

Analysis of Effects of Environmental Factors on Road Traffic Accidents in India

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ABSTRACT

The study describes the effects of environmental factors on road safety in India. The objectives of this study is to assess the effect of environmental factors on road traffic accidents (RTAs) in India and to analyse how lack of road signs and road crossing points contribute to motor and pedestrian road traffic accidents (RTAs) on the roads.

Accidents are now one of the major causes of death. In this study pathological features of these cases as type of injury, pattern and distribution of injuries, body parts involved, fatal injuries and cause of deaths are discussed based on the data and examination of victim.

Keywords: Road safety, Road traffic accidents (RTAs), black spots, Environmental factors.

INTRODUCTION

This study is motivated by the alarming statistics of death and injuries resulting from road traffic accidents (RTAs) in the world as a whole and in India in particular. Road Traffic Accidents (RTA) is a major but neglected public health challenge that requires concerted efforts for effective and sustainable prevention. Of all the systems with which people have to deal every day, road traffic systems are the most complex and the most dangerous.

Spectrum of accidents are Road traffic accidents, industrial accidents, domestic and peri-domestic, railway accidents, agricultural accident, intentional or suicidal injuries, etc.. But the epidemics of road traffic accidents are leading cause of mortality and morbidity. The alarming increase in mortality and morbidity owing to road traffic accidents has been a matter of great concern globally.

The main risk factors for road traffic injuries are:

- economic factors such as level of economic development and social deprivation;
- demographic factors such as age and sex;
- land-use planning practices which influence length of trip and mode of travel;
- mixture of high-speed motorized traffic with vulnerable road users;
- insufficient attention to integration of road function with decisions about speed limits, road layout and design.
- inappropriate and excessive speed;
- presence of alcohol, medicinal or recreational drugs;
- being a young male;
- having youths driving in the same car;
- being a vulnerable road user in urban and residential areas;
- travelling in darkness;
- vehicle factors – such as braking, handling and maintenance;
- defects in road design, layout and maintenance, which can also lead to unsafe behaviour by road users;
- inadequate visibility because of environmental factors (making it hard to detect vehicles and other road users);
- poor eyesight of road users.

The specific objectives of the study are:

- (1) to discuss the effect of weather and road conditions on road traffic accidents (RTAs) in New Delhi and
- (2) to examine and analyse how environmental features contribute to road traffic accidents (RTAs) on the roads.

LITERATURE REVIEW

Many studies have examined the causes of traffic road accidents the world over. But, there is no consensus on their causes. This section reviews the existing literature on the effect of environmental factors on road traffic accidents. The main findings of the reviewed literature and any research gaps identified are discussed below. According to the study by Shankar et al (1995), rainfall plays a significant role in road traffic accidents. They argued that higher rates of fatalities resulting from road traffic crashes in poor weather could be explained by (a) poor visibility due to rainy or snowy weather (b) the road surface which may be more slippery thereby reducing the vehicle-roadway friction. Previous study by Hajar et al (2000) in Mexico tended to support the findings of the study of Shankar et al (1995). Hajar et al (2000) showed a definite association of adverse environmental conditions such as rain, fog, and wet pavement as well as driving in daylight with traffic crashes.

However, Kashani et al (2012) revealed that weather and road surface conditions, shoulder type and road width, lighting as well as location type are less important variables, influencing the injury severity by traffic crashes than the use of seat belt, cause of crash and collision type. A study of traffic accidents at hazardous locations of urban roads in Jordan indicates that road accidents represent a major social and economic problem that causes a lot of losses in lives and injuries (Mohammed. & Thanaa 2012). This study found that logarithmic and linear statistical models could efficiently and practically predict the expected number of accidents, injuries, fatalities and their associated types as functions of numerous independent variables. It was found that the most important contributing factors to traffic safety issues at urban roads were geometrical, behavioral, traffic condition and environmental factors.

The most contributing factors to accidents at hazardous locations on urban roads were speed, degree of curvature, road surface type, traffic properties, number of horizontal and vertical curves, lighting conditions and roadway geometry. The traffic accidents study in Jordan adopted an engineering approach to examine the causes of road accidents in the hazardous locations of urban areas in Jordan. The present study adopted a geographical approach to analyse the effect of environmental factors on road accidents at black spots in the City of New Delhi. Lankarani et al (2014) in a study in Iran revealed that environmental factors are major causes of road accidents. It was established that dusty weather had the highest death rate compared to other weather conditions.

