EPIDEMIOLOGY OF HEAD INJURIES

SUMMARY REPORT

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EPIDEMIOLOGY OF HEAD INJURIES

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1. INTRODUCTION

Head injuries are a major cause of morbidity, mortality and disability all over the world. During the past few years head injuries have become a major public health problem. It has been estimated that incidence of head injuries is around 200 per 100,000 per year. Apart from bringing instantaneous death, head injuries contribute for large number of disabilities of various types. The impact of head injuries on the individual, his family and society is enormous in terms of loss of life, financial burden due to medical costs, loss of income, damage to property and long standing psychosocial and socioeconomic impact. This is also coupled with enormous suffering, agony and distress to the individuals and their families. The loss to the society and community is enormous when the load and expenditure of health care institutions is added to other indirect costs.

Among the several causes of head injuries, road traffic injuries contribute for more than 60 per cent of the total cases. The significant increase in motor vehicles without corresponding increase in the supportive, related areas of prevention is one of the principle reasons for this scenario. It has been clearly noticed that several causes of head injuries are preventable and would definitely save human resources in both developing and developed countries. Injuries are not considered to be due to fate or unknown causes any more and, a clear mechanism or process or sequence of events are known to play a role in its causation and occurrence.

With the magnitude of the problem being so enormous, efforts towards prevention and control along with rehabilitation have been slow in developing countries like India. A major lacunae for work in this direction has been the lack of epidemiological information. Epidemiology can contribute significantly by developing information on the nature and extent of the problem, the different causes, the type of population being affected, the nature, type and mode of injury occurrence, outcome from head injuries, the extent of disability and examining the role of interventions by evaluation along with other aspects.

Some of the earlier studies have been undertaken on hospital subjects depending upon the areas of researchers' interest and availability of resources. Clear information on epidemiology of head injuries is not available for any major city in India. The present study is an attempt in this direction to comprehensively examine the problem of head injuries in its various facets by working in close collaboration with other related sectors in the city of Bangalore.

2. SITUATION IN BANGALORE

The city of Bangalore is one of the rapidly progressing cities in India and also in South East Asian region. The city is the capital of Karnataka and has a population of 4,086,458. The district has been divided into Bangalore urban and rural for administrative purposes. Bangalore urban had a decennial growth rate of 20.69 during 1981-91. The city has a population density of 2204 per sq.km. (average for Karnataka State - 234 per sq.km.) Male to female sex ratio as per the latest census is 960 females per 1000 males. The literacy level of population is 66.2% - Males 72.1% : Females 59.7% (1991 census).

Since the pace of urbanisation accelerated enormously from 1960's, the city of Bangalore has recorded unprecedented growth in all aspects. It is known clearly that cities in developing countries are growing at a much faster pace than cities in developed countries. The pace of population growth has been unidirectional without corresponding increase in related areas thus leading onto 'crumbling effects' on quality of life. A key aspect of this rapid urbanisation to progress towards modernisation, has been the increased motorisation with an accompanying rise in traffic related injuries and deaths predominantly constituted by head injuries. Table 1 shows the increase in motor vehicles in the city of Bangalore during 1992.

As per the latest figures available for the city, about 7 lakh city registered vehicles and a similar number of vehicles from outside the city use the available roads thus amounting to increased density of vehicles on the roads. The exact number of vehicles as 31-07-92 stands at 6,80,919, with two wheelers numbering 5,16,703 (75.8%). Approximately about 5,000 new vehicles are added onto the city roads every month. It can be noticed that about 160 new vehicles are registered everyday, out of which, about 130 are two wheelers. The distribution of other vehicles is shown in Table 1.

TABLE 1: Registered vehicles in the city of Bangalore

As on	31-01-1992		31-01-1992	
	No.	%	No.	%
Two wheeler vehicles	4,92,906	75.6	5,16,703	75.8
Motor cars	89,844	13.7	92,976	13.7
Jeeps	6,734	1.0	6,938	1.0
Autorikshaws	22,760	3.4	23,723	3.5
Motor cabs	2,678	0.4	2,990	0.4
Omni Buses	2,784	0.5	2,877	0.4
Station wagons	179	0.1	179	0.1
Buses	4,726	0.8	4,913	0.8
Goods vehicles	21,358	3.2	21,488	3.2
Tractors	2,187	0.4	2,252	0.3
Trailors	1,885	0.3	1,951	0.3
Fire engines	104	0.1	110	0.1
Delivery vans	2,376	0.4	2,685	0.4
Ambulance vans	155	0.1	161	0.1
Others	947	0.2	973	0.2
TOTAL:	6,51,623	100.0	6,80,919	100.0

The city has also seen rapid increase in the number of large and small scale industries. The increasing population in the city coupled with unchecked migration has also added to the problem. An increase in the number of educational institutions, transport vehicles, housing construction activities within the city has given rise to major urban problems. The rise in number of vehicles owned by college-going youth has been a significant phenomenon.

Construction site head injuries and head injuries due to fall from height or fall of an object are a common mode of head injuries, a picture definitely varying from the west.

Organisation and provision of services for head injury victims and rehabilitation has to take the emerging development in other sectors. The health care infrastructure for injury and head injury victims are poor as compared to any other country. A health information system for head injuries is virtually nonexistent in the city of Bangalore and other cities of India. Several problems like lack of total case registration, lack of case ascertainment, cross referral within hospitals, incomplete death records registration, differing interval between site of injury occurrence and reaching a hospital compound are some existing problems.

The city police department is the only source maintaining a complete record of injuries and deaths for the city. However, it has to be taken note that every injury case is not registered with the police due to situational problems. The data available from police records reveal that:

1. The number of injuries has been steadily increasing from 3,800 in 1985 to 5600 in 1991 (around 6000 in 1992). This leads onto the conclusion that about 600 cases of injury are registered every month due to road accidents in Bangalore. Highest number of injuries had occurred in the age groups of 20-30 years to the extent of 40% during the year 1990.

2. The number of people killed in road traffic accidents has also increased from 420 in 1985 to 550 in 1991 with an average of 45 deaths per month.

3. A comparative look at the age specific mortality rate reveal that mortality in the age group of 20-30 years has increased from 28.7% in 1988 to 34.5% in 1990.

