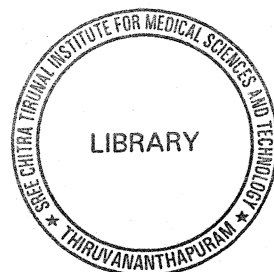


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# **Epidemiology of hospital admitted pedestrian victims of road traffic injury, Howrah, West Bengal, India, 2008**

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By

**Subhranshu Chakrabarti**

**(MAE- FETP Scholar 2007-2008)**



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**DECEMBER 2008**

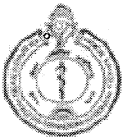
# Epidemiology of hospital admitted pedestrian victims of road traffic injury, Howrah, West Bengal, India, 2008

By

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(MAE- FETP Scholar 2007-2008)

Dissertation project submitted in partial fulfillment of the requirements for the degree of Master of Applied Epidemiology (M.A.E) of



**Sree Chitra Tirunal Institute for Medical Sciences and  
Technology,**

Thiruvananthapuram Kerala -695 011.

This work has been done as part of the two year Field Epidemiology Training Programme (FETP) conducted at



**National Institute of Epidemiology,**

(Indian Council of Medical Research),

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**DECEMBER 2008**

## CERTIFICATION

This is to certify that this dissertation, entitled 'Epidemiology of hospital admitted pedestrian victims of road traffic injury, Howrah, West Bengal, India, 2008', submitted by Dr. Subhranshu Chakrabarti, in partial fulfillment of the requirements for the degree of Master of Applied Epidemiology, is the original work done by him and has not been submitted earlier, in part or whole, for any other (Publication or degree) purpose.

Date 07.1.09



**DIRECTOR**

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## Abbreviations

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DALY	Disability adjusted life year
CDC	Centers for Disease Control & Prevention, Atlanta, Georgia, USA
FETP	Field Epidemiology Training Programme
HMV	Heavy Motor Vehicle
ICD	International Classification of Disease
IEC	Information Education Communication
JIPMER	Jawaharlal Nehru Institute of Post graduate Medical Education & Research
KAP	Knowledge, attitude and practice
LMV	Light Motor Vehicle
MAE	Master of Applied Epidemiology
NIE	National Institute of Epidemiology
NMV	Non Motorized Vehicle
RTI	Road Traffic Injury
WHO	World Health Organization

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Date: the 31st December 2008

Dr. Subhranshu Chakrabarti

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## **Abstract**

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### **Introduction**

In the road traffic injury statistics of Howrah, pedestrians contribute a major share. An understanding of factors influencing pedestrian injuries is prerequisite to design effective accident prevention strategies for Howrah district, West Bengal, India.

### **Methods**

Our descriptive epidemiological study surveyed through structured questionnaire, all 141 pedestrian victims attended at three study hospitals for time place and person distribution, types of vehicle involved, selected risk factors and knowledge, attitude and practices relating to road safety. We also compared the strength of association of some exposure variables between alive and dead victims.

### **Results**

Out of 141 admitted pedestrian victims, risk factors were being male 129(92%), Education secondary & above 104 (74%), maximum case on Tuesdays 43 (30%), being at a road turn 43 (30%), and walk roadway 43 (30%), 119 (84%) on a district road, 76 (54%) with a light motor vehicle and 51 (36%) with non motorized vehicle. Analytical study identified not knowing colour of traffic signal (OR 16, P- value 0.0065) and not using side walk (OR 34, P-value 0.0014)

### **Conclusions**

All categories of vehicles shared the district roads at the same time. The side-walks were blocked, Two peaks a day. Maximum no took place on Tuesdays. Maximum cases on "Bi-directional" traffic area. Road turning intersections and bus stops were two most vulnerable areas for pedestrian injury. Lack of knowledge, negative attitude and practice was identified. Segregation of nonmotorized vehicle, freeing the walk way, maximization of one way traffic and awareness generation is recommended for the study

**Key words:** Pedestrian, Risk factors, Howrah

# **Epidemiology of hospital admitted pedestrian victims of road-traffic Injury, Howrah, West Bengal, India 2008.**

## ***Chapter 1 - Introduction***

### ***Background***

Walking remains a commonly employed mode of travel. In less motorized countries, people have a lower car use and therefore spend more time walking. Walking almost inevitably involves crossing a road, where the desire line of the pedestrian conflicts with the higher speed and lesser vulnerability of motor vehicles. Global injury mortality rate was estimated to be 98/1, 00,000 population with male to female rates of 128 and 67/1, 00,000, respectively. Injuries contributed for 13% of total Disability Adjusted Life Years lost (DALYS) during 2002. Unintentional and intentional injuries accounted for 69% & 31%, respectively with RTIs (34%), being the major cause with a global mortality rate of 20/1,00,000. RTIs resulted in 10% of total deaths and 29% of DALYs among injuries. Men were affected 3-4 times more compared with women <sup>(1)</sup>.

Data provided by the WHO and the World Bank in the World report on road traffic injury prevention, showed that, in 2002, 1.2 million People died as a result of road traffic collisions, and 20 to 50 million people were injured or disabled. Road traffic injuries were the 11th leading cause of death worldwide and accounted for 2.1% of all deaths globally. 90% of road traffic deaths occurred in low and middle-income countries, where 81% of the world's population lives. Pedestrians, cyclists and motorcyclists, regarded as "*Vulnerable road users*"

account for a much greater proportion of road traffic collisions in low-income and middle-income countries <sup>(1)</sup>. Each year RTI claim some 6,00,000 lives and thirty times this number, that is over fifteen million, are injured. This represents more than one life lost every minute and an injury every two seconds <sup>(8)</sup>.

Review of available National data from the recent "Burden of Disease in India" by the National Commission on Macroeconomics and Health, Government of India, reveals that road traffic injuries are a major public health problem. The health sector faces the maximum impact by providing diagnostic, curative and rehabilitative services and incurs huge expenditure, when it is established that RTI are predictable and preventable. Data published by National Crime Record Bureau 2007 shows a total of 1,12,590 Road traffic accidental deaths reported in India in 2007, of which, 10,125 were Pedestrians. West Bengal reported 482 pedestrian deaths during 2007 <sup>(9)</sup>. In a do-nothing scenario, it is possible that India will have 1,20,000 - 1,30,000 road traffic fatalities in the year 2008 and possibly 1,50,000 - 1,75,000 in 2015 <sup>(2)</sup>.

Integrated Disease Surveillance Programme highlights that Road Traffic Injuries are the sixth leading cause of death in India <sup>(3)</sup>. RTI in each year result in death of over 100,000 persons, 2 million hospitalization 7.7 million minor injuries and an estimated economic loss of Rs. 55,000 crores or nearly 3% of GDP every year <sup>(4)</sup>.

In a hospital based study at Howrah during July to October 2006, 4987 road traffic accident victims attended at 3 major hospitals. 443 cases (9%) were admitted & 61 (14%) victims died. 134 (30%) case & 15 (4%) death among pedestrians. Pedestrians contribute about 30% of cases & 4% of deaths due to

road traffic accidents. 27% of road traffic accident associated head injuries were among pedestrians.<sup>(7.)</sup>

The descriptive epidemiology of pedestrian victims, the injury they sustain, vehicles associated with those accidents, and risk factors of traffic injury of the pedestrian victims of Howrah remains unknown. To prevent road traffic accident among pedestrians of the district and for containment of road traffic injury of pedestrians in other similar settings, the study conducted with the following primary objectives:

- **To estimate frequency of characteristics of pedestrian victims**
- **To estimate frequency of offending vehicles involved**
- **To estimate frequency of selected risk behaviors of the victims**
- **To estimate Knowledge-Attitude-Practice of victims on traffic rules**

The secondary objective of this study is:

- **To identify the association of different exposure variables between victims who have died and victims who remain alive.**

## ***Chapter 2. Methods***

### *Overview*

The current study was carried out to provide with more complete information on the full spectrum of situations and events causing injury to pedestrians in order to increase awareness of the problem and to help countermeasure development.

### *Data Collection Procedures:*

#### ***1. Emergency Department Data Collection:***

The general study approach coupled prospective data collection at hospital emergency departments. These databases were analyzed independently and in conjunction with one another to address the study's key research questions.

Because of the fact that about 80-85% of road traffic injuries occurring in the Howrah district were referred to three large public hospitals of the district <sup>(7)</sup>, we selected these hospitals located in large urban setting and its surrounding suburbs, for this hospital-based descriptive study.

#### ***2. Quality control of the data collected:***

All three hospital authorities were willing to participate in the data collection. At the three participating hospitals, emergency department staffs volunteers were trained to identify prospective cases and complete a supplementary checklist for each case identified. Once every week, primary investigator of the project visited the emergency department and, working from the information sheets. Prior to initiating data collection, the primary investigator met with emergency department

staff at each hospital to explain the project, recruit volunteers, provide in-service training, and finalize the specific data collection procedures.

For this phase of the study, a special survey form was developed for use in recording information about pedestrian cases to be included in the study (appendix A). Emergency department data were collected over 4 months time period at each of the hospitals. A more detailed description of the data and study methodology follows.

The following hospitals participated in the emergency department data collection:

Howrah Sadar Subdivision:

- District Hospital, Howrah.
- T.L.Jaiswal State General Hospital.

Uluberia Subdivision:

- Subdivisional Hospital, Uluberia.

The survey forms were completed by staff volunteer at the time of the emergency admission. The actual dates of data collection also spanned over a 4 month time period, July 2008 to October 2008. All data were collected between 1<sup>st</sup> July '08 and 31<sup>st</sup> October '08.

### *Study population*

Population of Howrah district.

Exclusion: victims who are not residents of Howrah were excluded.

### *Study participants*

Pedestrian victims admitted to the three selected hospitals in the Howrah district during the period from July '08 to October '08.

### *Study Design*

Descriptive study

### *Study period*

Between 1st July 2008 to 31<sup>st</sup> October 2008.

### *Operational definitions*

We conducted active surveillance of road traffic injury cases admitted in these hospitals during 1st July 2008 to 31<sup>st</sup> October 2008.

We defined ***Pedestrian***: as “Any person traveling on foot from one location to another, not in or upon any vehicle”.

#### **Includes:**

1. Persons injured as a result of being struck by a vehicle, regardless of where the collision took place.
2. Persons injured as the result of a fall or other mishap while walking, running, standing, working, playing, etc. on a public vehicular area.
3. A public vehicular area is an area that is generally open to and used by the public for vehicular traffic, including entrances to public buildings, parking lots and garages, etc.

### **Excludes:**

1. Any injury incurred while inside a building, residence, or other structure.
2. Persons injured on public property not serving a transportation function (playgrounds, parks, etc.)

We define **Types of accidents** for the purpose of the study as:

- Pedestrian-Heavy Motor Vehicle (HMV): Heavy Motor Vehicle includes all motorized four or more wheeled vehicle (eg. Bus, Truck, Cab etc).
- Pedestrian-Light Motor Vehicle (LMV): Light Motor Vehicle includes all motorized two / three wheeled vehicles (eg. Motor cycle, Scooter, Moped, Auto rickshaw).
- Pedestrian-Non Motorized Vehicle (NMV): Non Motorized Vehicle includes all manually operated two / three wheeled vehicle (eg. Bicycle, Cycle rickshaw, Delivery van).
- Pedestrian only event (P-only): Pedestrian falls that occur in on-road locations.

