Case Report

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Identification of hazardous locations for road traffic injuries

COMMUNITY MEDICINE

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ABSTRACT

Background: Road crash injury is largely preventable and predictable; it is a human-made problem amenable to rational analysis and countermeasures. All the studies on Road Traffic accidents either use number of accidents or victims according to availability of accident data. Studies combining these two types of data to identify hazardous locations are a rarity. In this study data on both, the number of accidents and severity of Road Traffic Injuries is used to identify hazardous locations. **Materials and Methods**: Using the values of Glasgow coma scale, Systolic Blood Pressure and Respiratory Rate of the RTI victims at the causality department, Revised trauma score for each case is calculated. Depending on the type of injury Abbreviated injury score is calculated for each case. From AIS, Injury severity score is calculated. The widely used technique – Trauma score – injury severity score methodology was used to evaluate probability of survival for each patient. From probability of Survival Hazardous Index is calculated for all the accident sites. **Results:** Five accident sites were identified as Hazardous with high hazard index. Young adults closely followed by elder adults are highest number of victims for RTI in all the hazardous sites. Males are affected mostly in all the sites compared to females. **Conclusion**: A study combining both the number of accidents and severity of injuries, like this study based on Hazardous Index would be more scientific, lead to correct identification of hazardous sites and thus the interventions will be cost effective.

Key words: *Hazardous sites, Probability of survival, Road Traffic injuries, TRISS methodology*

Introduction

Of all the systems with which people have to deal everyday Road Traffic Systems (RTS) are the most complex and the most dangerous [1]. With the transit of human race from 19th to 20th century a slow transition started in the cause of deaths from infectious to non-infectious agents. By the advent of 21st century Road Traffic Injuries (RTI) emerged as one of the major cause of injuries and deaths worldwide in the post transition era. RTIs are the leading cause of deaths, hospitalization and disabilities in India. In India RTIs result in death of more than 100000 persons, 2 million hospitalizations, 7.7 million minor injuries and an estimated economic loss of 55000 crores or nearly 3% of GDP every year [2]. The available data reveals that nearly 10-30 % of hospital registrations are due to RTIs and majority of those hospitalized are discharged with varying levels of disabilities. Road crash injury is largely preventable and predictable; it is a human-made problem amenable to rational analysis and countermeasures. In the 1960s and early 1970s many highly motorized countries began to

achieve large reductions in casualties through outcome-oriented and science-based approaches. The health sector has an important role to play in establishing data systems on injuries and the effectiveness of interventions, and the communication of these data to a wider audience. Many studies were carried in India based on hospital records, which were mainly limited to metropolitans and large cities. All the studies either use number of accidents or victims according to availability of accident data. Studies combining these two types of data to identify hazardous locations are a rarity. In this study data on both, the number of accidents and severity of RTIs is used to identify hazardous locations.

Materials and Methods

The objective of the study is to identify hazardous locations for Road traffic injuries in and around Kurnool city and identify factors responsible for accidents at these sites. The study area includes Kurnool Municipal Corporation and the area around Kurnool city with in the radius of 10 km from the centre of Kurnool city. Road traffic injury data for complete year is collected from Government General Hospital, Kurnool. Almost all the accident cases in and around Kurnool approach this medical facility for medical care. The hospital has an accident register, which maintains the preliminary data of all accident cases coming to the facility. For reasons of clear data collection, only harm involving a road vehicle is included. A person tripping with fatal consequences on a public road is not included as a road-traffic fatality. To be counted a pedestrian fatality, the victim must be struck by a road vehicle. Preliminary data regarding these cases is collected from accident registers. These cases are followed till a complete assessment of injuries is carried out in their respective wards. As the current study uses injuries succumbed and post injury status to assess the outcome of RTI by calculating probability of survival using Trauma score – injury severity score methodology, the treatment given and outcome is not recorded except for the deaths to know the fatality rates. Using the values of Glasgow coma scale (GCS), Systolic Blood Pressure (SBP) and Respiratory Rate (RR) of the cases at the time of admission Revised trauma score for each case is calculated. The Revised Trauma Score is a physiological scoring system, with high inter-rater reliability and demonstrated accuracy in predicting death.