4. During the period of 1988-1989, the category of road users killed was predominantly constituted by pedestrians, motor vehicle riders and pedal cyclists to the extent of 40%, 22.4% and 14.3% respectively, with minor variations during the years.

Apart from this brief observation which represents only the tip of the iceberg, no scientific studies are available except a small study by Mohan et al.

Studies on the problem of head injuries in particular have been very little in the city of Bangalore. It is clearly known that head injuries constitute 10-20% of total injury cases varying from place to place.

A preliminary study conducted on cases registered in emergency service department of NIMHANS during Jan-Feb 1988 was of a retrospective nature on a sample of 478 cases through a record analysis (Gururaj et al 1988). The study disclosed that about 30% of cases in ERS of NIMHANS was constituted by head injuries. Highest number of cases were recorded in the age group of 15-35 years (50%) with a male to female ratio of 5:1. Road traffic accidents, falls, and hit by / fall of an object contributed for 59.6%, 28.3% and 7.5% of cases respectively. About 16% of cases were admitted at NIMHANS for detailed investigations and management.

This study was followed by a study on factors contributing to mortality from head injuries (Gururaj et at 1991) undertaken during 1989-1990 with the objectives of delineating trends and to identify the role of individual factors on 262 deaths recorded in one year. The study revealed that:

- Mortality was highest in the groups of 35-44 years and 25-34 years to the extent of 21.8% and 18.4% respectively. Children and elderly accounted for 10% each.

- During the period 1985-1990 mortality in the age group of 15-54 years increased from 60% to 75%.

- Only 5.7% of victims had reached the hospital within 1 hour after the injury occurrence.

- Road traffic accidents, falls, assaults and fall of an object had contributed for 61.5%, 22.5%, 3.8% and 4.6% respectively.

- Pedestrians, motor cyclists and occupants of motor vehicles were killed in 24.7%, 16.7% and 14.2% respectively, with pedal cyclists accounting for 9.3% of cases.

- Prior alcohol consumption was observed in 10% of cases.

- About 15% of patients died soon after arrival, within one hour.

3. NEED FOR AN EPIDEMIOLOGICAL STUDY

The above mentioned studies in the city of Bangalore suffer from methodological limitations as mentioned earlier. The need for a large scale, prospective study on the problem of head injuries was felt by the research team to:

1. Enable policy makers to evolve programmes for prevention, acute care and rehabilitation based on a scientific rationale.

2. Study the problem on a wider basis involving several hospitals and also by generating and pooling data from multiple sources.

3. Increase awareness and participation among professionals, public and media by generating information on various aspects of head injuries.

4. Examine the problem of head injuries in a wider perspective for the whole city to understand the various aspects.

4. AIMS AND OBJECTIVES

The aim of the present study was to study the epidemiological dimensions of head injuries in a broader extent as applicable to the city of Bangalore through a "sentinal hospital approach" for generating information towards evolving suitable strategies for care, prevention and rehabilitation.

The specific objectives were:

1. To establish the magnitude of the problem of injuries and head injuries.

2. To know the influence of alcohol, drugs and comorbid conditions in head injury occurrence.

3. To study the causes of head injuries.

4. To understand the nature, type and mode of head injury occurrence.

5. To outline the pathways of care and outcome among head injury patients.

6. To delineate the problem and types of sequelae among head injury victims.

5. DESIGN OF THE STUDY

Phase I - Preparatory Phase

(a) Identification, contact, establishing liaison, meeting of all hospital administrators and consultants.

(b) Development of study instruments.

(c) Selection and training of field investigators.

(d) Pilot study.

(e) Information pooling.

(f) Formulation of head injury advisory group and preliminary discussions.

Phase II - Data collection phase

(a) Information collected from head injury patients. (n = 2897)

(b) Information collected from injury patients. (n = 14036)

Phase III - Follow-up activities

(a) Information from head injury patients and their families by domicillary visits. (n = 425)

Phase IV - Data pooling activities

(a) Information from allied sectors of police, transport, industries, health and corporation.

Phase V - Data analysis and report development

MONITORING & FEEDBACK

6. MATERIALS AND METHODS

OUTLINE

Study Place	:	Bangalore.
Study Centers	:	7 Hospitals in the city.
Study Duration	:	Phase 1: May 1991 - Sept. 1991.
		Phase 2: Sept. 1991 - Feb. 1992.
		Phase 3: March 1992 - May 1992.
		Phase 4: June 1992 - Dec. 1992.
		Phase 5: Jan.1993 - June 1993.
Study Instruments	:	1. Specially designed, pre-tested coded proforma for first contact information.
		2. Specially designed, pre-tested coded proforma for follow-up information.
Study Subjects	:	All patients registering for the first time as per the definition of head injury.
Study Team	:	Project investigators and eight trained field investigators.

An instruction manual clearly specifying the operational guidelines was developed for the purpose of the study. This was fully adopted for the training of investigators and data collection during the study period.

6.1 Selection of hospitals

Since this was a hospital-based study, we adopted the concepts of a Sentinal approach for identifying the study centres in Bangalore. The criteria under which hospitals were identified were:

(a) Regular attendance of patients with head injuries reporting to these hospitals as a source of agency for help.

(b) Willingness of the staff to participate in the project.

(c) Availability of reasonably good medical records.

(d) Easy accessibility for rural-urban population.

(e) Geographical limits to cover the entire city.

The nature of hospitals included, varied in terms of their characteristics. H1 (NIMHANS) is a tertiary referral institute for management of head injuries, H2 (Sanjay Gandhi accident relief complex) is a referral hospital for management of injuries: H3, 4 and 5 (Victoria hospital, St. John's hospital and M.S. Ramaiah hospital) are hospitals with provision for treatment of head injuries and injuries: H6, 7, 8 (St. Martha's hospital, K.C. General hospital and Bowring hospital) are centres with provision for emergency and injury treatment without specialised neurosurgical facilities.