### *Data collection*

We interviewed all admitted pedestrian victims of road traffic injury (or their attendants, as the case may be) using a semi-structured, pre-tested questionnaire translated into Bengali and back-translated. We collected information on socio-demographic characteristics, type of the vehicle involved, place and time of occurrence of injury, different risk factors related to human behavior (under influence of alcohol, use of mobile phones etc) and road factors

(i.e., visibility, condition of roads etc). We categorized the place of occurrence of road traffic injuries as those occurring on National highway and those occurring on non-highways. Non-highways included District motorable roads and District Non-motorable roads. We collected clinical information including body parts affected, type of injury according to ICD 10 format, and outcome of the victim. We collected data on Knowledge-Attitude-Practice of victims relating to road safety.

#### **Hospital Indoor Admission Data:**

A total of 141 pedestrian injury cases were admitted at 3 participating hospitals. We collected data from the admitted case patients, or their relatives for those who were critically ill or brought dead.

#### *Data analysis*

We analyzed the data using Epi Info software.

#### **Human subject protection**

We appraised the hospital authorities about the objectives of the study and obtained the permission to carry out the study. We obtained permission of the concerned physician prior to the interview of the victim. We obtained informed consent from the victims or their guardians (in case of minor and incapacitated person and in case of death cases). The principal investigator kept all the data confidentially under lock and key in his custody.

### **Chapter 3. Results**

We surveyed three study hospitals of Howrah. We found, during July to October '08, a total of 42,134 patients were registered in the casualty departments, 8,359 (19.8%) were injury victims, and 5,207 (62.3%) were due to road traffic injuries. We found, during this period, 8,036 patients who were admitted in these three hospitals, 847 (4.7%) were due to all injuries, and 511 (2.8%) were due to road traffic injuries. Road traffic injuries accounted for (511/847) 60.3% of all emergency injury admissions. Out of the 511 patients admitted with road traffic injuries, we found 141 (27.6%) were pedestrians. 89 (63.1%) admitted in Howrah District Hospital, 30 (21.3%) in Uluberia Sub-divisional hospital and 23 (16.3%) in T.L.Jaiswal Hospital (Fig: 2). Of the 89 pedestrian victims of Howrah District Hospital, 3 died and 1 was brought dead, of the 30 pedestrian victims of Uluberia Sub-divisional Hospital, 2 died and 2 were brought dead, and of the 23 pedestrian victims of T.L.Jaiswal Hospital, 1 died. In total, out of 141 admitted pedestrian victims during the period of study, i.e. July to October 2008, 9 (6.4%) died (*Table 2*). Of the 141 pedestrian victims, we could not interview 3 brought dead cases and 1 admitted case because of deep unconsciousness. However, some of the information eg, demographic details and types of injuries, were collected from the "Police inquest", hospital mortuary records or the accompanying relatives. Thus we were able to interview 137 victims (97.2%) for the study. The results of our study are described below:

Median age of victims is 30 (range 5 to 75). 64 (46%) are in the age group of 15 to 30 yrs, only 12 (8.5%) were female (Table 1). 52 (37%) have education up to or above H.S. (Table 2). 14 (10%) victims had family income below Rs. 2000 per month (Table 2). 55 (39%) persons were self employed, (Table 2). 18 case patients (13%) were physically compromised, (Table 2). 86 (61%) took place in motorized district roads, (Table 3). 76 (54%) were Pedestrian and Light Motor Vehicles injury, (motorized two wheelers and auto rickshaw). 51 (36%) were Pedestrian and Non motorized vehicles injury (bicycle and cycle rickshaw / pedal trolley), (Table 3). 59 (42%) found road to be uneven, 30 (21%) cases sidewalk was blocked (street vendors / repair of underground electric / telephone cable or pipe line) (Table 3). 69 (49%) cases occurred during 6 PM and 6 AM, (natural light insufficient), Of these cases, 41 (59%) found the place of accident was poorly illuminated (Table 3). Majority of the cases 43 (30%), took place on Tuesdays, Followed by Saturday 22(16%), Friday 21 (15%), and Mondays 21 (15%) cases (Fig 4). 40 (28%) cases reported in the month of August (Fig.5). Maximum no. of cases, 65 (46%) took place during "Evening" (18 hrs to 23.59 hrs), followed by 47 (33%) cases during "Forenoon" (6 hrs to 11.59 hrs), (Fig: 6). Majority of cases, 116 (82%) took place in the areas where traffic movement is Both ways (Table 3). 43 (30%) were at a road turning intersection, 35 (25%) were at a bus stop, 43 (30%) were walking on roadways (Fig 3). 37 (26%) had injury over Head & Face (S00-09), 15 (11%) on Thorax (S 20-29), 13 (9%) on Abdomen, Lumber spine and lower back (S 30-39), (Table 2). 47 (36%) cases sustained Fracture and dislocation. 15 (11%) sustained injury to brain and another 15 (11%) sustained

visceral injury (Table 2). 132 (94%) victims remained alive and 9 (6%) died of which, 3 persons were brought dead (Table 2).

## *KNOWLEDGE*

13 (9%) victims did not know all the three colours of a traffic signal. 60 (43%) did not know the meaning of all three colours of a traffic signal. 81 (57%) victims did not know to look "Left-Right-Left" before road crossing. 100 (71%) did not know it is safe to walk facing the flowing traffic, & 124 (88%) victims knew that side-walks segregate pedestrians from traffic (Table 4).

Gradation of "Knowledge" of victims according to response:

- Responded affirmatively to all 5 responses:           Excellent: 4 cases (3%)
- Responded affirmatively to 4 responses:            Good: 63 cases (45%)
- Responded affirmatively to 3 responses:           Average: 20 cases (14%)
- Responded affirmatively to 2 or less responses:    Poor: 54 cases (38%).

## *ATTITUDE*

125 (89%) victims feel that it is safe practice to observe traffic rule. 70 (50%) victims are of opinion that traffic signals delay journey time. 130 (92%) victims feel that side walk should be free from encroachments. 69 (49%) of the victims feel that Zebra crossings are safe corridors for road crossing (Table 4).

## *PRACTICE*

108 (77%) victims used to wait for the green light at a signalized crossing. 88 (63%) victims did not look "Left-Right-Left" before crossing the road. 85 (60%) victims did not use the Zebra crossing even when it is available. 18 (15%) victims did not use the side walk even when it is available (Table 4).

## *SCALE OF EXPOSURES:*

41(29%) victims used to walk more than one hour a day, , 72 (51%) victims used to go out two to three times a day. 9 (6%) victims used either cell phone/ FM radio/ I-pod while walking, 6 days a week (Always). 51 (36%) victims used to read documents while walking roadways 1 to 2 days a week (Sometimes). 47(33%) victim always used to chat with others while walking. 4 (3%) victims use to watch bill boards / posters while walking roadways 6 days a week (Always). Only 6 (4%) victims walk roadways under influence of alcohol / intoxicants 6 days a week (Always). 47 (33%) victims used to stand by road side 6 days a week (Always). 48 (34%) victims need to cross road 8 or more times a day, 18 (13%) victims required to cross road 1 to 3 times a day. 85 (60%) victim never walked facing the traffic flow, 68 (48%) victims usually walk alone (Table 5).

### *Result of analytical study*

As a component of secondary objective of this study, we conducted an unmatched case control study to identify the association of some of the exposure variable between those who died of the injury (*Cases*) and those who were alive after the injury (*Controls*). We took unmatched Case and Control at 1:3 ratios.

We found significant association only in two exposure variables, viz.

1. Do not know all 3 colours of traffic signal, had Odds Ratio of 16, 95% Confidence Interval 1.14 to 254.14, P value 0.0065, and
2. Do not use side walk, had Odds Ratio of 34, 95% Confidence Interval 1.77 to 1529.6, P value 0.0014 (Table 7).

## **Chapter 4. - Discussion**

Road traffic injury accounted for 60% of all emergency injury admissions in the current study. Unpublished study on Road traffic injuries accounted for 58% of emergency injury admissions <sup>(7)</sup>.

In 28% of all R.T.I. were pedestrians in the current study, pedestrians constituted 22% of the road users involved in RTI in a study conducted at South India <sup>(8)</sup>, 17% of all Cities All India <sup>(9)</sup>. Hospital studies in Bangalore during 1993, 1998, and 2005 have shown that pedestrians injured and killed to the extent of 25-35%, and 7-10% with minor variations across studies <sup>(10)</sup>. Data from population-based surveys also indicate a similar picture <sup>(11)</sup>.

12 (8.5%) victims were female in the present study, while study done in central India found female victims to be 14% <sup>(5)</sup>.

Mean age of the victims were 30 yrs in the current study, average age was 31.5 years in a study conducted at South India <sup>(8)</sup>.

Over 90% victims were males in the current study, 83% were males in a study conducted at South India <sup>(8)</sup>. Research has also shown that men, and in particular, young males, are more likely to be involved in collisions as pedestrians than are women <sup>(12)</sup>.

In the current study, monthly family income below 2000/- per month appeared as risk factor ( $OR=5$ ,  $P=0.102$ ). In a study by Graham et al, risk of having a collision as a pedestrian increases as social economic group (SEG) decreases <sup>(13)</sup>.

84% cases took place at the district roads. In majority cases, a light motor vehicle or a non motorized slow moving vehicle were involved.

In about a fifth of the cases, the sidewalk was blocked, either encroached by vendors, or due to repair work like fault in underground cable or pipe line, compelling pedestrians to walk through the roads, exposing them to the flowing traffic.

In the present study, about 60% cases that took place between 6 PM and 6 AM, the accident site was poorly illuminated ( $OR=5, P = 0.151$ ). T.R.L. study reported that darkness may play a role in determining trends in pedestrian collisions <sup>(14)</sup>.

Contrary to observations made in similar studies in separate settings, eg research by the AA Foundation identified that more collisions occur on a Saturday compared to weekdays, with fewest collisions occurring on Sundays. This, however, contradicts data from Transport for London (2003) who found that 77% of pedestrian casualties occurred during the week, with a peak on Friday <sup>(14)</sup>. We found maximum number of the cases, 43 (30%) occur on Tuesdays. Followed by 22 (16%) on Saturdays, 21 (15%) cases each on Mondays and Fridays. Only 8 (6%) cases occurred on Sundays. This may be because of the following reasons:

- On Tuesdays, there is a huge make shift market in the locality
- Saturdays and Fridays are weekly office / factory holidays. Large out migration occur on those days.
- Mondays may be the first working day of the week as well as preparatory day for the make-shift market.

Most of the heavy vehicle accidents took place on Fridays; majority cases of remaining three groups took place on Tuesdays. On Tuesdays, because of the

make-shift market, there is such massive traffic congestion that Heavy vehicles move slowly, hence fewer heavy vehicle casualties on those days, while on Fridays, because of weekly holidays, out migration expose large number of people to heavy vehicles.

While looking at "time of accident" in the current study ( $OR = 1.25, P = 0.813$ ), there were two peaks, one during 10 AM to 12 noon, and another during 6 PM to 8 PM. The periods correspond with the usual working hour. In TRL research in 2004, they found their National statistics show that more collisions occur between 3pm and 5pm during weekdays<sup>(14)</sup>.

Four fifth of cases in the current study occurred on roads with bi-directional traffic flow. Studies from America and Canada have suggested that there are lower pedestrian collision rates on one-way streets as compared with two-way streets and have therefore suggested that this may be a relatively low cost pedestrian collision countermeasure<sup>(15)</sup>.