RTS = 0.9368 GCS + 0.7326 SBP + 0.2908 RR

Values for the RTS are in the range 0 to 7.8408. The RTS is heavily weighted towards the Glasgow Coma Scale to compensate for major head injury without multisystem injury or major physiological changes. The RTS correlates well with the probability of survival. Depending on the type of injury, Abbreviated injury score is calculated for each case. Injuries are ranked on a scale of 1 to 6, with 1 being minor, 5 severe and 6 an unsurvivable injury. From Abbreviated Injury Score (AIS), Injury severity score is calculated. The Injury Severity Score is an anatomical scoring system that provides an overall score for patients with multiple injuries. Each injury is assigned an Abbreviated Injury Scale score and is allocated to one of six body regions (Head, Face, Chest, Abdomen, Extremities (including Pelvis), and external). Only the highest AIS score in each body region is used. The 3 most severely injured body regions have their score squared and added together to produce the ISS score. The widely used technique – Trauma score – injury severity score methodology is used to evaluate probability of survival for

each patient involved in a single or multiple body region injury by referencing the patient's anatomical injury and post-injury physiological status. Anatomical injury data for each body-region were coded by the Abbreviated injury scale and used as input for the Injury severity score for either single or multiple body-region injury. Post-injury physiological status was assessed from the Revised Trauma Score which depended upon the value of systolic Blood pressure, Respiratory Rate and consciousness status as called the Glasgow coma scale. The Probability of Survival (PS) value is calculated by using equations

$$\mathbf{PS = 1/ 1+ e^{-b}}$$

Where 'b' is calculated:

$$b = b0 + b1 (RTS) + b2 (ISS) + b3 (AGE)$$

The coefficients b0 - b3 are derived from multiple regression analysis of the Major Trauma Outcome Study database. Age Index is 0 if the patient is below 54 years of age or 1 if 55 years and over. b0 to b3 are coefficients, which are different for blunt and penetrating trauma. If the patient is less than 15, the blunt coefficients are used regardless of mechanism. Hazardous Index (HI) is calculated from PS. HI is composed of two dimensions of accident frequency and severity. To obtain the HI, it was assumed that severity and frequency of accident occurrences are mainly perceived factors, which normally be used to discriminate whether such locations are hazardous.

$$\mathbf{HI_i = \frac{N_i}{N^m} \sum_{j=1}^{j=j} (1- PS_{ij})}$$

Where,

HI_i = Hazardous Index for location i

N_i = Number of accident cases occurred on location I

N^m = Maximum number of accident cases observed for all locations

PS_{ij} = Probability of Survival estimated for patient jth after involved an accident occurrence in location or situation i.

Results

A total of 916 cases of injuries are recorded in a year from Government General Hospital (GGH), Kurnool. For all the victims probability of survival is calculated using Revised Trauma score and Injury Severity Score. From probability of Survival Hazardous Index is calculated for all the accident sites. Of all the accident sites Hazardous sites are identified with HI > 100. The results for these hazardous sites are as follows. Among all hazardous sites bellary chaurastha has maximum number of victims (table 1). Maximum number of victims from an accident site was from government general hospital site. As the HI of GGH site is less than 100 and it is not considered as a hazardous site. Young adults (20-30 yrs) closely followed by elder adults (40-59 yrs) are highest number of victims for RTI in all the hazardous sites (table 2). Very young and the elderly population are less victimized at these sites. Males are affected mostly in all the sites compared to females (table 3). When injuries are studied in respect to the site of accident GGH accounted for maximum number of injury cases (6%). Bellary chourastha is the site with maximum HI (779.86) followed by check post area with HI 217.19, C camp area with HI 163.64, Krishna nagar with HI 140.51 and kallur with HI 105.93.