6.2 Preparatory phase

Soon after the hospitals were identified, discussions were held with the hospital administrators, concerned consultants in casuality, neurosurgery and orthopaedic departments requesting them to participate in the study. Permission was obtained from hospital authorities for including their patients in the study. Contacts were also established with medical records officers for obtaining records. Out of the 8 hospitals identified in this manner, data collection from one hospital was terminated in the middle of study due to operational problems. Thus, data collection for the

total study period was done from seven major hospitals. Periodical discussions were held throughout the study period for providing a feedback on the study and its implications. The state directorate of health services was also involved throughout this period.

6.3 Selection and training of investigators

Eight investigators with a background in sociology or social work or rural development and with a previous experience of health research in hospital and community were selected. Familiarity in local languages was an important criteria. These investigators were trained in various aspects of interview and data collection methods. Their training consisted of:

(a) Theoretical orientation towards problem of injuries and head injuries.

(b) Familiarising and understanding different items in proforma through individual and group discussions.

(c) Translating and back translating to English.

(d) Mock interviews.

(e) Interview of patients in screening block, emergency services and neurosurgical wards of NIMHANS.

(f) Guided, Supervised Interviews in emergency service departments of NIMHANS.

(g) Data entry and coding methods.

(h) Pilot study in identified hospitals.

In this way, the field investigators were clearly trained in all aspects of data collection, data entry and coding practices. A training manual was prepared before the initiation of project ("Instruction manual for field investigators on the project - Epidemiology of Head Injuries" - copy available on request) which was fully

utilised during the study period.

After their training, they were introduced to their identified hospitals by the project investigator and familiarised with local procedures. A pilot study was done before the actual study was undertaken to establish uniform methodology in data collection.

6.4 Study instruments

The instruments used in this study were:

(i) Proforma for first contact information.

(ii) Proforma for follow-up information.

The proforma for first contact information consisted of 62 items covering seven major areas. These were (i) identification variables, (ii) socio-demographic characteristics, (iii) information on risk factors and comorbid conditions, (iv) injury details, (focusing in detail on road traffic accidents, fall, assault, fall of an object and industrial accidents), (v) referral information, (vi) clinical aspects and (vii) management information.

The identification variables consisted of details on registration numbers, hospital admitted, date and time along with source of information.

The socio-demographic information consisted of name and age of patient along with address. Both residential and occupational address of the patient along with telephone numbers in available situations were recorded. Additional information consisted of religion, education, occupation, family income, family size along with marital status. The occupational categories were coded as per the ICMR classification procedures.

The personal information with regard to the various risk factors focussed mainly on smoking, alcohol and consumption of drugs. Since alcohol is found to be the major risk factor in the occurrence of head injuries, information collected from the patient was cross examined with medical and police records at the time of

registration. Consumption of alcohol was established by self-reporting / breath examination / medical documentation / police records. Blood alcohol levels were not estimated as it is not done routinely in hospitals. Presence of comorbid conditions was elicited mainly from patients and their relatives and cross verified with referral letters and medical records.

Details on information about the occurrence of head injuries consisted of mode of arrival, date, time, day and place of occurrence. The injury site was mainly classified as road, industrial, construction, domestic, play site, agricultural and others. Details about the address of injury location was also entered into the proforma for geographical mapping. The time interval between occurrence of injury and medical contacts was recorded in number of hours to ascertain the time interval before treatment was provided to the victim. The cause of head injury was mainly classified as per the standard practices and corresponding details were elicited.

Further details about various aspects of each of these causes to precisely understand the nature, mode and type of injury was elicited. The injury classification procedures as per the ICD-9 (external causes) methodology was adopted in this study. More details about the type of vehicle involved, status of the injured person and usage of protective equipment were recorded. Details about the nature of fall, reasons and height of fall were recorded. The type of assault, nature of an object, falling on the head along with mode and area of fall were documented. Both in fall and fall of an object the height of fall was specifically elicited to assess the impact of fall from greater heights. Details about industrial accidents were also included in specific situations.

To assess the importance of immediate first-aid services for head injury victims, information was noted on availability, source and the referral agency for the victim. The cost incurred till the patient reached a definite hospital was also recorded.

The clinical information consisted of predominantly various aspects on the level of consciousness, post traumatic amnesia, presence of seizures, nature of external injuries, presence of skull fracture and various associated injuries. The severity of injury was measured as per the Glasgow Coma Scale at the time of hospital registration. The clinical information was mainly obtained from attending

consultants and medical records. Since the purpose of the study was explained to all people concerned, greater attention was focussed on recording information by treating doctors in all hospitals. The referral letters brought by patients was also reviewed by the investigators in necessary situations. The nature of injuries along with final diagnosis was recorded and coded as per the ICD-9 methods. The procedure followed by NIMHANS for classification of head injuries was also adopted as it was found to be more elaborate and useful.

The management information was collected at the end of their recommended hospital stay along with the duration of hospital stay. The final status of the patient was obtained at the time of discharge of the patient from the individual hospitals in consultation with the patient and attending medical consultant.

The proforma for follow-up information primarily consisted of (i) present health status of the head injured person, (ii) opinion on care provided during initial contact, (iii) Nature of current follow-up care, (iv) sequelae of head injury and, (v) suggestions for prevention of head injuries based on patients and family experience.

The follow-up information was collected from 425 patients, who were residents of Bangalore and having sustained head injury during the period of study. The information collected mainly focussed on the present health status, mobility status, working or schooling status and whether patient had returned to his previous occupation. The current source of income along with absenteesm was enquired. The opinion of the patients on the care, referral and education provided during their initial hospital contact was enquired to ascertain their satisfaction over the nature of care provided to them. The expenditure incurred in relation to their head injury after discharge from the hospital was specifically noted. The various sequelae from head injury was enquired to elicit problems present after the occurrence of the injury. Finally, the suggestions given by the patients based on their initial experience was recorded.

6.5 Data collection procedures

Data collection was done mainly in the casuality divisions and attached wards of individual hospitals from all patients with a difinite history of head injury through

direct interviews by trained investigators. For the purpose of this study, a case of head injury was defined as:

"a person with a history of definite injury to the head by an external agent accompanied with (a) reported or observed definite loss of consciousness, and / or (b) an obvious recognisable neurological deficit, and / or (c) accompanying skull fracture."