Location of victim "on road" at the time of accident was a risk factor for our study ( $O.R = 3.8, P=0.318$ ), however, the case control study could not yield O.R. as statistically significant, because of small sample available for the analytical study. 26% victims of the current study sustained injury over Head & face (ICD S 00-09), 11% among them were head injuries. A study done in South India found head injury to be 22.6% among pedestrians<sup>(8)</sup>. 49% cases of the current study had injury over any of the extremities, and 36% were orthopedic injuries. The limbs and the face were the most commonly affected areas to suffer external injuries. Similar observations were made in JIPMER study, where commonest

site of fracture was the lower limb (43.4%), followed by upper limb (19.0%) and facial bones (10.9%). Other sites were ribs (7.7%), clavicle (6.8%), skull (5.4%), pelvis (3.6%), scapula (2.3%) and spine (0.9%)<sup>(16)</sup>.

54 (38%) victims were unable to give correct answer to any of the "Knowledge" related question, 70 (50%) victims were of opinion that traffic signals delay journey time, 88 (63%) do not look both sides before road crossing, 85 (60%) do not use Zebra crossing and 18 (15%) do not use side-walk even when it is available.

Our study suffers from the following limitations:

1. As the study was a hospital based study, we are unable to generalize the result for the community.
2. It is difficult to obtaining an appropriate denominator when a pedestrian in the numerator, because statistics on the number of people who walk are not available.
3. As the primary design of the study was descriptive, subsequent analytical part i.e. to compare the "Dead" with the "Alive", did not yield significant result, only two associations came out as statistically significant (Table 7).

In our study, we found that the District roads accounts for 84% of pedestrian injuries. All categories of vehicles shared the district roads at the same time. The side-walks were blocked, either occupied by street vendors, or due to repair of underground cable / pipe line, compelling pedestrians to walk through the road. Half of the cases which occurred during 6 pm to 6am time group were in poorly illuminated areas. Time distribution of the accidents shows two clear peaks a

day. Maximum no took place on Tuesdays. Majority of cases occurs in areas where traffic flow is "Bi-directional". Road turning intersections and bus stops were two most vulnerable areas for pedestrian injury. Lack of knowledge, negative attitude and practice was identified in the study. Neurological and Orthopedic injuries are identified as most common injuries.

Howrah, a city of about 500 yrs old (18), modern town planning are grossly lacking here. Traffic signals at the accident hot spots are to be ensured. Non motorized slow moving vehicles must be prevented from sharing the motorable roads. Side-walks of the districts are to be made free from all obstructions. Accident hot spots are to be identified and illuminate. Strategic traffic management during peak accident hours and on the vulnerable days of the week is to be ensured. Maximization of "one way" traffic flow will reduce the accidents considerably. Restriction of free left turn of vehicles at turning intersections and paved waiting places at the bus stops will protect pedestrians from flowing traffic. Measure to generate awareness regarding road safety among the commuters may be taken up regularly. Appropriate resource mobilization for handling neurological and orthopedic injuries, which were most common injury types. Analytical studies are proposed to measure strength of association of different exposures.

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**Table 1: Distribution of Pedestrian victims by age and sex, during July to October '08, District Howrah, West Bengal, India, 2008**

<b>Demographic characteristics</b>		<b>#</b>	<b>%</b>
<b>Age</b>	0 to 4 years	0	0%
	5 to 14 years	7	5%
	15 to 44 years	98	70%
	45 to 59 years	26	18%
	60 years +	10	7%
<b>Sex</b>	Male	129	91.5%
	Female	12	8.5%
<b>Total</b>		<b>141</b>	<b>100%</b>

**Table 2: Characteristics of hospital admitted pedestrian victims (N=141), Howrah, West Bengal, India, (July to Oct '08)**

<b>Characteristics</b>	<b>Outcome</b>	<b>#</b>	<b>(%)</b>
<b>Severity</b>	Died	9	6%
<b>Monthly family income</b>	Less than Rs. 2000	18	13%
	More than Rs. 2000	120	85%
<b>Educational status</b>	Illiterate	14	10%
	Secondary	52	37%
	Higher secondary and above	52	37%
<b>Occupation</b>	Beggar / Rag picker	8	6%
	Student	21	15%
	Service	44	31%
	Self employed	55	39%
	Home maker	6	4%
<b>Physical fitness of the victim</b>	Fit	105	74%
	Hearing Impaired	12	8%
	Visual Impaired	3	2%
	Otherwise Impaired	18	13%

<b>Day of accident</b>	Mon	21	15%
	Tue	43	30%
	Fri	21	15%
	Sat	22	16%
<b>Time of injury</b>	06 to 11.59 hrs (Forenoon)	47	33%
	18 to 23.59 hrs (Evening)	65	46%
<b>Location at the time of injury</b>	At a bus stop	35	25%
	At turning intersection	43	30%
	Walking roadways	43	30%
<b>Treatment outcome*</b>	Treated & discharged	95	67.8%
	Referred out	36	25.7%
<b>Anatomical location (ICD 10)</b>	S00-19 (Head including Face)	37	26%
	S20-29 (Thorax)	15	11%
	S30-39 (Abdomen/Low back/Lumber spine/Pelvis)	13	9%
	S40-69 (Upper extremity)	28	20%
	S70-99 (Lower extremity)	41	29%
<b>Injury sub types (ICD 10)</b>	Orthopaedic injury	47	33%
	Injury to nerve	15	11%
	Injury to internal organ	15	11%
	Superficial injury	26	18%

\* 1 case remained admitted at the end of the period of study (n=140)

**Table 3: Characteristics of road at the site of accident involving admitted pedestrian victims (N=141) (July to Oct '08), Howrah, West Bengal, India, 2008**

<b>Characteristics</b>	<b>Outcome</b>	<b>#</b>	<b>(%)</b>
<b>Nature of road associated with accident</b>	National highway / Expressway	22	16%
	District road (Motorable)	86	61%
	District road (Non-motorable)	33	23%
<b>Condition of road</b>	Blocked side walk	30	21%
	Good	41	29%
	Uneven	59	42%
<b>Traffic flow at the accident site</b>	One way	18	13%
	Two way	116	82%
<b>Illumination at the accident site*</b>	Good	25	36.2%
	Poor	41	59.4%
<b>Type of vehicle involved</b>	Pedestrian & HMV	9	6%
	Pedestrian & LMV	76	54%
	Pedestrian & NMV	51	36%
	Pedestrian only	5	3%

\*Restricted only for cases occurring between 6 PM & 6AM (n=69)

**Table 4: Knowledge-Attitude-Practice of hospital admitted (July to Oct '08) pedestrian victims (N=141), Howrah, West Bengal, India, 2008**

<b>KNOWLEDGE*:</b>	<b>Status</b>	<b>#</b>	<b>(%)</b>
<b>Knows all the 3 colours of a traffic signal</b>	Yes	125	88.7%
	No	13	9.2%
<b>Knows it is safe to walk facing traffic flow</b>	Yes	38	27.0%
	No	100	70.9%
<b>Knows side-walks separate pedestrians from traffic</b>	Yes	124	87.9%
	No	14	9.9%
<b>Knows meaning of all 3 colours of traffic signal</b>	Yes	78	55.3%
	No	60	42.6%
<b>Knows to look "Lt-Rt-Lt" before crossing a road</b>	Yes	57	40.4%
	No	81	57.4%
<b>ATTITUDE*:</b>	<b>Status</b>	<b>#</b>	<b>(%)</b>
<b>Observing traffic rule is a safe practice</b>	Yes	125	88.7%
	No	13	9.2%
<b>Side walks should be free from encroachments</b>	Yes	130	92.2%
	No	8	5.7%
<b>Traffic signals delay journey time</b>	Yes	70	49.6%
	No	68	48.2%
<b>Zebra crossings safe corridor for road crossing</b>	Yes	69	48.9%
	No	69	48.9%

<b>PRACTICE*:</b>	<b>Status</b>	<b>#</b>	<b>(%)</b>
<b>Looks "Lt-Rt-Lt" before crossing a road</b>	Yes	50	35.5%
	No	88	62.4%
<b>Use zebra crossing to cross road when available</b>	Yes	53	37.6%
	No	85	60.3%
<b>Use side walk when available</b>	Yes	120	85.1%
	No	18	14.9%
<b>Walk alone in road ways</b>	Yes	68	48.2%
	No	70	49.6%
<b>Wait for the green light at a signalized crossing</b>	Yes	108	76.6%
	No	30	21.3%
<b>Walk facing traffic if there is no side walk</b>	Yes	20	14.2%
	No	118	83.7%

\* 3 (2%) cases were brought dead, data not available

**Table 5: Scale of exposure to potential risk factors of pedestrian injury among hospital admitted (July to Oct '08) pedestrian victims, (N=141), Howrah, West Bengal, India, 2008**

<b>EXPOSURE SCALE*</b>	<b>Status</b>	<b>#</b>	<b>(%)</b>
<b>Chat while walking on road</b>	Always	47	33.3%
	Never	5	3.5%
	Sometimes	86	61.0%
<b>Frequency of going out on foot per day</b>	Four or more times /day	27	19.1%
	Two – three times /day	72	51.1%
	Once a day	35	24.8%
	Not sure	4	2.8%
	<b>Average time spent on walking on foot per day</b>	One hr or more per day	41
	Half to one hr per day	50	35.5%
	Less than Half hr per day	43	30.5%
	Not sure	4	2.8%
<b>Average no. of road crossings per day</b>	Eight or more times a day	48	34.0%
	Four to seven/day	67	47.5%
	One to three/day	18	12.8%
	Not sure	4	2.8%
	<b>Read something while walking on foot</b>	Sometimes	51
Never		87	61.7%

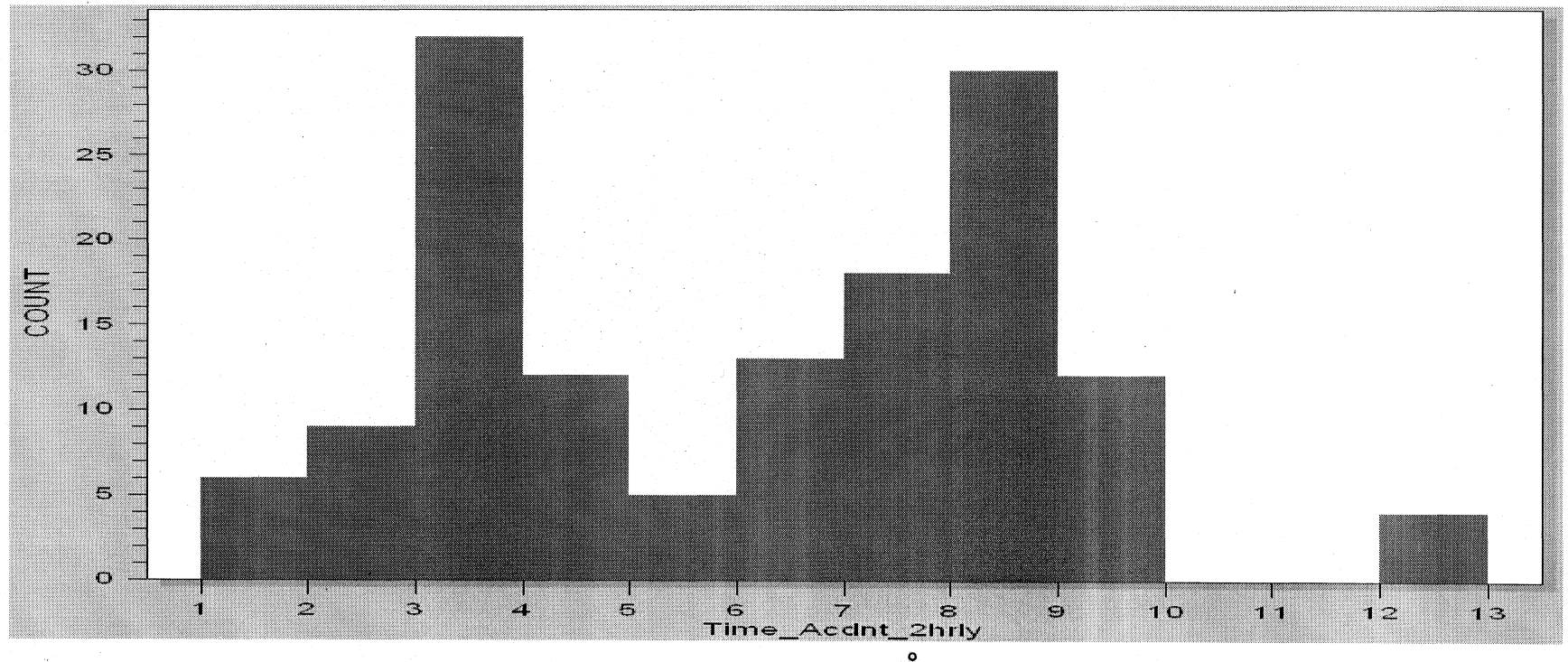
<b>Need to stand by the road side regularly</b>	Always	47	33.3%
	Sometimes	88	62.4%
	Never	3	2.1%
<b>Use cell phone / I-pod / F.M. while walking</b>	Always	9	6.4%
	Sometimes	80	56.7%
	Never	49	34.8%
<b>Walk roadways facing the traffic flow</b>	Always	7	5.0%
	Sometimes	46	32.6%
	Never	85	60.3%
<b>Walk under influence of alcohol / intoxicants</b>	Always	6	4.3%
	Sometimes	46	32.6%
	Never	86	61.0%
<b>Watch bill boards / posters during walking</b>	Always	4	2.8%
	Sometimes	107	75.9%
	Never	27	19.1%