Table 1: Number of accident victims at hazardous sites

Accident site	Accident victims	Frequency (%)
Bellary chaurastha	52	5.7
Check post	25	2.7
C camp	36	3.9
Krishna nagar	32	3.5
kallur	32	3.5
Total	177	19.3

Table 2: Age group differences of victims at hazardous sites

Accident site	1-19 yrs	20-39yr	40-59yr	> 60 yr	Total
Bellary chaurastha	7	26	17	2	52
Check post	3	11	11	0	25
C camp	6	14	15	1	36
Krishna nagar	6	14	9	3	32
kallur	7	13	11	1	32

Table 3: Sex differences of the victims at hazardous sites

Accident site	Male	Female	Total
Bellary chaurastha	42	10	52
Check post	21	4	25
C camp	32	4	36
Krishna nagar	31	1	32
kallur	27	5	32
Total	153	24	177

Table 4: Hazardous sites (HI>100)

Accident site	Hazardous Index
Bellary chourastha	779.86
Check post	217.19
C Camp	163.64
Krishna nagar	140.51
Kallur	105.93

Discussion

Common to all RTI studies males are the commonly affected population in this study as males tend to travel more in comparison to females. Most active and more travelling age group (20-60) is the highly injured population at all the hazardous sites. Hazardous sites are usually determined by the number of accidents reported from any site or the severity of accidents at these sites. If these criteria are followed GGH area has maximum number of RTI victims reported while the severity of injuries is less from this site. Thus GGH is considered a non hazardous site with HI less than 100. Bellary chaurastha second to GGH area in number of accident victims has more injury severity thus considered to be a hazardous site with highest Hazardous Index. When hazardous accident sites were surveyed for the cause of accidents at these sites the following observations were made:

Bellary Chaurastha - Inverted "T" shaped intersection, Residential area comes in direct contact with NH 7, One of the limbs enters into residential area with narrow lanes, sharp curves and multiple intersections, No signal lights, The highway limb is two-lane without road dividers, No road marks for different vehicles, No road crossing marks and signal for pedestrian crossing, No rails to prevent animal entry into roads, Number of RTI, Severity of accidents and injuries is high and a hazardous location.

Check Post - "Y" shaped intersection, State highway joins national highway at this point, Highway traffic with heavy loaded vehicular traffic, No signal lights, No road dividers, No lane markings for different types and speeds of vehicles, No sign boards about the intersection, Number of RTI, Severity of accidents and injuries is high and a hazardous location.

C Camp - Very large roundabout with four approaches, No signal lights, Highway traffic mixes with town traffic at this point, No lane markings around it for direction of travel, Bus stop and auto stand at close proximity,

Number of RTI, Severity of accidents and injuries is high and a hazardous location.

Krishna Nagar - Inverted "T" shaped intersection, Residential area comes in direct contact with NH 7, One of the limbs enters into residential area with narrow lanes, sharp curves and multiple intersections, No signal lights, The highway limb is two-lane without road dividers, No road marks for different vehicles, No road crossing marks and signal for pedestrian crossing, No rails to prevent animal entry into roads, Number of RTI, Severity of accidents and injuries is high and a hazardous location.

Kallur - Straight road section on national highway 7, Two-lane road without road dividers, Heavy Vehicles stationed at either side of the road, No road marks for different vehicular traffic, No railings to prevent animal entry on to the road, Numerous small roads entering main road, Number of RTI low but very high Severity of accidents and injuries and a hazardous location.

Conclusion

If traditional methods of determining hazardous sites for road traffic accidents is followed based on either number of accidents or severity of accidents erroneous conclusions will be drawn in identifying hazardous sites. A lot of money would be wasted and engineering these sites to prevent accident injuries would be cost ineffective. While a study combining both the approaches like this study based on Hazardous Index would be more scientific, lead to correct identification of sites and thus the interventions will be cost effective.

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