Investigations into problems of head injuries requires considerable amount of judgement and human touch by the investigating team because of considerable pain, grief, suffering and anxiety by patients and accompanying persons. Hence, the following points were paid special consideration during data collection.

(a) The injured person was interviewed only after examination and treatment by the attending medical person.

(b) In situations of fully unconscious patients, information was collected from the person accompanying the patient.

(c) Information was kept totally confidential.

(d) Information was collected only after obtaining oral consent from the patients and accompanying persons.

(e) The investigator was not allowed to treat or to give any false hopes and promises to the patient as the responsibility of management rested with attending medical faculty.

6.6 Information pooling

One of the objectives of the study was to examine the problem of head injuries in a wider perspective of injuries. It is essential to have information from other related areas to achieve this objective. Brief information from injuries was collected from all registered cases during the study period. This consisted of salient information on brief identification characteristics, cause of injury, nature of injury, date and time of injury, first-aid care and diagnosis. This information was entered into separate injury registers maintained for the specific purpose.

Information was also pooled from the departments of police, transport, industries, associations of nursing homes and general practitioners, corporation health office (to examine death certificates) and from public specially on their opinion regarding helmet wearing during study time.

6.7 Follow-up phase

It is well known that sequelae from head injuries has not been studied in detail. The present study focussed in detail on answering this question.

Among the total head injury cases, 425 (25%) were selected based on the following criteria:

(i) Patient should have registered in one of the identified hospitals with a specific diagnosis of head injury.

(ii) Patient should be a resident within the city limits of Bangalore.

(iii) Patient must have been alive at the time of discharge or referral during first contact.

(iv) Must have had a definite diagnosis of head injury.

After making a list of patients eligible for follow-up study, letters were sent requesting them to come to NIMHANS for follow-up on any working day over a period of one month. Since the response to first postal letters was only 15%, it was decided to make home visits. All the remaining patients were contacted at home and information was obtained from them. It was essential to make second and third visits in 35% of cases as they were not available during first contact. Since follow-up was done by trained field non-medical interviewers, a clinical examination could not be undertaken due to operational difficulties and resource constraints.

6.8 Data analysis

Data thus obtained was checked regularly for clarity, accuracy, completion and coding. This was entered into a computer on a regular basis. The analysis was done using EPI-INFO (Ver. 5) software package.

6.9 Monitoring and supervision

Throughout the study period, much attention was paid to this aspect. The monitoring was done at four levels.

(i) Data collection in all the hospitals was regularly supervised and checked by the project officer.

(ii) Data collection in individual hospitals was supervised by a local coordinator, identified for this purpose. Discussions were held on a regular basis with the local coordinator to solve day-to-day problems.

(iii) The research team met regularly once in a month to review the activities.

(iv) Feedback was given to all hospital authorities once in 2 months for understanding the problem.

6.10 Review of activities

The entire project was reviewed at periodical intervals by an advisory group consisting of senior decision makers from health, police, industry, road transport and media. Meetings were held regularly for sharing information, obtaining feedback and making mid-course corrections.

By the above mentioned methodology, information was collected from 14036 injury cases and 2897 head injury cases from 7 sentinal hospitals in the city of Bangalore during September 1991 to March 1992. Four hundred and twenty five patients were followed at a median interval of 4 months to identify sequelae from head injuries during March 1992 to June 1992. Pooling of data from related sectors of police, industries, transport and corporation health office was also done during the study period.

7. SUMMARY FINDINGS OF THE PROJECT "EPIDEMIOLOGY OF HEAD INJURIES IN BANGALORE"

The rapid progress towards urbanisation, industrialisation and modernisation have brought together a gamut of problems causing unprecedented proportions of human misery, grief and suffering. Among these, injuries and especially head injuries place considerable amount of burden on the individual, family and society at large by draining precious human resources. Information on the problem of head injuries has been very limited from any of the Indian cities, with the available statistics representing only the tip of the iceberg. To enable policymakers and programme managers to develop appropriate programmes towards CARE, PREVENTION and REHABILITATION, the present study was undertaken in the city of Bangalore during the period August 1991 and July 1992.

During the study period, information was collected from 2897 head injured patients registered in seven hospitals within the city. Trained investigators collected data through direct interviews from patients or their accompanying members with the help of a pretested and precoded proforma. Brief information was also collected from 14036 injury patients for the same period. The results of the study indicate the alarming situation emerging in the city. At the same time attempts towards prevention and control have received low priority. The study results given below indicate the serious nature of the problem in its various facets.

Injuries

1. The number of injuries has been steadily increasing over a period of time. During the period 1985 to 1991 the number of injuries increased from 3800 to 5600 per year. The first six months of 1992 have registered a total of 3200 cases as per official reports.

2. About 500 to 600 individuals are killed in road traffic accidents alone every year.

3. The number of vehicles has increased considerably over a period of time and as on July 1992, about 7,00,000 vehicles use the existing roads in the city apart from vehicles entering the city from outside places.

4. During the period September 1991 and February 1992 a total of 14036 injuries were registered in the study centres, thus averaging to about 160 injuries per day or 4800 per month or 57,600 per year. As compared to any other disease, injuries are a major public health problem.

5. Highest number of injuries occurred in the age group of 25-34 years (30.6%) followed by 15-24 years (23.7%). The age groups 15-44 years constituted 71.8% of total cases. Male to female ratio was 1 : 0.2.

6. Cause of injury revealed that road traffic accidents (51.6%), assaults (27%), falls (10.8%), burns (5.1%) and others (5.5%) were the major categories.

7. Mondays recorded highest number of injuries to the extent of 17.2% with a gradual decline towards the end of the week.

8. Highest injuries occurred between 12 noon to 6 p.m. (32.9%) followed by 6 p.m. to 12 midnight (29%).

Head Injuries

9. Head injuries consituted 20.6% of the total injuries.

10. On an average, about 485 head injuries are registered every month in various hospitals of the city or about 16 cases per day with NIMHANS registering 71.2% of the total cases.

11. The incidence of head injuries in the city of Bangalore was 61/100,000 / for six months period as per the study results. With the consideration that about 25% of the cases might have been underreported, the incidence estimate would be 160/100,000 per year.