The study found that winding uphill/downhill road was the roadway geometry with the highest rate of RTAs. This roadway geometry limits the driver's vision and causes difficult control of vehicle at crash time with subsequent increase in fatal RTAs risk Well-designed roads with separate lines for pedestrians and cyclists are much safer than those without such facilities. Sometimes barriers to discourage pedestrians to motor roads reduce the rate of injuries. Road signs should be clear by themselves and should convey an unmistakable message to the driver. It has also been observed that accidents mostly occur on broader roads than narrower ones (Majumder et al 1996).

In Nigeria it was reported that better roads have resulted in excessive speed and reckless driving resulting in an increase rather than reduce death toll on national roads (Asogwa 1992). There is also a relationship between seasonality; weather and time factor in road traffic accident occurrence (CSA 1983, Jegede, 1988, Zhang et al 1998). Fatal accidents have been reported during winter season. For instance, a study carried out by Kong et al (1996) has revealed that most of the accidents occur at night or in weekends during the Northern winter (e.g. October to December). Shibata et al. (1994) observes that informal tertiary sector activities along the road side tend to increase exposure risk to traffic accidents. In addition, improved road quality may lead to behavioral adjustments in terms of more risk prone driving (Jorgensen and Abane; 1999). According to Agoki (1992) the major causes of RTAs were behavioural, environmental, vehicular and governance factors. Agoki (1992) further noted that these factors influenced one another and a single solution or an arbitrary set of un-researched measures cannot resolve the complex issues in RTAs particularly in urban areas like New Delhi.

The present study examined to a large extent how environmental factors cause RTAs. The study does not consider how the inter-dependence of the social, environmental and governance factors causes RTAs. In India, Ishwar Prasad (1996) observes that development and expansion of road transport system has been revolutionary promoting efficient and quick exchange of goods and services between distant places which would not be accessible by any other cheaper and convenient mode of transport. This development has led to increased road traffic accidents in Kenya. Among the key recommendations proposed by Ishwar Prasad (1996) are that drivers of Matatus and their proprietors should be well trained and informed on traffic management and made aware of road safety issues. He recommends that roads should be regularly maintained to make them motorable and to reduce road traffic accidents and all road users should be made aware of the importance of road safety in order to minimise RTAs. The recommendation by Ishwar Prasad (1996) takes cognisance of the fact that there are some environmental and governance factors that to a larger extent affects road safety on our roads in one way or another. The present study examines the environmental factors which affect road safety at road black spots in the City of New Delhi. This is a major departure from studies reviewed so far.

THEORETICAL FRAMEWORK

This study applies the systems theory in analyzing RTAs. According to Muhlrud et al (2005), explanations of the systems theory are based on human-environment adjustments and maladjustments. Krug et al (2000) distinguish three main components of the systems theory. They are: environmental factors, the means of transport (vehicles) and the behavior of driver (human factors). The environmental component comprises the natural and the built environments and road networks. The means of transport component comprises the volume and quality of vehicles on the road. The behavior of driver/human factors component consists of demographic characteristic of road users (age, sex, education, socio-economic status, stage in life cycle), people's perceptions of risk and people's general behavior on the streets. Integrated in the systems theory is a system of highway codes and enforcement mechanisms designed to ensure that road users adhere to the controls and regulations of traffic flow for maintaining road traffic safety. According to Button (1993) and Haur (1995) comprehensive traffic management should be sufficient to maintain road traffic safety.

A good control of the vehicles on the road depends very much on behavior (which is very complex) and skills of the drivers (CSA1983). Accidents may be due to judgement errors, ignorance, incompetence, rule violation, lapses or carelessness, all of which are human errors. The human factor contributes to the majority of road traffic accidents in many parts of the developing world. Lack of driver training, drug abuse, fatigue and speeding have been reported in literature as contributory factors to RTAs (Orsay et al 1994: .Shibata et al 1994, Zhang et al 1998). Odero (1995) in a study carried out in Kenya also found out that human factors were responsible for 85% of all causes. Available literature points to the fact that adolescents or young drivers are frequently involved in traffic accidents than other age groups (Leon et al, 1996; Bjornskau, 2000). Vehicle characteristics and vehicle use are also frequently cited in the literature as being potentially important factors contributing to high motor vehicle related fatality rates. Nelson et al (1991; Bener et al (1992). Design of the vehicle, well breaking system of the vehicle, better tyres and extended visibility due to improved lighting of the vehicle reduce risk of accidents.

