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Road traffic accident paradigms in Bengaluru: An empirical study

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Abstract
Road Traffic Accidents have been a major economic problem in India and more so in the city of Bengaluru. The subtle difference in the economic and social impact of the RTAs on the individuals, families and the society need a concern. The traffic authorities in the city of Bengaluru have been proactive to deal with the occurrence of road accidents. The monetisation of the road accidents is not possible. The underreporting of the accident cases has also led to the improper analyses. The studies in respect of the sociological perspective is far and few. The present study is an empirical study undertaken in the city of Bengaluru to study the RTAs.

Keywords: Traffic, morbidity, enforcement

1. Introduction
Fatalities and injuries resulting from road traffic accidents are a major and growing public health problem in India. Every week nearly 2,650 people get killed and 9,000 get injured due to traffic accidents. In 2013, 137, 423 people died and 469,900 people got injured due to road accidents in India. Traffic accidents have now earned India a dubious distinction; with nearly 140,000 deaths annually, the country has overtaken China to top the world in road fatalities. India is the only country in the world which faces more than 15 fatalities and 53 injuries every hour as a consequence of road crashes. While in many developed and developing countries including China, the situation is generally improving, India faces a worsening situation. If the trend continues, the total number of road traffic deaths in India would increase by 100% between 2013 and 2027. Without increased efforts and new initiatives, the total number of road traffic deaths in India is likely to cross the mark of 250,000 by 2025.

Definition of "accident"
For the purpose of the study, "A road traffic accident was defined as accident which took place on road between two or more objects, one of which must be any kind of a moving vehicle".40
The international classification of diseases (ICD-10) classifies road traffic accidents according to external external causes of morbidity and mortality.

Time Interval
The time at which patient met with the road traffic accident was categorized under seven broad time intervals of different duration, depending upon the general activity of the people and road users at that time.

Definition Related To Transport Accidents
1. A public highway (traffic way) or street is the entire width between property lines (or other boundary lines) of land open to the public as a matter of right or custom for purposes of moving persons or property from one place to another. A roadway is that part of the public highway designed, improved and customarily used for vehicular traffic.
2. A pedestrian is any person involved in an accident who was not at the time of the accident riding in or on a motor vehicle, train, streetcar or animal-drawn or other vehicle drawn physically (bicycle), animals (horse).
3. A driver is an occupant of a transport vehicle who is operating or intending to operate it.
4. A passenger is any occupant of a transport vehicle other the driver.
5. A person on outside of vehicle is any person being transported by a vehicle but not occupying the space normally reserved for the driver or passengers, or the space intended for the transport of property.
6. A pedal cycle is any land transport vehicle operated solely by pedals.
7. A pedal cyclist is any person riding on a pedal cycle or in a sidecar or trailer attached to such a vehicle.
8. A motorcycle is a two-wheeled motor vehicle with one or two riding saddles and sometimes with a third wheel for the support of a sidecar. the sidecar is considered part of the motorcycle.
9. A motorcycle rider is any person riding on a motorcycle or in a sidecar or trailer attached a vehicle.
10. A three-wheeled motor vehicle is a motorized tricycle designed primarily for on-road use.
11. A car (automobile) is a four-wheeled motor vehicle designed primarily carrying up to 10 persons.
12. A pick-up truck or van is a four-or six-wheeled motor vehicle designed primarily for carrying property, weighing less than the local limit 13. A heavy transport transport vehicle is a motor vehicle designed primarily for carrying property, meeting local criteria for classification as a heavy goods vehicle in terms of

kerbside weight (usually above 3500kg), and requiring a special driver's license.

13. A bus is a motor vehicle designed or adapted primarily for carrying more than 10 persons, and requiring a special driver's license
14. A tractor is a specialized motor vehicle mainly used in agriculture for farming and agriculture purposes, for example ploughing the land, tend and harvest crops and transpot materials to and from the farm.