12. Head injuries were found to occur in all age groups with the highest incidence in the 20-29 years age group to the extent of 26.5%. Children, adolescents, middle aged and elderly constituted 20.8%, 20.9%, 51.0% and 7.3% respectively. The male of female ratio was 1 : 0.3.

13. Twenty three per cent of the injured patients were educated beyond high school levels (more than 10th standard) and 19.4% were illiterates.

14. The occupational status of patients revealed that 18.6% were students, 10% were housewives and 43.5% were engaged in various productive jobs. The highly skilled and professional people constituted 6.8% of total cases.

15. The family income of our case series revealed that about 40.5% belonged to families with a total income of less than Rs. 1000 per month. Only 9.4% of the cases were from families with an income of more than Rs. 3000 per month.

16. About 43.0% of the individuals were married and 27.7% were unmarried at the time of injury occurrence.

17. More number of head injuries had occurred on Mondays, Thursdays and Sundays to the extent of 16.0%, 14.6% and 14.5% respectively.

18. As noticed earlier, the bulk of head injuries occurred between 12 noon to 12 midnight (68.4%), with head injuries between 12 noon to 6 p.m. constituting 35.7% of total cases.

19. The commonly associated medical conditions were visual problems (3.8%), hearing problems (3.2%), hypertension (3.0%) and epilepsy (2.8%).

20. Alcohol was found to be a major risk factor for head injuries in the study. About 16.5% of head injuries were directly attributable to alcohol consumption in individuals aged 15 years and above, with 75% of them consuming alcohol within the past 3 hours of head injury occurrence.

21. The risk of mortality increased by 1.8 times among those who had consumed alcohol as compared to non-alcoholic persons.

22. The proportion of road accidents, falls and assault among those who had consumed alcohol accounted for 14.8%, 19.6% and 17.2% respectively.

23. Road traffic accidents (61.6%), falls in various places (22.5%), assault (10.6%) and fall of objects (3.6%) were the major external causes of head injuries.

24. The major external cause of mortality due to head injuries was road traffic accidents in 68.8% of cases. Falls, assaults and fall of objects constituted 22.6%, 5.4% and 3.1% respectively.

25. Only 15% of the patients had used ambulance services to reach a hospital, while the major mode of transportation in 65.4% of cases was public transportation. This finding did not vary much according to different causes.

26. While all the road accidents had occurred on the roads, falls were commonly occurring at place of residence (67.9%), on the roads (11.6%) and agricultural lands (6.1%). Assaults were common in similar places to the extent of 45.9%, 27.4% & 6.5% respectively. Fall of objects at residence and playsites were commonly noticed.

27. The interval between injury and first medical contact varied widely with 86.5% receiving 'some' medical help within one hour of injury occurrence.

28. An interval of < 1 hour had elapsed in 24.1% of injuries while they were brought to a multidisciplinary hospital (study centre). The number of patients reaching a major hospital in 1 - < 3 hours, 3 - < 6 hours and > 6 hours constituted 30.5%, 19.0% and 26.5% respectively.

29. Only 13.3% of head injuries were provided first-aid services at or near the accident spot and the major source was a medical practitioner in 83.1% of cases.

30. About 21.0% of head injury victims had reached a definitive hospital directly, while 49.2% were referred from nearby and distant government hospitals.

31. Information on expenditure incurred by patients till they reached a major hospital revealed that 95% had spent an amount of < Rs. 1500.

32. ROAD TRAFFIC INJURIES

32.1 The geographical location of road traffic accidents revealed that about 20.2% were highway accidents and 64.9% had occurred within the city limits.

32.2 Among highways, Bangalore-Mysore road, Bangalore-Bellary road and Bangalore-Tumkur road were the highest accident sites contributing for 24.4%, 19.4% and 13.9% of accidents respectively.

32.3 Within the city, Sampangiramnagar, Subhasnagar and Rajajinagar were the highest accident sites.

32.4 Motor vehicle collision with a pedestrian was the commonest mode of injury (29.5%), followed by collision between two or more than two vehicles (27.0%). Motor vehicle collision due to loss of control over vehicle and pedal cycle accidents accounted for 13.1% and 8.1% respectively.

32.5 Specific examination between mortality and mode of road accidents revealed a similar pattern as mentioned above, in 40.0%, 21.7% and 9.5% of deaths.

32.6 Two wheelers had caused highest number of head injuries (47.9%) followed by heavy vehicles (14.9%), bicycles (10.6%) and autorickshaw (9.5%).

32.7 Pedestrian, motorcyclist and passenger in a motor vehicle were the status of persons at the time of head injury in 30.3%, 21.1% and 17.1% respectively.

32.8 Among those head injuries resulting in death, pedestrians, motor cyclists and passenger in a motor vehicle were the principle groups in 37.0%, 31.0% and 12.5% of deaths.

32.9 The major human factors responsible for road accidents were sudden road crossing without observation (33.5%), fall from a moving vehicle (14.4%), overtaking a passing vehicle in high speed (10.8%) and overspeeding on the road (10.6%).

32.10 Predominant vehicle problems were break failure (44.2%), mechanical problems of the vehicle (28.8%) and wheel associated defects (26.9%).

32.11 Presence of road problems, road humps without indicators and sudden entry of stray animals were the main environmental factors in 50.5%, 23.2% and 13.4% respectively.

32.12 About 17.5% of motorcyclists and 6.1% of pedestrians were found to be under the influence of alcohol at the time of accident. The corresponding figures for motor vehicle drivers and pedal cyclists was 19.1% and 8.8% respectively.

32.13 The mortality among two wheeler drivers without helmets was 2.2 times higher as compared to those with helmets (OR=2.16)

32.14 On an average, in the city of Bangalore, about 60-65 two wheeler riders meet with head injuries every month, among whom about 6-8 succumb to death (10%).

32.15 With the removal of compulsory wearing of helmets, the frequency of helmet usage declined from 52% in September to 14% by February 1992.

32.16 In an opinion observation from public, it was found that 88% were in favour and 12% against helmet use. Several reasons were given by the public for the same.

33. OTHER INJURIES

33.1 Fall from one level to another and fall from or out of building were the commonest mode of falls in 28.3% and 23.7%, followed by fall from stairs or steps in 16.2% of head injuries. Domestic falls contributed for 67.7% of total cases.