\* 3 (2%) cases were brought dead, data not available

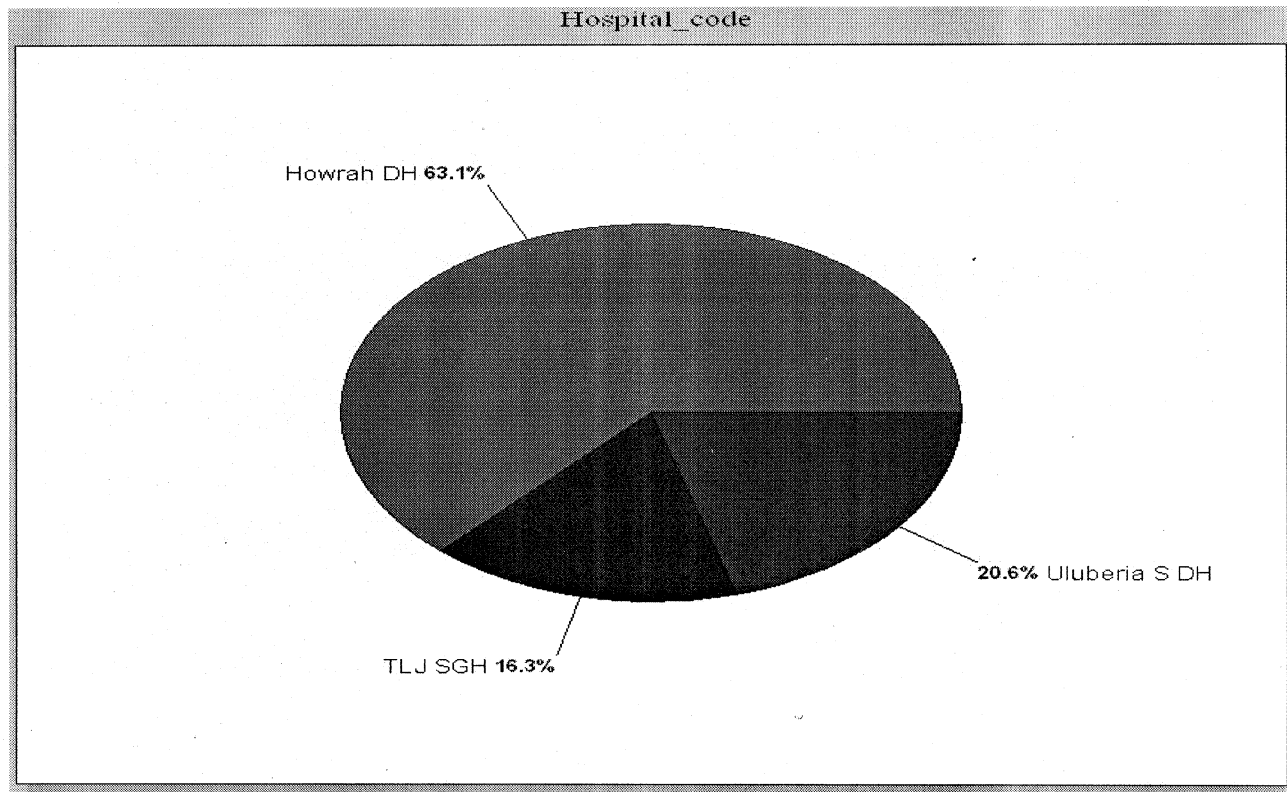
**Table 6: Distribution of pedestrian traffic injury cases and controls according to the exposure status of the cases and control, Howrah, West Bengal, India, 2008**

Parameters	Case		Control		OR	95% CI	P-value
	<=45	>45	<=45	>45			
Age	3	3	13	5	0.38	0.04-3.62	0.317
Sex	Male	Female	Male	Female	1.73	0.21-16.59	0.558
	4	2	15	3			
Time group	Day	Night	Day	Night	1.25	0.14-11.28	0.813
	3	3	8	10			
Location of victim	On road	Off road	On road	Off road	3.18	0.24-88.53	0.317
	5	1	11	7			
Monthly income below 2000/-	< 2000	>2000	<2000	>2000	5	0.47-64.67	0.102
	3	3	3	15			
Condition of road	Good	Poor	Good	Poor	2	0.22-19.3	0.465
	3	3	6	12			
Poor illumination	Poor	Good	Poor	Good	5	0.39-138.34	0.151
	5	1	9	9			
Physical fitness	Fit	Unfit	Fit	Unfit	0.77	0.07-8.63	0.795
	4	2	13	5			
	Yes	No	Yes	No			
Use Cell phone	4	2	11	7	1.27	0.13-13.69	0.808
Walk alone	2	4	7	11	0.79	0.07-7.55	0.807
Do not know colour of signal	4	2	2	16	16	1.14-254.14	0.0065
Know meaning of colours	1	5	10	8	0.16	0.01-2.04	0.098
Know side-walk separate Pedstrn	2	4	15	3	0.10	0.01-1.3	0.019
Atd: Signals delay journey time	1	5	7	11	0.31	0.01-4.12	0.317
Prct: do not use side walk	4	2	1	17	34	1.77-1529.6	0.0014
Pract: Wait for Green light	2	4	13	5	0.19	0.02-1.89	0.088

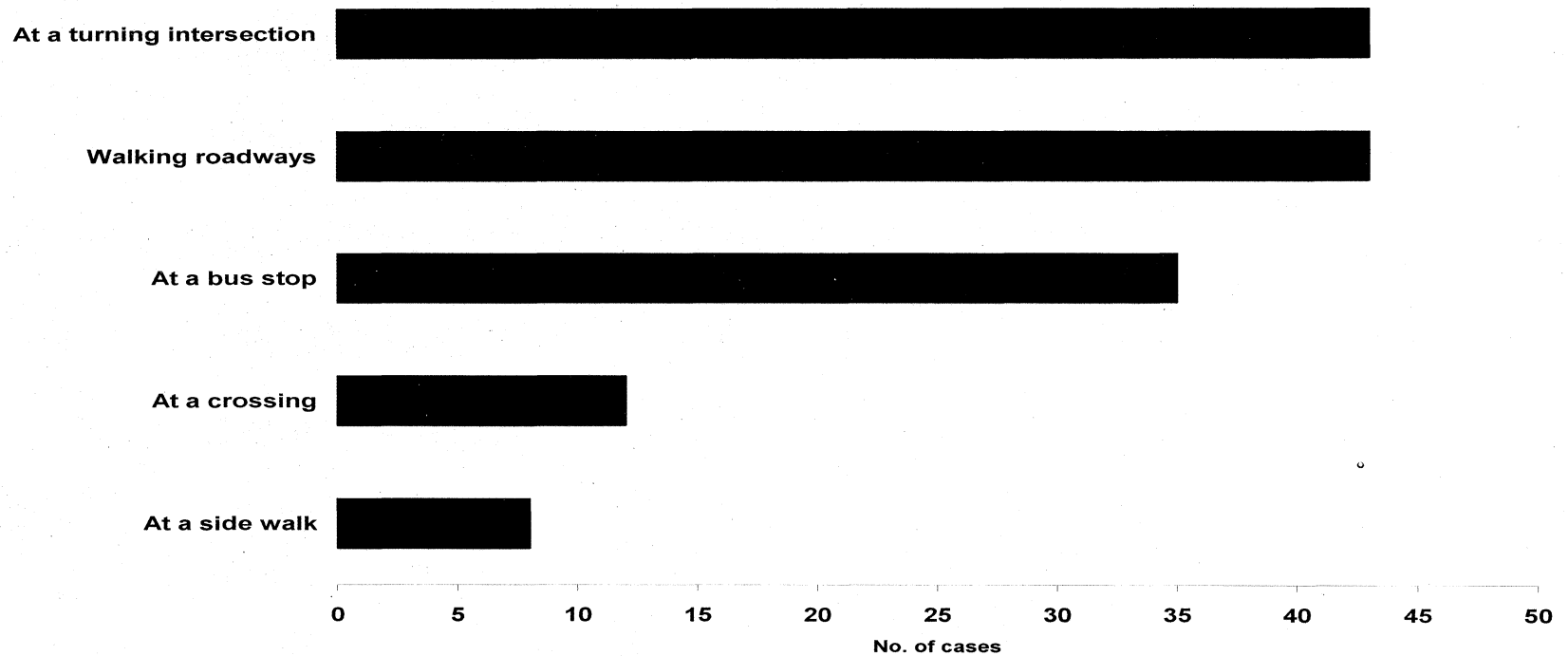
**Fig:1- Histogram showing time of pedestrian accidents according to the hour of the day, Howrah, West Bengal, India, 2008.**