Defects in design or manufacture of vehicle can threaten occupants' safety. Improvement of the interior of the vehicle tends to increase the safety of the occupants (Graham 1993). Bener et al (1992), (1992), Moen et al (2005) and Lankarani et al (2014) argue that environmental parameters are important contributory factors to RTAs. For example, the physical environment, various climatic threats and geo hazards like heat, fog, high winds, snow, rain, ice, flooding, tomadoes hurricanes, and avalanches have effects on roads hence on traffic accidents. The weather (e.g. heavy tropical rain) also threatens surface transport and impacts road way safety, mobility. It affects road safety through increased crash risk as well as exposure to weather related hazards. Weather impacts roadway mobility by increasing travel time delay, reducing traffic volumes and speeds and reducing roadway capacity. Weather and road conditions in terms of road qualities therefore have a role in the causes of traffic accidents (Komba, 2006).

Conceptual framework

The conceptual framework adopted in this study is a multilevel based framework which attempts to address the ways in which the physical or environmental factors influence road traffic crashes (Fig.1). The framework is used to aid understanding of the multiple causes and prevention of traffic accidents that occur in developing cities such as Delhi, Mumbai etc. Available literature identifies the causes of traffic accidents in a place as being caused either by physical factors in the road network (environmental factors), the vehicle characteristics or behavior and how they interact with enforcement regulations in unique settings. The conceptual framework investigates risky driving behaviours.

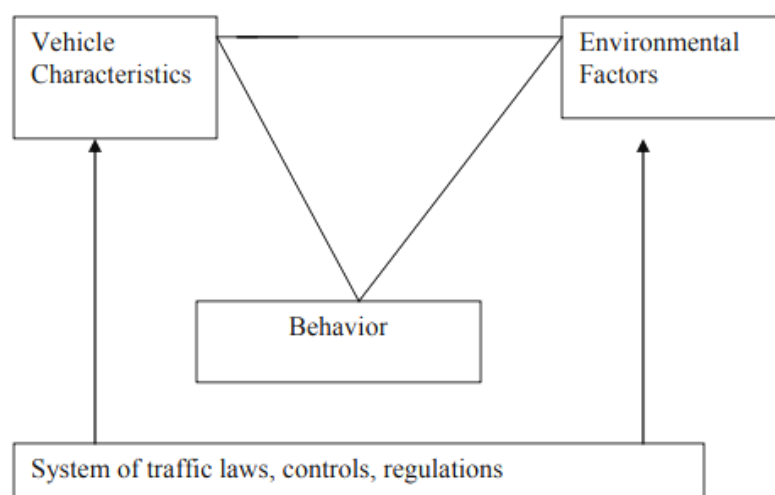


Figure 1: Conceptual Framework

RESEARCH METHODOLOGY

The methodology for data collection being used in this type of studies is based on both qualitative and quantitative methodologies within a framework of a case study approach. Interviews, focus group discussions, observations and review of secondary data, were also done. The study used triangulation to obtain data from multiple sources to adequately address the research objectives from different points of view. Triangulations strengthen reliability and validity of the research.

Study Area

This study should be carried out in any chosen city area which may be a developing or a developed city.

Data collection

The methods of data collection used in this type study included on-site observations and study of accident scenes and environmental features of road accident black spot sites. The Police Traffic Department keeps records of traffic accidents in each area. These records provided useful data on road accident black spots in the City. Major Black spots are selected using systematic sampling method. Every second black spot was picked for study from the list of six black spots. The road accident black spots are distributed throughout the City which made it difficult for the researcher to cover all of them. But the ones selected were considered representative enough. Interviews are also held with key informants in the City such as Traffic Commandant in the City and Ministry of Transport and Infrastructure officials. Key informants are selected using purposive sampling method. Focus Group discussion (FGD) involving representatives of key stakeholders such as traffic police, PSVs/Matatus drivers, PSV SACCOs, Private vehicle drivers and Traffic police officers in the respective police bases within the sampled road accident black spots provides additional information on possible black spots and causes of traffic crashes in that area. Focus group discussion group is made up of between 10-15 members. Questionnaires for public transport operators were administered at the route termini to avoid rushing the respondents. This is done mostly for PSV drivers. The private car drivers are interviewed at road side parking bays and supermarkets parking yards within the road accidents black spot areas. In order to get adequate data from PSV drivers questionnaires, the PSVs CBD Bus tops where driver Interviews should be done were randomly chosen. These are chosen from the sampled Road Accident Black spots and road locations.

Data analysis

Data is analyzed using many statistical tests like Pearson chi-square goodness of fit test. This inferential statistical technique is also used for testing the two hypotheses formulated for the study. Data on observations of the presence of road side activities and their encroachment on the pedestrian sidewalks is also analyzed using descriptive statistics. Base on the various information's from the respondents, it can be seen that all of the respondents which were interviewed (100 percent) reported that road accidents at black spots in cities occurred during dry weather conditions.

