh in 1970 to 1.27 lakh in 2009).

2.1 STATE WISE ROAD ACCIDENT DISTRIBUTION IN INDIA

In 2008, the 'Accidental Deaths' due to Un-Natural Causes were mainly on account of 'Road Accidents' (37.1%). The road accidental death details of States and UTs categorized as high prone areas (percentage share exceeding the All-India share) on the basis of the percentage share of deaths on these counts are presented in figure 3. The cause-wise analysis of un-natural deaths revealed that 72.5% deaths in Sikkim (highest) was due to 'Road Accidents' (GoI, 2009).

3. CRITICAL ANALYSIS OF EPIDEMIOLOGY OF ROAD ACCIDENTS IN INDIA

In order to establish what is known from available research, prior to conducting further research or promoting particular public health policies on road safety, it is important to examine the public domain literature for available evidence concerning the epidemiology of traffic injuries, with the objective of identifying and summarizing available information about the epidemiology of motor vehicle crashes in India. During search, it has been found that very less number of research reports/papers are available in the area of epidemiological research of road accidents in India. It was also found that most of the available researches are based on regional or even city specific data.

3.1 ROAD ACCIDENT RATE, INJURY RATE AND CASUALTY RATE AND FATALITY RATES

Fatality rate in terms of deaths per thousands vehicle for the duration of 2005 to 2009 is given in Table 1. 'Road Accidents' in the country have increased by 1.4% during 2009 compared to 2008. The casualties in Road Accidents in the country have increased by 7.3% during 2009 as compared to 2008. Share of casualties in Road Accidents in total deaths due to Un-natural causes has increased from 37.1% in 2008 to 37.9% in 2009. It is observed that the rate of deaths per thousand vehicles has increased by 7.7% from 1.3 in 2008 to 1.4 in 2009 as the number of vehicles in the country have increased and the quantum of 'Road Accidents' has increased (GoI, 2010). It is observed that the rate of Accidental Deaths per thousand vehicles was highest in Arunachal Pradesh at 5.7 followed by Sikkim 4.0, Himachal Pradesh 3.3, Bihar 3.1 and Assam, Jammu & Kashmir and Tripura 2.2 each as compared to 1.4 at the National level although the States of Maharashtra and Tamil Nadu had the highest and the second highest number of registered vehicles in the country. The rate of deaths per 100 cases of road accidents was highest in Lakshadweep (200.0), followed by Nagaland (106.0), D & N Haveli (100) and Punjab (89.1) compared to 30.1 at the National level. During the period of 2004 to 2009, road accident rate, injury rate and casualty rate per 10^5 population have been increased by 8.5%, 4.7% and 29.8%, respectively in India (Table 2) (GoI, 2010).

Table 1: Road accidental death rate per thousand vehicles from 2005 to 2009

Sl. No.	Year	Road Accidents (in thousand)	% variation over previous year	Persons injured (in thousand)	% variation over previous Year	Persons killed (in nos.)	% variation over previous Year	No. of vehicles (in thousand)	% variation over previous Year	Rate of Deaths per thousand Vehicles (Col.7/ Col.9)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	2005	390.4	8.0	447.9	8.2	98,254	7.5	66,289*	–	1.5
2	2006	394.4	1.0	452.9	1.1	1,05,725	7.6	72,718@	9.7	1.5
3	2007	418.6	6.1	465.3	2.7	1,14,590	8.4	72,718#	–	1.6
4	2008	415.8	– 0.7	469.1	0.8	1,18,239	3.2	89,618@	23.2	1.3
5	2009	421.6	1.4	466.6	-0.5	1,26,896	7.3	89,618@	–	1.4

Source : for Col.9, Motor Transport Statistics of India, Transport Research Wing, Ministry of Road Transport & Highways, New Delhi.
* : data for the year 2003 is repeated in 2004 and 2005 due to non availability of data for these years.
@ : as per latest data of Ministry of Road Transport & Highways.
# : data for the year 2006 is repeated in 2007 due to non availability of data for this year.