Review of Literature

P. Shruthi (2013) [24]. Road traffic accident (RTA), a cause of unnatural death is the third major preventable one amongst all deaths. Road deaths in India are publicly glaring, while road safety is professionally lacking and politically missing. A retrospective observational study was conducted in the Department of Forensic Medicine and Toxicology, Kempegowda Institute of Medical Sciences, Bangalore between January 2010 to December 2012, with an objective to study the demographic, injury profile and mortality pattern in autopsy cases with an alleged history of RTA and to draw public attention and awareness in order to prevent/control RTA (P. Shruthi, 2013) [24].

Ahmad (2018) [3]. Accidents do not occur only due to ignorance, but are due to carelessness, thoughtlessness and overconfidence. As well as being a public health problem, road traffic accidents (RTA) are a development issue, Road traffic injuries are the leading cause of death among the people aged 15 to 29 years and cost countries 1-3% of GDP (Ahmad, 2018) [3].

Dhakal (2018) [14]. to sum up, Road Traffic Accident (RTA) has been really a serious problem in Kathmandu valley. Every year the number of casualties is increasing. The standard of road should be maintained and there must be coordination among the government bodies, vehicle owners, and civil society for the honest observation of traffic rules and regulations. The government should pay attention to improve the quality of roads by giving emphasis on infrastructure building. Traffic education should be included in school level curriculum so that youths may obey traffic rules and regulations (Dhakal, 2018) [14].

Md. Mazharul Isla (2019) [18]. the potential costs of road traffic accidents (RTAs) to society are immense. Yet, no study has attempted to examine the impact of climate change on RTAs in Saudi Arabia, though RTA-leading deaths are very high, and the occurrence of climatic events is very frequent. This study employed annual data from 13 regions of Saudi Arabia, from 2003 to 2013. This study also found that RTAs both inside and outside cities significantly caused injuries, but only RTAs inside cities significantly caused death. Furthermore, the death from RTAs injuries was found to be statistically significant only for motor vehicle accidents (Md. Mazharul Isla, 2019) [18].

Amina Ahmed Mohamed (2018) [4]. Road traffic accidents (RTA) have become an important public health concern over the past decades; it is one of the main causes of mortality and disability in the world. Driver's awareness regarding RTA is essential in decreasing accidents. This study aims to assess the knowledge regarding traffic safety and first aid measures among the traffic drivers in Alexandria and measure the effect of implementing traffic safety awareness program on driver's knowledge regarding traffic safety practices in Alexandria – Egypt (Amina Ahmed Mohamed, 2018) [4].

Huai-jun Peng (2015) [17]. as for the inadequate application of location information in traditional traffic police duty management and dispatching, this paper focuses on the actual needs of traffic police dispatching. A behavior analysis method of individual traffic police on duty based on time-series location information in the field of intelligent transportation is proposed, in order to solve the rationality and efficiency problems of deploying police force in dispatching. The method lays technical foundation for meticulous management of traffic police and dynamic scheduling (Huai-jun Peng, 2015) [17].

Bhagyaiah (2014) [9]. the police database and newspaper reports provide insights into the magnitude and nature of fatalities due to road traffic crashes. The limitations of the police database, which is the legal source of information on fatalities resulting from road traffic crashes, indicate a need for strengthening the road traffic crash surveillance system so that reliable, accurate and adequate data on road traffic crashes and the resulting fatalities and injuries can be collected. This could then form the basis for planning effective intervention strategies to improve road safety in the city. More effort is needed to have a comprehensive understanding of the various aspects of road traffic crashes, and the recommendations made for strengthening surveillance could serve as an initial step towards reducing fatalities and injuries due to road crashes in the long term (Bhagyaiah, 2014) [9].

Anteneh Kebed (2019) [5]. Road transportation provides benefits both to nations and to individuals by facilitating the movement of goods and people. It enables increased access to jobs, economic markets, education, recreation and health, which in turn has direct and indirect positive impacts on the health of populations However, the increase in road transportation, has also placed a considerable burden on people's health - in the form of road traffic injuries, and the health consequences that ensue from a reduction in physical activity (Anteneh Kebede, 2019) [5].