34. Height of fall was directly associated with the outcome in terms of mortality as noticed by an increase in deaths with an increase in height.

35. Assaults (10% of total cases) were commonly caused by fights and quarrels between individuals, family disputes and alcohol intoxication.

36. Fall of construction objects (32.0%), fall of household articles (20.4%) and objects falling at worksite were the major mode of injuries resulting in head injuries.

37. Only 0.7% of head injuries were caused by industrial accidents.

38. About 32.2% of patients were in different states of unconsciousness at the time of reaching the hospital. About 87.2% had lost consciousness immediately after the injury with a duration varying from few minutes to more than 3 hours.

39. Haemmorhage from nose, mouth, ears and scalp was recorded in majority of cases.

40. External injuries varying from superficial skin abrasions to lacerations were found to be present in 74.8% of total head injuries.

41. The area of head sustaining injury was commonly noticed to be frontal region, parietal region, occipital area and temporal region in 42.8%, 21.1%, 19.3% and 15.8% respectively.

42. Seizures at the site of injury was reported by 5.1% of head injury patients.

43. Presence of a skull fracture was found to be present in 8.0% of total head injuries.

44. Associated long bone fracture of upper and lower limbs was documented in 14.1% of total head injuries. Chest, abdominal and pelvic bone injuries were seen in a small number of cases.

45. Sixteen per cent of head injuries were found to be severe with a Glasgow Coma Scale of 3-8. Moderate and mild head injuries were documented in 10.7% and 73.3% of cases respectively.

46. The classification of head injuries is a complex area. Cerebral concussion, contusion and haemmorhage was documented in 51.2%, 20.8% and 4.3% of head injuries respectively with a combined diagnosis among others.

47. The mode of management revealed that about 19.6% were admitted for medical management and 7.8% for surgical line of management and the rest were provided immediate care followed by referral to other hospitals.

48. The average duration of hospital stay for outpatient and admitted series was 5.7 (+/- 5.0) hours and 7.8 (+/- 9.5) days respectively.

49. The case fatality rate during hospital stay was 8.7%. About 12 (0.4%) patients were dead at the time of hospital entry and 26 cases had expired after their discharge from hospital (6.1%). This provides a case fatality rate of 9.6% in the total series.

50. At the time of follow-up after an interval of 4.0 months, (n=425) about 51.8% had totally recovered, 42.1% were still recovering and 6.1% had expired after their hospital discharge.

51. About 18.1% of previously employed adults were not working and 14.4% of children were not attending to school at the time of domicillary visits.

52. Loss of work for a period of more than 90 days was reported by 37% of individuals.

53. School attending children had lost schooling for a period of upto 90 days in 20% of children.

54. Head injury sequelae was reported in majority of individuals. The commonly observed ones were post-traumatic headache (25.6%), memory problems (14.1%), behavioural problems (12.7%), and anxiety features in 16.9% of total cases.

55. Speech problems, hearing problems, visual problems and locomotor problems were reported by 1.4%, 1.4%, 3.5% and 5.9% respectively.

56. Expenditure incurred by head injured individuals revealed that 44.6% had spent an amount of more than Rs. 1500, with 9.8% spending between Rs. 6000 to Rs. 15,000 and 5.7% incurring an expenditure of more than Rs. 15,000 towards head injury care. This does not include the hospital incurred cost and also loss of income due to absence from work and the compensation amount.

Thus, the present study has developed relevant information on head injuries from seven major hospitals in the city. Pooling of information from several sources was also done to develop a comprehensive data base for head injuries. This would enable authorities concerned for developing programmes in the city of Bangalore. Undoubtedly, strategies and measures in this city will be of help and an eye-opener to other cities in our country and other countries.

8. RECOMMENDATIONS

The following recommendations are placed herewith for reducing morbidity, mortality and disability from head injuries. The recommendations have been developed based on study results, experience of the attending medical professionals, opinion expressed by members of the advisory group, head injured persons and their families. We sincerely hope that these recommendations will be considered seriously by policy makers, programme managers, politicians, professionals, press and public for developing the city in a more safety manner for the welfare of citizens. The suggested recommendations include both short- term and long-term measure.

1. Policy issues

1.1 There is need to consider head injuries and injuries as a health, socioeconomic and developmental problem. There is an immediate need to initiate National injury prevention and Control Programme including all related sectors working on a scientific and cost-effective basis to evolve suitable, appropriate and relevant programmes. National injury control programme has to be developed on a multidisciplinary, integrated, coordinated approach for reduction of morbidity, mortality and disability due to head injuries.

1.2 We strongly recommend the formulation of injury prevention council in the city of Bangalore and other major cities. This council must have inputs from health, police, industries, road and urban development, excise, judiciary, education, city corporation with senior administrators in all these portfolios. The head injury and injury surveillance programme will provide the requisite scientific information for this apex body to review and evaluate programmes periodically.

1.3 Government of India and State Governments must identify programme officers at central, state and district levels for networking and coordinating efforts towards injury prevention and control.

1.4 Road safety councils with appropriate funds, powers and responsibilities must become fully operational in all mega cities. These councils must be coordinating bodies with multidisciplinary inputs.

2. *Ambulance services*

2.1 Ambulance services needs to be more effective in the city. For a city of 4,183,083 individuals, 162 ambulances form a meager number amounting to roughly 1 per 25,000 population. While there is no specific standard about the number of ambulances, at least, there should be one ambulance for every 8-10,000 people.

2.2 Area-based ambulance services has to be planned for the city. Since ambulances are stationed in only hospitals and major centres, their availability should be planned in such a way that they are at the reach of individuals within a short period of time in high accident prone areas. Formulating this programme must take into account other emergencies as well.

2.3 Ambulances have to be equipped with trained and qualified staff, first-aid and resuscitation equipments, emergency medicines such that the purpose of ambulance is utilised fully.

2.4 Awareness about utilisation of ambulance services has to be increased in the public. Display boards in different parts of the city, specially on highways has to be put up. Available media like Doordarshan, press, etc., has to be fully utilised.