Table: 2: Road Accident rate, injury rate and casualty rate per 10^5 populations

Year	Road accident (10^3)	Person injured (10^3)	Person killed, in number	Estimated mid-year population, 10^5	Accident rate/10^5 population	Injury rate/10^5 population	Casualty rate/10^5 population
2004	361.3	413.9	91376	10856	33.3	38.1	8.4
2005	390.4	447.9	98254	11028	35.4	40.6	8.9
2006	394.4	452.9	105725	11197.75	35.2	40.4	9.4
2007	418.6	465.3	114590	11365.53	36.8	40.9	10.1
2008	415.8	469.1	118239	11531.3	36.1	40.7	10.3
2009	421.6	466.6	126896	11694.4	36.1	39.9	10.9

3.2 SEX AND ROAD USER DISTRIBUTION OF ACCIDENTAL DEATHS

It was observed that in last five years (2005 to 2009) average 84.9% male and 15.1 % female died in road accident (Figure 5). In 2009, total 1,08,409 male and 18,487 female died in road accident. 26,219 persons (20.7%) of these were riding on 'Two-wheelers', 25,136 (19.8%) were occupants of 'Truck/Lorry', 12,821 (10.1%) were killed while traveling in buses and 11,682 (9.2%) were traveling in car. Table 3 depicts the Sex wise distribution of different types accidental deaths in 2009. Figure 4 represents the percentage share of road accident as per different road users in 2009. Although break-up of total Government and Private vehicles are not available, it is pertinent to note that 97.7% victims of 'Jeeps', 97.6% victims of 'Truck/Lorry', '97.4% victims of 'Cars', 94.1% victims of 'Tempo/Vans' and 70.1% victims of 'Buses' involved in accidents, were traveling in private vehicles. The number of persons who died of 'Truck/Lorry' accidents was highest in

Andhra Pradesh (12.4%) followed by Tamil Nadu (12.1%) and Uttar Pradesh (11.1%). 19.7% of 'Bus' victims and 23.7% of 'Car' victims were from Tamil Nadu only. 15.5% of 'Tempo/Van' victims, 17.7% 'Jeep' victims and 24.6% 'Two Wheeler' victims were from Uttar Pradesh. 30.4% of 'Three Wheeler' victims were from Andhra Pradesh and 15.7% 'Pedestrian' victims were from Maharashtra alone (GoI, 2010).

Table 3: Sex wise distribution of different types of accidental deaths in 2009

Sl. No.	Type of Vehicle	Number of Road Accidental Deaths			
		Male	Female	Total	%share of total vehicles
(1)	(2)	(3)	(4)	(5)	(6)
1	**Truck/Lorry**	22290	2846	25136	19.8
	Government	541	69	610	0.5
	Private	21749	2777	24526	19.3
2	**Bus**	10336	2485	12821	10.1
	Government	3048	783	3831	3.0
	Private	7288	1702	8990	7.1
3	**Tempo/Vans**	6259	1166	7425	5.9
	Government	364	75	439	0.3
	Private	5895	1091	6986	5.5
4	**Jeep**	8101	1719	9820	7.7
	Government	195	31	226	0.2
	Private	7906	1688	9594	7.6
5	**Car**	9890	1792	11682	9.2
	Government	267	34	301	0.2
	Private	9623	1758	11381	9.0
6	Three Wheeler	5364	1252	6616	5.2
7	Two Wheeler	23180	3039	26219	20.7
8	Bicycle	3024	243	3267	2.6
9	Pedestrian	9077	2032	11109	8.8
10	Others	10888	1913	12801	10.1
	Total	**108409**	**18487**	**126896**	**100.0**

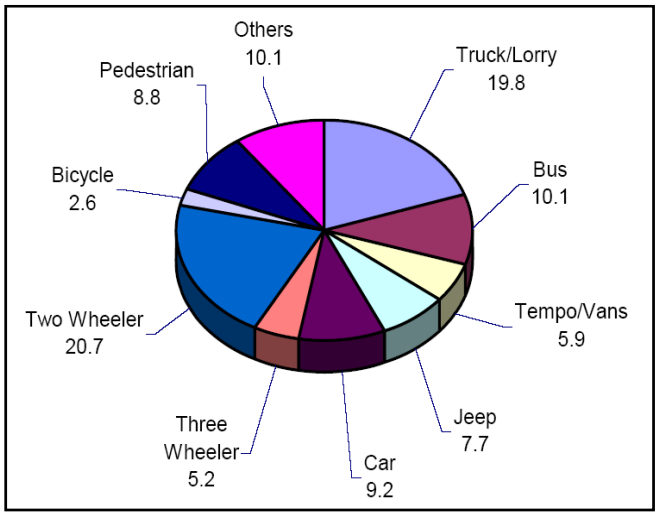

Figure 4: Percentage share of road accident as per different road users in 2009.