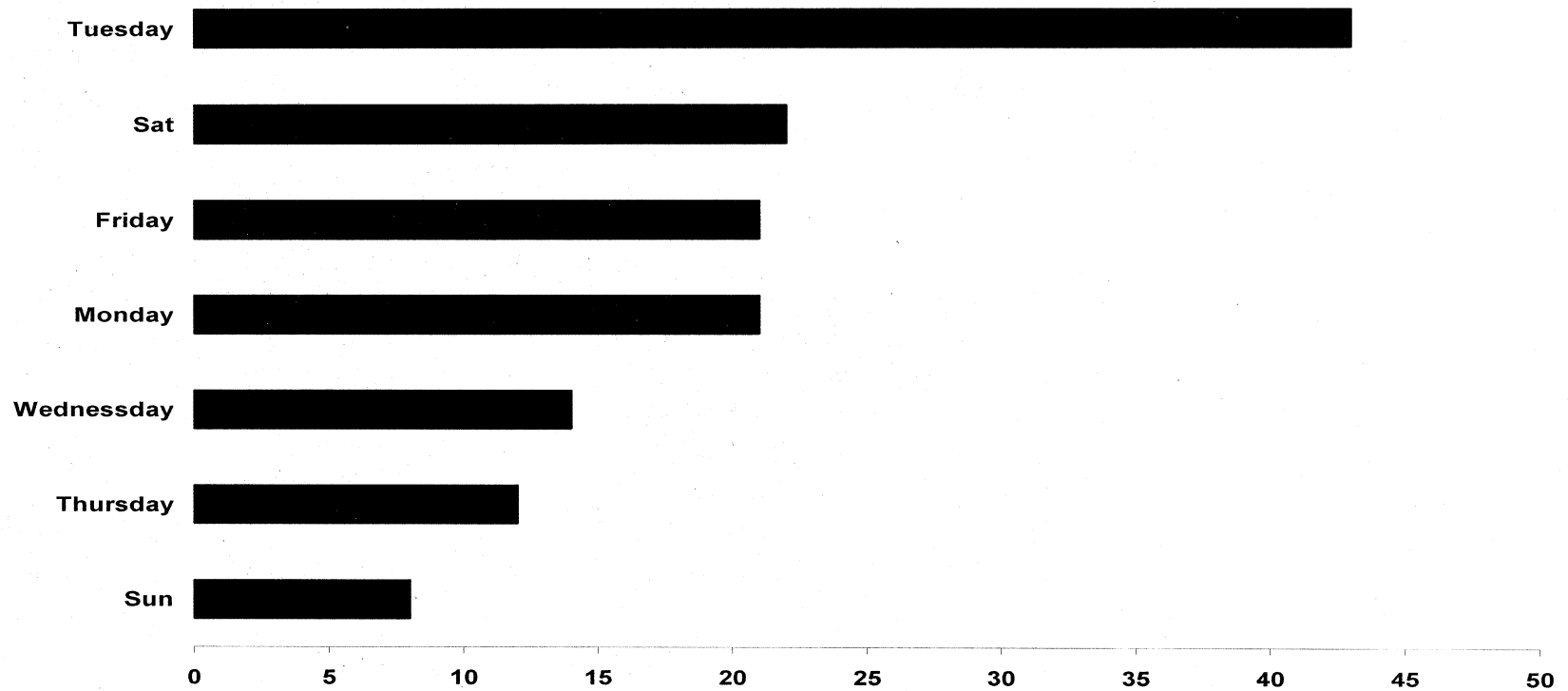
**Fig:2- Pie chart showing distribution of pedestrian accidents victims among the three hospitals under study, Howrah, West Bengal, India, 2008.**



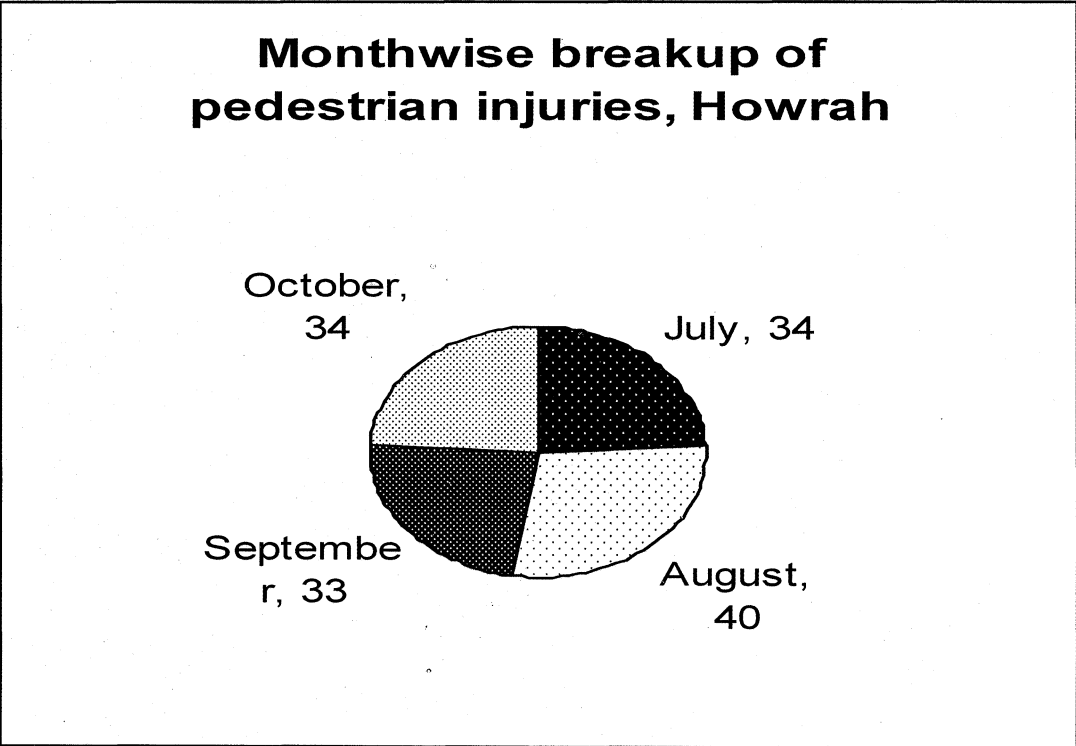
**Fig:3- Horizontal bar chart showing distribution of pedestrian accident victims according to location at the time of injury, Howrah, West Bengal, India, 2008.**



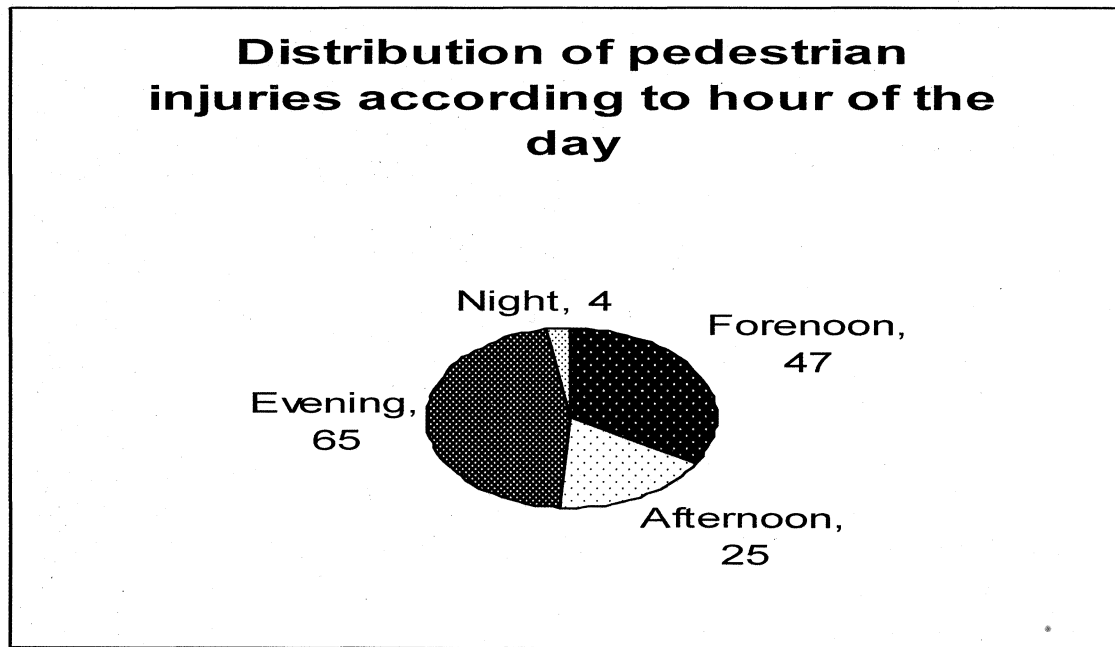
**Fig:4- Horizontal bar chart showing distribution of pedestrian accidents according to the day of the week, Howrah, West Bengal, India, 2008.**



**Fig:5- Pie chart showing month wise break up of pedestrian accidents, Howrah, West Bengal, India, 2008.**



**Fig:6- Pie chart showing distribution of pedestrian accidents according to the hour of the day, Howrah, West Bengal, India, 2008.**





## Annexure -A

### Questionnaire to be administered for descriptive study of pedestrian traffic injury victims at Howrah, West Bengal, 2008.

1. I/D No. \_\_\_\_\_
2. Age \_\_\_\_\_
3. Sex: Male / Female
4. Occupation: Student / Service / Business / Self employed / Retired / House wife / Unemployed / Not applicable / Unknown
5. Education: Illiterate / Primary / Secondary / Higher secondary / Graduate / Post graduate / Not applicable / Unknown
6. Place of sustaining injury: Non motorable / Motorable / National highway / Unable to say
7. Date & time of injury (dd/mm/ at hh/mm) \_\_\_\_/\_\_\_\_/ @ \_\_\_\_ AM/PM
8. Day of week: Sun / Mon / Tue / Wed / Thurs / Fri / Sat
9. Severity of injury: Death / Alive
10. Date & time of admission (dd/mm/ at hh/mm) \_\_\_\_/\_\_\_\_/ @ \_\_\_\_ AM/PM
11. Date & time of discharge (dd/mm/ at hh/mm) \_\_\_\_/\_\_\_\_/ @ \_\_\_\_ AM/PM
12. Date & time of DORB (dd/mm/ at hh/mm) \_\_\_\_/\_\_\_\_/ @ \_\_\_\_ AM/PM
13. Date & time of Ref out (dd/mm/ at hh/mm) \_\_\_\_/\_\_\_\_/ @ \_\_\_\_ AM/PM

**14. Date & time of death** (dd/mm/ at hh/mm) \_\_\_\_/\_\_\_\_/ @ \_\_\_\_ AM/PM

**15. Location of injury:** Abbrn & Bruise / Head injury / Face & Neck /  
Thorax / Abdomen / Upper limb / Lower limb

**16. Type of injury:** Minor / Neurological / Orthopaedic /  
Surgical

**17. Case status:** Pedestrian / Non-pedestrian

**18. Class of accident:** Pedestrian only / Pedestrian & Non  
Motor Vehicle / Pedestrian & Light Motor vehicle / Pedestrian & Heavy Motor  
vehicle

**19. Direction of traffic movement:** One way / Two way / frequent violation  
/ not sure

**20. Location at the time of crash:** At a road crossing / Waiting at a Bus  
stop / At vehicle turning intersection / At a side walk / Walking along road way /  
Working, Chatting or playing at the road way / Not sure

**21. Monthly family income:** <2000 p.m. / >2000 p.m. / Can not say

**22. Condition of the road:** Good / Uneven / Blocked / Wet surface /  
Not sure

**23. Visibility of the road:** Good / Poor / Not sure

**24. Water logging:** Present / Absent

**25. Physical fitness:** Fit / Impaired hearing / impaired vision / otherwise compromised / Can not say

**EXPOSURE SCALE:**

**26. How frequent you walk facing traffic:** Never / 1-2 days a week / 3-5 days a week / 6 days a week / Not sure.

**27. How frequent you use cell phone while walking:** Never / 1-2 days a week / 3-5 days a week / 6 days a week / Not sure.

**28. How frequent you read a document while walking:** Never / 1-2 days a week / 3-5 days a week / 6 days a week / Not sure.

**29. How frequent you chat with friends while walking:** Never / 1-2 days a week / 3-5 days a week / 6 days a week / Not sure.

**30. How frequent you watch bill boards while walking:** Never / 1-2 days a week / 3-5 days a week / 6 days a week / Not sure.