Historical data shows that in over 56% of the observed occurrences, various road side activities were interfering with motor vehicle flow and in effect interfering with pedestrian walk ways and in 43% of the occurrences there were no interferences (Fig.2). Observations of the availability of pedestrian road crossing facilities along the road black spots are shown in Fig.3. The analysis shows that in 72% of the observed cases, there were no pedestrian fences to channel pedestrians to safe crossing points along the road black spots and in 28% of the cases there were pedestrian fences to channel pedestrians to allow for safe passage. This could be one of the causes of the pedestrian road crashes.

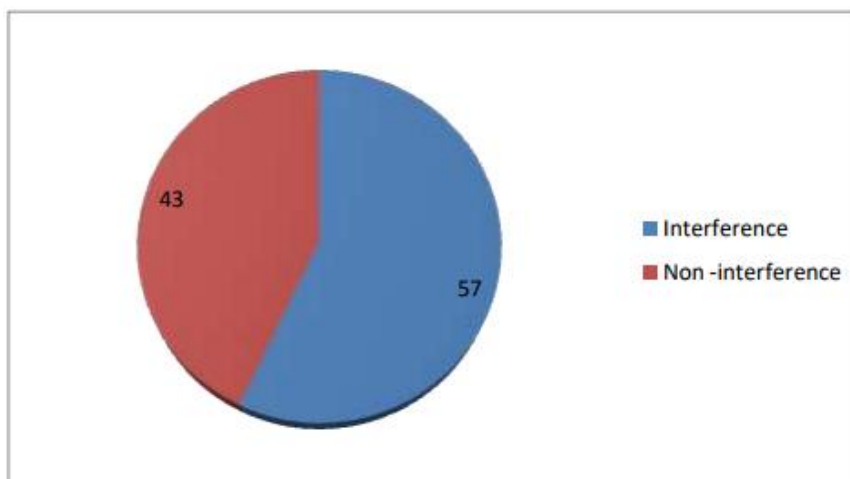


Figure 2: Road side activity interference with motor vehicle Flow

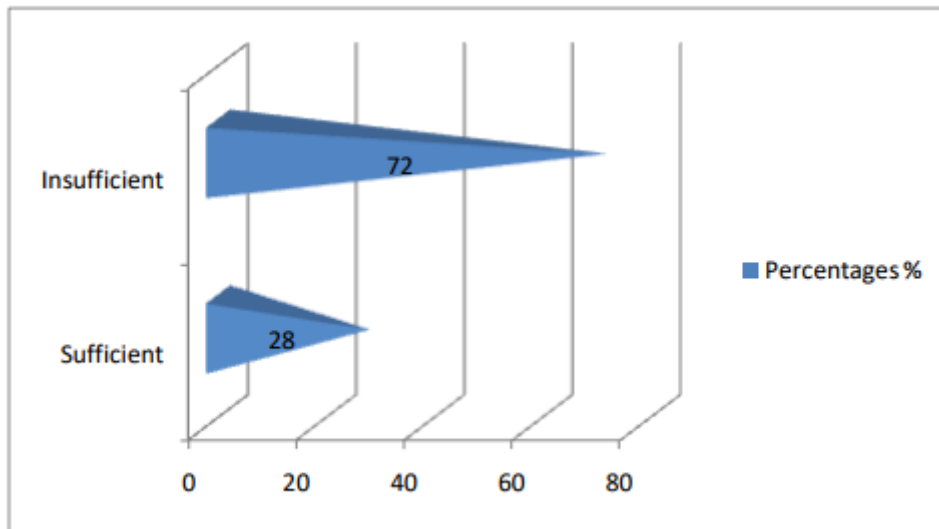


Figure 3: Available pedestrian crossing facilities situations

CONCLUSION

This study has discussed on the systems theory as its theoretical framework. The theory was complemented by the conceptual framework, which too was founded on the interrelationships of the main components of RTAs: environmental, behavior and governance factors. The main conclusions of the study are that;

- (1) road conditions did not contribute significantly to RTAs.
- (2) lack of adequate pedestrian road crossing facilities and fences at black spots led to traffic crashes
- (3) pedestrians tend to ignore designated pedestrian traffic ways and safe road crossing points thereby being involved in RTAs,
- (4) absence of speed limit signs and speed limit bumps at black spots increases the occurrences of RTAs.

The key recommendations of the study are:

- (a) road safety should be recognized as a national disaster and adequate funds allocated to deal with it
- (b) there should be enforcement of traffic rules
- (c) road designs should incorporate pedestrian crossing.

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