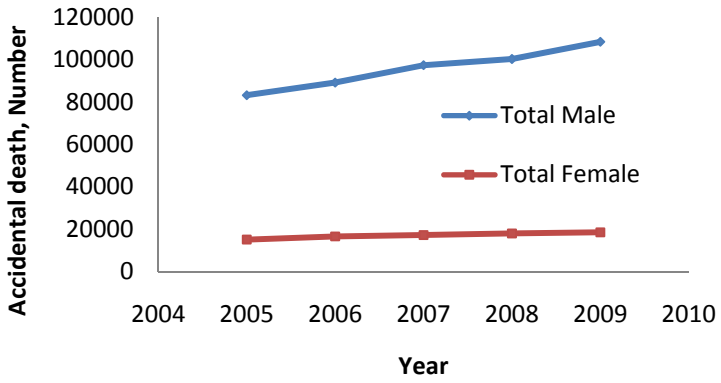

Figure 5: Male-female yearly distribution of accident from 2005 to 2009

3.3 AGE GROUP WISE DISTRIBUTION OF ACCIDENTAL DEATHS

In 2009, total 90,298 people, out of total 1,26,896 accident victims died from age group of (5-44 Yrs), which is the most productive age group for nation. In figure 6, percentage share of age group distribution for road accident is given for the year 2009. Average percentage share of last five years (2005-2009) for the age groups (Upto 14 Yrs), (15–29 Yrs), (30–44 Yrs), (45–59 Yrs), and (Above 60 Yrs) were 6.35, 29.84, 35.05, 20.97 and 7.79, respectively. Last five years average also showed that 71.25% of total accident took place up to the age-group of 44 Yrs, which is alarming (GoI, 2010).

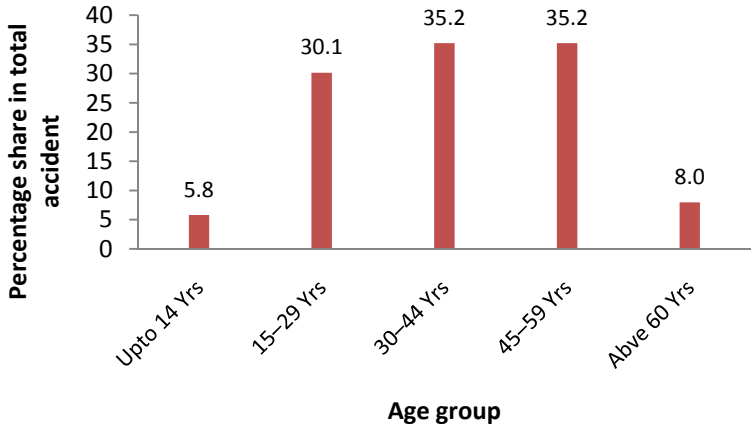

Figure 6: Percentage share of age group distribution for road accident in 2009

4. TRAFFIC INCIDENCE BY TIME AND MONTH

The month-wise distribution of ‘Road Accidents’ has also shown more accidents during May (38,928) and June (36,234) sharing 9.2% and 8.6% respectively. Tamil Nadu and Maharashtra, which accounted for the maximum (14.4%) and (11.6%) of 'Road Accidents' in the country have also reported the maximum number of 'Road Accidents' during each month of the year at national

level. Delhi has reported the maximum number of 'Road Accidents' among UTs which is 1.8% at the National level. Maximum 'Road Accidents' (68,835) were reported during 3 p.m. to 6 p.m. (16.3%), 64,191 cases during 9 a.m. to 12 noon (15.2%), and least number (28,984) of these accidents (6.9%) was reported during 1200 to 3 AM in the night.