**31. How frequently you remain boozed while walking:** Never / 1-2 days a week / 3-5 days a week / 6 days a week / Not sure.

**32. Do you walk heedless of traffic:** Never / 1-2 days a week / 3-5 days a week / 6 days a week / Not sure.

**33. How frequent you need to stand by the road side:** Never / at least once, 1-2 days a week / at least once, 3-5 days a week / at least once, 6 days a week / Not sure.

**34. How frequent you need to sit or sleep by the road side:** Never

/ at least once, 1-2 days a week / at least once, 3-5 days a week / at least once, 6 days a week/ Not sure.

**35. How frequently you need to go out per day:** Never / once

a day / 2- 3 times a day / 4 or more times per day/ Not sure.

**36. Hours spent on walking per day:** Never / Less than 30 min a

day / Half to one hr per day / Over an hour per day/ Not sure.

**37. How frequent you need to cross a road per day:** Never / 1 to 3 times

a day / 4 to 7 times a day / 8 or more times a day/ Not sure.

### ***KNOWLEDGE – ATTITUDE – PRACTICE:***

#### **KNOWLEDGE:**

**38. Knows all 3 colors of traffic signal:** Yes / No / Can not say

**39. Knows significance of all colors of traffic signal:** Yes / No / Can not say

**40. Knows privileges of Zebra crossing:** Yes / No / Can not say

**41. Knows it is safe to walk facing traffic:** Yes / No / Can not say

**42. Knows to look Left, Right & again to the Left before crossing**

**roads:** Yes / No / Can not say

**43. Knows side walks are meant to separate pedestrians and traffic:**

Yes / No / Can not say

**ATTITUDE:**

**44. Traffic signal delays journey time:** Yes / No / Can not say

**45. Zebra crossings are safe corridor for pedestrians:** Yes / No / Can not say

**46. Responsibility of Road Safety lies with the drivers only:** Yes / No / Can not say

**47. It is safe to observe traffic rules:** Yes / No / Can not say

**48. Side walks should be free from encroachments:** Yes / No / Can not say

**PRACTICE:**

**49. Do you generally walk alone:** Yes / No / Can not say

**50. Wait for Green light at a signalized crossing:** Yes / No / Can not say

**51. Look "Left-Right-Left" before crossing road:** Yes / No / Can not say

**52. Use side walk where available:** Yes / No / Can not say

**53. Use cross walk where available:** Yes / No / Can not say

**54. If side walk is not available, walk facing traffic:** Yes / No / Can not  
say

Data collector \_\_\_\_\_

Date \_\_\_\_\_

**The patient is physically fit and mentally alert. May be interviewed for the study**

\_\_\_\_\_  
**Superintendent / Bed in-charge**

**Hospital: HDH / TLJ / UBSDH**

## **Annexure -B**

### ***Informed consent form for participation in the study of risk factor of pedestrian road traffic injury at Howrah, 2008***

Greetings,

You know that road traffic injuries among the pedestrians is a problem in our Howrah district. I am \_\_\_\_\_ and working with the district health administration. We are look in to reasons that why pedestrians sustain traffic injuries and how sever are those injuries in the urban area of Howrah district. Your response will help us to identify the problem and thus we will able to suggest measures for containment of pedestrian injuries in the district. The National Institute of Epidemiology, Chennai is also working with us on this investigation.

To find out why pedestrians sustain traffic injuries and how sever are those injuries in the urban area of Howrah district, we need to ask you questions on your education, economy, travel history and knowledge, attitude and practices on traffic management. Thus, between \_\_\_\_\_ and \_\_\_\_\_, we will be asking these questions to you in selected locations. We would like to confidentially ask these questions. Answering these questions should take 15 minute. Taking part in this survey is voluntary. You can choose not to take part. You can choose not to answer a specific question. You can also stop answering these questions at any time without having to provide a reason. This will not

affect your right to health care. However, taking part in the survey may benefit the community, as it will help us to understand the problem.

The information we will collect in this survey will be completely confidential. We will not write your name on this form. We will only use a code instead. This key to this code will only be with principal investigator. It will be kept under lock and key. It will be destroyed after completion of the analysis. If you wish to find out more about this survey before taking part, you can ask me all the questions you want. You can also contact Dr. Subhranshu Chakrabarti, MAE scholar, NIE ICMR at the telephone number 033 2637 4012.

**I have received sufficient information about the project, I have had opportunities to ask questions and these questions have been answered to my satisfaction. I consent voluntarily to this assessment and I understand I have the right to withdraw at any time without any consequence on the type of medical care I receive.**

\_\_\_\_\_ **Signature**                      **Date:** \_\_\_\_\_

*(Consent and signature should be collected from a parent/ guardian in of minors)*

## Annexure-C

*(To ensure confidentiality, identifiers will not be collected in the paper questionnaires)*

### **Identifiers collection form**

**Name of the interviewer:**

**Place:**

ID1 name:		ID2 name:		ID3 name:	
ID4 name:		ID5 name:		ID6 name:	
ID7 name:		ID8 name:		ID9 name:	

## Annexure -D

**Extraction of clinical record of case patients:**

**Name of the Hospital:**

ID No.	Date of admission	Anatomical location of injury	Injury type	Status of case (Discharge / Referred / Dead)	Prognosis (Good /Fair/ Poor)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

# Literature review for epidemiology of pedestrian victims of road-traffic Injuries.

## *Introduction*

### *History of Road traffic accident:*

After the first road fatality on 17th August 1896 in London, the Coroner said, "This must never happen again". More than a century later, globally, 1.2 million people die each year on roads <sup>(1)</sup>.

### *Burden on road <sup>(1, 14)</sup>:*

Data provided by the World Health Organization (WHO) and the World Bank were used for the statistical analyses that form the basis of the World report on road traffic injury prevention. In summary, these data showed that, in 2002:

- 1.2 million People died as a result of road traffic collisions. This means that on average 3242 people were killed daily on the world's roads.
- 20 million to 50 million people were injured or disabled in road collisions.
- Road traffic injuries were the 11th leading cause of death worldwide and accounted for 2.1% of all deaths globally. Furthermore, these road traffic deaths accounted for 23% of all injury deaths worldwide.

- 90% of road traffic deaths occurred in low income and middle-income countries, where 5098 million people or 81% of the world's population live and own about 20% of the world's vehicles.

Two wheelers, motorized (70%) and non-motorized (10-35%) are the main component of Indian traffic. Less than 1 in 40 families own a car. A study conducted in Pondicherry, shows that males casualties (83%) were far more than female casualties (17%) on roads.

Pedestrians constitute one of the most vulnerable groups for road traffic injuries. In minds of Indian road users there is no place for pedestrians on roads; one would observe that, zebra crossings are made on very few roads in the country, and those, which exist, are not used by the pedestrians or the rules are not followed by the traffic. Also, subways built in few cities are homes for beggars than pathways for pedestrians. Though all vehicles share the same road space, there are no laws or regulations for using roads or safety guidelines for bicyclists, rickshaw pullers and other non-motorized vehicles.

According to the estimates of 1995, 3.2% of GDP is the estimated cost of road traffic injuries, in India.

### ***Pedestrian signals*** <sup>(2, 4)</sup>:

Traffic lights for pedestrians normally have two main lights: a red light that means 'stop' and a green light that means 'go' (or, more correctly, 'proceed with caution'). There is usually a flashing phase (red in the US and Australia, green in Europe) that means 'complete your crossing'.

The Manual of Uniform Traffic Control Devices (MUTCD) has long used 4.0 ft/sec as the recommended walking speed to be used in setting the time for the pedestrian clearance phase for pedestrian signal installations. Recently, the National Committee on Uniform Traffic Control Devices voted to change the recommended walking speed to 3.5 ft/sec for the pedestrian clearance phase and 3.0- ft/sec for the entire Walk/Flashing Don't Walk interval.

One of the reasons the "Flashing Don't Walk" is so misunderstood is the *counterintuitive nature of the signal*. While the primary purpose of the signal is to inform pedestrians who have already begun crossing the street on the steady "Walk" signal that they have enough time to complete their crossing and they should continue walking, the message actually says "Don't Walk," and it further emphasizes that message by flashing it.

### **Traffic rules <sup>(3)</sup>:**

Traffic on roads may consist of pedestrians, ridden or herded animals, vehicles, streetcars and other conveyances, either singly or together, while using the public way for purposes of travel. Traffic laws are the laws which govern traffic and regulate vehicles, while rules of the road are both the laws and the informal rules that may have developed over time to facilitate the orderly and timely flow of traffic.

Rules of the road are the general practices and procedures that road users follow. They govern interactions with other vehicles and pedestrians. The basic traffic rules are defined by an international treaty under the authority of the United Nations, the 1968 Vienna Convention on Road Traffic. Not all

countries are signatory to the convention and, even among signatories, local variations in practice may be found. In many countries, the rules of the road are codified, setting out the legal requirements and punishments for breaking them

*The Vienna Convention on Road Traffic* (October 7, 1968 - November 8, 1968) is an international treaty designed to facilitate international road traffic and to increase road safety by standardising the uniform traffic rules among the contracting parties. It entered into force on May 21, 1977.

*The Vienna Convention on Road Signs and Signals* is an international treaty designed to increase road safety and aid international road traffic by standardising the signing system for road traffic (road signs, traffic lights and road markings) in use internationally. It came into force 6 June 1978.

The convention revised and substantially extended the earlier 1949 Geneva Protocol on Road Signs and Signals, itself based in turn on the 1931 Geneva Convention concerning the Unification of Road Signals

**Priority (right of way)** Vehicles often come into conflict with other vehicles and pedestrians because their intended courses of travel intersect, and thus interfere with each other's routes. The general principle that establishes who has the right to go first is called "right of way", or "priority". It establishes who has the right to use the conflicting part of the road and who has to wait until the other does so. Signs, signals, markings and other features are often used to make priority explicit. Trends toward uniformity are exemplified at an international level by the Vienna Convention on Road Signs and Signals,

which prescribes standardized traffic control devices (signs, signals, and markings) for establishing the right of way where necessary.

*Crosswalks (or pedestrian crossings)* are common in populated areas, and may indicate that pedestrians have priority over vehicular traffic. In most modern cities, the traffic signal is used to establish the right of way on the busy roads. The intervals of time assigned for each road may be adjusted to take into account factors such as difference in volume of traffic, the needs of pedestrians, or other traffic signals.

### ***Traffic signals*** <sup>(4)</sup>:

The traffic light, also known as traffic signal, stop light, is a signaling device positioned at a road intersection, pedestrian crossing, or other location. Its purpose is to indicate, using a series of colors (Red - Amber - Green), the correct moment to stop, drive, ride or walk, using a universal color code (and a precise sequence, for those who are color blind).

On 10 December 1868, *the first traffic lights* were installed outside the British Houses of Parliament in London, by the railway engineer J. P. Knight. They resembled railway signals of the time, with semaphore arms and red and green gas lamps for night use. The gas lantern was turned with a lever at its base so that the appropriate light faced traffic. Unfortunately, it exploded on 2 January 1869, injuring the policeman who was operating it.

*The modern electric traffic light* is an American invention. As early as 1912 in Salt Lake City, Utah, policeman Lester Wire invented the first red-green electric traffic lights. On 5 August 1914, the American Traffic Signal Company

installed a traffic signal system on the corner of East 105th Street and Euclid Avenue in Cleveland, Ohio. It had two colors, red and green, and a buzzer, to provide a warning for color changes.