3. *Emergency and casualty services*

3.1 The casualty services in all hospitals has to be upgraded immediately in totality. This essentially involves increase in manpower, equipment, drugs, beds, investigative and emergency operative facilities, etc. Each hospital has to draw up individual long-term oriented plans for upgrading their casualty services.

3.2 The casualty medical and paramedical personnel need to be given additional training in the management of head injury patients through short-term orientation training programmes.

3.3 There is also need to appoint public relations officer / liaison officer in all hospitals. This person needs to be educated about trauma care services for suitable interaction with patients, police, public and press.

4. Trauma care services

4.1 All major hospitals need to be provided and equipped with investigative and laboratory services for managing head injury victims. This would avoid referral of critically ill patients from hospital to hospital.

4.2 Suitable referral services need to be established within the city. Only those patients requiring advanced investigations and management should be referred to tertiary apex institutions.

4.3 Trauma care centres need to be established on highways at a distance of every 100 km. The district and taluk hospitals could be upgraded as integrated trauma care centres with upgraded facilities for immediate care of patients.

4.4 All hospitals and medical practitioners must provide total and immediate care for head injury patients. Awareness and education about the existing legislation must be strongly reinforced.

5. Rehabilitation services

5.1 Neurorehabilitation must be given importance specially for rehabilitation of head injury victims. Rehabilitation must form a part of comprehensive post trauma care services.

5.2 People should be educated and counselled about measures for reducing post head injury effects through proper follow-up services.

5.3 The specialised categories of manpower, equipments and supportive elements for rehabilitation must be developed in every city. There is an immediate need to develop training programmes for community-based rehabilitation of head injury patients.

5.4 Apex institutions or regional centres for service, training, rehabilitation and research on injuries and head injuries must be developed in every major city.

5.5 Population based epidemiological research at community level must be undertaken to identify the magnitude, types and disabilities due to head injuries along with other disabilities. There is an immediate need to assess the magnitude of the problem and various aspects about disabilities and handicaps among head injury patients.

PREVENTING ROAD TRAFFIC INJURIES

Since road traffic accidents are the major cause of head injuries, integrated efforts through engineering, enforcement and education are essential for prevention of this problem.

6. Road planning and engineering aspects

6.1 Road planning has to be given utmost importance in every city. Planning of new roads, expansion and maintenance of existing roads has to be undertaken on a warfooting based on scientific rationale and long-term planning, which would yield more results as compared to *adhoc* temporary measures.

6.2 Laying of road humps or speed breakers has to be changed. Indicators visible at all times on both sides of road humps along with marking of road humps should be placed for the safety of road users. A new design of road humps is required in the long-term planning.

6.3 Proper road maintenance has to be immediately undertaken to eliminate ditches, pits, road cutters, manholes and natural obstacles.

6.4 City lights have to be improved considerably as dark roads, dark lanes and others have been found to be a major cause of road traffic accidents.

6.5 Ring roads or peripheral roads passing outside the city connecting different highways and entry points have to be planned for reducing the traffic within the city.

7. Traffic control measures

7.1 Traffic control measures needs to be evolved urgently in the city. Roads with high density of vehicles and population needs to be identified and measures to reduce or diversify vehicle movements should be evolved for reducing the same. The identified areas and roads should receive immediate attention on this aspect.

7.2 Traffic safety measures must be strictly enforced in the city. Strategies towards education of the community along with strict enforcement must be developed.

7.3 Long-term road planning must be developed for the city to avoid congestion, heavy traffic and accompanying effects like pollution in the city. The public transport system must be made more effective and efficient thus avoiding new entry of vehicles on the already congested roads.

7.4 Road behaviour of the users must be given due attention. Public must be educated to inculcate a sense of safety road usage behaviour to avoid head injuries.

8. Educational and enforcement measures

8.1 Helmet wearing must be made compulsory for drivers and passengers of two wheeler engine vehicles. Information on helmets must be available to vehicle buyers at the time of purchase or insurance explaining the role and importance of helmets. Education on this aspect must be incorporated in schools, colleges, inservice training programmes, industries and other ongoing training programmes.

8.2 Alcohol consumption and driving has to be tackled immediately through education and enforcement measures. Random checking for alcohol and drunken driving, with heavy penalties for drunken driving should be enforced. Education of all categories of road users and other sections of community has to be given topmost importance in this aspect.

8.3 Overspeeding and overtaking should be strictly banned on highways and major roads with measures for speed control being strictly enforced. Implementation of speed limits in and out of cities and towns is an immediate need of the hour.

8.4 Education is also vital in educating the public about proper maintenance of vehicles in good condition.

8.5 Education on following traffic safety norms and rules should be given to public, specially to avoid overspeed, overtaking, sudden crossing, caution during road crossing, pedestrian road practices and other issues.

8.6 Educational materials in all local languages should be developed and used regularly especially in schools, colleges, driving schools, industries, and any other refresher or inservice training programmes of health, police, etc.

9. Preventing other causes of injuries

9.1 Community must be educated through available media and other channels about safety precautions at home, work place and industrial establishments. Simple safety technologies must be developed for this purpose with application in design, layout, construction and regular use.

9.2 Use of protective equipments like headgear should be encouraged at worksite, playsite, construction site and others.

9.3 Parents and teachers must be educated about fall of children at home, school, playsite and other areas. Younger children must not be allowed to be on their own in these places.

9.4 Housing standards must be established to discourage rooftops without guards or railings. Environmental safety precautions must be incorporated in all construction activities at home, school and playgrounds.

9.5 Playgrounds must be made non-hazardous with smooth materials and energy absorbing surface.

9.6 People should be educated about the harmful effects of violence and assaults. Educational efforts in colleges, schools and other places must be increased. People must be discouraged about the harmful use of instruments.

10. First-aid services

10.1 Education on first-aid services must form a part of curriculum in schools, colleges and any inservice training programmes of police, industrial workers and health workers. Simple illustrative manuals in all regional languages must be published to enable trainers.

10.2 First-aid services and training must be a part of learning in all the driving schools. Issue of driving licences must examine this while certifying potential learners.

10.3 Special use of media like television and press along with newsletters, pamphlets and others must be employed in spreading first-aid knowledge to communities for understanding the basis components of first-aid services.