5. ACCIDENT CATEGORIZATION AS PER TYPES OF CAUSES

The cause-wise number of persons killed in road accidents indicates that almost three-fourths of the accidents were due to driver's fault during the period in 2004 for the reporting States/UTs. Accidents attributed to mechanical fault were only 2% amongst the causes. The pedestrian's fault works out to 1 to 2. The number of persons killed in the road accidents cause-wise are given in the table 4 (Planning Commission, 2006).

Table 4: Number of Persons Killed in Road Accidents in India (Cause-wise)

Sl.No.	Cause	2002	2003	2004*
1	Fault of Driver	62830 (74)	58961 (69)	69631 (75)
2	Fault of Cyclist	1361 (2)	1193 (1)	979 (1)
3	Fault of Pedestrian	1875 (2)	1451 (2)	1363 (1)
4	Mechanical Defect	1909 (2)	1967 (2)	2015 (2)
5	Bad Road	936 (1)	1224 (1)	1506 (2)
6	Other Causes	15763 (19)	21202 (25)	17124 (19)
7	Total	84755 (100)	85998 (100)	92618 (100)

6. REQUIREMENT OF STRATEGIC PLANNING FOR ROAD ACCIDENT MITIGATION

Road crashes deserve to be a strategic issue for any country's public health and can lead to overall growth crisis, if not addressed properly. Thus, there is an urgent need to recognize the worsening road safety situation in order to take appropriate action. Road traffic injury prevention and mitigation should be given the same attention and scale of resources that are currently being channeled towards other predominant health issues, if increasing human loss and injury on the roads, with their devastating human impact and large economic cost to society are to be avoided. There is no organized programme to combat morbidity and mortality on Indian roads while there are structured programmes to combat communicable diseases, with substantive allocation of plan funds. Table 5 indicates the number of fatalities reported from a few select communicable diseases and the plan allocation for combating these diseases as compared to the allocation for road safety (Sundar, 2007).

Table 5: Disease –related Mortality and Plan Allocation

Diseases	Number of deaths	Centrally Sponsored Schemes	Outlay Xth Plan (2002-2007) (Crores Rs.)
Tuberculosis	37,639 (2004)	National TB Control Programme	680
Malaria	638 (2005)	National Vector Borne Diseases Control Programme (including Malaria, Kala-Azar, Filaria, Dengue and J.E.)	1370
AIDS	1094 (8286 cumulative till 2005)	National AIDS Control Programme including Blood Safety Measures and National S.T.D. Control Programme	1270
Road crashes	92618(2004)	*	187

*** No significant and major scheme.**

1 US$ = approx: 46 Indian Rs.

7. CONCLUSIONS

- The analyzed data show that men are more at risk than women of being injured in crashes. The preponderance of males may be attributed to their greater exposure to traffic and other associated factors. Similar evidence is well documented in several studies in industrialized countries (Odero et al., 1997). While most motor-vehicle drivers are men, a high proportion of males involved as pedestrians, passengers or cyclists, suggests the co-existence of other social and behavioural factors contributing to their vulnerability. However, no study is available which has attempted to investigate specific potential factors that would explain the observed gender differences. Such a study is desirable and would need to assess and correct for levels of exposure by gender.

- The findings, that the age group of (5-44 Yrs), are at high risk of traffic injury is well documented in this paper. This has important economic impacts as these are people in their most economically productive years. It also has implications for the design and implementation of more targeted interventions.

- This paper produced sufficient evidence in support of a high incidence of day-time casualties. This can be explained by greater traffic volume during the day resulting in greater risk of accident involvement as people travel to work, children go to school, and commercial enterprises are open for business. The relative decline in traffic casualties at night may be explained by less night-time activity and travel. Simple interventions, such as painting bicycles yellow instead of black or wearing reflector bands may be cost-effective and decrease traffic injuries. Such easy but seems to be effective interventions need to be tested.

- Considering the gigantic social and economic impact of road accidents, more planned allocation Govt. fund and initiatives for accident research and subsequent policy development and implementation is required.

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