*The first four-way, three-color traffic light* was created by police officer William Potts in Detroit, Michigan in 1920. In 1923, Garrett Morgan patented a traffic signal device. It was Morgan's experience while driving along the streets of Cleveland that led to his invention of a traffic signal device.

*The first interconnected traffic signal system* was installed in Salt Lake City in 1917, with six connected intersections controlled simultaneously from a manual switch. *Automatic control of interconnected traffic lights* was introduced March 1922 in Houston, Texas.

The color of the traffic lights representing stop and go are likely derived from those used to identify port (red) and starboard (green) in maritime rules governing right of way, where the vessel on the left must stop for the one crossing on the right.

Traffic lights for vehicles usually contain three lamps: red, orange or yellow (officially amber), and green. In some systems, a flashing amber means that a motorist may go ahead with care if the road is clear, giving way to pedestrians and to other road vehicles that may have priority (essentially the same as arriving at a non-signalized intersection and not facing a stop sign).

The use of these colors is thought to originate from nautical right-of-way. Usually, the red light contains some orange in its hue, and the green light contains some blue, to provide some support for people with red-green color

blindness. In the UK, traffic lights typically have a white reflective border which enables color blind users, during the hours of darkness, to distinguish the lights from other similarly-coloured street or automobile lights, and to allow them to distinguish the lights by vertical position (top/middle/bottom; British traffic lights are never mounted horizontally).

***Pedestrian crossing*** <sup>(5, 6)</sup>:

A pedestrian crossing or crosswalk is a designated point on a road at which some means are employed to assist pedestrians wishing to cross. They are designed to keep pedestrians together where they can be seen by motorists, and where they can cross most safely with the flow of vehicular traffic. Pedestrian crossings are often at intersections, but may also be at other points on busy roads that would otherwise be perilous to attempt to cross. They are common near schools or in other areas where there are a large number of children. Crosswalks can be considered a traffic calming technique.

The simplest crossings may just consist of some markings on the road surface. These are often called Zebra crossings, referring to the alternate white and black stripes painted on the road surface. Depending on local laws, pedestrians crossing the road may or may not have priority over road traffic when using the crossing. In some countries, pedestrians may not have priority, but may be committing an offence if they cross the road elsewhere (see Jaywalking)

Some crossings have special signals consisting of electric lamps or light-emitting diode (LED) panels. The signals allow pedestrians and road traffic to use the crossing alternately.

Sites with extremely high traffic, or roads where pedestrians are not allowed (freeways or motorways) may instead be crossed pedestrian bridges or tunnels. In many cities, countdown clocks are being added to give notice to both drivers and pedestrians the time remaining on the crossing signal.

Pedestrian refuges or small islands in the middle of a street may be added when a street is very wide, as these crossings can be too long for some individuals to cross in one cycle. Another relatively widespread variation is the Curb (or kerb) extension (also known as a bulb-out) which narrows the width of the street and is used in combination with crosswalk markings

Confusion over "right of way" when a driver who is facing a green traffic signal turns left or right across the path of a pedestrian crossing on a Walk signal, a Flashing Don't Walk signal, or a Don't Walk signal.

"Drivers may feel - wrongly - that they have right-of-way over pedestrians in these situations because they are facing a green traffic signal, and this may be particularly pronounced when the pedestrian is facing a flashing or static Don't Walk signal," says Dr Hatfield. "Road users should be aware that turning vehicles must give right-of-way to pedestrians, even when the vehicle is facing a Green signal, and regardless of the pedestrian signal."

Australian road rules governing signal-controlled intersections state that pedestrians may start to cross on a Walk signal. Pedestrians must not start to

cross, but may finish crossing on a flashing Don't Walk signal, and they must not start crossing on a Don't Walk signal.

### ***Sidewalk*** <sup>(7)</sup>:

A sidewalk / pavement / footpath or footway is a path for pedestrians that is situated alongside a road or formed like sidewalks that are alongside roads (such as a concrete footpath through a park).

In the 19th century and early 20th century, sidewalks of wood were common in some locations. They may still be found at historic beach locations and in conservation areas to protect the land beneath and around, called boardwalks. Contemporary sidewalks are most often made of concrete, tarmac, asphalt, brick, stone or slab.

In the United Kingdom the suburban pavements are most commonly constructed of tarmac. In urban or inner-city areas pavements are most commonly constructed of slabs, stone, or brick depending upon the surrounding street architecture and furniture.

Stone slabs called flagstones or flags are sometimes used where an attractive appearance is required, as in historic town centres. In other places, pre-cast concrete slabs (called paving slabs or, less correctly, paving stones) are used. These may be coloured or textured to resemble stone.

### ***Injuries in India: A National perspective*** <sup>(8)</sup>:

The rapid and unprecedented motorization in India combined with the lack of a safety environment has been a noticeable feature. The number of vehicles

has grown from a mere 306,000 in 1951 to 58,863,000 by 2002. The 23 metropolitan cities account for 33% of total vehicles in India. Two-wheelers; cars, jeeps and taxis; buses; goods vehicles; and others account for 71%, 13%, 1%, 5% and 10%, respectively of the total vehicle population

*Vulnerable Road Users (VRU)* in India are pedestrians, riders and pillion riders of motorized two-wheelers and bicyclists. Nearly 75% of deaths and injuries occur among them.

Nearly one-third of deaths and disabling injuries in India occur among pedestrians due to lack of safe walking spaces, crossing facilities and visibility factors.

Emphasis on road user education is not accompanied by changes in road engineering, enforcement, trauma care and systems improvement. Thus, there has been no decline in the number of deaths and injuries.

Road traffic injuries can be effectively reduced by several interventions such as reducing individual exposure by investing in and improving public transportation in all places; separation of slow- and fast-moving traffic on all possible roads; promoting traffic-calming measures by scientific methods; reducing speeds on roads, especially on highways and in all residential areas; mandatory helmet laws, seat-belt laws and their strict implementation in all States; implementing strict programmes on drinking and driving by the police; improving the visibility of vehicles (brighter, reflective colours) and roads in all places (at vehicle design and road formation levels and thereafter); applying

international safety standards for all vehicles and roads; improving safety on existing roads, and incorporating road safety audits, on all newly built roads; and restrictions on motorcycle engine power. Scientific evidence exists for most of these interventions and they only need proper implementation (WHO 2004a).

***The Haddon Matrix*** <sup>(9, 14)</sup>:

William Haddon developed a matrix that identifies risk factors before the crash, during the crash and after the crash, in relation to the person, vehicle and environment. Haddon described road transport as an *ill-designed "man-machine" system* in need of comprehensive systemic treatment. Each phase – pre-crash, crash and post-crash – can be analyzed systematically for human, vehicle, road and environmental factors.

The Haddon matrix is an analytical tool to help in identifying all factors associated with a crash. Once the multiple factors associated with a crash are identified and analysed, countermeasures can be developed and prioritized for implementation over short-term and long-term periods.

Haddon applied the epidemiological triad primarily to unintentional injuries, and most often to injuries from motor vehicle crashes.

- *HOST* is the human being whose behavior is operation of the vehicle.
- *AGENT* is the physical energy in injury events. For motor vehicle events, this translates into the physical energy involved with motor vehicles.

- *ENVIRONMENT* is the milieu in which the vehicle and the human interact—the type of road, the weather conditions involved, and so forth.

Haddon extended the epidemiological triad even further to consider how these factors relate to the crash sequence.

The *crash sequence* can be examined in terms of three elements:

- *PRECRASH* circumstances surrounding the event prior to the crash;
- *CRASH* circumstances of the crash; and
- *POST CRASH* circumstances that follow the crash.

The crash sequence interacts with human, environmental, and vehicular factors to define the frequency and severity of injury.

## Factors Related to the Likelihood of Crash Injury: The Haddon Matrix

Phases	Human factor	Vehicle factor	Physical and Social factor	Environment factor
<b>Pre-Crash</b>	Alcohol intoxication; Fatigue; Experience and judgment; Driver vision;	Amount of travel Brakes, tires; Center of gravity; Jackknife tendency; Ease of control; Load weight; Speed capability	Laws related to alcohol and driving;	Visibility of hazards; Road curvature and gradient; Surface coefficient of friction; Divided highways, one-way streets, intersections, access control; Signalization; Speed limits
<b>Crash</b>	Seat belt use; Age; Sex;	Speed at impact; Vehicle size; Automatic restraints; Hardness and sharpness of contact surfaces; Load containment		Recovery areas; Guardrails; Characteristic of fixed objects; Median barriers; Roadside embankments
<b>Post-Crash</b>	Age; Physical condition; Disabilities	Fuel system integrity		Emergency communication and transport systems; Distance to and quality of medical services; Rehabilitation programs

The Haddon Matrix changed how injuries are viewed and provided a framework for the development of injury control interventions. Haddon demonstrated that an appropriate understanding of the factors affecting injuries in each cell of the matrix could lead to more effective interventions. By identifying which factors are important and their location in the crash

sequence, it will be possible to understand where interventions may be most appropriate.

Haddon identified the pre-injury phase as the period when *primary prevention* approaches, such as divided highways and speed limit enforcement, could be implemented. The injury phase focuses on *secondary prevention* such as the deployment of airbags or the installment of breakaway signposts. The post-injury phase emphasizes *tertiary prevention* such as effective emergency medical services and trauma rehabilitation. Haddon applied this matrix to several other unintentional injuries and to those from motor vehicle crashes. The key message to take from Haddon matrix is that a road traffic crash or collision is the outcome of interaction among a number of factors and subsystems.

### ***Denominators in Motor Vehicle-Related Injuries*<sup>(9)</sup> :**

It is difficult to obtaining an appropriate denominator when a pedestrian in the numerator, because statistics on the number of people who walk are usually not available.

### ***The ICD 10 code*<sup>(10)</sup>:**

The "S" series of codes (S00-S99) is used to classify injuries related to single "body regions". The 10 body regions are the following:

<b>S00-S09:</b>	Head	<b>S10-S19:</b>	Neck	<b>S20-S29:</b>	Thorax
<b>S30.-S39:</b>	Abdomen, lower back, lumbar spine and pelvis				

**S40-S49:** Shoulder and upper arm  
forearm

**S50-S59:** Elbow and

**S60-S69:** Wrist and hand

**S70-S79:** Hip and thigh

**S80-S89:** Knee and lower leg

**S90-S99:** Ankle and foot

Within each block of 10 three-character categories, specific injury types are identified:

*Superficial injury*

*Open wound*

*Fracture*

*Dislocation, sprain and strain*

*Injury to nerves and spinal cord*

*Injury to blood vessels*

*Injury to muscle and tendon*

*Crushing injury*

*Traumatic amputation*

*Injury to internal organs*

*Other and unspecified injuries*

### ***The Risk Factors of Pedestrian Collisions*** <sup>(11, 14)</sup>:

- Factors influencing exposure to risk
  - economic factors and social deprivation;
  - demographic factors such as age and sex;
  - land-use planning which influence length of trip and mode of travel;
  - mixture of motorized traffic with vulnerable road users;
  - Integration of road function speed limits, road layout and design.
- Risk factors influencing crash involvement
  - presence of alcohol, medicinal or recreational drugs;
  - fatigue;
  - being a young male;

- being a vulnerable road user in urban and residential areas;
- traveling in darkness;
- defects in road design, layout and maintenance;
- inadequate visibility because of environmental factors
- poor eyesight of road users.
- Risk factors influencing crash severity
  - Roadside objects not crash-protective;
  - Presence of alcohol and other drugs.
- Risk factors influencing post-crash outcome of injuries
  - delay in detecting crash and in transport
  - presence of alcohol and other drugs;
  - difficulty in rescuing and extracting people from vehicles;
  - lack of appropriate pre-hospital care;
  - lack of appropriate care in hospital emergency rooms.