10.4 Public should be encouraged to utilise ambulance services for early transportation of victims. Information on this should be available through media. A simple directory of ambulance services must be published for the city of Bangalore and other megacities.

11. Surveillance on head injuries

11.1 Head injury and injury surveillance must be initiated in the city of Bangalore. To begin with, NIMHANS, SGARC, along with the departments of police, industries and road engineering must be involved. This activity could be expanded to include other areas thus becoming a permanent activity in the city.

11.2 Since NIMHANS is the major centre for the management of head injuries, a comprehensive database must be established on all aspects of head injuries.

12. Research

12.1 Increased budgetary allocations must be made on research towards prevention of head injuries due to various causes, specially road traffic accidents. Activities in this area should include epidemiological, sociological, behavioural, environmental safety, design and quality control along with related aspects.

12.2 Research on assessing the current levels of knowledge, attitude and practice towards head injury prevention and control should be undertaken specially among the youth, college-going students, industrial workers and public.

12.3 Needs assessment for rehabilitation must be undertaken. This should aim at assessing the needs and available facilities in terms of manpower, supportive facilities and mechanisms of developing community-based services.

12.4 Similar studies on the problem of head injuries and injuries should be undertaken in other cities with the joint participation of medical colleges, government health and related agencies, non-governmental organisations, police, industries and others.

12.5 Research on head injury diagnosis, classification and coding must be undertaken with a view to evolve simple mechanisms for application in developing countries. Suitable modifications are required for ICD-10 in some situations.

13. Training

13.1 There is an immediate need to develop training programmes at different levels. For the administrators and decision makers there is a need to evolve sensitisation and orientation programmes. There is also a need for incorporating injury and head injury prevention and management in school, college and undergraduate medical curricula at various levels.

13.2 All the medical officers in casualty, general hospitals and district hospitals must be given orientation and training in head injury management and referral services.

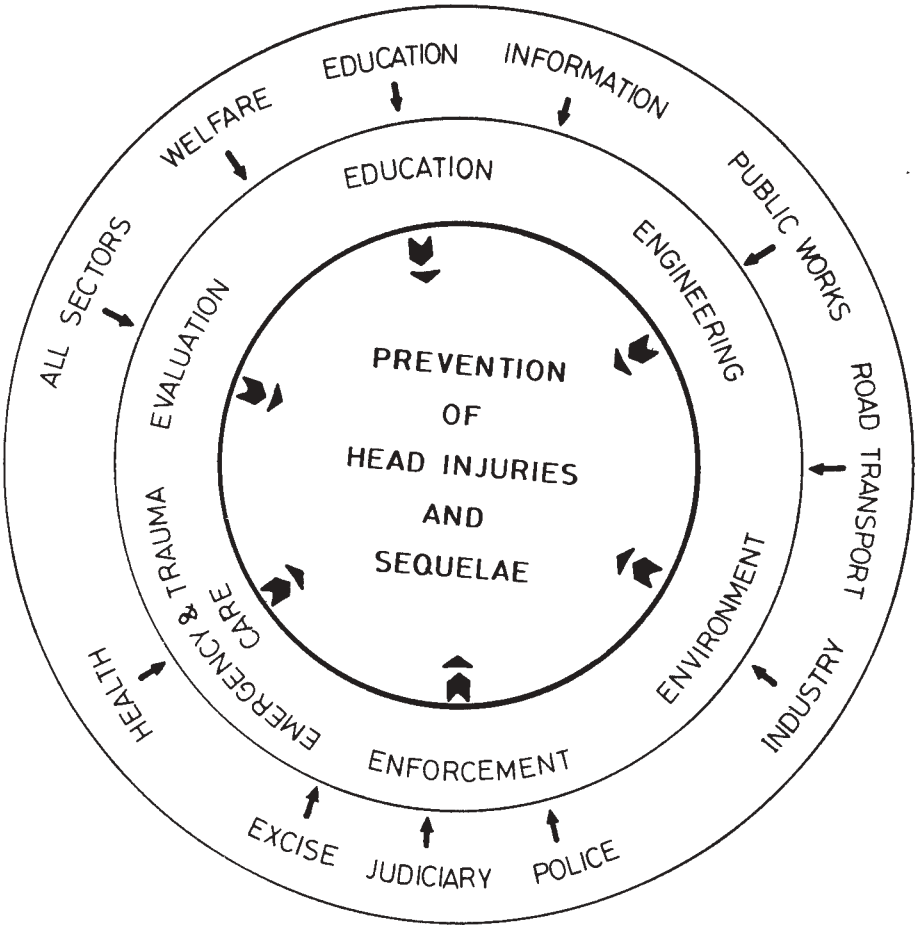
13.3 There is a need for interdisciplinary joint training programmes for doctors, nurses and allied personnel in Surgery, Neurosurgery, Orthopaedics and Plastic Surgery on comprehensive injury management.

14. Community participation

14.1 Community participation in injury prevention and control is vital and should be encouraged and strengthened. This would enhance the role of local communities to identify, plan, implement and evaluate programmes with people being active partners in prevention.

14.2 The local Non-governmental organisations must be encouraged to take up injury prevention and control, education and rehabilitation as part of their activities.

The above recommendations need the attention of every citizen in our society. Prevention programmes must identify the problem, causes and context of injury occurrence. The selection of individual or combined strategies requires 'prioritisation', 'integration', 'coordination' and 'long-term planning'. Evaluation of the impact of interventions is an important consideration for injury prevention practitioners.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WELFARE
EDUCATION
ENGINEERING
PREVENTION
OF
HEAD INJURIES
AND
SEQUELAE

PREVENTION AND CONTROL OF INJURIES AND HEAD INJURIES

must be an integrated, coordinated, multidisciplinary activity in Health Care delivery system.

The use of appropriate technology and community participation constitute the mode and focus of activities. The realities and challenges requires,

Political commitment,
Professional involvement,
People's participation,
Policy-makers cooperation, and
Press contribution

for developing

Emergency and trauma care,
Educational,
Engineering,
Enforcement and,
Evaluation strategies.

HEAD INJURY PREVENTION - CONTROL CARE AND REHABILITATION

must form essential components of national and international agenda in the forthcoming years.

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