A.A. Osoro (2015) [1]. the results show that Matatus (public mini buses), buses and small cars are the leading causes of accidents. Human errors and failings, defective vehicles and bad roads contribute significantly to RTAs. Victims of RTIs include pedestrians and passengers. The study includes public education, enforcement of observance of traffic rules, avoiding over-speeding, overloading and careless overtaking; stopping drunk driving; wearing seatbelts, recognizing the rights and needs of pedestrians, constructing good roads, provision of safe and efficient public transport, training and re-training of public service vehicle drivers (A.A.Osoro, 2015) [1].

Factors Contributing to Road Accidents

Even though human error is considered to be the main cause of road accidents, it is not the only factor responsible. There are many other aspects which directly or indirectly cause the accidents. The important factors contributing to road accidents are given as under.

1. **Drivers:** Over-speeding, rash driving, violation of rules, failure to understand signs, fatigue, alcohol.
2. **Pedestrian:** Carelessness, illiteracy, crossing at wrong places moving on carriageway, Jaywalkers.
3. **Passengers:** Projecting their body outside vehicle, by talking to drivers, alighting and boarding vehicle from wrong side travelling on footboards, catching a running bus etc.

4. **Vehicles:** Failure of brakes or steering, tyre burst, insufficient headlights, overloading, projecting loads.
5. **Road Conditions:** Potholes, damaged road, eroded road merging of rural roads with highways, diversions, illegal speed breakers.
6. **Weather conditions:** Fog, snow, heavy rainfall, wind storms, hail storms.

Transportation is one of the basic necessities that people use and need in their everyday lives. We need transportation to be able to travel and move to a different places especially if it is distant. We use different modes of transportation like airplanes, trains, boats, cars, and motorcycles. But the most abundant and commonly used of these are the cars, buses, bicycles, tricycles, scooters and motorcycles. This is the reason why there are a lot of vehicular accidents that happen every day. It may be caused by a lack of discipline of the driver, refusal to follow traffic rules, or poor infrastructure. Vehicular accidents usually lead to injuries or even death. However, there are traffic laws that may prevent these kinds of accidents to happen, but it is still up to the driver to follow these rules. There are traffic enforcement agencies that are willing to render service to help in maintaining a good traffic. It is the responsibility of the driver to strictly follow traffic rules and regulations for driving comes with great responsibility.

Sampling

The sample size in respect of Traffic Accident Survivors and Dependents of the traffic accident victim is 388.

Analysis of primary data

Table 1: Socio-Demographic Data of the Sample Traffic Accident Survivors and Dependents

Variable		N (%)
Gender	Male	324(83.51)
	Female	64(16.49)
Qualification	Illiterate	66(17.01)
	Primary	82(21.13)
	Middle School	83(21.39)
	Secondary, High School	87(22.42)
	Pre University	17(4.38)
	Graduate	18(4.64)
	Post Graduate and above	35(9.02)
Age Group	Less Than 20 Years	49(13)
	20-30	135(35)
	30-40	118(30)
	40-50	47(12)
	50-60	16(4)
	60 and above	23(6)
Road user category	Pedestrian	88(22.68)
	Pedal cyclist	23(5.93)
	Two wheeler rider	189(48.71)
	Two wheeler pillion	38(9.79)
	Three wheeler driver	12(3.09)
	Three wheeler occupant	18(4.64)
	Car driver	18(4.64)
	Car occupant	2(0.52)
Marital status	Married	243(62.63)
	Unmarried	121(31.19)
	Separated	16(4.12)
	Widowed	8(2.06)
Nature of house	Pucca House	122(31.44)
	Semi Pucca House	167(43.04)
	Kachha House	99(25.52)

In the sample respondents, 83.51% of the respondents are male and 16.49% of the respondents are female. The proportion of male to female category is based on the availability of the woman during the survey. The respondents who are illiterate are employed in un-organized sector work for daily wages. The respondents engaging in business, garments, education sector and the like are covered under the study. The necessity of traveling from one place to another for education, business opportunity, trade and the like is a routine in the city. The travel patters differ according to the age category that the respondents belong to. It is observed that young respondents aged 20-30 and 30-40 account for two-third of the total composition. Youngsters are more pronounced. 13% of the respondents are aged less than 20 years. 6% of the respondents are aged above 60 years.