### ***1 Pedestrian Crossing***

It has been well documented that most pedestrian collisions occur when pedestrians are crossing a road, and most research finds that risk is much higher away from crossing facilities compared with on a crossing. The Department of Transport, U.K reported National statistics show that approximately 40% of pedestrian collisions in 2003 occurred whilst the pedestrian was crossing the road away from a pedestrian crossing. Only 9%

of pedestrian collisions occur on a pedestrian crossing and nearly 8% occur within 50m of a crossing.

National figures suggest that more collisions occur at mid-block signalized crossings compared with other types of pedestrian crossing (such as zebra crossings, signal-controlled junctions and crossings with human control e.g. school crossing patrols).

It has been argued that the use of signalized crossings halves the risk compared with crossing without these facilities.

## ***2 Type of Road***

Research conducted by the AA Foundation (1994) found that in their study area, the highest proportion of pedestrian casualties occurred on 'District Distributor' roads which were A or B roads with speed limits of 40mph or less.

## ***3 One-Way Streets***

Studies from America and Canada have suggested that there are lower pedestrian collision rates on one-way streets as compared with two-way streets and have therefore suggested that this may be a relatively low cost pedestrian collision countermeasure. Zegeer (1991) reported that one-way streets can have a 40-60% reduction on pedestrian collisions.

## ***4 Time***

According to research by the AA Foundation, more collisions occur on a Saturday compared to weekdays, with fewest collisions occurring on Sundays. This, however, contradicts data from Transport for London (2003) who found that 77% of pedestrian casualties occurred during the week, with a

peak on Friday. During the weekend, most collisions occur between midday and 7pm with another peak between 11pm, Saturday and 1am, Sunday (*Department for Transport, 2004*). National statistics show that more collisions occur between 3pm and 5pm (during the week) than at any other time of day.

### ***5 Weather and Lighting Conditions***

Risk to pedestrians is greater when weather and lighting conditions are poor and injury severity is higher in these conditions. However less people are likely to go out in these circumstances therefore the statistics generally show fewer collisions under these conditions. The AA Foundation found that the weather can have an effect on collision risk to pedestrians as most collisions were reported in wet weather. Darkness may play a role in determining trends in pedestrian collisions, increasing the risk of having a collision by over four times than during daylight hours according to research by the AA Foundation (1994).

*Water logging of city roads* during heavy shower pose unique problem for mobility, pedestrian in particular are worst victim. Water logging of streets is responsible for extreme of poor visibility in addition to mechanical disadvantage for walking.

### ***6 Traveling Alone***

Traveling alone seems to have a significant effect on collision risk to pedestrians; research has shown that in many collisions, adult pedestrians were traveling unaccompanied. This is not true for children, who are more likely to be traveling in groups according to research.

## ***7 Effects of Age & Gender***

In 2003 there were 36,405 pedestrian collisions (involving injury) recorded on the roads of Great Britain. According to government statistics, 21,472 (approximately 60%) were male pedestrians and 14,905 were female pedestrians (approximately 40%). Research has also shown that men, and in particular, young males, are more likely to be involved in collisions as pedestrians than are women.

In terms of age, 17,485 were adult pedestrians (aged between 16 and 59) which accounts for nearly half of all pedestrian collisions. Child pedestrians (aged under 16 years) account for approximately 35% of collisions (12,544) and older pedestrians (adults aged over 60) account for approximately 14% of pedestrian collisions. Other research has shown that young people aged 20-24 years are at a high risk as pedestrians.

## ***8 Effects of Social background***

There is a link between the propensity for pedestrians to be involved in collisions and their social circumstances. In particular a link has been found between deprivation and the number of pedestrian casualties. The risk of having a collision as a pedestrian increases as social economic group (SEG) decreases. Evidence comes from a number of studies that have correlated various indicators of SEG with collision rates. Research has shown that:

- There are more pedestrian collisions in geographical areas with high unemployment rates compared with areas with lower unemployment rates

- family circumstances can have an effect on the risk of child pedestrian collisions: children with unemployed parents, single parents and children living in crowded accommodation are all more likely to be involved in a collision (Christie, 1998). Parents in lower SEG groups tend to take less responsibility for their children in traffic.
- children in lower social economic groups are at a higher risk of being in a collision because they are more exposed to traffic, and in particular traffic which is less safe than those from higher socio-economic groups.

### ***9 Effects of Social Psychological Variables***

Two relevant studies were identified which explored the effects of attitudes and other social cognitions on adult pedestrian crossing behavior. In one study, the health belief model (a social psychological theory of behavior) was used to investigate non-compliance with pedestrian crossing signals. It was found that pedestrians were more likely to be non-compliant at signals:

- if they did not perceive danger/risk of a collision
- if they thought that there were few losses (e.g. 'endangers lives' and 'annoys drivers') and many gains (e.g. 'saves time', 'prevents boredom' and 'prevents inconvenience')
- if they did not have a strong sense of obligation to obey rules and procedures

*Nicholls (1997)* found that pedestrian error accounted for 75% of collisions involving pedestrians and that lack of observation was a significant factor. A study of collisions conducted in Australia documented reported pedestrian

behaviour just before being involved in a collision and found that all related to the pedestrian being careless or making a mistake (child running across road, pedestrian not seeing vehicle, pedestrian standing in centre of the road etc).

### **Walking** <sup>(12)</sup>:

Walking (also called ambulation) is the main form of animal locomotion on land. The word walk is descended from the Old English wealcan "to roll". The average human child achieves independent walking ability around 11 months of age

#### **As a leisure activity**

Many people walk as a hobby, and in our post-industrial age it is often enjoyed as one of the best forms of exercise. The types of walking include racewalking, weight-walking, hillwalking, and hiking on long-distance paths. The Walking the Way to Health Initiative is the largest volunteer led walking scheme in the United Kingdom. Volunteers are trained to lead free Health Walks from community venues.

#### **As transportation**

"Walking is convenient, it needs no special equipment, is self-regulating and inherently safe. Walking is as natural as breathing". Said *John Butcher, Founder of Walk21, 1999*. Walking is the most basic and common mode of transportation and is recommended for a healthy lifestyle, and has numerous environmental benefits. Recent studies show, people are walking less in the

UK, a Department of Transport report found that between 1995/97 and 2005 the average number of walk trips per person fell by 16% per year. Many professionals in local authorities and the NHS are employed to halt this decline by ensuring that the built environment allows people to walk and that there are walking opportunities available to them.

There has been a recent focus among urban planners in some communities to create pedestrian-friendly areas and roads, allowing commuting, shopping and recreation to be done on foot. Some communities are at least partially *car-free*, making them particularly supportive of walking and other modes of transportation. In the United States, the Active Living network is an example of a concerted effort to develop communities more friendly to walking and other physical activities.

*On roads with no sidewalks, pedestrians should always walk facing the oncoming traffic for their own and other peoples' safety.*

However, some studies indicate that walking is more harmful to the environment than car travel. This is because more energy is expended in growing and providing the food necessary to regain the calories burned by walking compared to the energy used in the operation of a car. These studies have been criticised for using inefficient food sources (i.e. those that use large amounts of energy to produce) such as milk or meat to skew the results.

### ***Pedestrians accidents - Biggest Problem in Bangladesh <sup>(13)</sup>:***

In urban areas of Bangladesh pedestrians often represent up to 70% of road accident fatalities. Current statistics reveal a deteriorating situation in

metropolitan Dhaka. For example, pedestrians as a proportion of road accident deaths increased from 43% in 1986-1987 to 67% in 1991-1992. In recent years (1996-1998) the number of pedestrian casualties (fatalities and injuries) has increased markedly from 443 in 1996 to 588 in 1998, an increase of about 29%. Pedestrians are now making up approximately 63% of road accident fatalities, 32% of injuries and are involved in about 20% of all reported accidents. Indeed, with regard to fatal accidents 70% involved 'pedestrian-moto-rized vehicle' collisions. In rural areas pedestrians account for about 40% highway accidents. The seriousness of a pedestrian accident in Bangladesh is clearly evident from the comparative data of pedestrian involvement in fatal accidents and injuries for numerous countries in Asia-Pacific Region (ADB, 1997).

Overall, Hong Kong, China had the highest share of pedestrian deaths (two third of all fatal accidents) followed by Dhaka, Bangladesh (63%), Pakistan (50%), Republic of Korea (48%), Fiji (43%) and Papua-New Guinea (33%).

### ***Road courtesy & road safety, campaign for courtesy on road***

(15)

*"Kindness and common courtesy toward your fellow creature will lessen accident more than any other rule of the road. Teach this truth to your children."*

The above is from a notice, probably from the 1950s, of the Road Safety Division of the National Safety Council (S.A.) Inc. More recently, Evans (1990) considered six approaches to protecting road users:

- crash-phase protection, divided into
  - passive and active; technology for crash avoidance, divided into
    - high-tech and traditional; and
- behaviour modification, divided into
  - specific and social norms.

Of these, Evans judges that social norms have been the most important in the past and have the greatest potential for the future. Under the heading of social norms, Evans picks out three areas:

- portrayals in mass entertainment of the use of motor vehicles in what is actually a life-threatening way as instead heroic or humorous;
- courtesy on the road;
- alcohol.

Evans is quite open that these are his judgments or opinions, not facts rigorously established. They are, however, reasoned judgments, and are worth taking seriously.

What does Evans mean by courtesy on the road? Unfortunately, he does not fully explain. He certainly includes: *absence of driving behaviour of a competitive nature; making allowance for the limitations of other road users; making allowance for mistakes by others; and an attitude that lies behind such behavioural decisions.*

Evans views the mass media as extremely important in establishing social norms including road courtesy: he accepts that it may be difficult to prove that

any one advertising campaign had an effect, but believes that the cumulative effect over a period of years or decades is great.

Courtesy refers both to behaviours (the presence of some and the absence of others) and to the attitudes and habits of mind that accompany behaviours.

- In part, courtesy implies abiding by the rules and conventions of social behaviour. But there is also an implication of going beyond them, of being more polite than is demanded by the circumstances. Here there is an obvious conflict with road safety: safe roads depend upon everyone adhering to the same rules, behaving in a way that is predictable by others. Deviating from that --- even in order to be polite and considerate --- is potentially dangerous. For example, a driver on a main road who gives up the right-of-way may unwittingly contribute to a crash because other drivers are not expecting that.
- Turning to attitudes and habits of thinking, there is less ambiguity. Courtesy means thinking about possible actions of other road users and adjusting one's own behaviour, and avoiding any aggressiveness, then this certainly should be encouraged.

It thus seems likely that any campaign for courtesy on the road would need to be complex.

Koenig and Wu (1994) study on yielding to pedestrians The study most relevant to courtesy was that of Koenig and Wu (1994), who reported on the effectiveness of a media campaign aimed at persuading left-turning drivers to yield to pedestrians who were crossing. (The study was in Canada, so the

equivalent in Australia would be right turners.) It seems fair to describe this as a courtesy behaviour. They found an increase in this behaviour after the campaign. Though this is a positive result, two important reservations should be noted.

- It does not imply that courtesy campaigns would be expected to have wide relevance in road safety: turning usually occurs at slow speed, and thus there is more time for courtesy to occur than in many other traffic situations.
- The result refers to the behaviour of yielding: any effect on crashes and injuries is not investigated.

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