The road user category decides the vulnerability in road traffic accidents. The severity depends on the road user category that the victim belongs to. The increase in motor vehicles including two wheelers has led to increase in road accidents. The survey found that 62.63% of respondents are married. 31.19% of respondents are unmarried. 4.12% represent the separated ones. Only 2.06% of respondents are widowed. In the city of Bengaluru most vulnerable sections belong to those who are in the lower ranking of social strata. Even in high income countries, poor children are at greater risk than children from more prosperous families. In Mexico, the second commonest cause of children being orphaned is traffic crashes (source world report on road traffic Injury prevention) (2004).

Table 2: Problem associated with Vehicle involved in Accident

Variable		N (%)
Problem associated with Vehicle involved in Accident	Mechanical defect	235(74.60)
	Steering failure	3(0.95)
	Break failure	3(0.95)
	Lights defects	3(0.95)
	Others	(22.54)

Motor vehicle collisions cause more than 1.2 million deaths worldwide and an even greater number of non-fatal injuries each year (world Health organization, 2015) negatively affecting the health and wellbeing of injury survivors and their families (Donaldson, L.H., Brooks, k, faux, S.G., 2009. Orthopedic (25-38). The severity, nature and outcome of RTI as primarily determined by the impact of problem associated with the vehicle involved in accident as identified in the study due, steering failure, break failure, light defects and others greater incidence of Accident is attributed to mechanical defect at 74.60%, steering failure, break failure and light defects as attributed at 0.95%.

Table 3: Repercussions of the Road Traffic Accident

Consequences of road traffic accident		
Variables	**Number**	**Percentage**
Injuries	183/388	47.16
Property Damage	178/388	45.88
Death	123/388	31.70
Congestion	283/388	72.94
Disruption and Delays to public Transport	267/388	68.81
Clinical Factors		
Admitted to Hospital	108	87.80
Admitted And Surgery Done	45	36.59
Admitted but no Surgery Done	143	49.26
Not Admitted	92	74.80

Source: Primary Data

In emergency medicine, "Golden Hour" refers to the immediate one-hour time period following a traumatic injury, during which, chances of preventing death by way of prompt medical treatment are the highest. Health emergencies occur in passenger cars where victims do not have immediate access to either layperson or professional, proper medical services, resulting in deterioration of their health or death. Studies have shown that human intervention in the form of first aid given to victims of RTAs can preserve life, prevent further harm, and promote recovery in most cases. Of course, it works only when given properly, and the sad truth is that there are high chances of victims not getting proper help for reasons including absence of bystanders, responders fearful of legal action should they make mistakes, and entrapment of victims in the wreckage, thus being inaccessible. Traffic accident is one of the main causes of the increasing Congestion in traffic networks. Due to the fact that traffic accidents reduce the capacity of a freeway and that their effect and duration are rather unpredictable at the moment they occur, it is expected that they contribute for great proportion to less reliable travel times.

Hypothesis Testing

Ho: There is no relationship between the Socio-Demographic Characteristics and Factors Leading to Road Traffic Accidents in the city of Bengaluru

Ha: There is a relationship between the Socio-Demographic Characteristics and Factors Leading to Road Traffic Accidents in the city of Bengaluru

Dependent Variables

Factors Leading to Road Traffic Accidents

Independent Variables

- Road User Category
- Gender
- Age
- Income level
- Vehicle Problem
- Marital Status
- Place of Occurrence
- Place of Death
- Nature of the House
- Job Description
- Income Level
- vehicle hit by
- Fist Respondents at Accidents Site

Influence of the socio economic characteristics of the respondent on the factors leading to road traffic accidents

Table 4: Reliability test

Reliability Statistics	
Cronbach's Alpha	N of Items
.891	14

The reliability coefficients for the variables under study are presented in Table. Cronbach values above 0.7 are acceptable and denote very good reliability (Nunally, 1978).

Table 5

ANOVA						
	Cluster		**Error**		**F**	**Sig.**
	Mean Square	**DF**	**Mean Square**	**DF**		
Bald Tyres	68.751	2	1.630	385	42.186	.000
Burst	159.326	2	1.278	385	124.678	.000
Defective Steering/horns	154.389	2	1.358	385	113.662	.000
Using of Seat Belt Poor Visibility/ Rear View	182.644	2	1.088	385	167.865	.000
Lighting	152.727	2	1.128	385	135.446	.000
Sandstorms	185.944	2	1.164	385	159.688	.000

Temperature	126.243	2	1.390	385	90.807	.000
Precipitations	148.155	2	1.198	385	123.657	.000
Economic and Social Status	170.820	2	1.103	385	154.846	.000
Age and Gender of the victim	141.590	2	1.183	385	119.682	.000
Length of the Trip	101.017	2	1.343	385	75.230	.000
Mode of Travel	141.574	2	1.425	385	99.316	.000
Vehicle Handing and Maintenance	101.470	2	1.459	385	69.550	.000
Consumption of Alcohol Medicine or other drugs	84.092	2	1.650	385	50.953	.000

* Significant at the 5% level

Analysis: It can be seen from Table that null hypotheses are rejected as the p values are lesser than 0.05 for Bald Tyres, Burst, Defective Steering/horns, Using of Seat Belt Poor Visibility/ Rear View, Lighting, Sandstorms, Temperature, Precipitations, Economic and Social Status, Age and Gender of the victim, Length of the Trip, Mode of Travel, Vehicle Handing and Maintenance and Consumption of Alcohol Medicine or other drugs.

Discussion

There is significant difference between the Socio-Demographic Characteristics and Factors Leading to Road Traffic Accidents in the city of Bengaluru.

Interventions Attempted to Prevent Injuries or Deaths Due to Road Traffic Accidents

1. Safer Transport

- Restrictions on the speed and engine performance of motorised two wheelers
- Increasing the legal age for use of motorised two wheeler vehicles
- Graduate driver licensing
- Pre license educational interventions
- Post license driver education
- Monitoring driver behaviour
- Changes in the legislation on the use of daytime running lights by motorvehicles
- Deployment of network wide traffic policing programme
- Increase in fines and driver's license withdrawal
- Use of speed reduction or control mechanisms

2. Safer Roads

- Introduction of pavements
- Traffic calming interventions
- Use of safety camera interventions
- Street lighting
- Use of guard rails and crash cushions
- Use of roundabouts as an alternative to signals and stop sign controls

3. Safer vehicles

- Improving visibility
- Seat belt/ Safety belt use
- Booster seat use among four to eight year olds

4. Safer people

- Helmet use among bicycle and motorcycle drivers
- Drink driving interventions
- Pedestrian education interventions
- Community based injury prevention interventions
- Trauma care interventions

Measures needed to improve road safety

Five emergency measures

- Increasing national awareness of the problem of road safety, first among decision-makers.
- Establishing a system for the collection and analysis of crash data (causes of risk and black spots).
- Establishing a lead agency for road safety responsible for preparing and implementing a coordinated plan of action.
- Combating the four major risk factors through mass awareness campaigns backed up by a dedicated system of enforcement and penalties.
- Encouraging the involvement of the private sector and national associations.

Five Long-Term Measures

- Improving the general condition of vehicles.
- Introducing safety features in all existing and planned road systems.
- Improving or introducing road safety education in schools and evaluating and improving the quality of driver training and testing.
- Improving emergency services and the care of road crash victims and those disabled in road crashes.
- Encouraging international cooperation.

Conclusion

Road accidents are also a major economic burden for countries. The yearly number of people that are injured in road accident, frequently resulting in long-term disabilities, is much higher. The three components in the Safe System approach – human, vehicle and infrastructure - are similar as the components used in the Haddon Matrix. For the Human it concerns safe and responsible behavior, which includes for example that road users to the best of their ability comply with traffic rules and regulations. It includes also personal protection systems like helmets. Vehicles should be designed to avoid accidents in case of potential conflicts (crash avoidance technologies) and if an accident happens to protect road users in- and outside the vehicle (crashworthiness of the vehicle, protective equipment like seatbelts and airbags, safe pedestrian fronts etc.). Roads should be designed to minimize the risk of accidents and injuries for all road users, including for example the use of separate lanes for vulnerable road users and public transport, forgiven road infrastructure like guard rails and road barriers and speed measures.

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